

VR-Vantage

Users Guide

VR-Vantage Steatlh
VR-Vantage PVD
VR-Vantage IG

VT MÄK
A company of VT Systems



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MÄK Products Glossary

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VR-Vantage Quick Reference Card



Preface

This manual is for persons who will install VR-Vantage and use it to view simulations. The manual assumes that you are familiar with basic administrative tasks and the graphical window environment for your operating system.

For the latest product information, please see release-specific documentation for your version of VR-Vantage.

How the Manual Is Organized

This manual is organized thematically in the following major sections:

- Installation, startup, and basic concepts.
  - Chapter 1, *Introduction to VR-Vantage*, describes the basic features of VR-Vantage.
  - Chapter 2, *Installing VR-Vantage*, explains how to install VR-Vantage software, the license manager, and an RTI.
  - Chapter 3, *Running VR-Vantage Applications*, explains how to start and stop VR-Vantage, load a terrain, and connect to a simulation.
  - Appendix 4, *Managing Network Connections*, explains how to configure network connections.
  - Chapter 5, *Optimizing Performance*, describes issues that may affect performance.
- The display engine, streaming video, and Occulus support:
  - Chapter 6, *Windows, Channels, and Display Engines*, explains how to add windows and channels and how to configure them. It also explains how to set up multi-channel displays.
  - Chapter 7, *Display Engine Tutorials*, shows how to create display engine configurations, save them, and load them.

  - Chapter 8, *Using Streaming Video* explains how to send the view in the VR-Vantage window to a video stream.
  - Chapter 9, *Using the Oculus Rift HMD*, explains how to set up VR-Vantage to work with the Oculus Rift head mounted display.
- Scenes and environmental effects:
  - Chapter 10, *Scenes and Environmental Effects*, explains how to configure the environment, including date and time, clouds, and precipitation.
  - Chapter 11, *Using Sensors* explains how to view the terrain as if you had night vision goggles or an infrared view.
  - Chapter 12, *Lighting Effects* describes the lighting effects in VR-Vantage and how to configure them.
- The observer.
  - Chapter 13, *The Observer and Observer Modes*, explains how to create and change observer modes, how to add observers, and how to communicate information about the observer.
  - Chapter 14, *Moving the Observer*, explains how to navigate the observer through the 2D and 3D scenes.
  - Chapter 15, *Attaching the Observer to Objects*, explains attach modes and how to attach the observer to entities and props.
  - Chapter 16, *Inset Views, Sensor FOV, and HUDs*, describes several types of special secondary windows – inset views, instrument panels, and sensor fields of view. It also covers cockpit displays.
  - Chapter 17, *Exaggerating Models and Terrain* describes features that only apply to XR observer mode.
- Visual effects.
  - Chapter 18, *Viewing Simulation Objects*, explains how to select entities and how to view information about them, including entity labels, force coloring, and height-above-terrain lines.
  - Chapter 19, *Displaying Units* explains how to manage the display of aggregate entities.
  - Chapter 20, *Viewing Entity Effects*, describes how to display various types of entity-related effects, such as ground clamping and smoothing, and entity related graphics, such as trailing effects and decal effects.
  - Chapter 21, *Intervisibility Objects* explains how to create and configure intervisibility objects.
  - Chapter 22, *Sound Effects* explains how to enable and configure sound effects for entities and interactions.
- Terrain modeling.

  - Chapter 23, *Changing How the Terrain is Displayed* explains how to learn more about the terrain by displaying contour lines, grid lines, and coloring by elevation.
  - Chapter 24, *Composing Terrains*, explains how load terrains and how to build composable terrains and scenes.
  - Chapter 25, *Streaming Data Using Earth Files*, explains some of the details of how to set up *.earth* files to configure terrain servers.
  - Chapter 26, *Terrain Tutorials*, has tutorials that show how to create a terrain and how to configure a terrain server using local data.
  - Chapter 27, *Processing MetaFlight Files*, explains how to process MetaFlight files so that you can open them in VR-Vantage.
- Object modeling.
  - Chapter 28, *Model and Element Definitions*, explains how to create and edit schemas, model definitions, and element definitions.
  - Chapter 29, *Mapping Object Types to Element Definitions*, explains how to map 3D models to objects and effects.
  - Chapter 30, *Configuring Specific Visual Models*, explains how to configure some specific model types, such as 2D icons, cockpits, and SpeedTrees.
  - Chapter 31, *Configuring Emitter Volumes*, explains how to configure sensor volume color and segment size.
  - Chapter 32, *Adding DI-Guy Models to VR-Vantage*, explains how to add new DI-Guy models.
  - Chapter 33, *Model Tutorials*, has tutorials that show how to add an entity model and how to add a SpeedTree.
  - Chapter 34, *The WRM Specification (DIS Notes)*, explains the model specification for articulated parts.
- Graphics.
  - Chapter 35, *Tactical Graphics and Remote Graphics* explains how to manage tactical graphics and remote graphics.
- CIGI.
  - Chapter 36, *Mapping CIGI Models and Components*, explains how to map CIGI models and components, which are different from the mappings used for DIS and HLA.
  - Chapter 37, *CIGI Host Emulator Tutorial*, shows how to use the CIGI host emulator with VR-Vantage.
  - Chapter 38, *CIGI Utilities*, describes a set of scripts that you can use to test your CIGI connection to VR-Vantage.
  - Chapter 39, *CIGI Packets Supported*, lists CIGI packets and the extent to which they are supported by VR-Vantage.
- Graphical user interface (GUI) configuration.

- Chapter 40, *The VR-Vantage User Interface* describes some of the basic features of the VR-Vantage graphical user interface (GUI).
- Chapter 41, *Creating and Editing Key Mappings*, explains how to use the Key Map Editor to create and edit key maps for keyboard navigation.

MÄK Products Glossary defines DIS and HLA terms and terms specific to VR-Vantage and other MÄK products.

The *VR-Vantage Quick Reference Card*, at the end of the manual, lists command-line options, key mappings, and mouse button mappings.

Documentation Set

Electronic versions of VR-Vantage documentation are in *vrvantagex.x/doc*. On Windows, the documentation is accessible from the VR-Vantage folder on the Start menu. The VR-Vantage documentation set is as follows:

- *VR-Vantage Users Guide* describes how to use the VR-Vantage applications.
- *VR-Vantage Release Notes* lists system requirements, release-specific requirements, new features and updates, bug fixes, and known problems.
- Online help. The online help, accessible from the Help menu, replicates most of the information in *VR-Vantage Users Guide*.
- First Experience Guides. First Experience Guides are brief pamphlets that provide a guided tour of the most important features of each application. They are primarily for new users and persons evaluating VR-Vantage.
- *VR-Vantage Developers Guide*. The developers guide provides a high level introduction to the APIs, and class documentation, which is generated from the header files. You can open the developers guide and class documentation from the Windows Start menu on the VR-Vantage Documentation submenu or by opening *./vrvantage2.1/doc/classdoc/index.html*.

MÄK Products

VR-Vantage is a member of the VT MÄK line of software products designed to streamline the process of developing and using networked simulated environments. The VT MÄK product line includes the following:

- VR-Link® Network Toolkit. VR-Link is an object-oriented library of C++ functions and definitions that implement the High Level Architecture (HLA) and the Distributed Interactive Simulation (DIS) protocol. VR-Link has built-in support for the RPR FOM and allows you to map to other FOMs. This library minimizes the time and effort required to build and maintain new HLA or DIS-compliant applications, and to integrate such compliance into existing applications.

  VR-Link includes a set of sample debugging applications and their source code. The source code serves as an example of how to use the VR-Link Toolkit to write applications. The executables provide valuable debugging services such as generating a predictable stream of HLA or DIS messages, and displaying the contents of messages transmitted on the network.

- MÄK RTI. An RTI (Run-Time Infrastructure) is required to run applications using the High Level Architecture (HLA). The MÄK RTI is optimized for high performance. It has an API, RTIspy®, that allows you to extend the RTI using plug-in modules. It also has a graphical user interface (the RTI Assistant) that helps users with configuration tasks and managing federates and federations.
- VR-Forces®. VR-Forces is a computer generated forces application and toolkit. It provides an application with a GUI, that gives you a 2D and 3D views of a simulated environment.

  You can create and view entities, aggregate them into hierarchical units, assign tasks, set state parameters, and create plans that have tasks, set statements, and conditional statements. You can simulate using entity-level modeling, which focuses on the actions of individual people and vehicles, and aggregate-level modeling, which focuses on the interaction of large hierarchical units.

  VR-Forces also functions as a plan view display for viewing remote simulation objects taking part in an exercise. Using the toolkit, you can extend the VR-Forces application or create your own application for use with another user interface.

- VR-Vantage™. VR-Vantage is a line of products designed to meet your simulation visualization needs. It includes three end-user applications (VR-Vantage Stealth, VR-Vantage PVD, and VR-Vantage IG) and the VR-Vantage Toolkit.
  - VR-Vantage Stealth displays a realistic, 3D view of your virtual world, a 2D plan view, and an exaggerated reality (XR) view. Together these views provide both situational awareness and the big picture of the simulated world. You can move your viewpoint to any location in the 3D world and can attach it to simulation objects so that it moves as they do.
  - VR-Vantage IG is a configurable desktop image generator (IG) for out the window (OTW) scenes and remote camera views. It has most of the features of the Stealth, but is optimized for its IG function.

  - VR-Vantage PVD provides a 2D plan view display. It gives you the big picture of the simulated world.
  - SensorFX. SensorFX is an enhanced version of VR-Vantage that uses physics based sensors to view terrain and simulation object models that have been materially classified. It is built in partnership with JRM Technologies.
  - The VR-Vantage Toolkit is a 3D visual application development toolkit. Use it to customize or extend MÄK's VR-Vantage applications, or to integrate VR-Vantage capabilities into your custom applications. VR-Vantage is built on top of OpenSceneGraph (OSG). The toolkit includes the OSG version used to build VR-Vantage.

- MÄK Data Logger. The Data Logger, also called the Logger, can record HLA and DIS exercises and play them back for after-action review. You can play a recorded file at speeds above or below normal and can quickly jump to areas of interest. The Logger has a GUI and a text interface. The Logger API allows you to extend the Logger using plug-in modules or embed the Logger into your own application. The Logger editing features let you merge, trim, and offset Logger recordings.
- VR-Exchange™. VR-Exchange allows simulations that use incompatible communications protocols to interoperate. For example, within the HLA world, using VR-Exchange, federations using the HLA RPR FOM 1.0 can interoperate with simulations using RPR FOM 2.0, or federations using different RTIs can interoperate. VR-Exchange supports HLA, TENA, and DIS translation.
- VR-TheWorld™ Server. VR-TheWorld Server is a simple, yet powerful, web-based streaming terrain server, developed in conjunction with Pelican Mapping. Delivered with a global base map, you can also easily populate it with your own custom source data through a web-based interface. The server can be deployed on private, classified networks to provide streaming terrain data to a variety of simulation and visualization applications behind your firewall.
- DI-Guy™. The DI-Guy product line is a set of software tools for real-time human visualization, simulation, and artificial intelligence. Every DI-Guy software offering comes with thousands of ready-to-use characters, appearances, and motions. DI-Guy enables the easy creation of crowds and individuals who are terrain aware, autonomous, and react intelligently to ongoing events. Save time, money and create outstanding simulations with DI-Guy. The DI-Guy product line includes the following products:
  - The DI-Guy SDK. Embed the DI-Guy library in your real-time application and populate your world with lifelike human characters.
  - DI-Guy Scenario™. Author and visualize human performances in a rich, user-friendly graphical environment. Use DI-Guy Scenario as an end visualization application or save scenarios and load them into your DI-Guy SDK enabled application.

  - ECOSim. Enhanced Company Operations Simulation (ECOSim) is a company-level training simulation that teaches leaders how best to deploy troops, UAVs, convoys, and other assets. ECOSim focuses on ease-of-use, rapid scenario generation, runtime operator control, and realistic and reactive human simulation.
  - DI-Guy AI. Generate crowds of autonomous characters to quickly populate your worlds with hundreds and thousands of terrain-aware, collision avoiding DI-Guys. Used as a module on top of DI-Guy Scenario and DI-Guy SDK.
  - Expressive Faces Module. Enable DI-Guy characters to have faces that display emotion, eyes that look in directions and blink, and lips that sync to sound files.
  - DI-Guy Motion Editor. Create or customize motions to your particular needs in an easy-to-use graphical application.
- RadarFX. RadarFX is a client-server application that can simulates synthetic-aperture radar (SAR). The server application, which is based on VR-Vantage and SensorFX, loads a terrain database and, optionally, connects to simulations. A client application requests SAR images from the server. VR-Vantage includes a sample client application.

How to Contact Us

For VR-Vantage technical support, information about upgrades, and information about other MÄK products, you can contact us in the following ways:

Telephone

Call or fax us at:	Voice:	617-876-8085 (extension 3 for support)
	Fax:	617-876-9208

E-mail

Sales and upgrade information:	info@mak.com
Technical support:	support@mak.com
VR-Vantage support:	

Internet

MÄK web site home page:	www.mak.com
License key requests:	www.mak.com/support/licenses/get-licenses
Product version and platform information:	www.mak.com/support/product-versions
For the free, unlicensed MÄK RTI:	www.mak.com/resources/bonus-material
MÄK Community Forum:	www.mak.com/connect/forum

Post

Send postal correspondence to:	VT MÄK 150 Cambridge Park Drive, 3rd Floor Cambridge, MA, USA 02140

When requesting support, please tell us the product you are using, the version, and the platform on which you are running.

Document Conventions

This manual uses the following typographic conventions:

`Monospaced`	Indicates commands or values you enter.
`Monospaced Bold`	Indicates a key on the keyboard.
`Monospaced Italic`	Indicates command variables that you replace with appropriate values.
Blue text	A hypertext link to another location in this manual or another manual in the documentation set.
`{ }`	Indicates required arguments.
`[ ]`	Indicates optional arguments.
|	Separates options in a command where only one option may be chosen at a time.
`( | )`	In command syntax, indicates equivalent alternatives for a command-line option, for example, `(-h | --help)`.
/	Indicates a directory. Since MÄK products run on both Linux and Windows PC platforms, we use the / (slash) for generic discussions of pathnames. If you are running on a PC, substitute a \ (backslash) when you type pathnames.
Italic	Indicates a file name, pathname, or a class name.
sans Serif	Indicates a parameter or argument.
➤	Indicates a one-step procedure.
Menu → Option	Indicates a menu choice. For example, an instruction to select the Save option from the File menu appears as: Choose **File → Save**.
	Click the icon to run a tutorial video in the default browser.
	Indicates supplemental or clarifying information.
	Indicates additional information that you must observe to ensure the success of a procedure or other task.

Directory names are preceded with dot and slash characters that show their position with respect to the VR-Vantage home directory. For example, the directory *vrvantagex.x2.1/doc* appears in the text as *./doc*.

Mouse Button Naming Conventions

An instruction to click the mouse button, refers to clicking the primary mouse button, usually the left button for right-handed mice and the right button for left-handed mice. The context-sensitive menu, also called a popup menu or right-click menu, refers to the menu displayed when you click the secondary mouse button, usually the right button on right-handed mice and the left button on left-handed mice.

Third Party Licenses

MÄK software products may use code from third parties. This section contains the license documentation required by these third parties.

Boost License

VR-Link, and all MÄK software that uses VR-Link uses some code that is distributed under the Boost License. All header files that contain Boost code are properly attributed. The Boost web site is: www.boost.org.

Boost Software License - Version 1.0 - August 17th, 2003

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libXML and libICONV

VR-Link and all MÄK software that uses VR-Link, links in libXML and libICONV. On some platforms the compiled libraries and header files are distributed with MÄK Products. MÄK has made no modifications to these libraries. For more information about these libraries please see the following web sites:

- The LGPL license is available at: http://www.gnu.org/licenses/lgpl.html.
- Information about IconV is at: http://www.gnu.org/software/libiconv/.
- Information about LibXML is at: http://xmlsoft.org/.

Freefont OpenType Font Set

VR-Vantage applications and VR-Forces use the Freefont OpenType font set from the Free Software Foundation. It is covered by the General Public License (GPL). For details, please see: http://www.gnu.org/licenses/gpl.html

osgoculusviewer Library

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Third-Party Licenses for VR-Vantage Applications

VR-Vantage applications use a variety of third-party libraries. Developers who want to use these libraries may be required to purchase developer's licenses. Please see "Third-Party Software and Content," on page 1-8 for details.



I. Installation, Startup, and Concepts

VR-Vantage is VT MÄK's line of visualization products. It is designed to meet your needs for visualizing the simulated environment. The VR-Vantage product line consists of the VR-Vantage Toolkit and the following applications that are built with it:

- VR-Vantage Stealth. VR-Vantage Stealth is your 2D/3D information station. It has a 3D view for situational awareness, simulation debugging, or after action review; a 2D view to provide the "big picture" of a simulation; and an exaggerated reality (XR) mode to improve your understanding of the 3D view when the observer is not close to entities. The Stealth provides the most data about your networked virtual world, and presents it in a clear and accessible way.
- VR-Vantage IG. VR-Vantage IG is a configurable desktop image generator for customers who need an out-the-window (OTW) view or a picture from a remote camera. Vantage IG is designed for easy integration into desktop trainers and war gaming simulations.
- VR-Vantage PVD. VR-Vantage PVD provides a 2D plan view display (PVD) of terrain and simulated objects. Plan view displays provide the "big picture" of simulated environments. They sacrifice the situational awareness of the 3D environment, but let you see the entire simulated world at a glance. Entities are represented using MIL-STD 2525B icons that are color coded to represent their force.

- The VR-Vantage applications share many features in common. Therefore, for simplicity, in this manual we use the term VR-Vantage to refer generically to the VR-Vantage applications when we describe common features.
- Some screen captures of dialog boxes may show features that are not supported by all VR-Vantage applications. For example, VR-Vantage IG does not support intervisibility or grid lines, while VR-Vantage PVD does not support cockpit displays.

The VR-Vantage Toolkit is an API that comes with all the software you need to completely rebuild visual applications like VR-Vantage Stealth and also allows you to customize and extend these applications to fit your unique requirements. The toolkit also gives you the power to embed any of VR-Vantage's capabilities directly into your simulation applications. The VR-Vantage Toolkit is based on OpenSceneGraph[1], so you can leverage value-added plug-ins built by the OSG community and MÄK partners.

For details about the VR-Vantage Toolkit, please refer to the API documentation.

The chapters in this section get you started with VR-Vantage. They describe the features of VR-Vantage, how to install it, and how to start it. This section also provides some conceptual background an details about improving performance.

1. "OpenSceneGraph is an Open Source, cross-platform graphics toolkit for the development of high-performance graphics applications such as flight simulators, games, virtual reality and scientific visualization. It is based on the concept of a SceneGraph, providing an object-oriented framework on top of OpenGL." (http://www.openscenegraph.org/projects/osg/wiki/About/Introduction)



1. Introduction to VR-Vantage

This chapter introduces you to the main features of VR-Vantage.

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- osgEarth 1-11

1.1. VR-Vantage Features

VR-Vantage Stealth and IG deliver a realistic, three-dimensional view of terrain, vehicles, and other objects (Figure 1-1). VR-Vantage's navigation controls give you complete freedom to travel anywhere as an unobtrusive observer. You can place the observer at a specific location, or link it to a vehicle for automatic tracking of battlefield activities. While an exercise is underway, you can switch attach modes quickly to see the scene from any perspective. VR-Vantage can be visible to other applications or invisible, at your discretion.

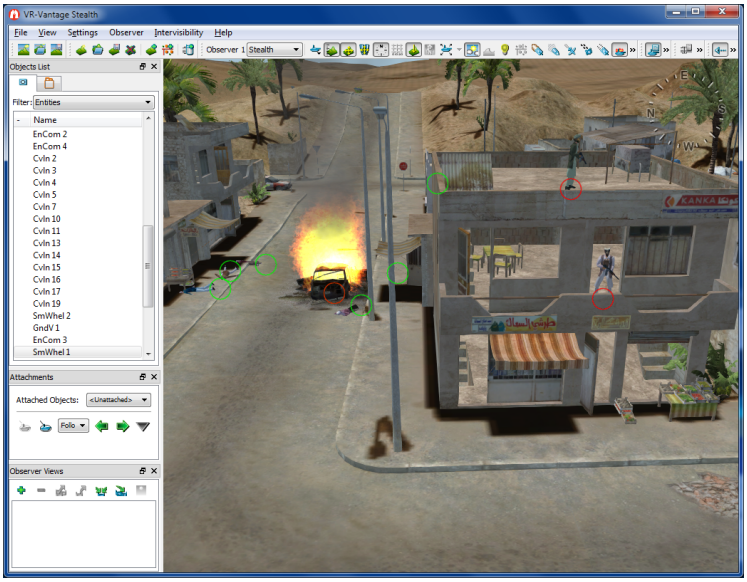


Figure 1-1. VR-Vantage Stealth (3D)

VR-Vantage Stealth and PVD provide a two-dimensional plan view-style display (Figure 1-2).

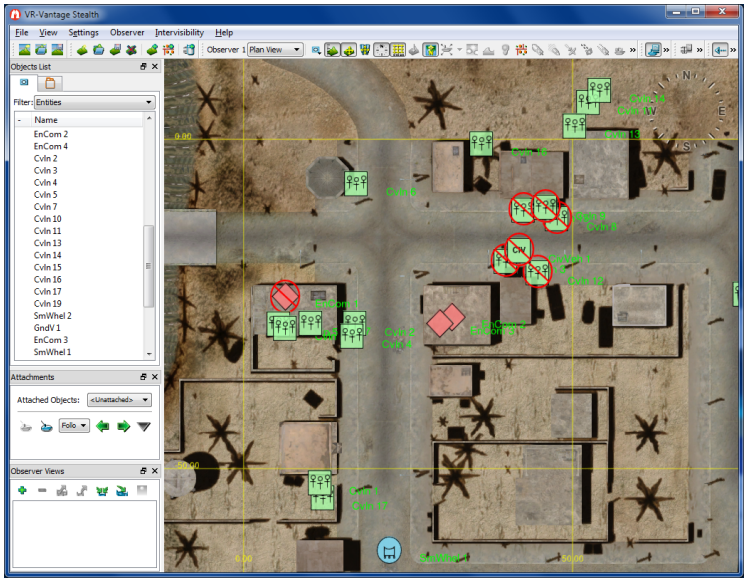


Figure 1-2. VR-Vantage Stealth (2D)

VR-Vantage provides a range of features that make it an essential tool during any phase of a Distributed Interactive Simulation (DIS), Common Image Generator Interface (CIGI), or High Level Architecture (HLA) project.

1.1.1. Support for HLA, DIS, and CIGI

You can connect and disconnect from simulations during runtime and can configure the connections in the graphical user interface (GUI). VR-Vantage supports the following simulation network protocols:

- HLA 1.3 and 1516. VR-Vantage supports the HLA 1.3 specification, the current draft of the IEEE 1516 C++ API maintained by the SISO Dynamic Link Compatible RTI API Product Development Group, and HLA Evolved (IEEE 1516-2010). It has built-in support for the HLA RPR FOM and can support other FOMs through the FOM Mapping feature.
- Distributed Interactive Simulation (DIS) protocols DIS 4, 5, 6, and 7.
- Common Image Generator Interface (CIGI) 3.2 and 3.3. CIGI is an interface that allows an image generator (IG) to receive messages from a host to control what is drawn by the IG.

1.1.2. Realistic Display of Vehicles and Terrain

The VR-Vantage 3D projection provides a realistic display using terrain and moving-model geometry in the OpenFlight format. It includes many 3D vehicle models, some of which display movement of articulated parts, such as turrets and rotors. These models can change to show a damaged or destroyed state. You can provide your own models and map them to entity types. For details about terrain, please see Section VII, *Terrain*. For details about models, please see Chapter 29, *Mapping Object Types to Element Definitions*.

VR-Vantage also displays:

- Smoking and flaming effects.
- Trailing effects.
- Muzzle flashes.
- Track histories.
- Explosions.

VR-Vantage presents terrain realistically, and lets you control visibility, time-of-day, and other effects. For details, please see Chapter 10, *Scenes and Environmental Effects*.

1.1.3. Multiple Attach Modes

VR-Vantage offers attach modes that let you:

- Manually control the observer's position and orientation.
- Follow an entity, maintaining a consistent positional offset, with a matching heading.
- Mimic a vehicle's position and orientation. You can place the observer inside the vehicle for a driver's-eye view, or fly outside of it, moving in tandem with the vehicle.
- Tether the observer to an entity, maintaining a consistent positional offset without changing the observer's heading.
- Automatically track a vehicle's movement from a fixed viewpoint, as if watching from a control tower.

For more information, please see Chapter 14, *Moving the Observer*.

1.1.4. Accurate Vehicle Positioning

VR-Vantage can smooth the trajectories of moving vehicles to compensate for discontinuous positional data. The ground clamping feature can ensure that all ground entities are placed correctly on the terrain surface. For details, please see "Configuring Trajectory Smoothing," on page 20-5 and "Using Ground Clamping," on page 20-2.

1.1.5. eXaggerated Reality (XR)

The XR observer mode enhances your ability to understand the layout of forces in the 3D projection. The colorized notional icons are scaled to be visible regardless of the observer's distance from the entities. You can resize the icons to ensure that you have the right view for your needs. For more information, please see Chapter 17, *Exaggerating Models and Terrain*.

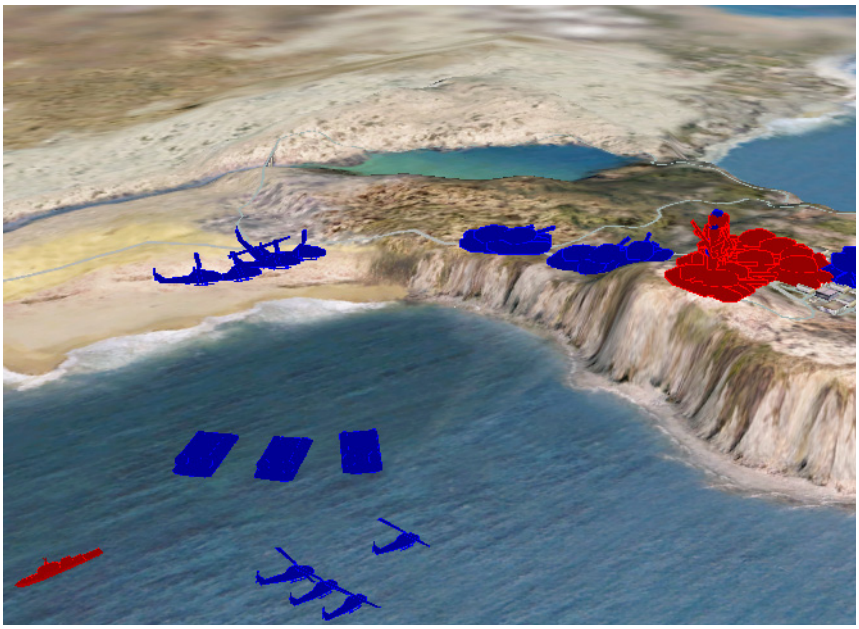


Figure 1-3. Model scaling and colorized models

1.1.6. Plan View Display

VR-Vantage PVD and the Plan View observer mode in VR-Vantage Stealth support many of the entity information features of the 3D projection plus features unique to a 2D view, such as grid lines. It supports the same terrain databases as the 3D projection.

1.1.7. Terrain Agility and Composability

VR-Vantage allows you to build your terrain at runtime using a variety of database and vector formats. It can load OpenFlight, DTED, CTDB, MetaFlight, CDB, and GDB (MÄK terrain format) databases. It can load feature data from shapefiles and GDB files. You can also superimpose geospatial images such as GeoTiffs or other raster image files on the terrain. You can save these composed terrains in the VR-Vantage MTF file format. For details, please see Chapter 24, *Composing Terrains*.

1.1.8. Dynamic Ocean

VR-Vantage provides dynamic ocean visualization in the Stealth and Out-the-Window observer modes. The ocean shows waves, swells, and spray effects. Surface entities have realistic wakes and buoyancy behavior. Changes to wind speed and direction affect wave action.

1.1.9. Lighting Effects

VR-Vantage supports a variety of lighting effects:

- Dynamic lighting
- Forward+ lighting
- Ocean planar reflection
- Lens flare
- Crepuscular (sun) rays
- Shadows.

Using Shader-based Effects Maps

VR-Vantage supports several types of shader-based effects texture maps. Shaders are computer programs that simulate the effect of light on the terrain and objects in the simulation. VR-Vantage makes extensive use of them for visualization effects.

Texture maps are raster images that apply highly realistic textures to the terrain and models. By applying different types of texture maps to terrain and models, you can improve the visual qualities of your simulation without the overhead of high polygon counts.

To see the effect of effects maps, you must enable advanced lighting and shading. For more information about shader based effects maps, please see "Using Shader-based Effects Maps," on page 1-6.

1.1.10. Streaming Video

VR-Vantage can send the view in the display window to a video stream. It supports several different open standards. If you have a supported viewer, you can use the simulated video as a flexible alternative to live video for demonstration, development, testing, and embedded training of operational video exploitation systems.

1.1.11. Remote Control

You can control VR-Vantage remotely through view control messages, which can be generated by MÄK applications such as the Data Logger and VR-Forces, and by programs that use the VR-Vantage Control Toolkit. For details, please see "Controlling the Observer from Other Applications," on page 14-28.

1.1.12. DI-Guy

VR-Vantage uses DI-Guy software and content for human character visualization.

VR-Vantage comes with DI-Guy functionality built-in and with a large set of DI-Guy characters and appearances,. A VR-Vantage customer does not need a DI-Guy license of any kind to use DI-Guy animated characters in a VR-Vantage-based application (including custom applications built using the VR-Vantage Toolkit).

However, you need a DI-Guy Developer's license if you want to:

- Develop new character types, or alter the geometry, appearances, textures, or motions of DI-Guy characters.
- Directly access the DI-Guy API to modify or extend the way that VR-Vantage uses the DI-Guy API or access DI-Guy functionality that MÄK has not already integrated into VR-Vantage.

DI-Guy libraries, models, textures, motion files, and other graphics resources are distributed in the VR-Vantage package solely so that VR-Vantage can use them. Use of DI-Guy software or content outside of VR-Vantage-based applications is not permitted by the VR-Vantage license.

1.1.13. Flexible, Intuitive Graphical User Interface

VR-Vantage's graphical user interface (GUI) allows you to manipulate VR-Vantage from menus, dockable control panels, and the keyboard.

You can hide and display the control panels, keep them docked to the VR-Vantage window, or undock them to make more space available for the display window. The GUI controls can be hidden for full-screen demonstrations.

The GUI follows standard conventions for modern windowing systems. For additional details, please see Chapter 40, *The VR-Vantage User Interface*. For descriptions of individual windows and dialog boxes, please see online help.

1.2. Third-Party Software and Content

The VR-Vantage product includes software and content licensed from third parties, including:

- SilverLining™: real-time sky and 3D cloud rendering from Sundog Software.
- Triton Ocean SDK™: 3D ocean and ship wakes from Sundog Software.
- GL Studio®: interactive cockpit instrumentation and HMI from DiSTI®.
- SpeedTree®: animated, 3D foliage from Interactive Data Visualization (IDV).
- 3D models, terrain, and graphical content from Simthetiq, RealDB, TurboSquid, Terrex (now Presagis), and TerraSim.
- OpenSceneGraph: an open source 3D graphics toolkit hosted at http://www.openscenegraph.org.
- osgEarth: an open source streaming terrain plug-in by Pelican Mapping, at http://osgEarth.org.

! The run-time and developers' rights for VR-Vantage customers vary from vendor to vendor. Please read this section carefully to understand which rights are included with VR-Vantage licenses, and which rights require additional third-party licenses.

1.2.1. SilverLining

VR-Vantage uses SilverLining software and content to compute lighting and to render the sky, clouds, sun, and moon. SilverLining is developed by Sundog Software (http://www.sundog-soft.com).

Most VR-Vantage customers do not need to buy a SilverLining license of any kind. In general, a VR-Vantage customer has the right to use the SilverLining technology that is built into VR-Vantage in any VR-Vantage-based application (including custom applications built using the Toolkit). However, there are two exceptions:

- If you want to extend or change the way that MÄK has integrated SilverLining into VR-Vantage by writing directly to the SilverLining API, then you need a SilverLining Developer's License.
- If you are building a commercial video game or other "mass-market" (consumer-level) commercial product on top of the VR-Vantage Toolkit, and the resulting product includes the SilverLining functionality, then you need a SilverLining Developer's License.

SilverLining libraries, textures and other graphics resources are distributed in the VR-Vantage package solely so that VR-Vantage can use them. Use of SilverLining software or content outside of VR-Vantage-based applications is not permitted by the VR-Vantage license.

1.2.2. Triton Ocean SDK

VR-Vantage uses the Triton Ocean SDK to render 3D oceans and ship wakes. Triton Ocean is developed by Sundog Software (http://www.sundog-soft.com).

Most VR-Vantage customers do not need to buy a Triton Ocean license of any kind. In general, a VR-Vantage customer has the right to use the Triton Ocean technology that is built into VR-Vantage in any VR-Vantage-based application (including custom applications built using the Toolkit). However, there are two exceptions:

- If you want to extend or change the way that MÄK has integrated Triton Ocean into VR-Vantage by writing directly to the Triton Ocean API, then you need a SilverLining Developer's License.
- If you are building a commercial video game or other "mass-market" (consumer-level) commercial product on top of the VR-Vantage Toolkit, and the resulting product includes the Triton Ocean functionality, then you need a Triton Ocean Developer's License.

Triton Ocean libraries, textures and other graphics resources are distributed in the VR-Vantage package solely so that VR-Vantage can use them. Use of Triton Ocean software or content outside of VR-Vantage-based applications is not permitted by the VR-Vantage license.

1.2.3. GL Studio

VR-Vantage uses GL Studio software and content to render interactive cockpit instrumentation displays. GL Studio is developed by DiSTI (http://www.disti.com).

VR-Vantage is delivered with several generic cockpit displays. You can use the built-in cockpit displays in any VR-Vantage-based application (including custom applications built using the Toolkit), without a GL Studio license of any kind.

If you want to build custom cockpits using the GL Studio editor or GL Studio API, you need a GL Studio Developer's license. If you want to execute custom cockpits in VR-Vantage-based applications (regardless of whether the custom cockpits are built by you or a third party), you need GL Studio Run-Time licenses.

GL Studio libraries and graphics resources are distributed in the VR-Vantage package solely so that VR-Vantage can use them. Use of GL Studio software or content outside of VR-Vantage-based applications is not permitted by the VR-Vantage license.

1.2.4. SpeedTree

VR-Vantage uses SpeedTree software and content for animated real-time 3D foliage and vegetation. SpeedTree is developed by Interactive Data Visualization (IDV) (http://www.speedtree.com).

A VR-Vantage customer does not need a SpeedTree license of any kind to use the SpeedTree functionality that is built into the VR-Vantage applications that MÄK delivers. You may build and run plug-ins to our out-of-the-box applications without a SpeedTree license, as long as your plug-ins do not need to directly access the SpeedTree API.

However, you need a SpeedTree Developer's license if you want to:

- Write a plug-in that uses the SpeedTree API directly to extend or modify the way that SpeedTree is integrated into VR-Vantage.
- Use the VR-Vantage Toolkit to develop new applications, and you want your applications to include SpeedTree functionality.

SpeedTree libraries, models, textures, and other graphics resources are distributed in the VR-Vantage package solely so that VR-Vantage can use them. Use of SpeedTree software or content outside of VR-Vantage-based applications is not permitted by the VR-Vantage license.

1.2.5. 3D Models, Terrain, and Graphical Content

VR-Vantage includes a rich set of 3D models for vehicles, weapons, cultural features and urban clutter (signs, barriers, lampposts, and so on). It also includes several sample terrain databases to help you get started with VR-Vantage, and to help demonstrate VR-Vantage. Much of this content is derived from 3D data that we have licensed from third parties:

- Many of the high-quality vehicle models come from Simthetiq (http://www.simthetiq.com).
- Some models come from Real DB (http://www.realdb.qc.ca/company).
- Some of the middle-eastern building models and urban clutter objects that are used in our sample terrain databases were licensed from Turbosquid (http://www.turbosquid.com).
- The TerraSim_SampleUrban terrain database comes from TerraSim (http://www.terrasim.com).
- The HarrisAfghanVillage terrain database was created using source data from Harris Inc.
- The Berkeley Database was developed by Terrex (now Presagis) (http://www.presagis.com).

All of this content is distributed in the VR-Vantage package solely so that VR-Vantage can use it. Use of any of the VR-Vantage models, textures, terrains, or other content outside of VR-Vantage-based applications is not permitted by the VR-Vantage license.

1.2.6. OpenSceneGraph

VR-Vantage uses OpenSceneGraph for its underlying scene graph representation, rendering, file loading, and many other capabilities. OpenSceneGraph is an open source, cross-platform graphics toolkit for the development of high-performance graphics applications. The OpenSceneGraph source repository is maintained by Robert Osfield at http://www.openscenegraph.org/projects/osg. It is distributed under the OpenSceneGraph Public License (OSGPL), which is based on the GNU Lesser General Public License (LGPL).

MÄK will provide modified source code for OSG upon request, as per the OSGPL license. Please contact support@mak.com to obtain the download links for our modified source.

1.2.7. osgEarth

VR-Vantage uses osgEarth to import streaming terrain elevation and imagery data. The data can be streamed from external servers and sources or from a directory on the computer running VR-Vantage. osgEarth is an open source plug-in to OpenSceneGraph, maintained by Pelican Mapping at http://osgEarth.org. osgEarth is distributed under the GNU Lesser General Public License (LGPL).

MÄK will provide modified source code for osgEarth upon request, as per the OSGPL license. Please contact support@mak.com to obtain the download links for our modified source.



2. Installing VR-Vantage

This chapter explains how to install the VR-Vantage applications, VR-Vantage Toolkit, and data. You must also install the MÄK license manager. To use VR-Vantage with HLA, you must install an RTI.

Installing VR-Vantage 2-2
- Installing VR-Vantage on Windows 2-2
- Installing VR-Vantage on a Linux System 2-3
- Uninstalling VR-Vantage on Windows 2-3

The VR-Vantage Directory Structure 2-4

Installing and Setting Up the MÄK License Manager 2-5
- Specifying the License Server 2-6

Installing an RTI 2-9
- Installing the MÄK RTI 2-10

Localizing the Graphical User Interface 2-11
- Translating Other Interface Files 2-14
- Applying the Language Files 2-15

2.1. Installing VR-Vantage

A full VR-Vantage installation includes three components: the application, the License Manager software, and for HLA operation, an RTI (or Runtime Infrastructure.)

Before you install VR-Vantage, please read the Release Notes to see if there are any special instructions for installation.

VR-Vantage has two installers, an application installer and a data installer. You must run both installers. You must run the application installer first.

To install the VR-Vantage toolkit, you must enter an installation code. Be sure you have received your code from your MÄK salesperson before you start the installation process. If you do not have an installation code, you can install the runtime files. When you receive your installation code you can install the toolkit.

2.1.1. Installing VR-Vantage on Windows

Note the following:

- You must have administrator privileges to install MÄK products on Windows Vista.
- When you install large applications on Windows Vista or later, there may be a delay of up to several minutes from the time you try to run the setup program to the time that an installation dialog box is displayed. This delay can also take place between the time that VR-Forces or VR-Vantage unpack compressed data files and the time the data installer starts. This is due to how Windows scans setup programs before it executes them. If you experience this problem, turning off User Access Control can reduce or eliminate this delay.

Windows versions of VR-Vantage are provided as executable installer files on DVD, or as downloaded files. The installers are named to indicate the compiler used to build that version of VR-Vantage and whether it is a 32 bit or 64 bit version. (Some installers have both 32 bit and 64 bit libraries and are not labeled for the number of bits.)

➤ To install VR-Vantage, run the installers. Follow the instructions in the installation wizards. (You must run the application installer and the data installer.)

2.1.2. Installing VR-Vantage on a Linux System

Linux versions of VR-Vantage are provided as compressed tar files on DVD, or as downloaded files.

To install VR-Vantage on Linux:

1. Create the directory in which you want to install VR-Vantage.
2. Copy the tar file to the install directory.
3. Uncompress and untar the application file:

   `tar -vxzf application.tar.gz`

   where *`application`* is the product release identification.
4. Uncompress and untar the data package into the same directory as the application.

2.1.3. Uninstalling VR-Vantage on Windows

Because installation of VR-Vantage is a two step process, uninstallation is also a two-step process.

To uninstall VR-Vantage on Windows:

1. In the VR-Vantage root directory, run *unins001.exe*.
2. In the VR-Vantage root directory, run *unins000.exe*.

2.2. The VR-Vantage Directory Structure

The installation process creates the VR-Vantage directory tree shown in Figure 2-1 (runtime and toolkit). Table 2-1 describe the contents of the directories.

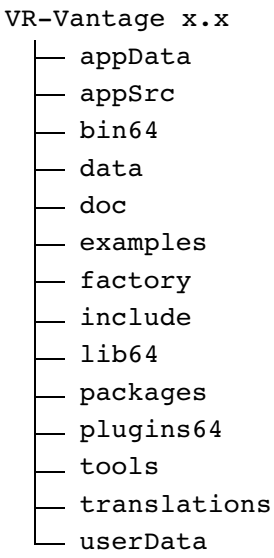


Figure 2-1. VR-Vantage directory tree

Table 2-1 describes the contents of the directories.

Table 2-1: Contents of VR-Vantage directories

Directory	Directory contents
./appData	Subdirectories contain data required by the VR-Vantage applications, such as model definitions and saved settings.
./appSrc	Source code for rebuilding the VR-Vantage applications.
./bin64	Executables and dynamic link libraries.
./data	Sample databases, images, and vehicle models.
./doc	VR-Vantage documentation and class reference files.
./examples	Examples for the VR-Vantage Toolkit API.
./factory	Default settings (for reverting to “factory” settings).
./include	Header files for the VR-Vantage Toolkit API.
./lib64	Libraries for building applications with the VR-Vantage Toolkit API.
./packages	Header files and libraries for third party and supplementary APIs that developers may need to build against.
./plugins64	Plug-in shared libraries.

Table 2-1: Contents of VR-Vantage directories

Directory	Directory contents
./tools	Helper applications such as MÄK Terrain Database Tool and the CIGI Host Emulator.
./translations	Translation files for localizing VR-Vantage menus.
./userData	Terrain and scene files saved by application users.

2.3. Installing and Setting Up the MÄK License Manager

Before you can use a MÄK product, you must obtain a valid license file, install the MÄK License Manager, and configure the license server and client machines. The License Manager uses a client-server architecture, so you do not need to install the License Manager on every computer on which you install MÄK products. You only need to install it on the computer that you will use as the license server.



If you have already installed the License Manager for another MÄK product, you do not have to install it again. You just need to make sure you have licenses for your newly installed products.

The License Manager installer is included on MÄK installation media. It is separate from the product installers. You can download the installers from our web site at http://www.mak.com/license-support.html or you can download directly from:

- Windows:
  ftp://ftp.mak.com/out/MAKLicenseManager-win-setup.exe (for 32-bit systems)
  ftp://ftp.mak.com/out/MAKLicenseManager-win64-setup.exe
- Linux:
  ftp://ftp.mak.com/out/MAKLicenseManager-linux-setup.tar.gz (for 32-bit systems)
  ftp://ftp.mak.com/out/MAKLicenseManager-linux64-setup.tar.gz

Complete installation and configuration instructions are included with the License Manager installer. Instructions are also available at the license support page.

Some customers use dongle licenses instead of running a license server. Instructions for using dongles are in the License Manager documentation.

2.3.1. Specifying the License Server

The first time you run a MÄK application on a particular computer, the License Setup dialog box opens (Figure 2-2). It prompts you to enter the hostname of the license server and optionally, a port number.

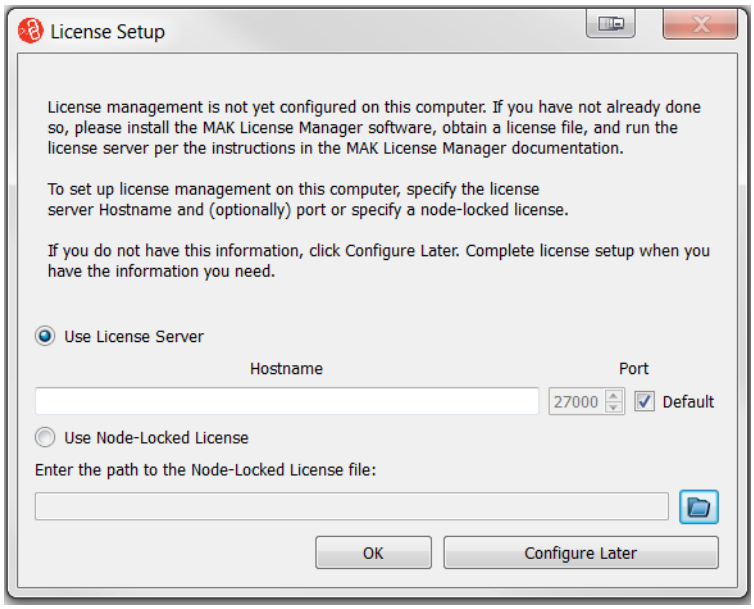


Figure 2-2. License Setup dialog box

If you do not know the hostname of the license server, click Configure Later. When you have the hostname, you can start the application again and complete the dialog box. You will not be able to run any MÄK applications until you set up license management.

If you know the hostname, type it in the Hostname box. Then click OK. The application will start.

Under limited circumstances, MÄK issues node-locked licenses. If you have a node locked license, select the Use Node Locked License option and enter the path to the license file.



- If you are running MÄK products on the license server machine, it is also a client, so you must specify the license server on that machine too.
- If you change the license server, the saved configuration will no longer be valid and the License Setup dialog box will open the next time you start a MÄK application.
- You can clear the saved license configuration by deleting the cache file. On Windows 7, it is *C:\Users\user_name\AppData\Roaming\MAK\licenses<n>.txt*. (The *AppData* directory is hidden by default.) On Linux, it is *.mak/license<n>.txt*. (There may be more than one cache file, for example, *licenses1.txt* and *licenses2.txt*.)

The MAKLMGRD_LICENSE_FILE Environment Variable

As an alternative to using the License Setup procedure described in the previous section, you can configure the license server in an environment variable. The MAKLMGRD_LICENSE_FILE environment variable identifies the server machine. If you set this environment variable, it overrides the settings stored by the License Setup procedure.

The syntax for the environment variable is: `@Server_name`. For example, if the server machine is oak, set the environment variable to `@oak`.

The following sections explain how to set environment variables on the different platforms that MÄK products run on.

Windows

To add the MAKLMGRD_LICENSE_FILE in Windows:

1. Open the Control Panel.
2. On Windows 7, click System and Security.
3. Click System.
4. In the sidebar menu, click the Advanced System Settings. The System Properties dialog box opens.
5. Click Environment Variables. The Environment Variables dialog box opens.
6. Click New. The New System Variable dialog box opens.
7. In the Variable Name field, enter MAKLMGRD_LICENSE_FILE.
8. In the Variable Value field, enter `@server_name`, where `server_name` is the name of the license server.
9. Click OK to back out of each dialog box and set the variable.



Different versions of Windows have slightly different wording of the various Control Panel options.

Linux

On Linux, you set environment variables in your *.cshrc* (or equivalent startup file). Set the variable similarly to the following example:

```
setenv MAKLMGRD_LICENSE_FILE @oak
```

If you are using the sh or bash shells, you set environment variables in your *.profile* file (or *.bashrc*). Set the variable similarly to the following example:

```
MAKLMGRD_LICENSE_FILE=@oak
export MAKLMGRD_LICENSE_FILE
```

Do not put spaces around the equal (=) sign.

You are ready to run the license server and use your new licenses or MÄK products.

2.4. Installing an RTI

An RTI is a software library (and perhaps supporting executables) that implements an HLA Interface Specification. In HLA, applications exchange FOM data through RTI calls, which means that all HLA applications need to use an RTI.



Because of differences in the low-level network mechanisms used by different RTI implementations (which include, but are not limited to packet layout), applications that want to interoperate in the same federation execution must use the same RTI implementation.

Because RTIs are usually provided as dynamic libraries that implement a fixed API, a federation can often switch from one RTI implementation to another between runs (without even recompiling the applications), but during each run, all participants must agree on which RTI to use, much as they must also agree on which FOM to use.

For the most recent information about the RTI versions supported by MÄK products, please see the release notes for your MÄK application.

2.4.1. Installing the MÄK RTI

To install the MÄK RTI, follow the instructions in Chapter 2 of *MÄK RTI Users Guide*.

Configuring Your System to Use the MÄK RTI

The RTI dynamic libraries must be located somewhere on your dynamic library search path. The path is specified in the PATH environment variable.The path is indicated by an environment variable as follows:

- Linux — LD_LIBRARY_PATH.
- Windows — PATH.

The MÄK RTI needs to know where to find the following configuration files:

- The federation configuration file (*.fed*, *.fdd*, or *.xml*) for your federation execution (required).
- The RID file (*rid.mtl*) (optional).

Put the configuration files in the directory from which you are running, or set the environment variable RTI_CONFIG to the directory that contains them.

Running Applications with the MÄK RTI

To run a MÄK application with the MÄK RTI:

1. Be sure the license server is running.
2. Start the application. The RTI Assistant will prompt you to choose an RTI configuration.
3. Choose a configuration. If necessary start the rtiexec.
4. Click Connect. The application should run.

In many cases, you do not need to run the rtiexec to use the MÄK RTI, however you can run the rtiexec if you want to. (It is required to use certain features of the MÄK RTI.) For more information, please see your RTI documentation.

2.5. Localizing the Graphical User Interface

You can localize your MÄK product's graphical user interface so that it uses languages other than English. Your product includes a file called *./translations/product_untranslated.ts*, for example *logger_untranslated.ts* or *vrforces_untranslated.ts*. The file contains entries for all of the application-specific menu and dialog box text. The Qt Linguist tool, which is included with VR-Vantage, lets you map the English text provided by MÄK to your chosen language.

To edit a resource file:

1. Start the Qt Linguist utility. It is *./translations/linguist.exe*
2. In the Qt Linguist window, choose **File** → **Open**. Select the file *./translations/product_untranslated.ts*. The Settings for filename dialog box opens (Figure 2-3).



Figure 2-3. Linguist settings dialog box

3. Select values for the source language, target language, and target region or country.
4. Click OK. The translation file is opened and a list of classes is displayed on the left side of the window (Figure 2-4).

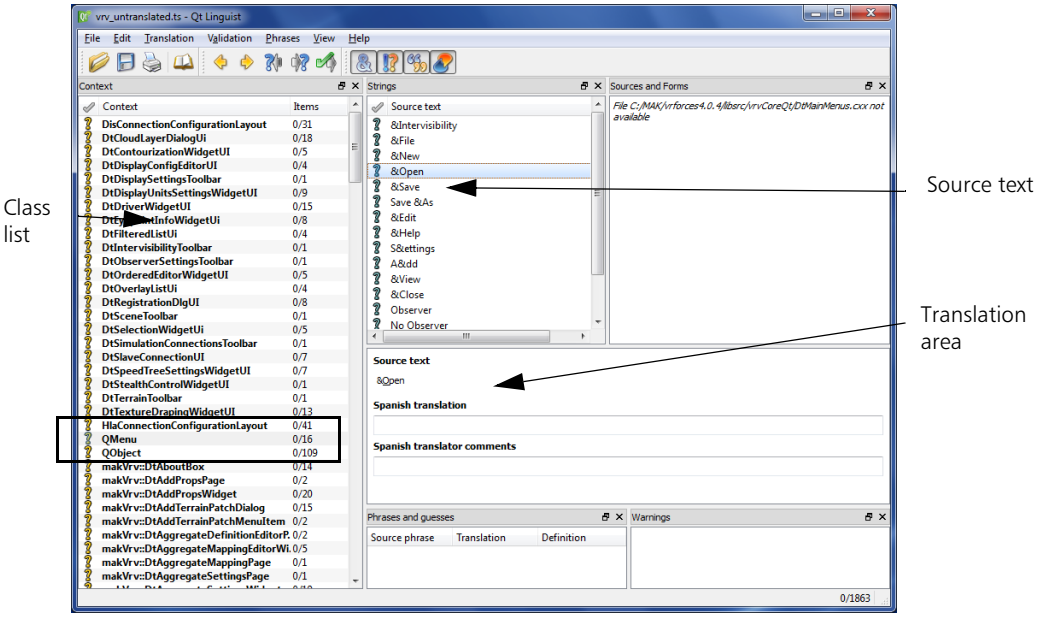


Figure 2-4. Linguist window

5. To translate text, you select each class in turn and translate the text associated with that class. You do not have to understand anything about what the classes mean, you just have to translate the text. In Figure 2-4, *QMenu* is selected. The Strings window lists text that can be translated. Text that has not been translated has a question mark in the checkmark column.

6. In the Source Text list, select the word you want to translate. The text is displayed under Source Text in the translation area (the window below the source text list.) Figure 2-5 shows the text Open selected.

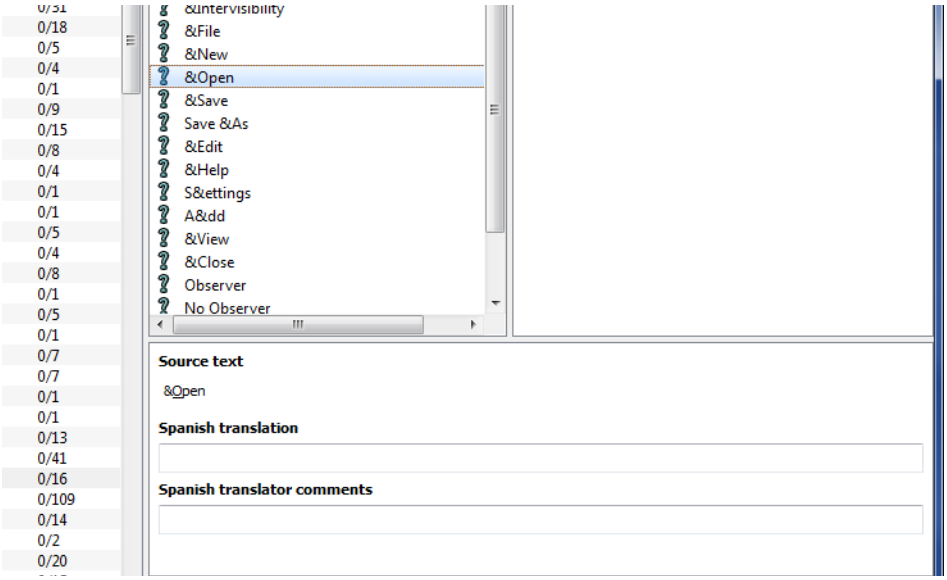


Figure 2-5. Text selected for translation

7. Place the cursor in the text box below *Language* Translation, where *Language* is the target language that you selected when you opened the translation file.
8. Type the translation text.
9. When you are done and you are certain of the translation, select the Done and Next button on the toolbar. A green check mark replaces the question mark (Figure 2-6). If you move to a different text string without clicking Done and Next, a yellow question mark is displayed for the string you translated. When you translate all elements for a class, a green check mark replaces the question mark next to the class name.

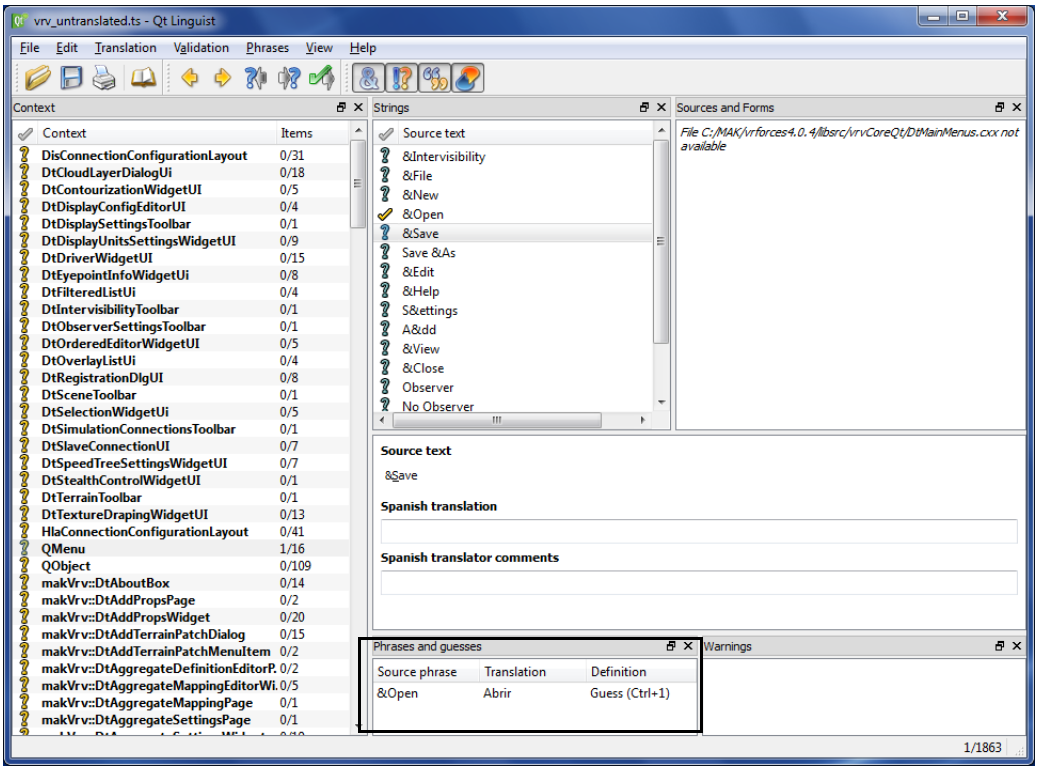


Figure 2-6. Completed translation for Open

10. Repeat this process for each element of source text for each class.
11. Choose **File** → **Release**. The file is saved in the format *filename.qm*.
12. Rename the file to a name that indicates the language to which you have translated the file, using the two-character abbreviation typically used with your language. For example, a Spanish translation would be renamed *product_es.qm*.
13. Save your translated *.ts* file.

2.5.1. Translating Other Interface Files

The *product_untranslated.ts* file contains all the text used in the VR-Vantage interface. However, there may be other text and messages that are not specific to VR-Vantage that are generated by the software that implements the VR-Vantage GUI. To translate this text, you need to translate the file *qt_untranslated.ts*. Follow the same procedure as you did for *vr-vantage_untranslated.ts*.

2.5.2. Applying the Language Files

To put the language file into effect, use one of the following methods:

- Set your computer's environment to the proper language (LANG environment variable).
- Set the locale to the proper language.
- Start VR-Vantage with the `-G locale` command line option, where `locale` is the two-letter country code for the local language.



3. Running VR-Vantage Applications

This chapter explains how to start and stop VR-Vantage, how to load a terrain, and how to connect to a simulation network.

Starting VR-Vantage Applications 3-2
- Starting VR-Vantage on Windows 3-2
- Starting VR-Vantage on Linux or the Windows Command Line 3-4
- Command-Line Options 3-4
- Shutting Down VR-Vantage 3-6

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Opening a Terrain 3-7
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Connecting to a Simulation Network 3-8
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- Using the Simulation Connections Toolbar 3-11

Managing VR-Vantage Settings 3-13
- Synchronizing Settings Among VR-Vantage Installations 3-15
- Global Settings and Observer-Specific Settings 3-15

3.1. Starting VR-Vantage Applications

The typical sequence for using a VR-Vantage application is to:

1. Start the application.
2. Load a terrain database.
3. Connect to a simulation network.

- If you want to connect to an HLA simulation, you must have an RTI installed. For details, please see "Installing an RTI," on page 2-9.
- Before you can start VR-Vantage, the license manager must be running.

3.1.1. Starting VR-Vantage on Windows

To start VR-Vantage on Windows:

1. On the Windows Start menu, choose **Programs** → **MÄK Technologies** → **VR-Vantage 2.1** → *application*, where *application* is one of the VR-Vantage applications, such as VR-Vantage Stealth or VR-Vantage IG. (Applications are also distinguished as 32-bit or 64-bit, depending on which version you have installed.)

   The VR-Vantage window opens (Figure 3-1). The Load Terrain dialog box opens on top of the window.

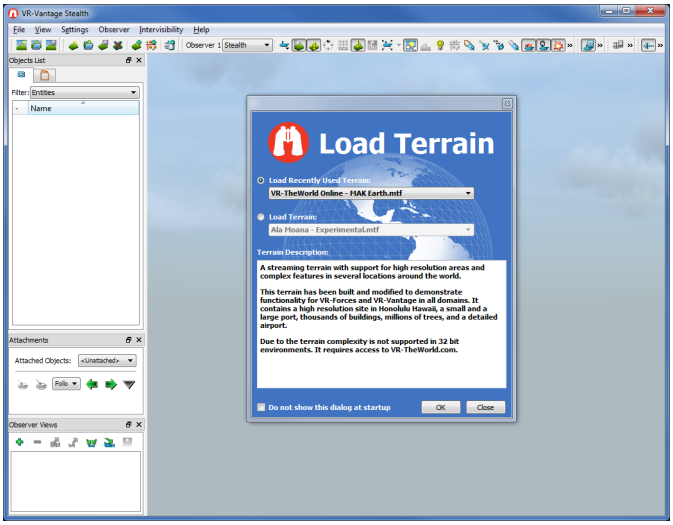


Figure 3-1. VR-Vantage window at startup

When you start VR-Vantage, if you receive the following message, it means that you did not install the data package:

```
Data package not found in specified data directory: 'c:\MAK\vrvan-
  tage2.1\data'.
Please make sure the data package is installed.
```

VR-Vantage has an application installer and a data installer. You must install both of them.

2. Select one of the terrain loading options:
   - Load a recently used terrain.
   - Select a local terrain database from the list.

   If you do not want to load a terrain, click Close, the dialog box closes and no terrain loads. Clicking Close does not close VR-Vantage.
3. Click OK. VR-Vantage loads the selected terrain (Figure 3-2).)

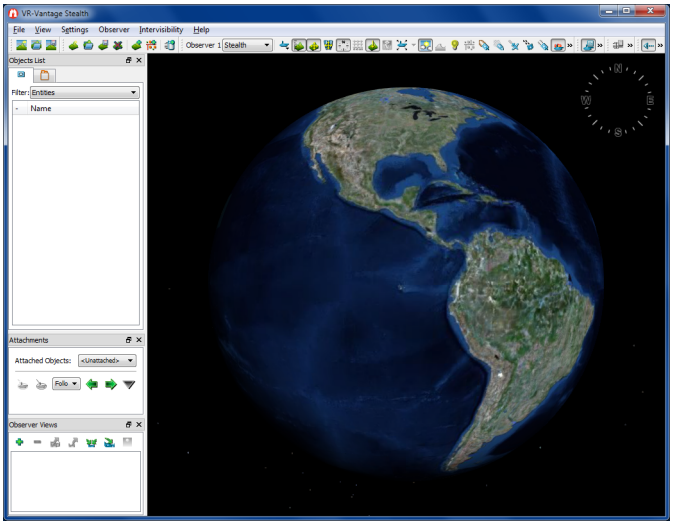


Figure 3-2. VR-Vantage window with a terrain loaded

3.1.2. Starting VR-Vantage on Linux or the Windows Command Line

To start VR-Vantage on Linux or the Windows command line:

1. Change directory to *./bin*.
2. Enter:

   application [*options*]

   where *application* is `vrvStealth`, `vrvIG`, or `vrvPVD`.

   VR-Vantage starts as described in the previous section.

"Command-Line Options," on page 3-4 describes the VR-Vantage command-line options.

3.1.3. Command-Line Options

Table 3-1 lists VR-Vantage's command-line options.

Table 3-1: VR-Vantage command-line options (Sheet 1 of 3)

Option	Description
`(--` | `--ignore_rest)`	Ignore all command-line options after this one. This option is useful for disabling part of a command line in a script for test purposes so that you do not have to retype all of the command options at a later point.
`--alphaBits` *bits*	Sets the number of alpha bits (0, 8).
`--antiAliasing` *level*	Set the anti-aliasing level (0, 2, 4, 8, or 16). Default: 4.
`--appDataDir` *directory*	Specifies the location of application data.
`(-B` | `--bindObservers)` *"observer1,...,observern,saved_views_file"*	If you load a scene that has multiple observers, this command assigns the views in the specified saved views file to the specified observers. The first saved view is assigned to the first observer, the second to the second observer, and so on. If the observers are not specified as arguments, only the first observer in the display engine configuration gets a view assigned to it. The entire string must be quoted. There are no spaces after commas. You would ordinarily also specify a display configuration that contains the observers with `--dispSetting`. You must specify a terrain database for this command to work. For more information about using this command-line option, please see "Attaching the Observer at Startup," on page 15-16.
`(-c` | `--showConsole)`	Display a console window.

Table 3-1: VR-Vantage command-line options (Sheet 2 of 3)

Option	Description
(-C | --autoConnect) {*filename* | *connector_name*}	Automatically connect to the network using the specified connector.
--dataDir *directory*	Specifies the location of the data directory (terrains and so on).
--depthBits *bits*	Sets the depth of graphics to 24 bits or 32 bits. Default: 24.
--displayEnginePort *port*	Specifies the display engine port used by a remote display engine. Used only if --slave is specified.
--dispSetting *filename*	Specifies the display engine configuration to load.
--enableOculus	Enable support for the Oculus Rift HMD. Implies --noVSync.
--entDispSetting *filename*	Specifies the entity display setting to load.
--envSetting *filename*	Specifies the environment configuration file to load.
(-E | --entTypeMap) *filename*	Load the specified object type mapping file. The file extension determines the type of mapping.
--factoryRootDir	Set the root directory used to restore settings to factory defaults.
--fullScreen	Start with the window in full screen mode.
(-F | --frameRate) *rate*	If rate is 0, the frame rate is variable. Otherwise, specifies a fixed frame rate for rendering.
(-G | --locale) *language*	Specifies the locale (for localization).
(-h | --help)	Display command-line usage information.
--highestPriority	Changes the priority of the application and the main render thread to the highest available priority. This command may starve other processes.
(-I | --unbatchedRendering)	Disables instance rendering. Default: Enabled.
(-K | --disableKDTrees)	Disable creation of KD trees for intersections.
(-l | --logFileName) *filename*	Specifies the log file name.
(-L | --loadObservers) *filename*	Loads the saved observers in the specified file. You can use this command multiple times, for example: --loadObservers file1 --loadObservers file2
(-n | --notifyLevel) *notify_level*	Specifies the notification level for application messages, where *notification_level* is a number from 0 through 4. The least verbose message level is 0, the highest is 4. The default is 2.
--noGui	Start without the graphical user interface.
--noVSync	Start without vsynched windows.

Table 3-1: VR-Vantage command-line options (Sheet 3 of 3)

Option	Description
(-O | --hasNTPSync)	Enables synchronized ocean between different VR-Vantage applications, such as VR-Vantage Stealth and the VR-Forces front-end. System clocks must be synchronized.
--plugin *filename*	Load the specified plug-in. Can be used multiple times.
--pseudoFullScreen	Use pseudo full screen for full screen mode.
(-s |--slave)	Run as a remote display engine.
(-S | --suppressHatInter-sectOnAttach)	Suppress the periodic HAT intersection when attached. This setting can improve performance if you need to attach the observer to ground vehicles a lot, but do not need to attach to air vehicles.
--stencilBits *bits*	Sets the number of stencil bits (0 or 8). Default: 0.
--tcpSendTimeout	Sets the timeout (in seconds) for the master display engine to wait for a remote display engine before giving up on a send. Default: 30 seconds.
(*terrain_MTF_file* | *scene_MSF_file*)	Specifies a terrain (MTF) or scene (MSF) file to load.
--unplug *filename*	Do not load the specified plug-in. Can be used multiple times.

> **!** If you select --useAbsoluteTimeStamps, it is your responsibility to ensure that the time clocks of exercise participants are synchronized. If they are not synchronized, VR-Vantage may not work properly.

--userDataDir *directory*	Specifies the user data directory.
(-v | --version)	Display version information and exit.
Windows syntax: -W | --withDisplayEngine *port@netAddress;displayConfigFilename1 .... n* Linux syntax: -W | --withDisplayEngine *port@netAddress:displayConfigFilename1 .... n*	Connect to a display engine running on another computer. For more information, please see *Loading Multiple Display Engine Configurations from the Command Line* under "Loading a Display Engine Configuration," on page 6-9.
(-Z | --ignoreZoomFor-SpeedtreeLod	Disable zoom for SpeedTree LOD.

3.1.4. Shutting Down VR-Vantage

➤ To shut down VR-Vantage, choose **File** → **Exit**.

3.2. Introduction to the VR-Vantage Graphical User Interface

The VR-Vantage graphical user interface (GUI) uses features that are common to most windowed applications, such as menus, toolbars, dockable panels, and context-sensitive help. For a brief introduction to these features and descriptions of common icons used in VR-Vantage, please see Chapter 40, *The VR-Vantage User Interface*.

3.3. Opening a Terrain

VR-Vantage includes several terrains. When you open a terrain in VR-Vantage, you open an MTF file; you do not open a file in its native format (such as OpenFlight or DTED). This procedure explains how to open the MÄK-supplied terrains or a terrain that you have created and saved in the MTF format.

(If you want to open files directly from their native formats, you do so by loading terrain patches, raster maps, and feature layers. You can then save the resulting terrain to an MTF file. For details, please see "Terrain Agility and Composability," on page 24-3.) For details about how to compose a terrain from source data, please see Chapter 24, *Composing Terrains*. For details about loading streaming terrains using an earth file, please see Chapter 25, *Streaming Data Using Earth Files*. For details about opening a geocentric terrain from a terrain server, please see "Connecting to Terrain Servers," on page 24-24.



- When VR-Vantage starts up, it prompts you to load a terrain (unless you have disabled the feature). Thereafter, you would use the procedure described here to load terrains.
- The first time you load a terrain (including the terrains supplied with VR-Vantage), VR-Vantage caches textures in its fast load format. This is a slow process. However, once it is cached, the terrain loads quickly. If you want to avoid runtime caching, you can preprocess the terrain with the medfTool before you load it. If you want to disable runtime caching, you can do so as described in "Configuring File Caching," on page 24-35.

To open a terrain:

1. Choose **File** → **Open Terrain**, or click the Open Terrain button () on the Terrain Toolbar. The Open Terrain dialog box opens.
2. Select the terrain (MTF format) that you want to open.
3. Click Open.

3.3.1. Closing a Terrain

To close a terrain, use one of the following methods:

- Choose **File** → **Close Terrain**, or click the Close Terrain button ( ) on the Terrain Toolbar.
- Choose **File** → **New Terrain**, or click the New Terrain button ( ) on the Terrain Toolbar.
- Choose **File** → **New Scene**, or click the New Scene button ( ) on the Scene Toolbar.
- Open a different terrain.

3.4. Connecting to a Simulation Network

To view a simulation, you must connect VR-Vantage to a simulation network. VR-Vantage includes connectors for DIS, CIGI, HLA 1.3, and HLA Evolved (IEEE 1516-2010, also referred to as HLA 1516e). You can change the configuration values of the default connectors and you can add connectors. For details about creating and editing connections, please see Chapter 4, *Managing Network Connections*.

When VR-Vantage starts up, it does not automatically connect to a simulation network unless you configure it to do so. The auto connect feature lets you specify that VR-Vantage automatically connect to a network through a connection when it starts up. If you do not use auto connect, you must connect manually. A connector's status is listed in the Status column in the Connection Status page of the Simulation Connections dialog box.

- You can connect to more than one simulation network at the same time.
- You can quickly get connection status, connect to a network, and disconnect on the Simulation Connections Toolbar. For details, please see "Using the Simulation Connections Toolbar," on page 3-11.

To connect to a simulation network:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens (Figure 3-3).

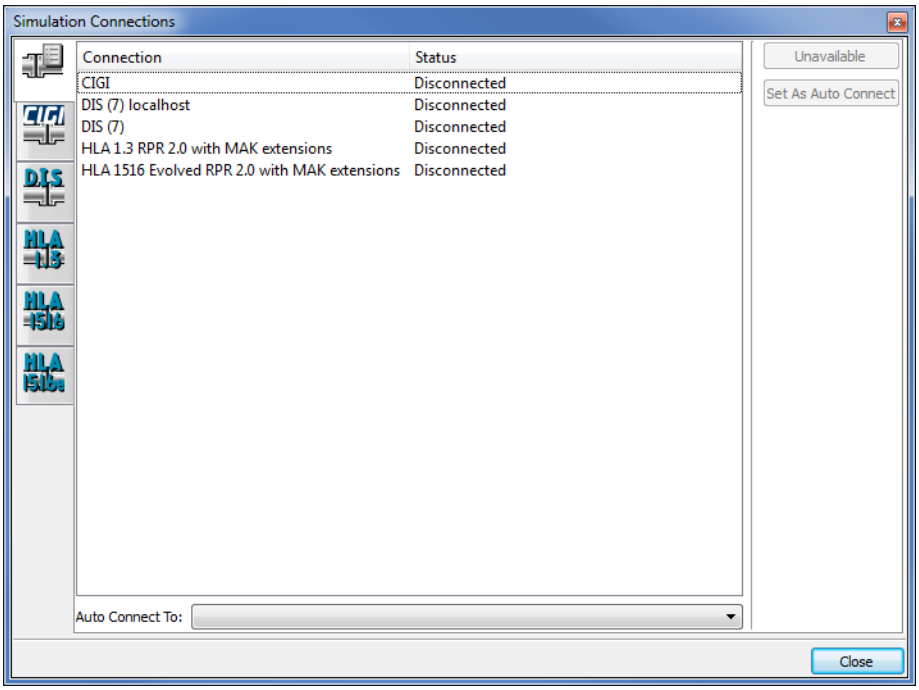


Figure 3-3. Connection Status page

2. Select the page for the connection type that you want to use.
3. Select a connector in the Connections list (Figure 3-4).

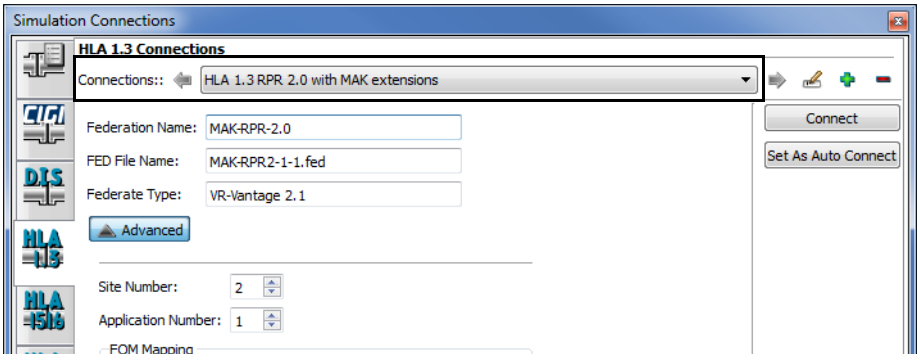


Figure 3-4. HLA 1.3 Connections page

4. Click Connect.

3.4.1. Setting Up Auto Connect

If you specify auto connection, VR-Vantage connects to the specified simulation network when it starts. If a connection is designated as an auto connection, a star is added to its entry in the connections list (Figure 3-5).

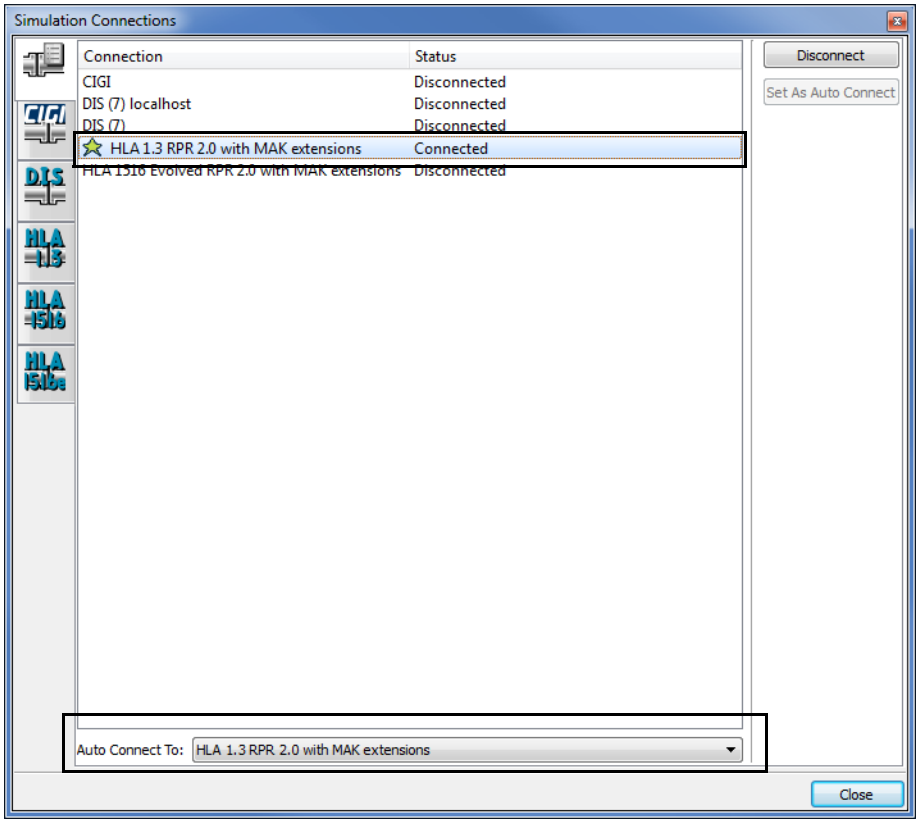


Figure 3-5. Auto connect enabled

To configure auto connection:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens.
2. To configure auto connect on the Connection Status page (Figure 3-5):
   a. Select the Connection Status page.
   b. Do one of the following:
      - Select the desired connection in the Connection list and click Set As Auto Connect.
      - Select a connection from the Auto Connect To list. (To disable auto connection, select the blank line.)

   To configure auto connect on a protocol-specific page:
   a. Select the page for the connection type that you want to use.
   b. Select a connector in the Connections list.
   c. Click Set As Auto Connect.

3.4.2. Disconnecting from the Simulation Network

To disconnect from the simulation network:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens (Figure 3-3).
2. On the Connection Status page or on a protocol-specific page, select the connection that you want to disconnect.
3. Click Disconnect.

3.4.3. Using the Simulation Connections Toolbar

The Simulation Connections Toolbar lets you quickly open the Simulation Connections dialog box to the Connection Status page. It also lets you quickly connect to and disconnect from a specific connection.



Figure 3-6. Simulation Connections Toolbar

➤ To view connection status, click the Connection Status button ( ).

To quickly connect to selected simulation connections:

1. Click the down arrow next to the Connect button ( ). A list of all configured simulation connections is displayed.

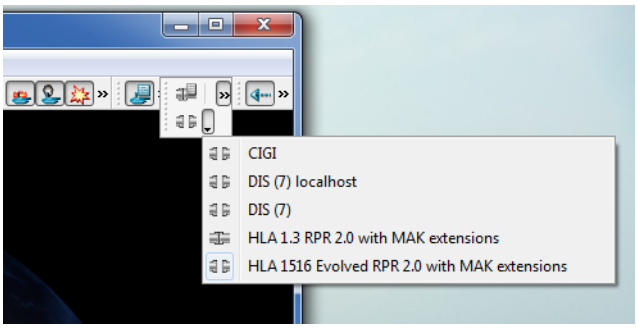


Figure 3-7. Connection list

2. Click the connection that you want to connect to when you use the toolbar.

- You can only select one connection in the list. To connect to multiple simulations, use the Connection Settings dialog box.
- The Connect button toggles between an open and closed state depending on the status of the connection.

3. Click the Connect button.

➤ To disconnect all connections, click the Disconnect button ( ).

3.5. Managing VR-Vantage Settings

VR-Vantage has the following types of settings:

- Independent, or display, settings are the individual settings managed on the Settings menu and the pages of the Display Settings dialog box. Changing an independent setting, such as enabling track histories or wireframe mode, does not affect other settings.

  Independent settings are categorized as being global settings or observer-specific settings. Global settings apply regardless of the observer mode. Observer-specific settings can be different for each observer mode. For more information, please see "Global Settings and Observer-Specific Settings," on page 3-15.

- Dependent settings are the schemas, model definitions, element definitions, and object type mappings that collectively determine how simulation objects and objects are modeled in the scene. Changing a dependent setting, such as a model definition may affect settings that depend on it, such as an entity definition.

VR-Vantage manages settings as follows:

- As you make changes to settings during a session, it saves the changes.
- It remembers the settings in effect when you exit and uses them as the default settings in your next session.
- During any particular session, you can revert to the default settings.
- You can save the current settings to a file.
- You can import saved settings.
- You can restore settings to those that were in effect when VR-Vantage was first installed (factory settings).

Dependent settings have two additional options that independent settings do not have:

- You can save or restore a specific setting.
- You can merge settings from a file into the current settings.

The procedures for saving and restoring settings are the same regardless of the types of settings. You start the process by clicking a button on a settings dialog box page. However, the way that VR-Vantage saves or restores settings depends on the type of setting, as follows:

- When you initiate a save or restore operation on independent settings, it only affects the settings on the dialog box page from which you started the save or restore. If you have changed a setting on another page, it is not affected.
- When you initiate a save or restore operation on dependent settings, all of the changes to all of the related settings get saved or restored. This ensures that the relationships do not get broken.

(Figure 3-8) illustrates the settings management buttons.



Figure 3-8. Settings buttons

- Revert to the default settings. Override any changes made to settings during this session.
- Restore the factory settings. Change settings to the settings used when VR-Vantage was installed. (The factory settings and default settings may be different.)
- Import settings from a file. Replace the current settings with those stored in the selected file.
- Merge in settings from a file. (Only supported for dependent settings.) Merging works as follows:
  - Saved settings that do not have a match in the current settings are added.
  - Saved settings replace matching settings.
  - Current settings that are not replaced (that is, for which there is no match in the saved settings) remain valid.

  Figure 3-9 illustrates how merged settings work. Setting A in the saved settings has no match in current settings, so it is added to the merged settings. Current settings B_2 and C_2 are replaced with saved settings B_1 and C_1. Current setting D has no match in saved settings, so it is retained in the merged settings.

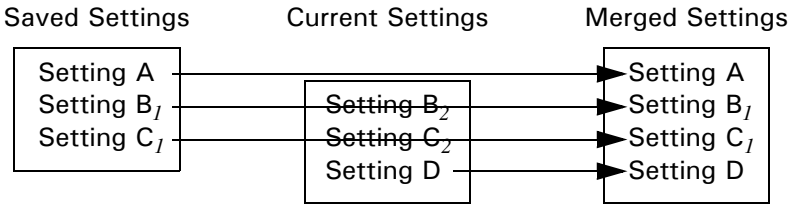


Figure 3-9. Merged settings

- Export settings to a file. Save the current settings to the selected file.
- Save the selected setting to a file. (Only supported for dependent settings.)

- The buttons described in this section are disabled on dialog box pages on which their function is not supported. This includes most of the pages on the Terrain Settings dialog box.
- Each VR-Vantage application saves settings to its own directory (*./appData/settings/stealth*, *./appData/settings/vantageIG*, and so on).
- If you load an alternative settings file at startup, it is treated like an imported settings file. If you save current settings as default, they get saved to the default files in *./appData/settings/*. They do not get saved back to the alternative file unless you explicitly export them to that file.

3.5.1. Synchronizing Settings Among VR-Vantage Installations

If your simulation is using several VR-Vantage applications or display engines, you may want to use the same settings across all of them, particularly if you have added model definitions and mappings to the factory settings. To synchronize settings, copy the data directories (*./appData*, *./data*, and *./userData*) from the computer on which you have updated them to the computers on which the other VR-Vantage applications and display engines are installed. Then import the settings into any Settings page that you customized on the source VR-Vantage machine.

3.5.2. Global Settings and Observer-Specific Settings

VR-Vantage has two types of independent settings – global settings and observer-specific settings.

Global settings affect the display regardless of which observer mode you are using. Global settings include simulation object labels, tactical graphics, and cockpit displays. The settings on the Settings menu are all global settings.

Observer-specific settings can be different for each observer mode. In fact, given a similar projection and model set, it is the different settings that distinguish one observer mode from another. For example, one difference between Stealth observer mode and Out-the-Window observer mode is that Stealth mode has tactical smoke enabled and Out-the-Window mode has it disabled.



4. Managing Network Connections

This chapter provides details about how to configure network connections.

Managing Simulation Connections 4-2
- Displaying Connections 4-2
- Adding a Simulation Connection 4-3
- Renaming a Simulation Connection 4-4
- Deleting a Simulation Connection 4-4

Configuring Connection Settings 4-5
- HLA Connection Settings 4-6
- CIGI Connection Settings 4-9

4.1. Managing Simulation Connections

VR-Vantage uses connectors to access the various types of input it requires. To connect to a simulation you connect an appropriate simulation connection, for example, an HLA 1.3 connection or a DIS connection. The Simulation Connections dialog box lists connections and lets you manage them. You can:

- Add connections.
- Configure connections.
- Delete connections.
- Connect to the network using a specific connection.
- Disconnect a connection.
- Specify a connection to use automatically at startup.
- Enable or disable publishing of observers.
- Enable or disable acceptance of view control messages.

4.1.1. Displaying Connections

The Connection Status page on the Simulation Connections dialog box displays all of the configured connections and their connection status.

To view the list of connections:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens.
2. Select the Connection Status page (Figure 4-1).

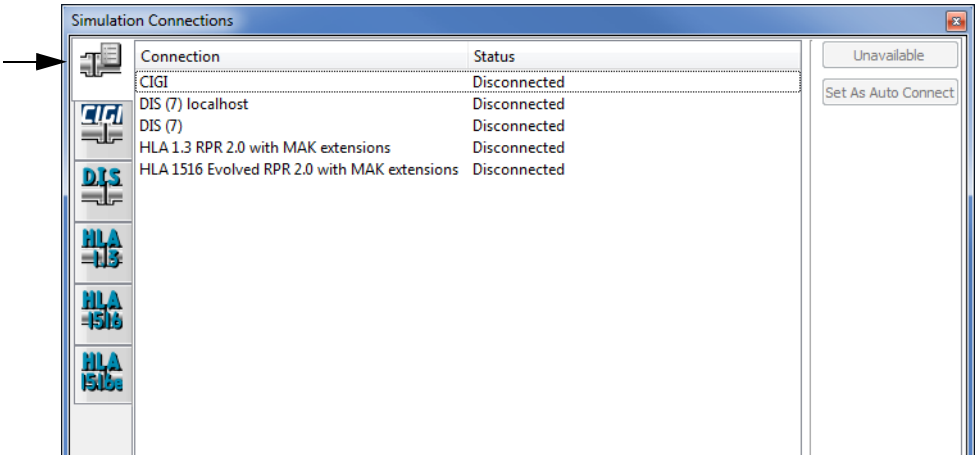


Figure 4-1. Simulation Connections dialog box, Connection Status page

4.1.2. Adding a Simulation Connection

You might want to edit the parameters for an existing connection and add a new connection with the updated parameters. In HLA, you might want to add a connection that supports a different FOM or FOM Mapper.

To add a simulation connection:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens (Figure 4-1).
2. Select the page for the connection type you want to add (Figure 4-2).

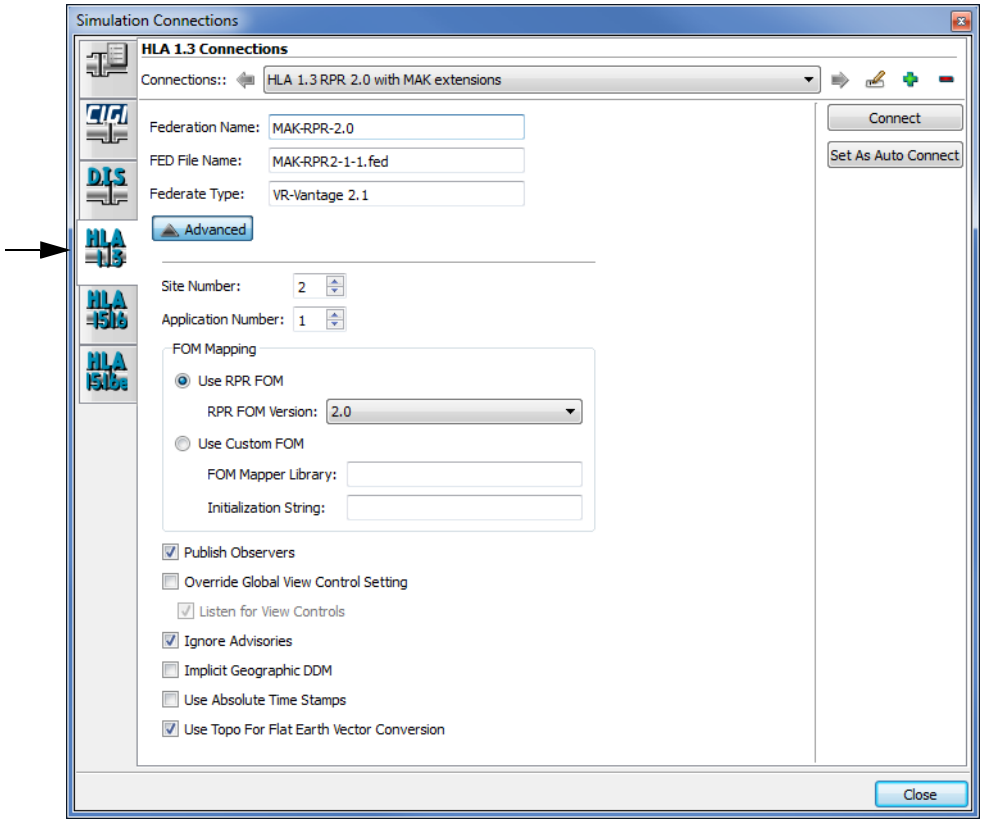


Figure 4-2. Protocol-specific page

3. Click the Add button (+) to the right of the Connections list. A new connection is added to the list. (To change the name of the connection, follow the procedure in "Renaming a Simulation Connection," on page 4-4.)
4. Set the connection parameters to the desired values. (For details about connection parameters, please see "Configuring Connection Settings," on page 4-5.)
5. Optionally, click Set As Auto Connect to have VR-Vantage automatically connect using this connection when it starts up.

6. Click Close.

4.1.3. Renaming a Simulation Connection

To rename a simulation connection:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens (Figure 4-1).
2. Select the page for the connection type that you want to rename.
3. In the Connections list, select the connection that you want to rename.
4. Click the Rename button (). The Rename Connection dialog box opens.
5. Type a new name for the connection.
6. Click OK.

4.1.4. Deleting a Simulation Connection

To delete a simulation connection:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens (Figure 4-1).
2. Select the page for the connection type that you want to delete.
3. In the Connections list, select the connection that you want to delete.
4. Click the Delete button (). You are prompted to confirm the deletion.
5. Click Yes.

4.2. Configuring Connection Settings

The different simulation connection types have different parameters, but the process of configuring a connection setting is essentially the same regardless of the connection type.

HLA 1.3 and HLA 1516 have the same set of connection parameters. HLA Evolved has one additional parameter. HLA 1.3 and HLA Evolved have default connections configured for RPR FOM 2.0 with extensions that support changing DI-Guy characters based on messages sent from VR-Forces, MÄK's computer generated forces application.

To configure connection settings:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens (Figure 4-1).
2. Select the page for the connection type that you want to configure.
3. In the Connections list, select the connection that you want to configure, or add a new connection, as described in "Adding a Simulation Connection," on page 4-3.
4. Click Advanced to display all of the parameters.
5. Specify values for connection parameters, as described in Table 4-1, Table 4-2, or Table 4-3.

4.2.1. HLA Connection Settings

4.2.2. Table 4-1 describes the connection settings for HLA 1.3, HLA 1516, and HLA

1516e.DIS Connection Settings

Table 4-1: HLA connection settings

Parameter	Description
Federation Name	Specifies the federation execution name.
FED File Name	Specifies the FED file. Default: the federation name with *.fed* appended.
Federate Type	Federate Type can be used to distinguish different categories of federates, and its only practical use is in save-and-restore.
Advanced	
Federate Name	Specifies a unique name that can be assigned to the federate. No two federates within the same federation can have the same name. If no name is specified, the RTI will automatically assign a unique name for the federate. (HLA 1516e only)
Site Number	Specifies the site number for the observer. The Site ID and Application Number uniquely identify the observer.
Application Number	Specifies the application number for the observer.
Use RPR FOM	Specifies use of a version of the RPR FOM.
RPR FOM Version	Specifies the RPR FOM version. VR-Vantage has built-in support for RPR FOM versions 0.5, 0.7, 0.8, 1.0, 2.0006, 2.0014, 2.0017, and 2.0020 (RPR FOM 2.0). You must specify the correct FED file for the version you use. If you use a different FOM, you must specify the correct FED file and FOM Mapper.
Use Custom FOM	Specifies use of a FOM other than the RPR FOM.
FOM Mapper Library	Specifies the name of a FOM Mapper library.
Initialize String	Specifies initialization data for the specified FOM Mapper, if required. It is your responsibility to know if your FOM Mapper needs initialization data.
FOM Modules	Lets you specify FOM Modules. Consult your RTI documentation for information about FOM Modules. (HLA 1516e Only)
Publish Observers	Specifies whether or not to publish an entity for the observer that is using this connection.
Override Global View Control Setting	Apply the setting in this connection to instead of the setting in the GUI. If this is used, the GUI setting is ignored.
Listen for View Controls	Specifies whether or not to respond to view control messages sent by other applications.

Table 4-1: HLA connection settings

Parameter	Description
Ignore Advisories	Enables or disables use of HLA advisory messages.
Implicit Geographic DDM	Enables or disables use of implicit DDM. Valid only with the MÄK RTI.
Use Absolute Time Stamps	Enables or disables use of absolute time stamps.

Table 4-2 describes the connections settings for DIS connections.

Table 4-2: DIS connection settings

Parameter	Description
Port	The DIS port to connect to.
Exercise ID	Specifies the exercise ID for VR-Vantage.
Site Number	Specifies the site number for VR-Vantage.
Application Number	VR-Vantage can send PDUs to the network to communicate the observer's position and orientation. By default, these PDUs are sent to the host machine's broadcast address. You may want to direct VR-Vantage data to a unicast address so it is received by only one application.
DIS Version	Specifies the DIS version (4, 5, 6, or 7).
Network Interface Address	On computers with multiple network cards, the address of the network card to use.
Advanced	
Destination Address	Specifies the destination address for outgoing PDUs. Default: the computer's broadcast address.
Multicast Addresses	Specifies one or more multicast groups to subscribe to. Separate multiple addresses with a semi-colon (;). For more information about multicast addresses, please see the note that follows this table.
Send Buffer Size	Increasing the send and receive buffer size can reduce dropped packets. If the parameters are set to 0, the system default setting is used.
Receive Buffer Size	Increasing the send and receive buffer size can reduce dropped packets. If the parameters are set to 0, the system default setting is used.
Multicast TTL	Specifies the number of routers that a message can pass through when PDUs are sent to multicast addresses.

Table 4-2: DIS connection settings

Parameter	Description
Enable Timeout Processing	Enables or disables applying a timeout value to discovered objects.
Timeout Interval	The number of seconds to wait without receiving an updated before timing out an object.
Use Asynchronous IO	Enables or disables asynchronous IO. Use of asynchronous IO can reduce dropped packets.
Use Absolute Time Stamps	Enables or disables use of absolute time stamps.
Show Self Published Objects	Broadcast the location of objects that VR-Vantage creates - primarily the observer.
Publish Observers	Specifies whether or not to publish an entity for the observer that is using this connection.
Override Global View Control Setting	Apply the setting in this connection to instead of the setting in the GUI. If this is used, the GUI setting is ignored.
Listen for View Controls	Specifies whether or not to respond to view control messages sent by other applications.

4.2.3. CIGI Connection Settings



Multicast subscription is a property of the host machine, not of individual applications. If several applications are running on the same machine using the same port, and some of those applications subscribe to multicast groups, all the applications will receive packets for all multicast groups to which any application is subscribed.

Therefore, if VR-Vantage is running on the same machine and using the same port as other applications that subscribe to multicast groups, VR-Vantage may receive traffic intended for the other applications.

Table 4-3 describes the connections settings for CIGI connections.

Table 4-3: CIGI connection settings

Parameter	Description
CIGI Version	The version of CIGI being used.
Driver Mode	Synchronous or asynchronous.
CIGI Entity Mapping	The host-specific CIGI mapping to use. These mappings are configured in the CIGI Mapping Settings dialog box. For more information, please see Chapter 36, *Mapping CIGI Models and Components*.
Driver Frequency	The frequency at which VR-Vantage should try to communicate with the host. There is no guarantee that this frequency can be maintained.
Transport Type	The network transport type to use: Best Effort, Reliable Client, or Reliable Server.
Host IP Address	The IP address of the CIGI host.
Network Device Address	The device address for the network card to be used.
Listen Port	The port on which to listen for CIGI messages.
Send Port	The port on which to send CIGI messages.
Packet Buffer Size	Specifies the amount of space to allocate for packets.
CIGI Messages: Incoming CIGI Messages: Outgoing	The number and size of CIGI message buffers to maintain. Decreasing the number or size can slow down performance. Increasing the number or size can use up memory.



5. Optimizing Performance

This chapter explains how to monitor performance and improve performance.

Factors that Affect Performance 5-2
Displaying Performance Statistics 5-4
Displaying the VR-Vantage Function Profiler 5-6
Displaying OSG Statistics 5-6
Configuring VSync 5-6
Configuring Graphics Quality 5-7
Using Incremental Compiling with Streamed Data 5-7
Coloring Draw Calls 5-8

5.1. Factors that Affect Performance

The performance of a visualization product such as VR-Vantage depends on:

- Processor speed.
- Video card. (Always use the latest drivers for your video card.)
- Available memory.
- Size of the terrain database.
- The number and complexity of models loaded.
- Number of objects in the simulation and how active they are.

You can display statistics to help you evaluate VR-Vantage's performance. For details, please see "Displaying Performance Statistics," on page 5-4.

The following actions can affect performance:

- Displaying performance statistics.
- Use of ground clamping.
- Displaying track histories.
- Displaying height-above-terrain lines.
- Enabling advanced lighting and various lighting effects.
- Enabling dynamic ocean effects. When you are using PVD observer mode, enabling wakes, spray effects, and the buoyancy model can seriously degrade performance. These features are disabled by default. If you inadvertently enable them and experience this problem, switching to Stealth mode and back to PVD restores performance.
- Anti-aliasing settings. For details, please see "Configuring Graphics Quality," on page 5-7.

The following sections describe options for optimizing performance:

- "Configuring SpeedTree Trees," on page 30-19.
- "Configuring File Caching," on page 24-35.
- "Clearing the Model Instancing Cache," on page 29-6.
- "Setting the Clipping Planes," on page 6-13.
- "Enabling Texture Compression," on page 24-37.
- "Considerations and Limitations for Building Terrains," on page 24-7.
- "Filtering Simulation Objects Using Interest Management," on page 18-17.
- "Setting the Ocean LOD Elevation," on page 24-18.
- "Configuring the Ocean Height Map," on page 24-19.
- "Displaying Wakes and Spray Effects," on page 20-22.
- "Configuring the Skybox Cube Map," on page 12-13.
- "Improving Performance when Attaching to Ground Objects," on page 15-7.
- "Enabling Buoyancy for Surface Entities," on page 20-23.
- Chapter 12, *Lighting Effects*.

5.2. Displaying Performance Statistics

VR-Vantage can display two kinds of performance statistics — OSG statistics (Figure 5-1), and VR-Vantage statistics (Figure 5-2). VR-Vantage also has a function profiler that developers can use to assess the performance of new code.

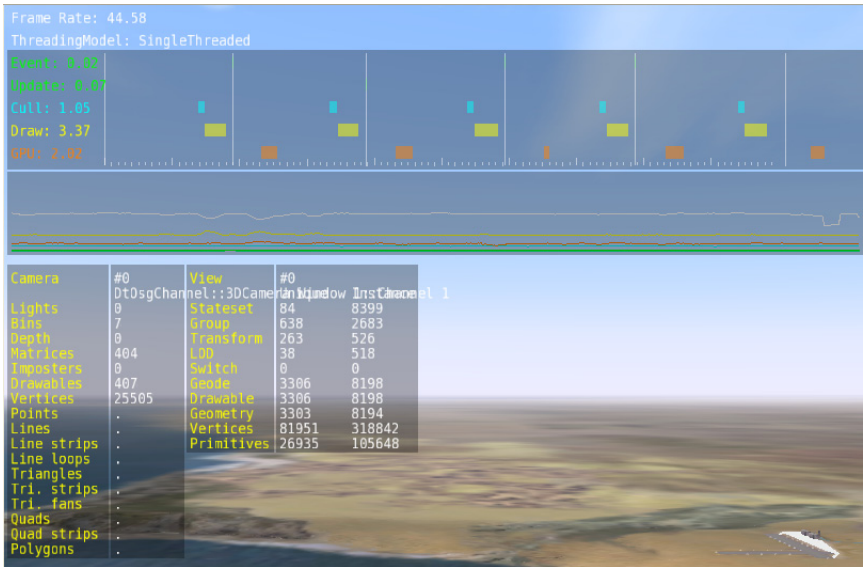


Figure 5-1. OSG performance statistics

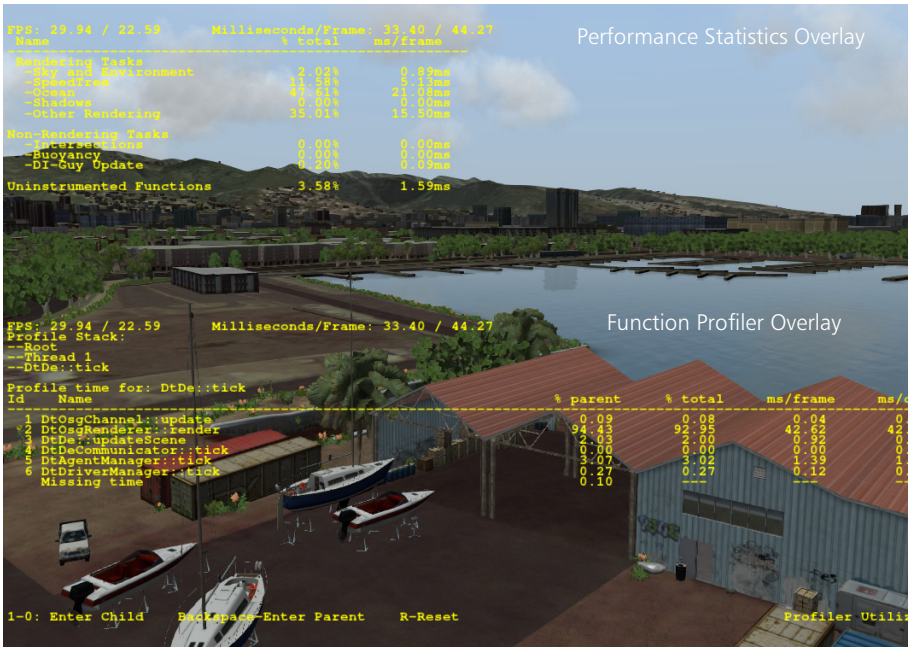


Figure 5-2. VR-Vantage performance statistics and function profiler

Displaying performance statistics may affect performance. Displaying OSG statistics may affect performance more than VR-Vantage statistics.

To display VR-Vantage performance statistics:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 5-3).

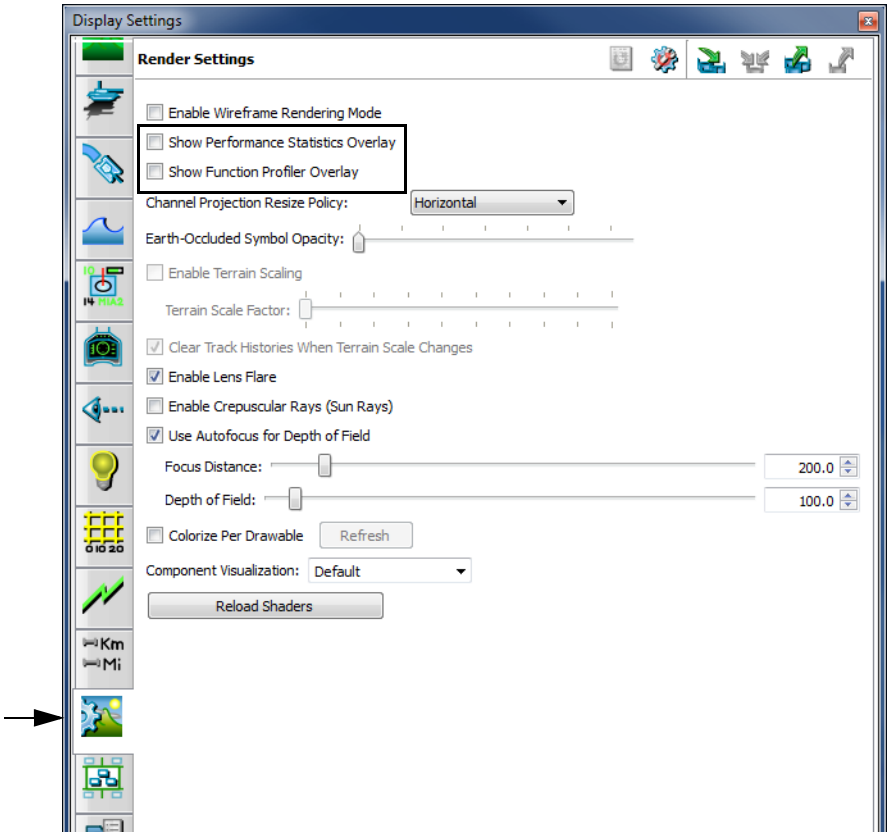


Figure 5-3. Render Settings page

3. Select the Show Performance Statistics Overlay check box. A statistics display is added to the window (Figure 5-2).

5.2.1. Displaying the VR-Vantage Function Profiler

The VR-Vantage Function Profiler is primarily for the use of developers who are debugging VR-Vantage applications. For information about how to integrate the profiler into your code, please see Chapter 11, Using the Function Profiler in VR-Vantage *Developers Guide*.

To run the VR-Vantage Profiler:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 5-3).
3. Select the Show Function Profiler Overlay check box. A statistics display is added to the window (Figure 5-2).

5.2.2. Displaying OSG Statistics



If you display OSG statistics and VR-Vantage statistics at the same time, they overlay each other.

To display OSG performance statistics:

1. Press F2. The frame rate is displayed.
2. Continue pressing F2. Additional statistics are displayed. When all statistics are displayed, pressing F2 closes the display.

5.3. Configuring VSync

By default, VR-Vantage enables VSync (vertical synchronization), which synchronizes VR-Vantage's frame rate with your monitor's refresh rate. This prevents a visual anomaly called tearing, in which parts of two frames of data can be visible at the same time. Use of VSync can also significantly improve terrain and feature data streaming performance.

In some cases, if the frame rate cannot quite keep up with the refresh rate, VSync can force the frame rate to a noticeably lower rate. To avoid this problem, we recommend that you enable triple buffering for your video card. You must do this in the video card's configuration application; VR-Vantage cannot do this for you.

If you prefer not to use VSync, you can disable it at startup with the `--noVSync` command-line option, or you can configure your video card to force it to be off.

5.4. Configuring Graphics Quality

VR-Vantage has command-line options that let you configure graphics quality. Depending on the capabilities of your graphics card, you may need to adjust the default settings for anti-aliasing and graphics depth and stencil buffers. The command-line options are:

- `--antiAliasing` *`level`*. Anti-aliasing is a technique used to reduce the jagged edges of digital graphics. You can set the level to 0, 2, 4, 8, or 16. Default: 4.
- `--depthBits` *`depth`*. The number of bits in an image determines its quality and the number of colors it supports. You can set the depth to 24 or 32. Default: 24.
- `--stencilBits` *`bits`*. The stencil buffer can be set to 0 or 8. Default: 8.
- `--alphaBits` *`bits`*. Specifies the number of alpha bits – 0 or 8.

On older graphics cards, you may need to set anti-aliasing to 0 to improve performance.

Depending on your graphics card and driver, some combinations of these settings may be incompatible. For example, if you set stencil bits to 8, the depth must be set to 24 and anti-aliasing may need to be set to 0 or 2.

5.5. Using Incremental Compiling with Streamed Data

Users of streamed terrains might want to consider using incremental compiling. This is an OSG option that allows the processing of streamed data to be spread across multiple frames, reducing performance spikes. To use it, create the environment variable OSG_ICO. (It does not need a value. It just needs to exist.)



Using OSG_ICO may cause LOD issues with other paged formats. It is only recommended for streamed terrains.

5.6. Coloring Draw Calls

One of the factors that affects performance is the number of draw calls it takes to render a scene. VR-Vantage lets you color the draw calls in a scene so that you can see which objects may be creating performance problems.

When you color draw calls, all the drawables in the scene are randomly colorized. The colors themselves do not convey any meaning. The important information is the number of draw calls required for a model. For example, if a vehicle has 25 different colored parts, you know that it requires 25 draw calls and you may want to edit the model to user fewer of them.

Figure 5-4 illustrates a tank with its drawables colorized.

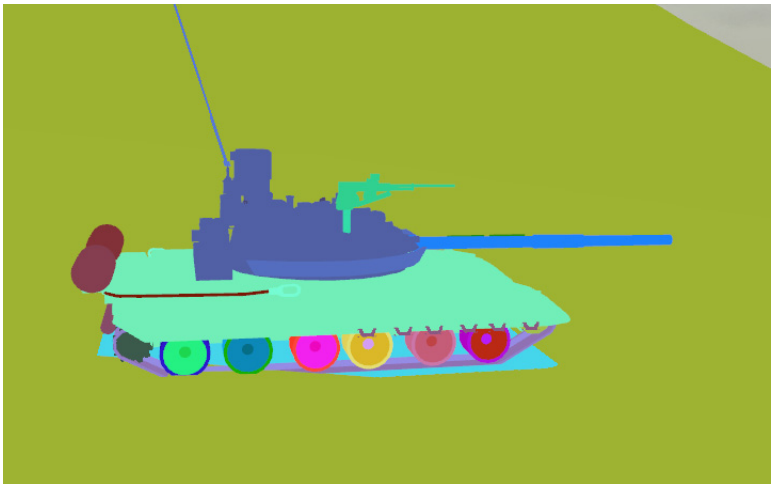


Figure 5-4. Colorized drawables on tank

The colors do not update as new information comes into the scene. Therefore, you can refresh the colorization.

To visualize draw calls:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 5-3).
3. Select the Colorize Per Drawable check box.
4. To refresh the display, click Refresh.



II. Display Engine

VR-Vantage applications have a component called a display engine. The display engine renders visual data. A display engine can also control the display on remote display engines.

VR-Vantage includes an application called the VR-Vantage Display Engine. A VR-Vantage Display Engine has a very limited GUI. Its primary purpose is to provide windows that can be controlled by a VR-Vantage application's (master) display engine.



6. Windows, Channels, and Display Engines

This chapter explains how to add and configure windows and channels and how to connect to remote display engines.

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- The Display Engine's Connection States 6-4
- Windows and Channels 6-4
- Window Types 6-4

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6.1. The VR-Vantage Display Engine

VR-Vantage applications have a component called a display engine. The display engine renders visual data. A display engine can also control the display on remote display engines.

VR-Vantage includes an application called the VR-Vantage Display Engine. A VR-Vantage Display Engine has a very limited GUI. Its primary purpose is to provide windows that can be controlled by a VR-Vantage application's (master) display engine.

The master display engine can connect to multiple VR-Vantage Display Engines (typically running on other computers) and control what is displayed in their windows.



For the remainder of this manual, we will continue to use VR-Vantage as an inclusive term for referring to VR-Vantage applications, will assume that you remember that VR-Vantage has a display engine that can control VR-Vantage Display Engine applications, and will refer to VR-Vantage Display Engine applications as display engines or external display engines (to distinguish them from the display engine in VR-Vantage).

VR-Vantage drives all of the display engines it is connected to, as illustrated in Figure 6-1.

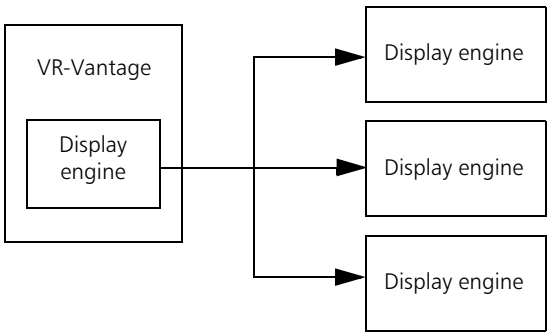


Figure 6-1. VR-Vantage and display engines



Display engines must have the same terrains, models, and other visualization data available as VR-Vantage. To replicate settings from a VR-Vantage application to a display engine, copy the data directories (*./appData*, *./data*, and *./userData*) from the computer on which VR-Vantage is installed to the computer on which the display engine is installed. Then import the settings into any Settings page that you customized on the VR-Vantage machine.

6.1.1. How VR-Vantage Responds to Display Engine Connections

VR-Vantage reloads the current scene each time a display engine is connected. This ensures that the display engine has an exact duplicate of the current scene. VR-Vantage does not perform any special actions when a display engine disconnects.

6.1.2. The Display Engine's Connection States

An external display engine is initially in an unconnected state. While it is unconnected, it cannot display a scene. When VR-Vantage connects to a display engine, the display engine creates an identical copy of the scene regardless of whether or not it can render it. The display engine is automatically sent a default display engine configuration that has a single channel on a single window. However, you can change this at runtime or programmatically. You could also load a saved configuration. If a display engine loses its connection to VR-Vantage, it clears its local scene and returns to an unconnected state.

6.1.3. Windows and Channels

A display engine (including the master display engine) can display multiple windows, each of which can have zero or more channels. The windows are all configured in VR-Vantage as part of a display engine configuration. You can save a display engine configuration and load it at a later time.

6.1.4. Window Types

To view a scene and simulation data, a display engine must have a window. VR-Vantage supports the following types of windows:

- Full screen. A full screen window uses the entire area of a monitor. It does not have any menus, panels, or other GUI controls.
- Resizable. A resizable window can be moved, resized, maximized, and minimized. It does not have any GUI controls. An inset view is an example of a resizable window. (For information about inset views, please see "Inset Views," on page 16-2.)
- Embedded. An embedded window is part of an application. The main display window in VR-Vantage is an embedded window. The application provides a variety of controls that affect the view in the window. You could, if you wanted to, change VR-Vantage's window to a different type, in which case it would no longer be embedded in the main application window.

A window can have zero or more channels. Each channel defines a viewable area on the screen. You must have at least one channel to see a rendered image in the window. Each channel can have its own observer.

6.2. Managing Display Engine Configurations

A VR-Vantage application has one display engine. You can add windows to the display engine and you can add channels to the windows. The windows and channels make up a display engine configuration. You can save a display engine configuration and load a saved configuration. Chapter 7, *Display Engine Tutorials*, shows how to edit a channel's attributes and how to save and load display engine configurations.

6.2.1. Adding a Window

You can add as many windows as you want. New windows are named for the window type, for example Stealth Inset 1, Stealth Inset 2, Plan View Inset 1, and so on. Each window is created with one channel. You can add new windows from the File menu or in the Display Engine Configuration Editor.

➤ To add a window from the File menu, choose **File** → **New Stealth Window** (or **New Plan View Window**). (The new window commands that are available on the File menu depend on which VR-Vantage application you are running.) A new window opens (Figure 6-2).

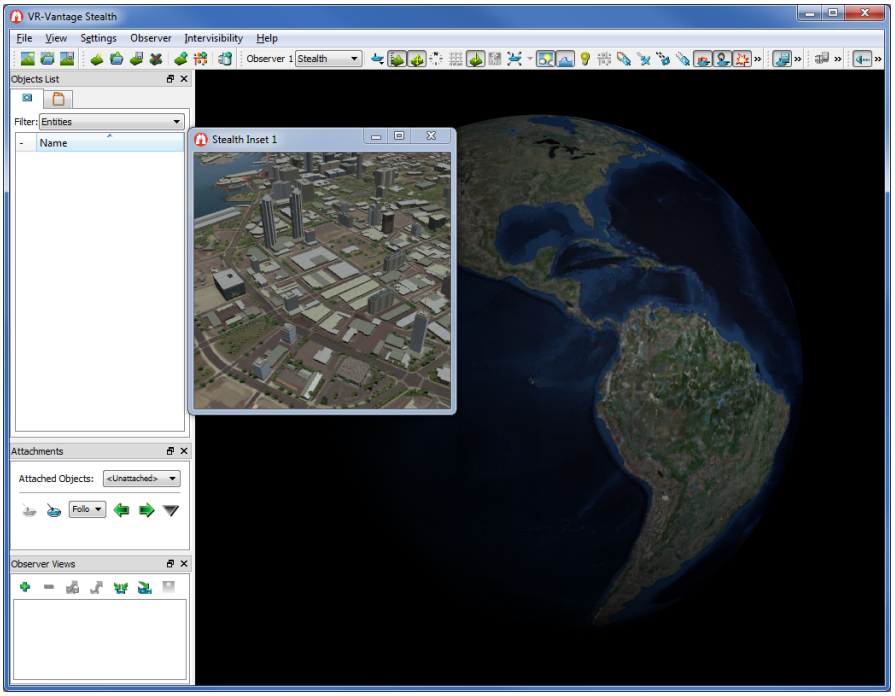


Figure 6-2. New window

To add a window from the Display Engine Configuration Editor:

1. Choose **View** → **Display Engine Configuration Editor Panel**. The Display Engine Configuration Editor Panel is added to the VR-Vantage window (Figure 6-3).

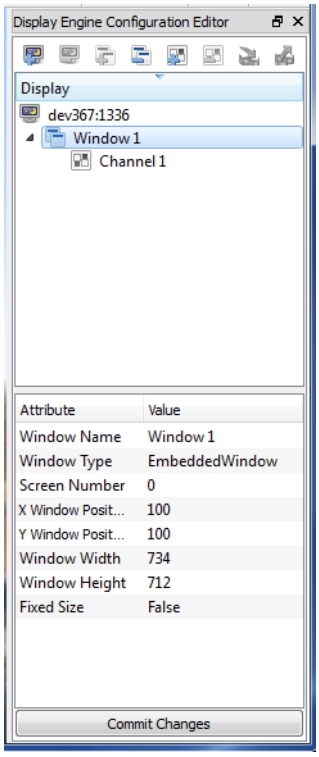


Figure 6-3. Display Engine Configuration Editor Panel



The Display Engine Configuration Editor Panel is available only in a VR-Vantage application, not on remote Display Engines.

2. Select the display engine at the top of the Display tree.
3. Click the Add a Window button (), or right-click the display engine name and choose **Add a Window** on the context sensitive menu. A new window opens and is listed in the Display Engine Configuration Editor Panel (Figure 6-4).

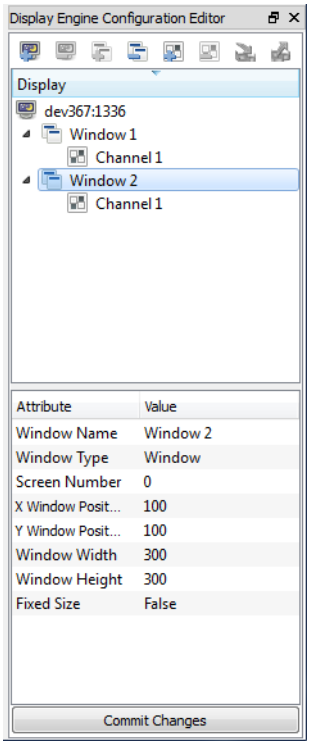


Figure 6-4. New window

6.2.2. Adding a Channel to a Window

Adding a channel to a window lets you configure multiple views within that window.

To add a channel to a window:

1. In the Display Engine Configuration Editor Panel, select the window to which you want to add a channel.
2. Click the Add a Channel button (), or right-click the window name and choose **Add a Channel** from the menu.



To see a difference between the channels, change the attributes of the new channel (Figure 6-11). For details about editing channel attributes, please see "Changing a Channel's Attributes," on page 6-11.

6.2.3. Removing a Window

To remove a window:

1. In the Display Engine Configuration Editor Panel, select the window that you want to remove.
2. Click the Remove Window button (), or right-click the window name and choose **Remove Window** from the menu.

6.2.4. Removing a Channel

To remove a channel:

1. In the Display Engine Configuration Editor Panel, select the channel that you want to remove.
2. Click the Remove Channel button (), or right-click the window name and choose **Remove Channel** from the menu.

6.2.5. Saving a Display Engine Configuration

You can save a display engine configuration so that you can easily replicate the configuration at a later time.

If you are running two or more display engines, you cannot save the configurations for all of them at once. You have to save the configuration for each display engine individually.

To save a display engine configuration:

1. In the Display Engine Configuration Editor Panel, select the display engine whose configuration you want to save.
2. Click the Save Display Engine Configuration button (), or right-click the name of the display engine and choose **Save Display Engine Configuration** on the menu. The Save Display Engine Configuration dialog box opens.
3. Type a name for the display engine configuration.
4. Click Save.

6.2.6. Loading a Display Engine Configuration



You cannot load multiple display engine configurations at the same time in the Display Engine Configuration Editor Panel. You can only load one configuration at a time. However, you can load multiple configurations from the command line. For details, please see "Loading Multiple Display Engine Configurations from the Command Line," on page 6-9.

To load a display engine configuration:

1. In the Display Engine Configuration Editor Panel, select the display engine at the top of the window.
2. Click the Load Display Engine Configuration button (), or right-click the name of the display engine and choose **Load Display Engine Configuration** on the menu. The Load Display Engine Configuration dialog box opens.
3. Select the display engine configuration you want to load.
4. Click Open.

Loading Multiple Display Engine Configurations from the Command Line

VR-Vantage users often set up multichannel configurations that they wish to reuse. (For details, please see "Configuring Multichannel Displays," on page 6-23.) You can load these configurations (or any set of configurations) in the Display Engine Configuration Editor Panel, as described in "Loading a Display Engine Configuration," on page 6-9. However, you cannot load them as a group. You must load each one individually. To automate the process of loading multiple display engine configurations, you can load them from the command line.

You load multiple display engine configurations from the command line with the `--dispSetting` command line argument and the `-W` or `--withDisplayEngine` command-line argument. The syntax on Windows is:

```
vrvIG.exe --dispSetting masterdisplayConfigFile
  -W port@netAddress;remotedisplayConfigFile1 ....
  port@netAddress;remotedisplayConfigFileN
```

The syntax for Linux uses a colon instead of a semi-colon:

```
vrvIG.exe --dispSetting masterdisplayConfigFile
  -W port@netAddress:remotedisplayConfigFile1 ....
  port@netAddress:remotedisplayConfigFileN
```

The `--dispSetting` argument specifies the display engine configuration file for the VR-Vantage application. The `-W` argument specifies the display engine configuration files for the VR-Vantage display engines. The display engine configuration file name can be an absolute path or a path relative to the executable. For example, suppose that you have saved display engine configurations for a master display engine and two remote display engines. You save the configuration for each display engine as follows:

- Master display engine — *../appData/settings/stealth/machine1.dcx*.
- First remote display engine — *../appData/settings/stealth/machine2.dcx*.
- Second remote display engine — *../appData/settings/stealth/machine3.dcx*.

To load these three configurations:

1. Run the remote display engines on the two remote machines.
2. Start VR-Vantage. On Windows use the following command line:

```
vrvIG.exe
  --dispSetting ../appData/settings/stealth/machine1.dcx
  -W 22563@machine2;../appData/settings/stealth/-
  machine2.dcx 22563@machine3;../appData/settings/-
  stealth/machine3.dcx
```

On Linux use:

```
vrvIG.exe
  --dispSetting ../appData/settings/stealth/machine1.dcx
  -W 22563@machine2:../appData/settings/stealth/-
  machine2.dcx 22563@machine3:../appData/settings/-
  stealth/machine3.dcx
```

! Make sure there is a space between each display engine configuration listed.

6.3. Changing a Window's Attributes

You can change the following attributes of a window:

- Window Name.
- Window Type (for details about window types, please see "Window Types," on page 6-4).
- Screen Number.
- Position (X, Y coordinates of upper left corner, in screen pixels).
- Width and height, in pixels.
- Fixed size.

To change a window's attributes:

1. Select the window in the Display Engine Configuration Editor Panel. A list of attributes is displayed at the bottom of the editor (Figure 6-3).
2. Click the value of the attribute that you want to change.
3. To change a numeric value, type or select a value.

   To change the Window Type or Fixed Size, select a value from the list.

   To change the name, type a new name.
4. Click Commit Changes. The window is updated.



You can also change a window's position by dragging it to a new location. You can change its size by resizing the window directly. The new values are shown in the attributes list the next time you select the window in the Display Engine Configuration Editor Panel.

6.4. Changing a Channel's Attributes

You can change the following attributes of a channel:

- Channel Name.
- Observer Name.
- Sensor. Use the sensor configured for the current observer, or override the observer and use one of the listed sensors.
- Projection Units – field of view, in angles, or database, in meters.
- Projection Resize Policy – fixed, vertical, or horizontal.
- Frustum (Left, Right, Top, and Bottom) (field of view).
- Z Near and Z Far (clipping planes).
- Near Far Clip Policy.
- Reduce Z Fighting Ratio.
- Dynamic Near Clip Attached Policy.
- Attached Near Clip Altitude.
- Fixed Near Clip When Attached.
- Dynamic Water Visibility Enabled.
- Dynamic Water Visibility Maximum.
- Camera Position Offset (X, Y, Z).
- Camera Orientation Offset (Psi (heading), Theta (pitch), Phi (roll)).
- Viewport (Left, Right, Bottom, Top).
- Keywords – keywords to associate with the channel, for example, "showCockpits".

To change a channel's attributes:

1. Select the channel in the Display Engine Configuration Editor Panel. A list of attributes is displayed at the bottom of the editor (Figure 6-5).

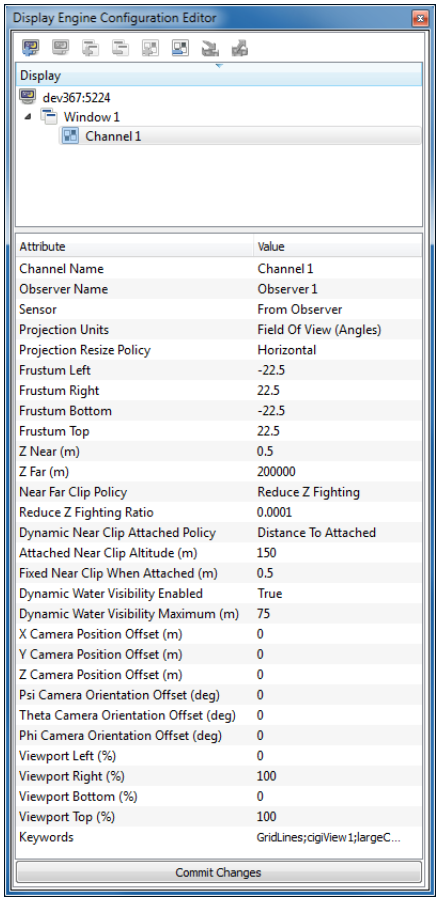


Figure 6-5. Channel attributes

2. Click the value of the attribute that you want to change.
3. To change a numeric value, type or select a new value.

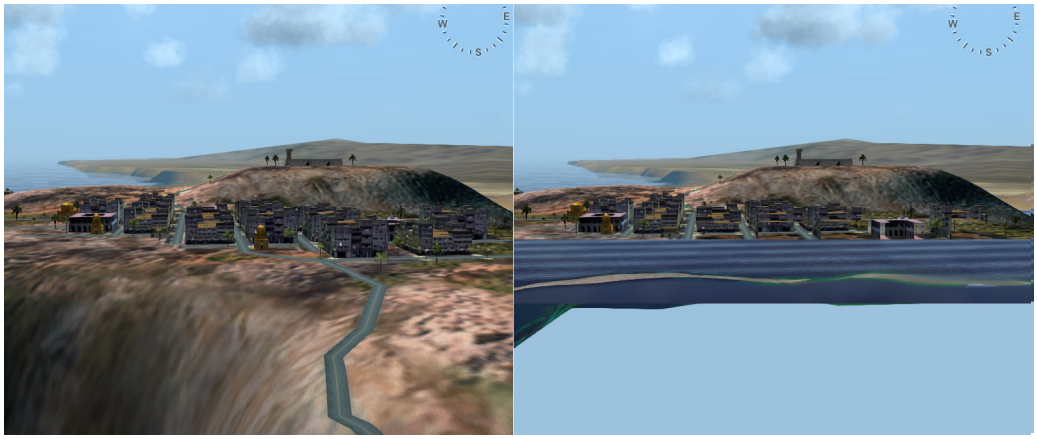
   To change the Observer Name, Sensor, Project Units, Projections Resize Policy, or Parent Channel, select a value from the list.

   To change the Channel Name, type a new name. (For details about some of these attributes, please see the sections that follow this one.)
4. Click Commit Changes. The window is updated.

6.4.1. Setting the Clipping Planes

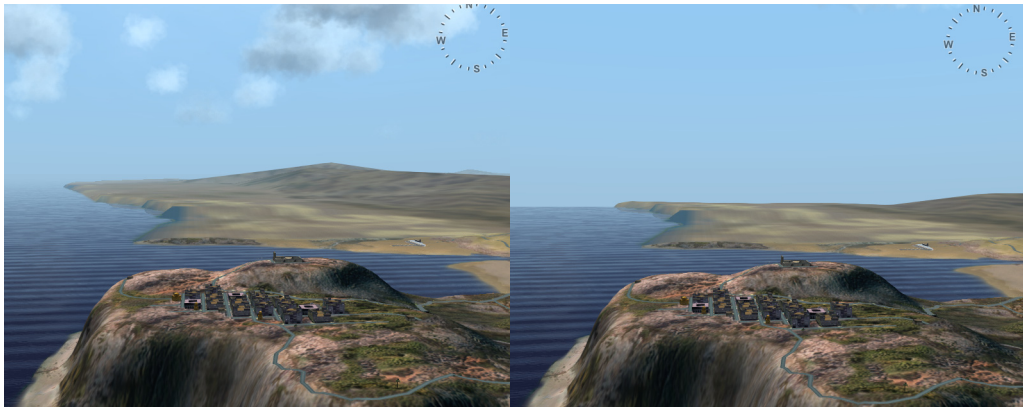
To improve performance, the graphics engine does not render anything that falls outside of a specified range of distances from the observer. This range is determined by the near and far clipping planes. Clipping planes are set on a per-channel basis.

Figure 6-6 illustrates the effect of changing the near clipping plane (the Z Near attribute). Figure 6-7 illustrates the effect of changing the far clipping plane (the Z Far attributes).



Z Near = 1 Z Near = 500

Figure 6-6. Near clipping



Z Far = 10000000 Z Far = 10000

Figure 6-7. Far clipping

The ratio between the far clipping plane and the near clipping plane determines the precision with which the renderer can determine differences in depth. If this ratio becomes too small, then terrain and objects that are distant may not sort correctly, resulting in what is referred to as Z-fighting. VR-Vantage provides different policies for managing the way near and far clipping planes are determined.

VR-Vantage sets the clipping planes using one of the following policies (the Near Far Clip Policy attribute), plus their modifiers:

- Fixed. Clipping planes are set explicitly using the Z Near and Z Far attributes.
- Reduce Near Clip. Clipping planes are adjusted dynamically based on the observer's altitude. The near clipping plane is increased slightly as the observer rises to 20,000 meters, but stays under 1.5 meters. When the observer rises above 20,000 meters, the near and far clipping planes gradually increase. The Reduce Near Clip policy can be modified by the Dynamic Near Clip Attached Policy.
- Reduce Z Fighting. Clipping planes are set based on a ratio of the near clipping plane to the far clipping plane (the Reduce Z Fighting Ratio attribute). The near clipping plane can get as large as needed to maintain the ratio. This policy is the default clipping plane policy. The Reduce Z Fighting policy can be modified by the Dynamic Near Clip Attached Policy.

The Reduce Z Fighting clipping plane policy greatly reduces Z-fighting when you are using dynamic ocean. However, if the observer is attached to a simulation object and its altitude is moderately high, it may be closer to the entity than the near clipping plane and the entity may be clipped away. You can adjust the ratio to provide the best results. If you are not using dynamic ocean or you are frequently attaching to entities, you may want to use one of the other clipping plane policies.

If you set the Near Far Clip Policy to Reduce Z Fighting or Reduce Near Clip and the observer is attached to a simulation object, VR-Vantage can dynamically change the near clipping plane based on the Dynamic Near Clip Attached Policy, as follows:

- Ignore Attached. Do not take entity attachment into account when setting the near clipping plane.
- Fixed Near Clip. Set the near clipping plane to the value of the Fixed Near Clip When Attached attribute if the observer altitude is >= the value of the Attached Near Clip Altitude attribute.
- Distance To Attached. Use the distance between the observer and the attached entity to determine the near clipping plane if the observer altitude is >= the value of the Attached Near Clip Altitude attribute. When this policy is selected, VR-Vantage compares the near clipping value without this modifier to the value with it and uses the smaller of the two values. This is the default policy.

6.4.2. Specifying the Projection Resize Policy Attribute

The Projection Resize Policy determines how a channel behaves when you resize it. The options are:

- Fixed. Keep the aspect ratio the same regardless of how the window is resized.
- Horizontal. Maintain the horizontal aspect ratio when the window is resized.
- Vertical. Maintain the vertical aspect ratio when the window is resized.

Figure 6-9 illustrates the effect of different resize policies, as follows:

- In the window with the fixed resize policy, all of the visual data in the initial view is still in the resized view, although the vertical dimensions are distorted.
- In the window with the horizontal resize policy, the field of view is widened to maintain the correct aspect ratio of the visual data.
- In the window with the vertical resize policy, the field of view is shortened.

You can change the projection resize policy for individual channels by editing the Projection Resize Policy attribute. You can also change the projection resize policy for all channels.

To change the projection resize policy for all channels:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 6-8).

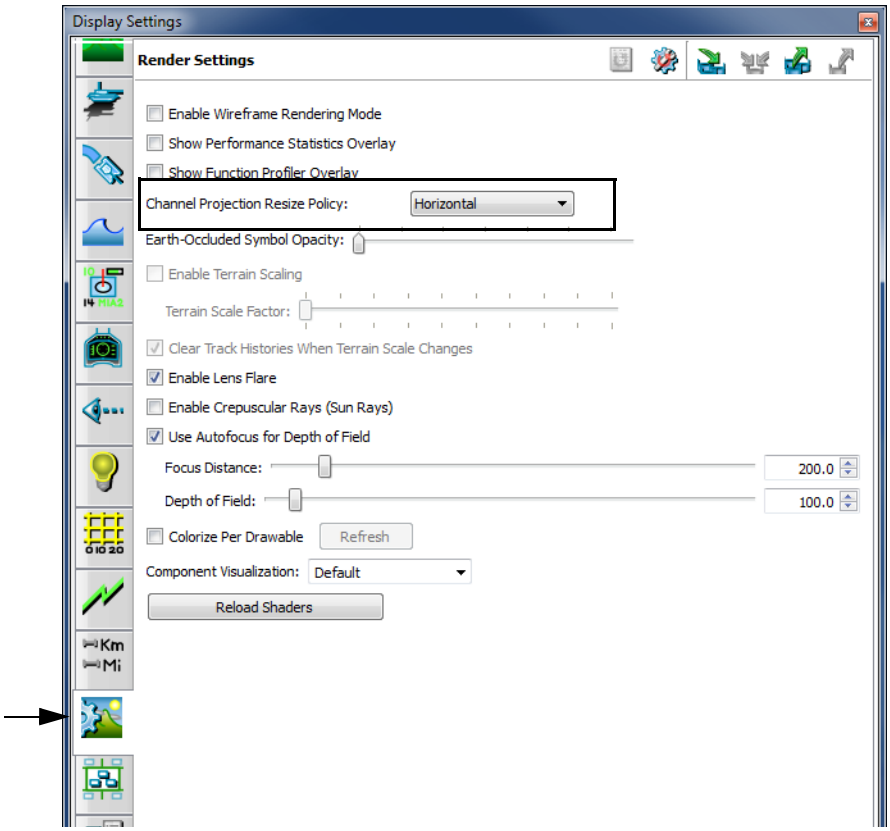
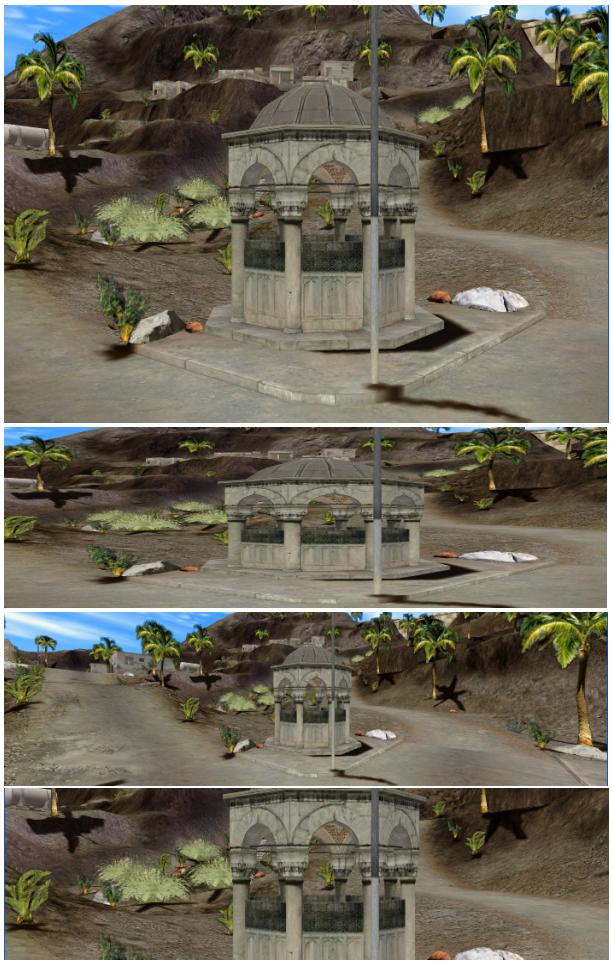


Figure 6-8. Display Settings, Render Settings page

3. Select an option on the Channel Projection Resize Policy list.



Initial view

Resized with Fixed resize policy

Resized with Horizontal resize policy

Resized with Vertical resize policy

Figure 6-9. Effect of different projection resize policies

6.4.3. Changing a Channel's Frustum (Field of View)

The field of view setting affects perspective in a manner similar to a camera lens.

A wide field of view creates an effect like that of a wide-angle lens. Objects appear smaller and farther away from the observer, since the observer coverage spans a wider area. Depth distances between objects become exaggerated.

A narrow field of view creates an effect like that of a telephoto lens. Objects appear larger and closer to the observer, and the overall scene depth appears flattened. The distances between objects appears compressed.

Figure 6-10 illustrates different field of view settings taken from the same observer location. The view on the left has frustum values -22.5, 22.5, -22.5, 22.5. The view on the right has the frustum values -10, 10, -10, 10.

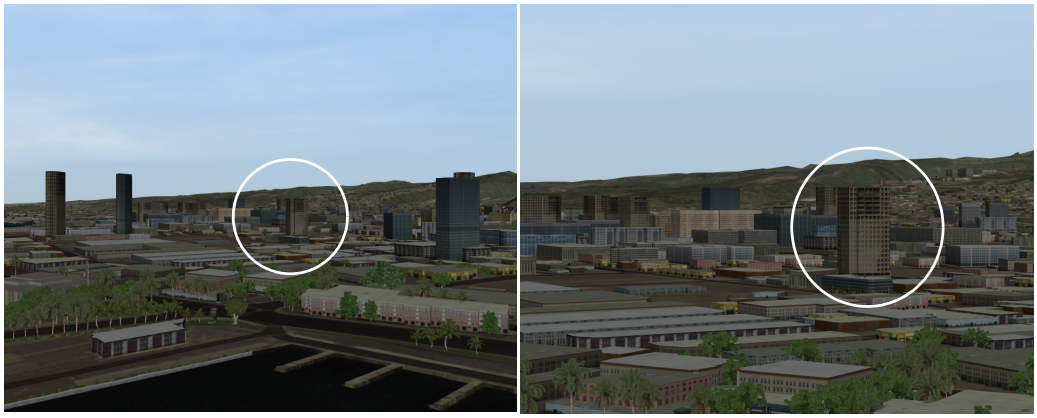


Figure 6-10. Field of view

➤ To change a channel's field of view, edit the frustum values in its attributes list.

6.4.4. Changing the Viewport

When you change the viewport of a channel, you change the portion of the window in which the channel is displayed. This does not change the extents of the scene. A narrow viewport compresses the scene width. A short viewport compresses the height. Figure 6-11 shows a window that has three channels, each with a different viewport. (The arrows show which portion of the window corresponds to each channel.) Notice that each channel has the same field of view.

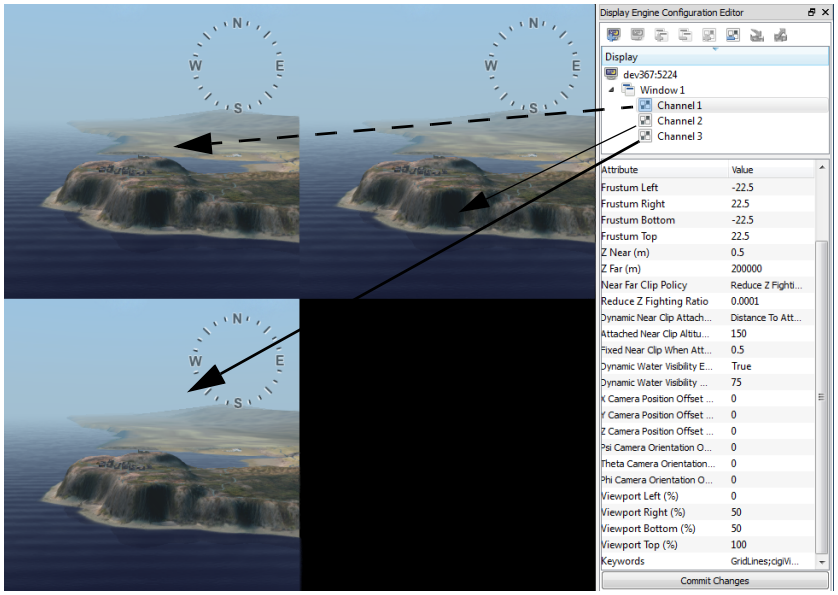


Figure 6-11. Window with three channels and three viewports

Viewports are specified as a percentage of the window from left to right and top to bottom. Figure 6-12 shows the percentage allocation for the viewports in (Figure 6-11).

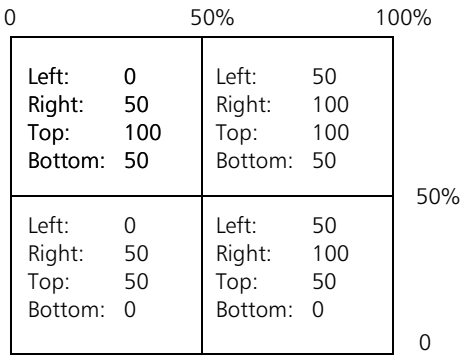


Figure 6-12. Viewport configuration



When you change viewports, the window might not completely refresh. To see the changes, resize the window.

6.4.5. Configuring Water Visibility

The water visibility attributes (along with the surface transparency setting on the Scene Settings dialog box, Environment Conditions Settings page) are designed to reduce Z fighting. Z-fighting occurs when the altitude of the ocean surface and the depth of the ocean floor are very close to each other, usually around coastlines that have bathymetry data. The likelihood of Z-fighting decreases as the difference between the ocean surface and ocean floor increases, but it increases as the observer's altitude increases (because the ocean surface and ocean floor are proportionally closer to each other). Therefore there is a dynamic relationship as these factors change.

Adding transparency to the water reduces Z-fighting. The Dynamic Water Visibility Enabled attribute is used to increase transparency automatically as the observer's altitude increases. Dynamic Water Visibility Maximum specifies the maximum depth to which transparency is added (Figure 6-13).

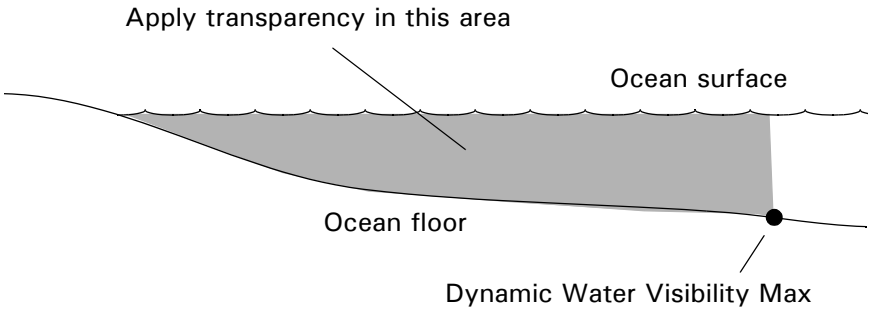


Figure 6-13. Dynamic water visibility

Dynamic water visibility is enabled by default. When Dynamic Water Visibility Enabled is True, VR-Vantage increases the water visibility depth from the value Surface Transparency setting (at 0 meters altitude), to the maximum value specified here at the current Ocean LOD Elevation. The default depth is 75 meters. This value provides reasonable performance given the default Ocean LOD Elevation (5000 meters), the altitude above which VR-Vantage stops displaying dynamic ocean. If you change the Ocean LOD Elevation so that dynamic ocean is displayed when the observer is higher than 5000 meters, Z-fighting may increase and you may need to increase the Dynamic Water Visibility Maximum value. (For details about setting the Ocean LOD Elevation, please see "Setting the Ocean LOD Elevation," on page 24-18.)

There is no performance cost to enabling this attribute when you are not using dynamic ocean. If there are no underwater terrain polygons, these attributes have no effect.

6.5. Starting a VR-Vantage Display Engine

On Windows, you can start a display engine from the Start menu or by running a batch file. On Linux, you start a display engine from a script.

➤ To start a display engine on the Windows Start menu, choose **All Programs** → **MÄK Technologies** → **VR-Vantage 2.1** → **VR-Vantage Display Engine**.

➤ To start a display engine from the Windows console or on Linux, run:

`./bin64/displayEngine.`*`extension`*

where *`extension`* is the appropriate script extension for the platform.

6.6. Connecting to a Display Engine

If you want to control a display engine, you must first connect to it.

Connections are made using TCP networking. All computers running display engines together must be on the same network. The display engines listen for VR-Vantage on a TCP socket. A display engine can only be connected to a single master application.

- If you have trouble connecting to a remote display engine, make sure that your firewall is not blocking the port you are using to connect.
- The 64 bit version of VR-Vantage cannot connect to VR-Vantage running on a 32 bit computer.



It is possible to run multiple display engines on the same machine with different ports. However, this is not a recommended configuration.

To connect to a display engine:

1. On one computer (the master), run VR-Vantage.
2. On another computer, run the VR-Vantage Display Engine application, as described in "Starting a VR-Vantage Display Engine," on page 6-21.
3. On the master computer, choose **View** → **Display Engine Configuration Editor**. The Display Engine Configuration Editor Panel panel opens (Figure 6-3).

4. In the Display Engine Configuration Editor Panel, click the Connect a Display Engine button (), or right-click the main display engine icon and choose **Connect a Display Engine** on the popup menu. The Connect To Display Engine dialog box opens (Figure 6-14).

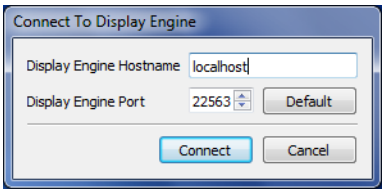


Figure 6-14. Connect to Display Engine dialog box

5. In the Display Engine Hostname box, type the host name or IP address of the computer on which the display engine is running.
6. Optionally, in the Display Engine Port box, specify a port for the display engine. The default is 22563. In most cases the default value will work well.
7. Click Connect. The display engine is added to the Display Engine list. A window is added to the display engine. It shows the same view as Window 1 on VR-Vantage.

6.6.1. Disconnecting from a Display Engine

To disconnect from a display engine:

1. In the Display Engine Configuration Editor Panel, select the display engine that you want to disconnect.
2. Click the Disconnect a Display Engine button (), or right-click the display engine name and choose **Disconnect a Display Engine** on the menu.

---

i You cannot disconnect the master display engine.

6.7. Configuring Multichannel Displays

People running simulations often want to set up a multichannel configuration using multiple monitors (on one or more computers) to display exercises. Typical configurations are a horizontal alignment, which widens the view, and the angled alignment, which surrounds the observer to simulate an out-the-window view (Figure 6-15). Since VR-Vantage just sends out its view, if you do not configure the displays for multichannel, the subordinate monitors display the exact same view as the master (Figure 6-17, default window views). Therefore, for multiple views, you must configure the channels to calculate an offset from the master view.

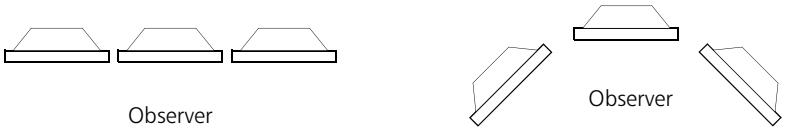


Figure 6-15. Multi-channel displays (top-down view)

The distribution of the view across multiple channels is controlled by the frustum. Figure 6-16 illustrates the default frustum for Channel 1. It has a 60° field of view, from -30° to +30°.

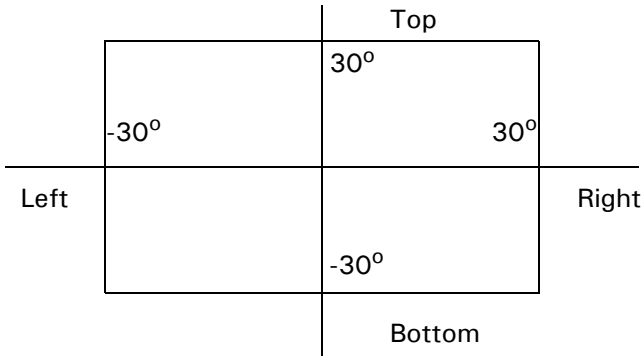


Figure 6-16. Default frustum for Channel 1

If you wanted to split the view into, for example, three horizontal channels, you would edit the left and right frustum values for each channel, as shown in Figure 6-17. The field of view is the same: -30° to +30°. However, now each channel shows a 20° segment of the total field of view.

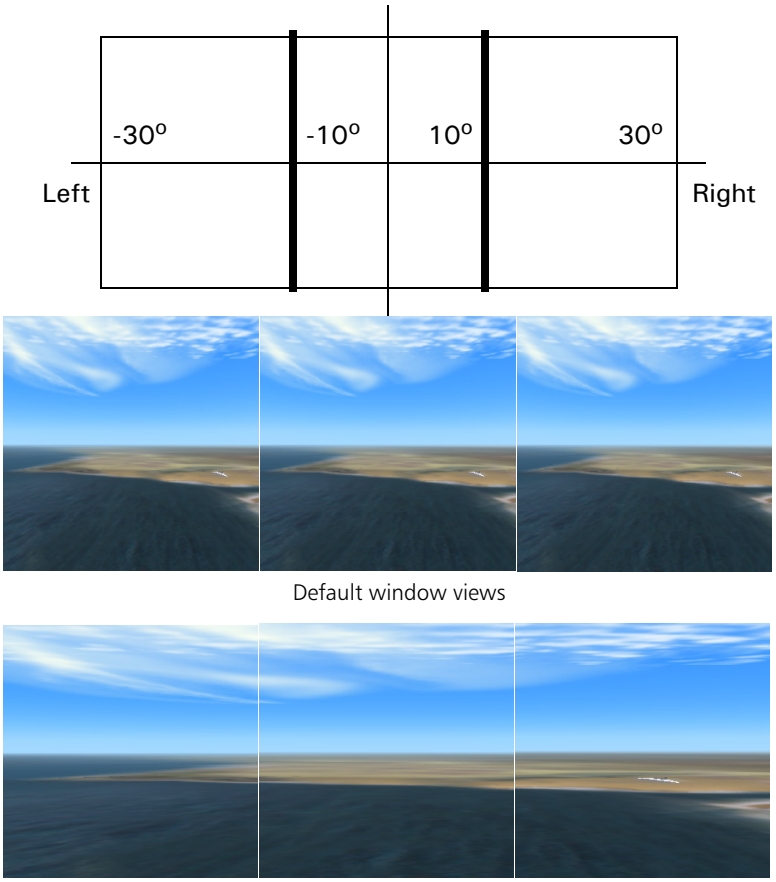


Figure 6-17. Frustum values for three channels

6.7.1. Changing the Camera's Position and Orientation Offset

Changing the frustum affects how much of the database is in the view. Changing the camera's position and orientation affects the point from which you look at the view. For example, imagine you are simulating the view from a vehicle, as in vehicle 1 in Figure 6-18. (The camera location is represented by the binoculars.)

If you wanted to show the view as experienced by a gunner riding in the back of the vehicle, or in a turret, you would change the X, Y, and Z camera position offsets in the channel's attribute list (vehicle 2).

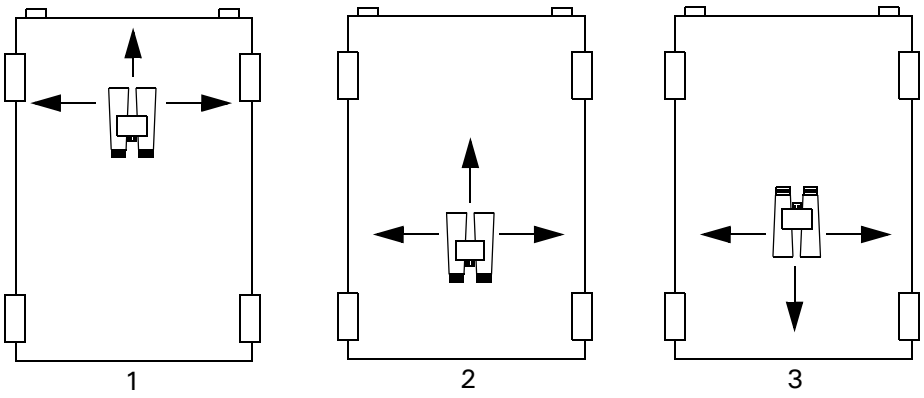


Figure 6-18. Position and orientation offsets

If you wanted the gunner to look out the rear of the vehicle, you would change its orientation, with the Psi (heading), Theta (pitch), and Phi (roll) Camera Orientation Offsets (vehicle 3).

6.7.2. Creating a Multichannel Configuration

A multichannel configuration is a set of display engine configurations. You must save each configuration individually. Chapter 7, *Display Engine Tutorials* shows how to create, save, and load a multichannel display engine configuration.

To save a multichannel configuration:

1. Start VR-Vantage and one or more VR-Vantage Display Engines.
2. In the Display Engine Configuration Editor Panel, connect the display engines.
3. Configure the display engines with the windows and channels that you want them to have.
4. For each display engine in the Display Engine Configuration Editor Panel:
   a. Select the display engine.
   b. Click the Save Display Engine Configuration button ( ).
   c. Type a name for the configuration.
   d. Click Save.

6.7.3. Loading a Multichannel Configuration

You can load a multichannel configuration in the Display Engine Configuration Editor Panel or from the command line. If you load it in the editor, you must load each configuration individually. For details about loading multiple configurations from the command line, please see "Loading Multiple Display Engine Configurations from the Command Line," on page 6-9.

To load a multichannel configuration:

1. Start VR-Vantage and one or more VR-Vantage Display Engines.
2. In the Display Engine Configuration Editor Panel, connect the display engines.
3. For each display engine in the Display Engine Configuration Editor Panel:
   a. Select the display engine.
   b. Click the Load Display Engine Configuration button ( ).
   c. Select the configuration you want to load.
   d. Click Load.

6.8. Stereoscopic Displays

Stereoscopic display produces realistic three dimensional imagery by showing each of the viewer's eyes a different image, rendered from that eye's point of view. A stereoscopic display requires a system that can render two channels, one for each eye, and a method of displaying the correct channel to the correct eye of the viewer. Three common display methods are active stereo, polarized display, and anaglyphic stereo. OpenSceneGraph can support all three of these methods, and since VR-Vantage uses OpenSceneGraph for most of its rendering, all three should be possible in VR-Vantage.

- Active Stereo: In an active stereo setup, frames are alternated on the display for the left eye and the right eye, and a pair of shutter glasses blocks light to either the left or right eye in synchronization with the display. This method requires hardware support to synchronize the glasses to the display, along with a graphics card capable of quad buffering, and a display that can refresh at twice the desired frame rate. Active stereo should be possible with VR-Vantage, but has not been tested.
- Anaglyphic Stereo: Anaglyphic stereo is the cheapest and simplest method to use. A typical setup is a display showing a red channel and a cyan channel simultaneously, along with a pair of glasses with one red lens and one cyan lens for the viewer. This will work with no special hardware aside from the inexpensive glasses. It is also the simplest method to set up in VR-Vantage, requiring only that some OpenSceneGraph environment variables be set.
- Polarized Stereo: A polarized display shows the frames for both eyes simultaneously, but with their light polarized in different directions. The viewer wears glasses that have lenses polarized to match the two different frames, allowing each eye to see only the frame intended for it. Polarized stereoscopy requires some specialized equipment to display the images with the correct polarization. One simple method for producing this kind of display is to use two projectors with polarizing filters, projecting onto a rear projection screen. Monitors are available that can polarize the two frames. It is easy to configure a polarized display with VR-Vantage.

6.8.1. Configuring Anaglyphic Stereo

You can configure OpenSceneGraph for anaglyphic stereo rendering through environment variables. To use VR-Vantage in anaglyphic mode, run it with the environment variables described in Table 6-1.

Table 6-1: Environment variables for anaglyphic stereo

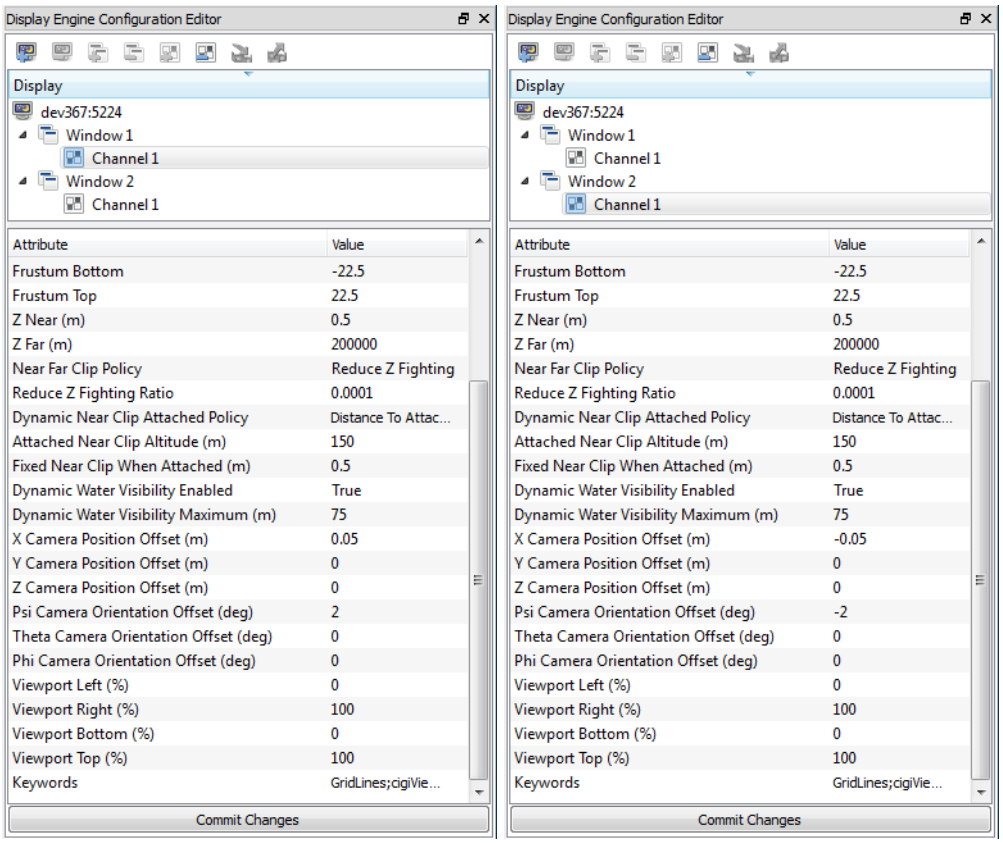
Environment Variable	Description	Default
OSG_STEREO	Turn stereo on.	ON
OSG_STEREO_MODE	Use anaglyphic stereo when in stereo.	ANAGLYPHIC
OSG_SCREEN_DISTANCE	Specifies the distance, in meters, that the viewer is from the screen.	0.50
OSG_SCREEN_HEIGHT	Specifies the height of the image, in meters, on the screen.	0.26
OSG_SCREEN_WIDTH	Specifies the width of the image, in meters, on the screen.	0.325
OSG_EYE_SEPARATION	Specifies the eye separation (interocular distance).	0.06

For more information, pleases see the OpenSceneGraph documentation at http://www.openscenegraph.org/projects/osg/wiki/Support/UserGuides/StereoSettings.

6.8.2. Configuring Polarized Stereo

You can configure polarized stereo by taking advantage of VR-Vantage's ability to produce multichannel displays. You configure one channel per eye. Each channel renders with a camera that is at a slight offset from the other channel's camera to represent the spacing between the viewer's eyes.

Varying the eye spacing and focal length can produce different effects, and the best values may depend on what the viewer is looking at. Figure 6-19 shows an example configuration.



Left channel Right channel

Figure 6-19. Polarized stereo channel configurations

To compute the correct channel configuration values:

1. Pick a focal length, `L`. Objects at this distance will appear to be in the plane of the display. Objects that are further away will appear behind the display, and objects closer will appear in front of it.
2. Pick an eye spacing, `E`, to represent the distance between the viewer's eyes. Human eyes are typically about 0.063m apart (http://www.cl.cam.ac.uk/~nad10/pubs/EI5291A-05.pdf).
3. Set the X Camera Position values to `–E/2` meters for the left channel and `E/2` meters for the right channel.
4. Set the Psi Camera Orientation values to `–arctan(E/2)/L` degrees for the left channel and `arctan(E/2)/L` degrees for the right channel.

6.9. Using Multiple Projectors

VR-Vantage can support displays made up from multiple projectors using the Scalable Display Manager (SDM) from Scalable Display Technologies (http://www.scalabledisplay.com). This software automates the process of combining and edge blending the projectors together into one seamless display. Each computer driving a projector from VR-Vantage is set up either as the SDM or as a Scalable Display Client (SDC).

This section covers the integration of SDM with VR-Vantage. For documentation about configuring your projectors please see the SDM User Manual (available from Scalable).

The VR-Vantage SDM plug-in is only supported on 64-bit Windows.

6.9.1. Configuring the Scalable Display Manager

The arrangement of the projectors in the SDM and any SDC's must match that of the display engine configuration that you create in VR-Vantage.

VR-Vantage requires that the SDM perspective data be written out. Check Generate Perspective Outputs on the SDM's Perspective screen. By default this data is written to *C:\Program Files\Scalable Display\DEI\LocalCalibration\ScalableData.ol*. The plug-in looks in this directory by default. If you want to write the data to a different directory, you can specify it with the MAK_SCALABLEDATA environment variable.

Make sure the Perspective Scene test pattern display in SDM shows circular patterns and not ovals. If you are creating a flat screen you may need to specify the **FlatScreenWidth**, **FlatScreenHeight** and **FlatScreenDistance** parameters for your display (in meters) in the advanced options of the SDM support menu.

6.9.2. Running VR-Vantage with the SDM

To use the Scalable Display Technologies plug-in, start VR-Vantage applications with the `--plugin` command-line option, as follows:

```
vrvapplication --plugin ..\plugins64\scalableDisplay\scal-
  ableDisplayPlugin.dll
```

VR-Vantage includes batch scripts for running the release and debug versions of the main VR-Vantage applications in the *./bin64* directory (*displayEngineScalableDisplay.bat*, *stealthScalableDisplayd.bat*, *displayEngineScalableDisplayd.bat*, *vantageIGScalableDisplay.bat*, *stealthScalableDisplay.bat*, and *vantageIGScalableDisplayd.bat*). In most cases multi-channel applications will run an IG with multiple display engines, but it is also possible to use the correction capabilities in SDM for a single standalone Stealth channel. All applications must run in full screen mode for them to combine properly.

6.10. Display Issues on Linux

VR-Vantage does not support two separate X screens. The reason is that when you create two separate X screens and try to create two OpenGL windows, they may not share OpenGL contexts. A number of VR-Vantage components require sharing contexts for our rendering to work. These include: SilverLining, SpeedTree, and our 2D overlays (possibly also GL Studio).

The work-arounds to support two screens include:

- Use Nvidia driver's TwinView mode. This behavior is identical to the Window multi-monitor behavior and VR-Vantage works correctly with this setting.
- Use Xinerama, which is an X extension that behaves similar to TwinView.
- Run VR-Vantage on one X Screen and run a Remote Display Engine on the other. This will require two installs to ensure that the appData directories are not compromised.



7. Display Engine Tutorials

This chapter has a tutorial that shows how to connect to a remote display engine, edit display engine configurations, and apply display engine configurations to display engines.

Saving and Loading Display Engine Configurations 7-2
Connect a VR-Vantage Display Engine..... 7-2
Save Display Engine Configurations..... 7-5
Load the Display Engine Configurations in the GUI..... 7-7
Loading the Display Engine Configurations from the Command Line... 7-7

7.1. Saving and Loading Display Engine Configurations

This tutorial demonstrates how to:

- Connect a VR-Vantage application to a VR-Vantage Display Engine.
- Change a display engine configuration.
- Save display engine configurations.
- Load display engine configurations in the Display Engine Configuration Editor Panel.
- Load multiple display engine configurations from the command line.

7.1.1. Connect a VR-Vantage Display Engine



This tutorial assumes that you have two computers, one for your VR-Vantage application, and one for the remote display engine. You could run this tutorial on one computer if you have two monitors.

To create the display engine configurations:

1. On computer 1, start VR-Vantage.
2. Load *makland.mtf*.
3. Choose **View** → **Display Engine Configuration Editor Panel**. The Display Engine Configuration Editor Panel opens. It shows one window and one channel for the VR-Vantage window on the local computer (Figure 7-1).

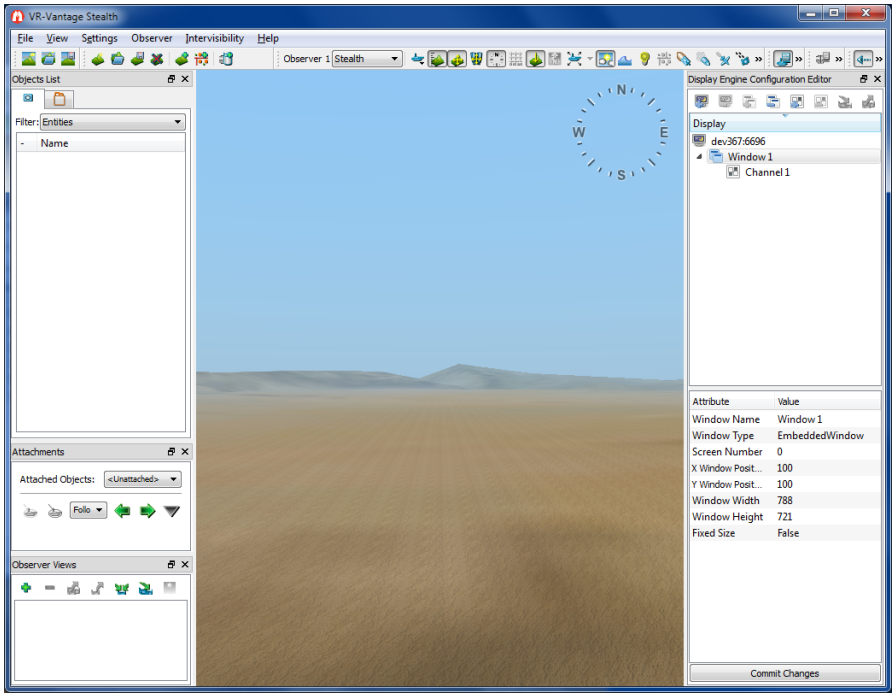


Figure 7-1. Display Engine Configuration Editor Panel and default window

4. On computer 2, on Windows, choose **Start** → **All Programs** → **MAK Technologies** → **VR-Vantage 2.1** → **VR-Vantage Display Engine**.

   On Linux, run:

   `./bin/displayEngine.`*`extension`*

   where *`extension`* is the appropriate script extension.

   A VR-Vantage display engine opens. It does not show a default window.

5. On computer 1, in the Display Engine Configuration Editor Panel, click the Connect a Display Engine button ( ). The Connect to Display Engine dialog box opens.

6. In the Display Engine Hostname box, replace "localhost" with the name of computer 2. (If you are using one computer with two monitors, leave the text as localhost.)

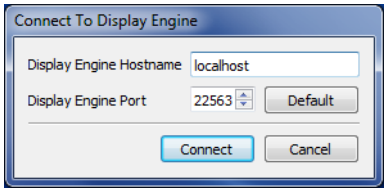


Figure 7-2. Connect to Display Engine dialog box

7. Click Connect. An entry for the remote display engine is added to the Display Engine Configuration Editor Panel (Figure 7-3). The remote display engine now displays the Makland terrain with the same view as the VR-Vantage application.

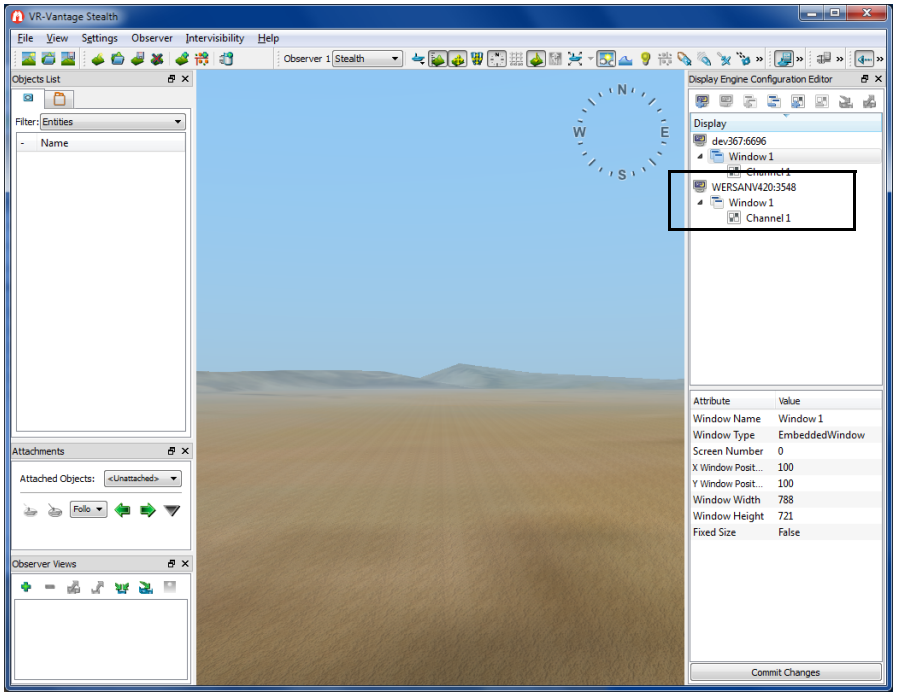


Figure 7-3. Remote display engine connected

7.1.2. Save Display Engine Configurations

By default, the views in the VR-Vantage window and the remote display engine window look exactly the same. So we will change the view in one of them so that when we load the display engine configurations later on, we can tell that each is different.

To edit the display engine configurations and save them:

1. Select Channel 1 of the remote display engine. Its attributes are displayed.
2. Change the value for the Viewport Right and Viewport Top attributes to 50 (Figure 7-4).

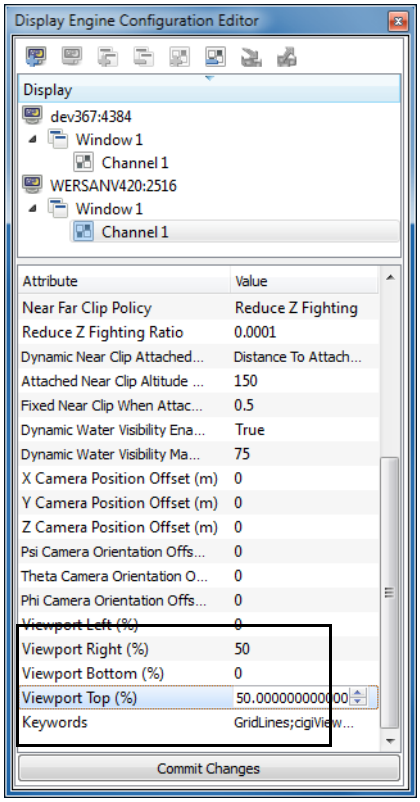


Figure 7-4. Channel with changed viewports

3. Click Commit Changes. The view of the terrain is now in the lower left quadrant of the display engine (Figure 7-5). (The full screen view of the terrain may also be visible until such time as the display engine refreshes.)

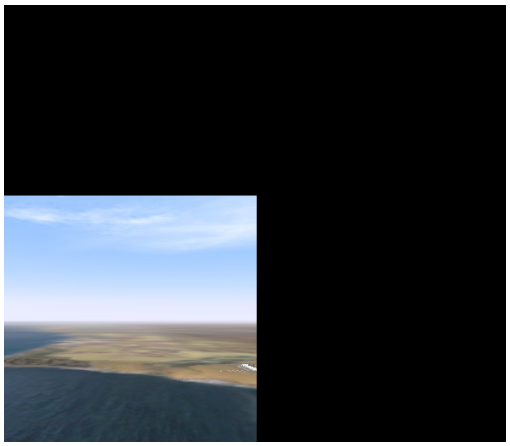


Figure 7-5. Remote display engine view after changing configuration

4. Select the display engine on the VR-Vantage application (in this example, WERSANV420).
5. Click the Save Display Engine Configuration button ( ). A save dialog box opens.
6. Call this configuration *mainwindow.dcx*.
7. Click Save.
8. Select the display engine on the remote display engine (in this example, WERSANV420).
9. Click the Save Display Configuration button. A save dialog box opens.
10. Call this configuration *remotedisplay.dcx*.
11. Click Save.

7.1.3. Load the Display Engine Configurations in the GUI

We now have two visually distinct display engine configurations. In this part of the tutorial, we simply load them into the two display engines to see that loading a display engine configuration changes the view in the window. This part of the tutorial also demonstrates that display engine configurations are not unique to a particular display engine and are not tied to one either. Any particular configuration can be loaded into any display engine.

To load the display engine configurations in the GUI:

1. Select the display engine on the VR-Vantage application.
2. Click the Load Display Engine Configuration Editor button (). The Load Display Configuration dialog box opens.
3. Select *remotedisplay.dcx*.
4. Click Open. The window on the VR-Vantage application now shows the terrain in the lower left quadrant. (You may need to press **`Space Bar`** to reset the observer.)
5. Reload the *mainwindow.dcx* configuration in the main window.
6. Try loading the two different configurations in the remote display engine.

7.1.4. Loading the Display Engine Configurations from the Command Line

As you have seen in the previous part of this tutorial, you can load display engine configurations for individual display engines through the GUI. However, you cannot load more than one at a time. If you have a complex set of display engines that you need to configure, loading them one at a time can be tedious. To load multiple display engine configurations at one time, you must start VR-Vantage from the command line.

You load multiple display engine configurations from the command line with the `--dispSetting` command line argument and the `-W` or `--withDisplayEngine` command-line argument. The syntax for Windows is:

```
vrvApplication.exe --dispSetting masterdisplayConfigFile
  -W port@netAddress;remotedisplayConfigFile1 ....
  port@netAddress;remotedisplayConfigFileN
```

The syntax for Linux is:

```
vrvApplication.exe --dispSetting masterdisplayConfigFile
  -W port@netAddress:remotedisplayConfigFile1 ....
  port@netAddress:remotedisplayConfigFileN
```

In this tutorial, we use the default port (22563). The netaddress for the remote display engine is the computer name (WERSANV420). The display engine configuration files are *mainwindow.dcx* and *remotedisplay.dcx*.

So the command line to load the two display engine configurations that we created would be:

```
vrvIG.exe --dispSetting ../appData/settings/vantageIG/-
  mainwindow.dcx -W 22563@WERSANV420;
  ../appData/-settings/vantageIG/remotedisplay.dcx
```

To load the tutorial configurations from the command line:

1. Open a command window.
2. Change directory to *./bin64*.
3. On Windows, enter the command:

   ```
   vrvIG.exe --dispSetting ../appData/settings/-
     vantageIG/mainwindow.dcx -W 22563@WERSANV420;
     ../appData/settings/vantageIG/remotedisplay.dcx
   ```

   On Linux, enter the command:

   ```
   vrvIG.exe --dispSetting ../appData/settings/-
     vantageIG/mainwindow.dcx -W 22563@WERSANV420:
     ../appData/settings/vantageIG/remotedisplay.dcx
   ```

   VR-Vantage starts. The display engine configurations are visible in the main window and the remote display engine window.

4. Choose **View** → **Display Engine Configuration Editor Panel**. In the Display Engine Configuration Editor Panel, confirm that VR-Vantage is connected to the remote display engine.



8. Using Streaming Video

VR-Vantage can send the view in the display window to a video stream. It supports several different video formats.

Streaming Video 8-2
Starting a Video Stream 8-3
Setting Up Auto Start 8-4
Configuring Video Streams 8-5
Configuring the Number of Capture Buffers 8-8
Viewing Streaming Video 8-9
Viewing Streaming Video Using VLC 8-10
Recording the VR-Vantage Display 8-12

8.1. Streaming Video

VR-Vantage can capture the view in the display windows and send it as a video stream. Streaming video can be used for embedded training to stimulate devices that expect live video with simulated video. Video streams can be encoded and transported in several different ways using common open standards. VR-Vantage can encode metadata about the video image into the video stream following MISB (Motion Imagery Standards Board) metadata standards for UAV systems.

You can also stream video to a file. In other words, you can record the VR-Vantage display. To do so, use the GStreamer MPEG2 - File Out video stream, as described in "Configuring Video Streams," on page 8-5.

! Streaming video is not supported on Linux.

VR-Vantage processes captured video with image tasks. Some image tasks transform the image and some transport the image. You can mix together multiple image tasks to accomplish your goal. You can replace or add your own image tasks through the API. The image tasks provided are:

- Shared Memory. VR-Vantage compresses the video and places it in shared memory. We provide an example application that shows how to read the shared memory data for your application.
- TCP. VR-Vantage acts as a server and connected clients are able to connect over TCP and get raw or compressed images through the connection.
- Web socket. VR-Vantage acts as a server and web browsers can connect to it and display the video stream.
- GStreamer. GStreamer is a multimedia library that uses configuration files to build a pipeline. Pipelines allow for different encoding, multiplexing, and transport options. This is how VR-Vantage encodes video with MPEG-2 and H.264 encoding schemes and transports them over a network with embedded metadata. (GStreamer is a complex SDK. If our implementation does not meet your needs for video streaming, please contact MÄK support. We will work with you to help you achieve your goals.)
- Image Compression. VR-Vantage compresses the video frame using JPG or PNG compression. This is typically used with video sinks that use image frames such as the WebSocket, shared memory, and TCP video sinks.
- Transform. VR-Vantage transforms the video frame by scaling, flipping, or converting the bit depth of the image. This is typically used with video sinks that use image frames such as the WebSocket, shared memory, and TCP video sinks. GStreamer is also capable of transforming the image and you may get better results using GStreamer alone than using a Transform operation and a GStreamer operation.

- VR-Vantage does not include metadata plug-ins. They are distributed as bonus material. For details, please see your MÄK sales representative.
- Streaming video can reduce performance.

8.2. Starting a Video Stream

You can start a video stream manually or specify that a video stream start automatically when VR-Vantage starts up.

To start a video stream:

1. Choose **Settings** → **Video Streams**. The Video Streams dialog box opens. Select the Video Streams page (Figure 8-1).

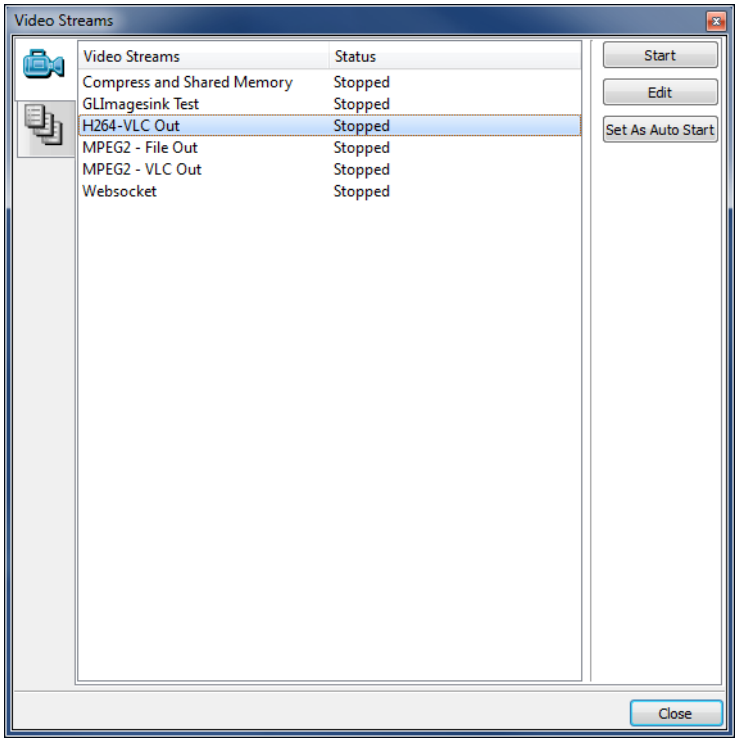


Figure 8-1. Video Streams page

2. Select the video stream that you want to start. If it is available, the Unavailable button changes to Start.
3. Click Start.
4. View the video in your viewing application.
5. Click Stop to stop the video stream.

8.2.1. Setting Up Auto Start

You can specify that a video stream start when VR-Vantage starts up.

To specify auto start:

1. Choose **Settings** → **Video Streams**. The Video Streams dialog box opens. Select the Video Streams page (Figure 8-1).
2. Select the video stream that you want to start automatically.
3. Click Set As Auto Start. VR-Vantage displays a star next to the video stream name.

8.3. Configuring Video Streams

You can configure the different streaming video streams to work with your playback environment. A video stream configuration has:

- A set of parameters that specify how VR-Vantage should capture the video.
- A pipeline. VR-Vantage sends video through a pipeline. The pipeline processes the video based on image tasks that you specify. You can specify one or more image tasks and can set the order in which they are executed. The video stream configurations included with VR-Vantage are examples of how to configure different types of video streams.

To configure a video stream:

1. Choose **Settings** → **Video Streams**. The Video Streams dialog box opens. Select the Video Streams Configuration page (Figure 8-2).

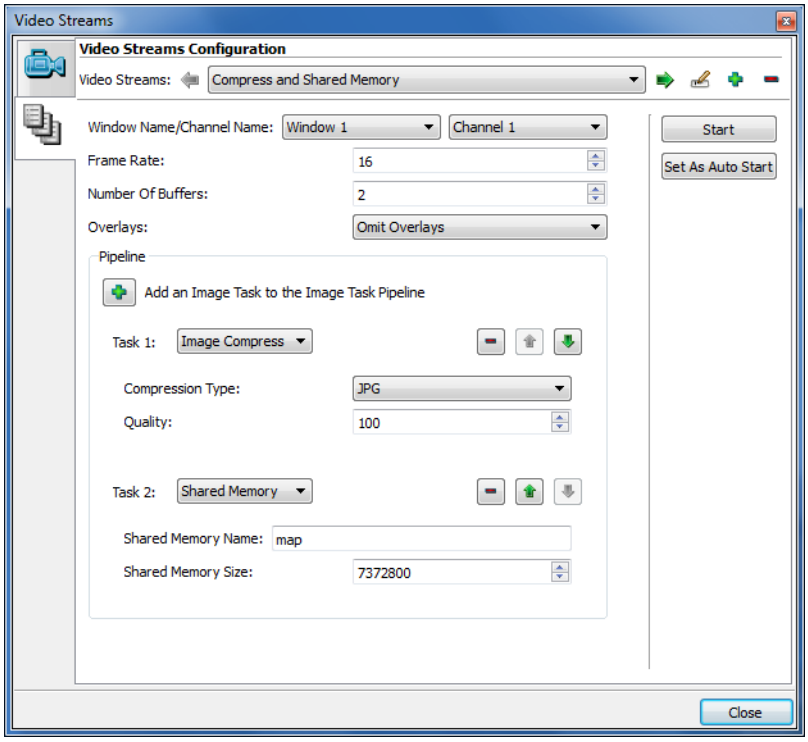


Figure 8-2. Video stream configuration page

2. In the Video Streams list, select the video stream that you want to configure.

3. Specify values for the capture parameters. Table 8-1 describes the parameters

Table 8-1: Video stream configuration capture parameters

Parameter	Description
Window Name	The window from which to stream video.
Channel Name	The channel, in the window specified by Window Name, from which to stream video.
Frame Rate	The frame rate at which to stream video.
Number of Buffers	The number of buffers affects how well VR-Vantage captures video from the rendering process. Depending on your hardware, more buffers may help rendering and capture performance at the cost of overall latency and video memory usage. Please see "Configuring the Number of Capture Buffers," on page 8-8 for information about how to configure the number of buffers.
Overlays	Omit or include 2D overlays, including 2D icons, the compass, and tactical graphics.

4. To add a task, in the Pipeline group box, click the Add button (+). A task is added to the group box.
5. For the new task or any existing tasks, select an image task in the Task drop down list.
6. Select values for the parameters that are appropriate to the task. The supported tasks and their parameters are as follows:
   - TCP. Send the video over TCP.
     - Port. The port to which the video stream should be sent.
   - GStreamer.
     - Pipeline Configuration. This is a complex string that varies depending on what you want done with the video. It defines the GStreamer nodes that the video frames will be processed through. You can resize, transform, compress, and multiplex the video. Then you can send the results to disk as a file or to the network as a stream. VR-Vantage has examples that show how to encode video, multiplex in metadata about the video stream, save to file. and stream to a network. For information about GStreamer and how to build a configuration description, please go to http://gstreamer.freedesktop.org/.
   - Transform.
     - Flip Image. Optionally, flip the image.
     - Scale Image. Optionally, scale the image to the specified X, Y values.
     - Convert Bit Depth. Optionally, convert the image to the specified bit depth.
   - Shared Memory.
     - Shared Memory Name. The name of the shared memory space.

- Shared Memory Size. The amount of shared memory. This must be large enough to hold at least three frames of data as specified in the capture parameters.

– Image Compress.

- Compression Type. Select an option from the list.
- Quality. Specifies the level of compression as a percentage. The higher the percentage, the less the compression and therefore, the better the quality.

– Web Socket.

- Connection Port. The port on which VR-Vantage will listen for a browser connection.

7. Optionally, add additional image tasks.
8. Optionally, change the order of the tasks.

8.3.1. Configuring the Number of Capture Buffers

When a frame is captured from the frame buffer in OpenGL, it is copied to an offscreen buffer that resides on the GPU. Then the buffer is copied across the bus from the GPU side to the CPU side where it can be pushed into the encoding system. With some video cards, this process can cause all rendering to stop until all the memory copying is completed between buffers and between GPU and system memory. Moving data across the bus can be a slow process. This is called stalling out the rendering pipeline and generally results in a significant drop in rendering performance.

To see if the rendering pipeline is stalling:

1. Press **`F2`** to get the on screen frames-per-second (FPS) display.
2. Start streaming video.
3. See if the FPS value drops.

To see if the number of buffers affects performance:

1. Start VR-Vantage Stealth from the command line with the `--showConsole` option.
2. Watch the timing values that are displayed in the console. If the readback and copy times are in the 10-15ms range, then the rendering pipeline is probably stalling. If they are in the 0-2 ms time range, then they are not adversely affecting performance.

Using one buffer instead of multiple buffers also affects the latency in the video stream. If a system can render, capture, and read back the data using only one buffer, then the data in the buffer is from the current frame and has no additional latency. If your system needs to use more than one buffer (two is typical) to prevent stalling the rendering pipeline, the buffer that is copied from GPU memory to CPU memory is from the previous capture and has one capture frame of latency. If frame capture is occurring at 25fps, then this means the frame that is pushed into the encoding process already has 40ms of latency in it.

8.4. Viewing Streaming Video

The method used to view a video stream depends on its configuration. This section describes viewing the video that results from the default configurations included with VR-Vantage.

- Compress and Shared Memory. This video stream configuration is an example of a pipeline that compresses and moves frames into a shared memory segment. To use this configuration you must provide an application that reads the frames from shared memory and displays them using whatever method it likes. The exampleReadVideoShm example shows how to access frames from shared memory.
- GLImagesink Test. This video stream configuration uses a GStreamer pipeline task to stream video directly to an OpenGL viewer. If this configuration is started, a new OpenGL window opens containing the video stream.



The GStreamer pipeline task can only be used once per application run. To start another video stream using GStreamer, you must stop VR-Vantage and start it again.

- MPEG2 - VLC Out. The MPEG - VLC Out video stream configuration uses a GStreamer pipeline task to compress video using MPEG-2 and then send the video to a UDP port. The port used is part of the pipeline configuration string (and is a parameter to the udpsink GStreamer element). There are commercial and freeware video viewers that can connect to and display MPEG video from a UDP stream. One such viewer is VLC. VLC is a commonly used application to show received network video streams. You can download VLC from http://www.videolan.org/vlc/index.html.
- MPEG2 - File Out. This video stream configuration uses a GStreamer pipeline task to output MPEG-2 video to a file. The file that the video is written to is specified in the pipeline configuration, as a parameter to the filesink GStreamer element. If no path is included in the filename, the file is written to *./bin64*.
- WebSocket. The WebSocket video stream configuration streams capture frames to a web browser. When the video stream is started, it listens on the Connection Port specified for connections from a web browser. Specify the URL as `hostname:port` (use localhost if connecting from the same machine). Typical usage is to put an Image Compress task element prior to this task element to send compressed images to the connected web clients.



Some older versions of browsers may not support WebSockets.

8.4.1. Viewing Streaming Video Using VLC

For information about reducing latency in VLC, please see "Reducing Latency in VLC," on page 8-10.

To view video in VLC streamed from VR-Vantage:

1. Start the MPEG - VLC Out stream.
2. Start VLC.
3. Choose **Media** → **Open Network Stream**.
4. For the network URL, put "udp://@:5000" (if the parameter to udpsink is port=5000).

Reducing Latency in VLC

The default setting for viewing network streams in VLC includes a lot of buffering to make sure the video plays smoothly. This introduces a lot of latency on the receiving side. This section explains how to reduce that latency.



Reducing latency may lead to jitter. However, when working on a LAN, MÄK engineers have rarely had problems.

To reduce latency when using VLC:

1. Start VLC.
2. Choose **Tools** → **Preferences**. The Preferences dialog box opens.
3. Select Input & Codecs (Figure 8-3).
4. Select Use GPU Accelerated Decoding.
5. In the x264 Preset and Tuning Selection list, select ultrafast.
6. In the Network group box, in the Default Caching Policy list, select Lowest latency.
7. Click Save.

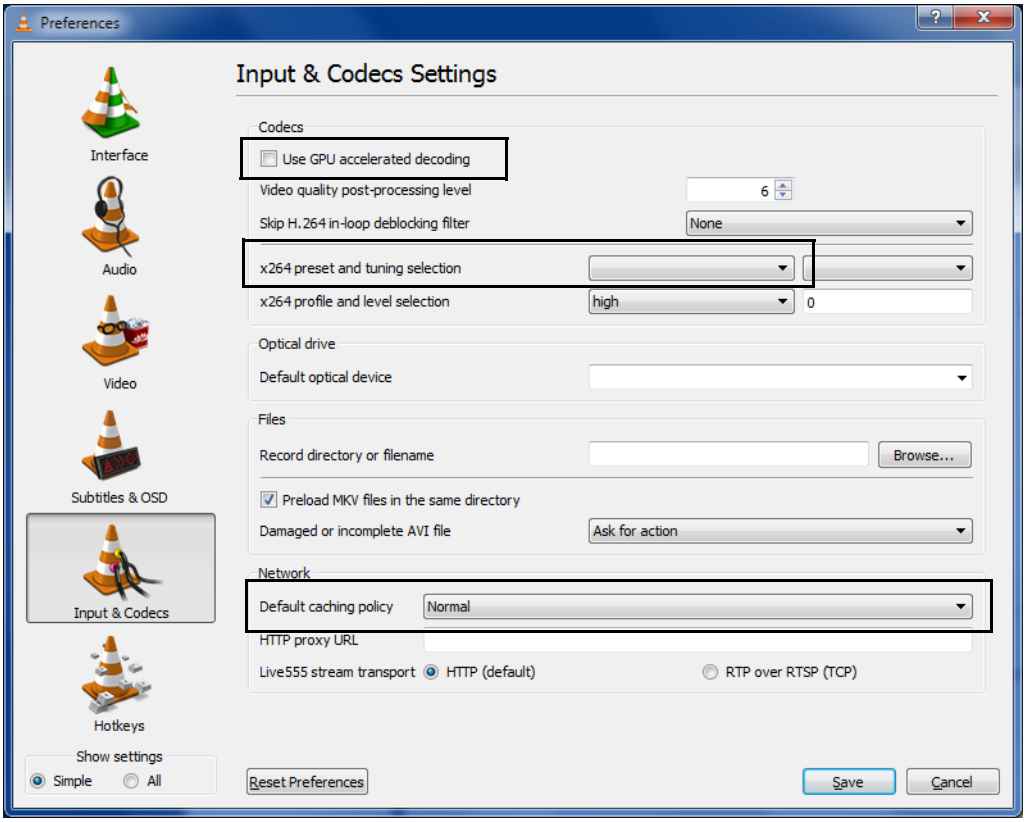


Figure 8-3. VLC Preferences, Inputs & Codecs

8. Choose **Media** → **Open Network Stream**. The Open Media dialog box opens.
9. Select the Network tab (Figure 8-4).
10. Enter the URL as udp://@:5000 (or whatever port you have your system set up for).
11. Select the Show More Options check box. The dialog box expands with more options.
12. Set Caching to 1ms. (Do not set caching to zero. VLC will crash.)

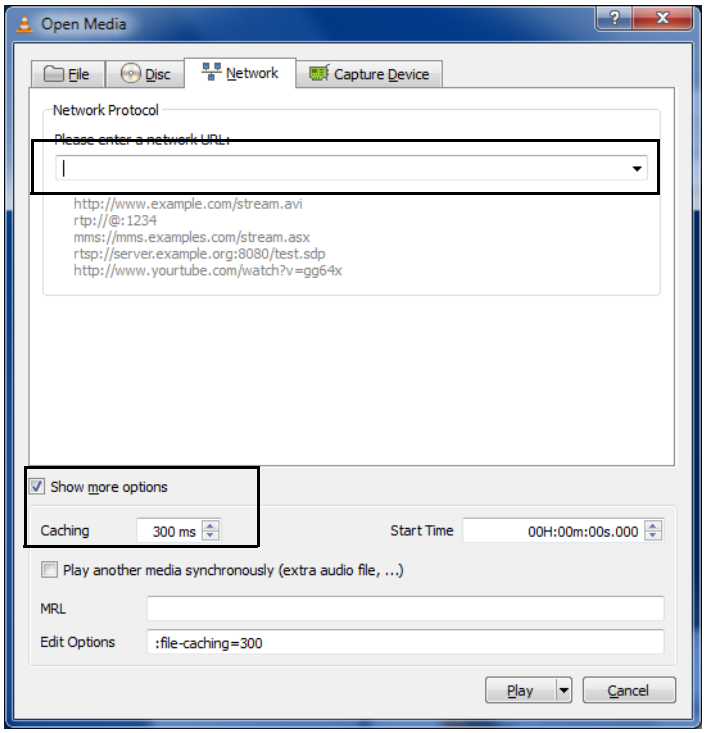


Figure 8-4. Open Media dialog box, Network tab

13. Click Play.

8.5. Recording the VR-Vantage Display

VR-Vantage users often want to record the VR-Vantage display. You can do this with commercial video capture tools. You can also send a video stream to disk. The MPEG2 - File Out video stream configuration provided with VR-Vantage sends the output to a file. The configuration is described in "Viewing Streaming Video," on page 8-9.



9. Using the Oculus Rift HMD

This chapter explains how to use an Oculus Rift head mounted display with VR-Vantage.

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Requirements 9-2
Resetting the Tracking Sensor 9-2
Running VR-Vantage with the Oculus Rift 9-3
Measuring Performance 9-3
Configuration Options 9-3

9.1. Introduction to the Oculus Rift

VR-Vantage is integrated with the Oculus Rift, a head mounted display (HMD) for virtual reality applications from Oculus VR. This integration allows VR-Vantage to render stereo views, which are presented inside the HMD. The head position and orientation tracking of the HMD are reflected in the observer as the wearer of the HMD moves their head.



Use of the Oculus Rift is supported by VR-Vantage Stealth and VR-Vantage IG. VR-Vantage PVD does not support it.

9.1.1. Requirements

To use the Oculus Rift, you need the following software and VR-Vantage setup:

- Oculus Rift Development Kit 2 (DK2).
- Oculus Runtime installer version 0.8. You do not need to install the Oculus SDK. You can download the runtime from the Oculus VR website (https://www.oculus.com/).
- The observer must be in a 3D view mode.
- The observer must be attached to an entity in Mimic mode.
- In most cases cockpits should be turned off in the observer settings.

9.1.2. Resetting the Tracking Sensor

For user comfort, the origin of the positional tracking performed by the HMD can be reset. This allows you to restart the head tracking once you have put on the HMD and assumed a comfortable position. You can reset the sensor at any time by pressing the **–** key on the numeric keypad. You can change the keyboard assignment by changing the "Reset Oculus Sensor" action in the VR-Vantage Key Mapping Editor.

9.2. Running VR-Vantage with the Oculus Rift

To use the Oculus Rift with VR-Vantage:

1. Start VR-Vantage Stealth or IG.
2. Connect to a simulation.
3. Attach to an entity in Mimic mode.
4. Disable cockpit displays (Display Settings dialog box, Cockpit Displays page.)
5. Position the observer to the location of the eyes of the entity or operator of the vehicle.
6. Put on the HMD.
7. When you are comfortable, reset the tracking sensor as described in "Resetting the Tracking Sensor," on page 9-2.

9.3. Measuring Performance

The Oculus runtime has a built-in "Performance HUD" that you can activate using the **Tools** → **Advanced** menu of the Oculus Configuration Utility. For more information on the HUDs available refer to the Performance Head-Up Display section of the PC SDK Developers Guide

9.4. Configuration Options

You can set the following configuration options for the Oculus HMD:

- Mirroring. Mirroring allows the view shown inside the HMD to be mirrored onto the screen. Because HMD's generally have a faster refresh rate than most 60Hz monitors the display you see onscreen may update much more slowly. Mirroring is really only useful for testing, development, or in situations when others need to be able to see what the HMD wearer sees. Disabling this setting may increase performance.
- Monoscopic Rendering. Monoscopic rendering presents the same image to each eye, which eliminates stereoscopy. This improves performance (as it eliminates one of the cameras) and it may also increase user comfort for those who are experiencing eye convergence issues when looking at objects that are close to the observer. Sacrificing three dimensional display may be an acceptable trade off for simulations in which there is not a lot of content in the foreground.
- Pixels Per Display Pixel. This setting adjusts the ratio between render target pixels and the density of pixels at the center of the display. The default value of 1 uses the render target size recommended by the Oculus SDK. Reducing this value to less than one will reduce the effective resolution displayed which can help performance in pixel-bound scenes.

To set Oculus HMD configuration settings:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Oculus Settings page (Figure 9-1).



The Oculus Settings page is available only if the Oculus plug-in is loaded and an HMD is detected.

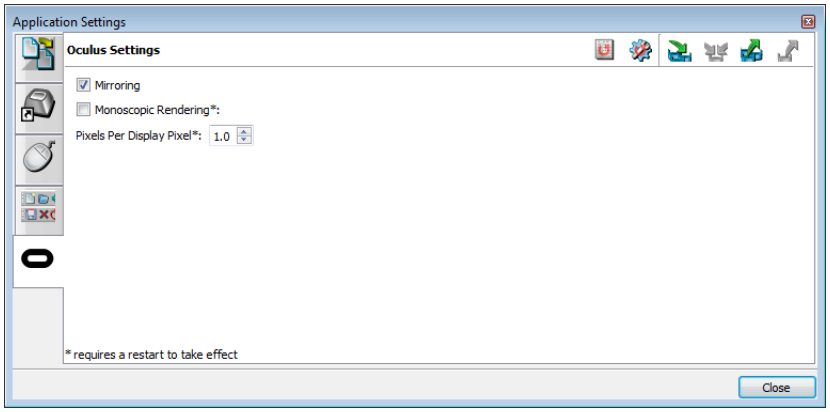


Figure 9-1. Oculus Settings page

3. Change the settings as desired. If you change the monoscopic rendering or pixels per display pixel settings, you must restart VR-Vantage.



III. Scenes and Environmental Effects

The chapters in this section describe scenes and environmental effects such as weather, marine conditions, lighting, and sensor effects.



10. Scenes and Environmental Effects

This chapter describes scenes and environment conditions.

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- Saving a Scene 10-3
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10.1. Working with Scenes

A scene contains an environment, the time of day, and a terrain filename. If particular environment settings are important to the simulations you are viewing, use of scenes can be an important convenience feature.

10.1.1. Creating a Scene

To create a scene:

1. Optionally, choose **File** → **New Scene**, or click the New Scene button () on the Scene Toolbar. If a terrain is currently loaded, it is removed from the scene.
2. Load the terrain that you want to include in the scene. For details, please see "Opening a Terrain," on page 3-7 and "Terrain Agility and Composability," on page 24-3.
3. Optionally, set the date and time of day.
4. Optionally, specify environment settings, as described in this chapter.

10.1.2. Saving a Scene

To save a scene:

1. Choose **File** → **Save Scene**, or click the Save Scene button () on the Scene Toolbar. The Save Scene dialog box opens. If you did not load a terrain when you created the scene, or if you built a terrain, but did not save it, you are prompted to specify a terrain for the scene.
2. Type a name for the scene.
3. Click Save.

10.1.3. Opening a Scene

To open a scene:

1. Choose **File** → **Open Scene**, or click the Open Scene button () on the Scene Toolbar. The Open Scene dialog box opens.
2. Select the scene you want to open.
3. Click Open.

10.2. Setting the Date and Time of Day

VR-Vantage changes the ambient, diffuse, and specular light based on the simulated time of day and the date. Figure 10-1 illustrates different time of day settings.

When you save a scene, VR-Vantage saves the time of day as part of the scene.



5:15 A.M., June 1 11:15 A.M., June 1

Figure 10-1. Time of Day

To set the date and time of day:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Date and Time page (Figure 10-2).

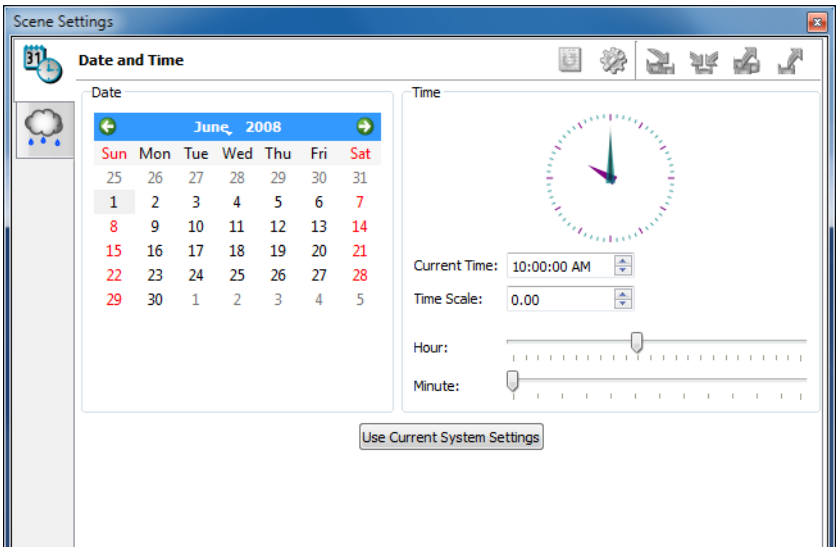


Figure 10-2. Date and Time page

3. To change the month, click the right or left arrows, or click the month and select a month from the list.

4. To change the year, do one of the following:
   - Click the right or left arrows to cycle through the months to a new year.
   - Click the year and type in a year.
   - Click the year and use the spin controls to select a year.
5. To specify the date, select a date in the calendar.



If you change the month, you must explicitly select a date for it to be set.

6. To specify the time, in the Time group box, in the Current Time box, type or select a time value, in HH:MM:SS format, or drag the Hour and Minute sliders. The analog clock display changes to reflect the current simulated time.
7. To set the date and time of day to the system settings, click Use Current System Settings.

10.2.1. Setting the Time Scale

VR-Vantage advances the date and time based on a time scale. By default the time scale is 0.00 and VR-Vantage does not advance time. A time scale of 1.00 means VR-Vantage advances time at real time. The time advance affects VR-Vantage's display of light, sun, star, and moon positions. It has no relationship to or effect on the simulation that VR-Vantage is displaying.

To set the time scale:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Date and Time page (Figure 10-2).
3. In the Time group box, type or select a value in the Time Scale box.

10.3. Specifying the Environment Conditions

VR-Vantage has a set of preconfigured environment conditions. Each environment condition has settings for:

- Weather:
  - Wind speed and direction.
  - Cloud cover.
  - Visibility.
  - Precipitation type and intensity.
  - Fog height and color.
- Marine:
  - Sea swell.
  - Sea state.
  - Surface transparency.
  - Underwater visibility.
  - Choppiness.
  - Surge depth.

Conditions range from clear to stormy and let you quickly set the weather without needing to adjust all the various weather parameters. However, if you want to, you can change any of the individual weather parameters. Changing a weather or marine setting does not affect the saved settings unless you specifically overwrite them.

You can save and import environment settings. When you save a scene, environment settings are saved as part of the scene. Environment settings support the standard VR-Vantage settings behaviors, as described in "Managing VR-Vantage Settings," on page 3-13.

You can add your own environment conditions. You can also set an environment condition as the default condition to use when VR-Vantage starts up. If you do not set a default condition, VR-Vantage saves the settings that were in effect when you last closed it.

To specify an environment condition:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-3).

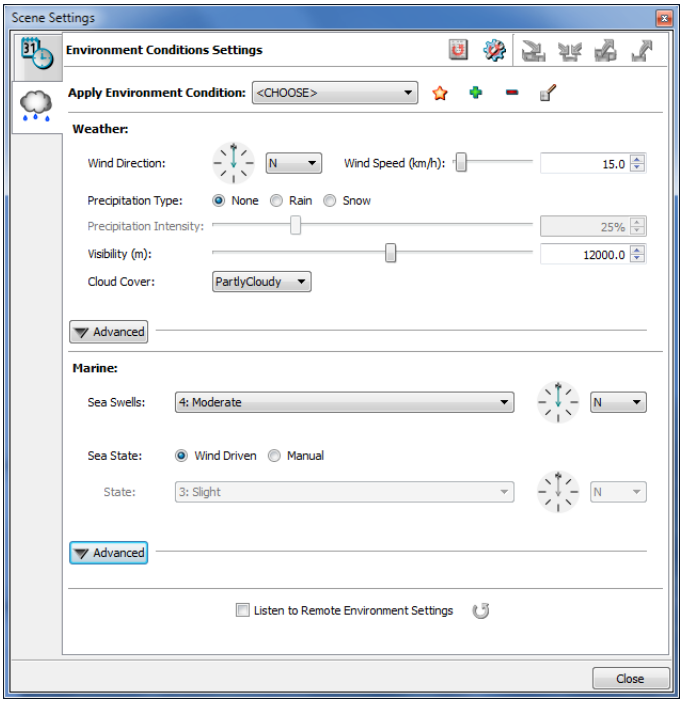


Figure 10-3. Environment Conditions Settings page

3. In the Apply Environment Condition list, select the condition you want.

10.3.1. Setting the Default Environment Condition

The default environment condition is the condition that is in effect when you start VR-Vantage.

To set the default environment condition:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-3).
3. Click the Star button (☆). The Select an Environment Condition dialog box opens.
4. In the environment condition list, select the condition you want to be the default.
5. Click OK. The selected environment condition now has a star next to it in the Apply Environment Condition list.

10.3.2. Adding an Environment Condition

If you add an environment condition, it gets added to the Apply Environment Condition list.

To add an environment condition:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-3).
3. Change the weather settings to the ones you want for the new condition.
4. Click the Add button (). The Name an Environment Condition dialog box opens.
5. Type a name for the new condition.
6. Click OK.

10.3.3. Editing an Environment Condition

You can change the settings for an environment condition. Editing a condition essentially means overwriting a condition with the current set of weather and marine conditions.

To edit an environment condition:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-3).
3. Optionally, in the Apply Environment Condition list, select a condition you want to use as your starting point.
4. Change whatever conditions you want.
5. Click the Edit button (). The Select an Environment Condition dialog box opens.
6. In the Select Name list, select the condition you want to overwrite.
7. Click OK.

10.3.4. Deleting an Environment Condition

If you delete one of the built-in environment conditions, you can restore it from the factory settings.

To delete an environment condition:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-3).
3. Click the Delete button (−). The Select an Environment Condition dialog box opens.
4. In the Select Name list, select the condition you want to delete.
5. Click OK.

10.4. Configuring the Weather

This section describes the individual weather conditions that you can set.

10.4.1. Setting the Wind Speed and Direction

You can set the wind speed and direction. If you do not specify the sea state manually, it is set based on the wind conditions. The maximum wind speed that you can set is 360 km/h.) The wind direction affects the angle at which precipitation falls. Wind speed and direction affect particle systems (dust clouds, smoke, and so on).

To set wind speed and direction:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-4).

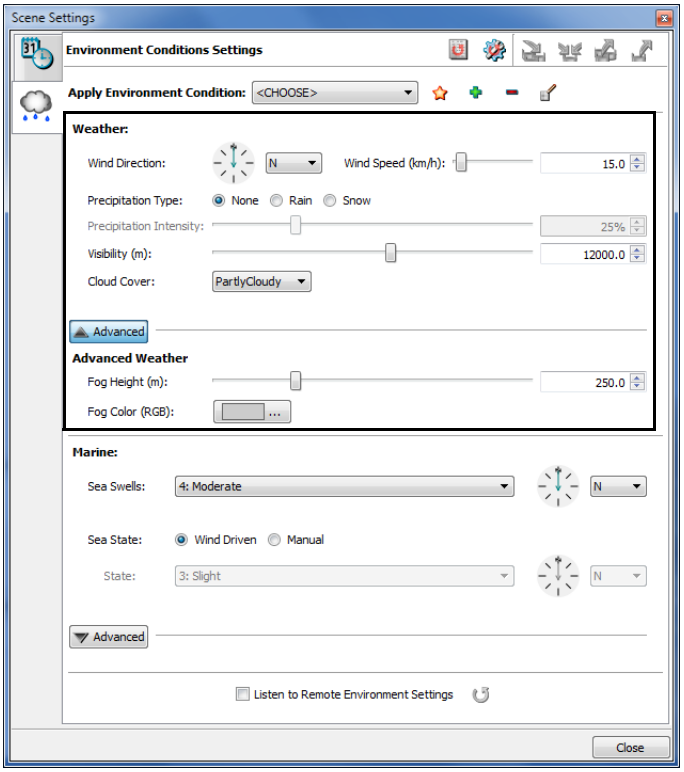


Figure 10-4. Environment Conditions Settings page

3. Drag the Wind Direction indicator to the desired compass point or select an option from the list.
4. Drag the Wind Speed slider or enter a value in the box.

10.4.2. Setting Visibility (Fog)

The visibility setting determines the denseness of the fog effect, which determines how far you can see.

To set visibility:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-4).
3. Adjust the Visibility slider or enter a value in the box.

Configuring Fog

You can set the fog height and color. The fog height affects how much sky the observer can see when looking up from ground level. For example, if you set the fog height to 50m and look up, you will see some amount of sky above you, and to the sides it will be very gray. If you then set it to 10m and look up, you will see mostly blue sky above you, but still quite a bit of gray to the sides.

To configure fog:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-4).
3. In the Weather section of the page, click Advanced. The dialog box expands to show options for fog.
4. To set the fog height, adjust the slider or enter a value in the box.
5. To set the fog color:
   a. Click the color swatch. A color picker dialog box opens.
   b. Select the color you want to apply to the fog. It is applied immediately, so you can easily see the effect of the new color and change it if you want to.
   c. Click OK.

10.4.3. Specifying Precipitation Type and Intensity

VR-Vantage supports display of rain and snow. You can configure the intensity of precipitation.



Precipitation has no effect on the simulation. It is only a visual effect. Snow does not accumulate.

To specify the precipitation type and intensity:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-4).
3. Select a Precipitation Type. If you select rain or snow, the Precipitation Intensity setting becomes editable.
4. Adjust the Precipitation Intensity slider or enter a value in the box. The range is 0% through 100%.

10.4.4. Specifying Cloud Cover

VR-Vantage simulates varying amounts and types of cloud cover, from clear, to cloudy, to thunderstorm. When you choose an environment condition, it includes an appropriate degree of cloud cover. You can also change the cloud cover at any time.

To specify the cloud cover:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-4).
3. Select an option from the Cloud Cover list.

10.5. Configuring Marine Conditions

VR-Vantage supports a variety of dynamic ocean effects (Figure 10-5), including:

- Douglas Sea State. This includes wind waves (wind sea), swell character, and the directions of each. VR-Vantage allows each to be separately configured.
- Wave chop.
- Surface transparency. The ability to see through the water from above sea level.
- Underwater visibility. The ability to see underwater.
- Swell.
- Surge depth. When bathymetry data is present, this is the depth of the water at which full storm effects take place. As the water gets shallower, it gets calmer.
- Tidal current speed and direction. If tidal stream wakes are enabled, they are automatically applied to streamed buoys and beacons.



Figure 10-5. Fishing boat

Enabling dynamic ocean effects can affect performance.

10.5.1. Enabling Marine Effects

Marine effects can reduce performance. Therefore, they are disabled by default.

➤ To enable marine effects, choose **Observer** → **Dynamic Ocean**, or click the Dynamic Ocean button ( ) on the Observer Settings toolbar.

10.5.2. Configuring Marine Conditions

The preconfigured environment conditions include marine conditions. You can also customize the marine settings at any time.

To configure marine effects:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 10-6).

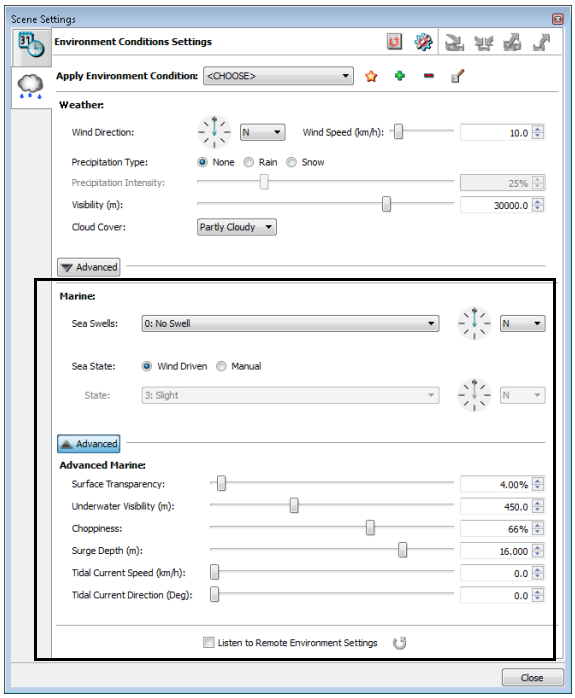


Figure 10-6. Marine Settings

3. Change settings as desired. The settings are described in Table 10-1.

Table 10-1: Advanced marine settings

Parameter	Description
Sea Swells	The amount of rise and fall of waves independent of wind. Choose from 10 fixed swell states. You can also set the compass direction from which swells originate.
Sea State	Determined by the wind direction and speed or set manually. If manual, one of the swell states for the Douglass sea state scale. You can also set the compass direction from which sea state originates.
Advanced Parameters	
Surface Transparency	The depth at which VR-Vantage begins to apply transparency to the water surface if the terrain has bathymetry or underwater polygons. This setting helps reduce Z-fighting along the shoreline. It does not mean that you can see some distance into the water when the observer is over deep water. The maximum value represents transparency to 500 meters.
Underwater visibility	The distance you can see underwater if the observer is underwater.
Choppiness	The percentage of turbulence on the water.
Surge depth	When bathymetry data is present, this is the depth of the water at which full storm effects take place. As the water gets shallower, it gets calmer.
Tidal Current Speed	The speed of the tidal current. This affects the display of tidal wakes on buoys and beacons. Default: 0.
Tidal Current Direction	The direction of the tidal current flow. This affects the display of tidal wakes on buoys and beacons.

10.5.3. Enabling Tidal Stream Wakes

Tidal stream wakes create wake effects around buoys and beacons based on the movement of the tides. Tidal stream wakes are supported as stand-alone models. They are automatically attached to streamed buoys and beacons. VR-Vantage includes wake models for each of the supported buoy and beacon models. They are named for the buoy or beacon type they support, for example, BuoysPillarWake or BeaconsLatticeWake. You may want to edit the **wakeLength** parameter to provide the best visuals for your terrain.

Tidal stream wakes are disabled by default.



Even if tidal stream wakes are enabled, you will not see any wakes unless you also specify a tidal current, which is 0 by default. For details about setting tidal current, please see "Configuring Marine Conditions," on page 10-14.

To enable or disable tidal stream wakes:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 10-7).

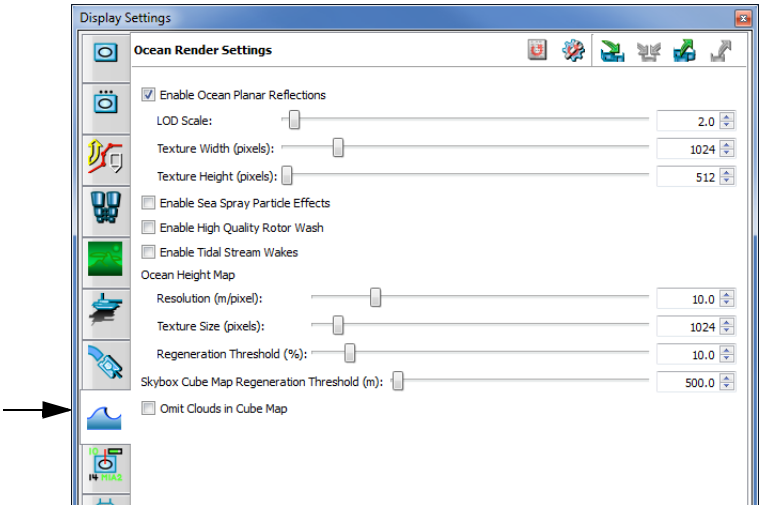


Figure 10-7. Ocean Render Settings

3. Select or clear Enable Tidal Stream Wakes.

10.5.4. Experimental Ocean Features

VR-Vantage has some marine features that are considered experimental. In some cases they improve the scene. In others, they may not be realistic or may degrade performance.

Configuring Breaking Waves

VR-Vantage can simulate the effect of waves breaking along the shore line. This feature uses shapefile data that defines the direction of the breaking waves. The *VR-TheWorld Online - MAK Earth.mtf* terrain includes sample data for breaking waves. To see it, view the island of Oahu, Hawaii.

You can set the amplitude of breaking waves. By default, the amplitude is 0.

To configure breaking waves:

1. Choose **Settings** → **Experimental Features**. The Experimental Features dialog box opens (Figure 10-8).

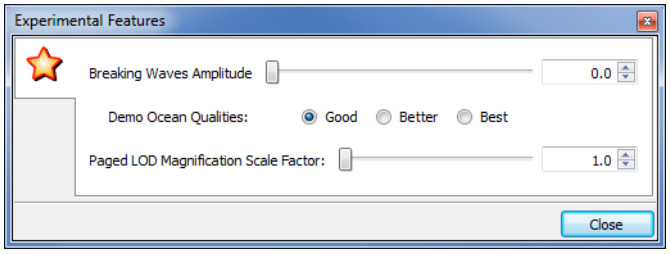


Figure 10-8. Experimental Ocean Utilities dialog box

2. Adjust the Breaking Waves Amplitude slider or type a value in the box. The maximum value is 10.0.

Setting Ocean Quality

You can adjust the overall quality of visualization of the ocean. Increasing ocean quality decreases performance. Best quality may affect overall performance of your computer. Therefore this setting is primarily for use in demonstrations rather than large scenarios.

To set ocean quality:

1. Choose **Settings** → **Experimental Features**. The Experimental Features dialog box opens (Figure 10-8).
2. Select one of the Demo Ocean Qualities options.

10.6. Displaying Water Effects

When it is raining, VR-Vantage can simulate raindrops hitting the observer's camera lens (Figure 10-9). If the observer is close to the surface of the ocean (as if a periscope were being raised or lowered), VR-Vantage can simulate the effect of waves and water droplets splashing on the observer's camera.



Figure 10-9. Rain effect

When dynamic ocean is enabled, VR-Vantage can simulate sea spray (most visible in high seas) (Figure 10-10). It can also display rotor wash for hovering helicopters. You can display rotor wash at two levels of quality.

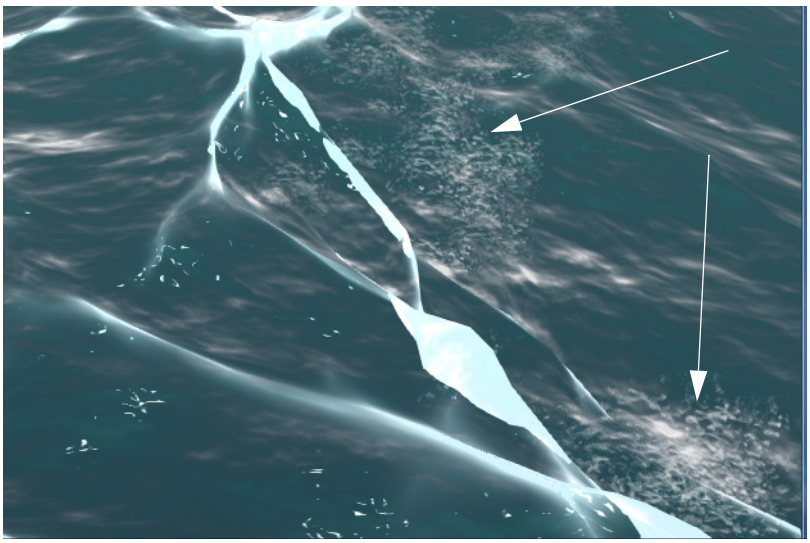


Figure 10-10. Sea spray effects

To enable or disable splash effects:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 10-11).

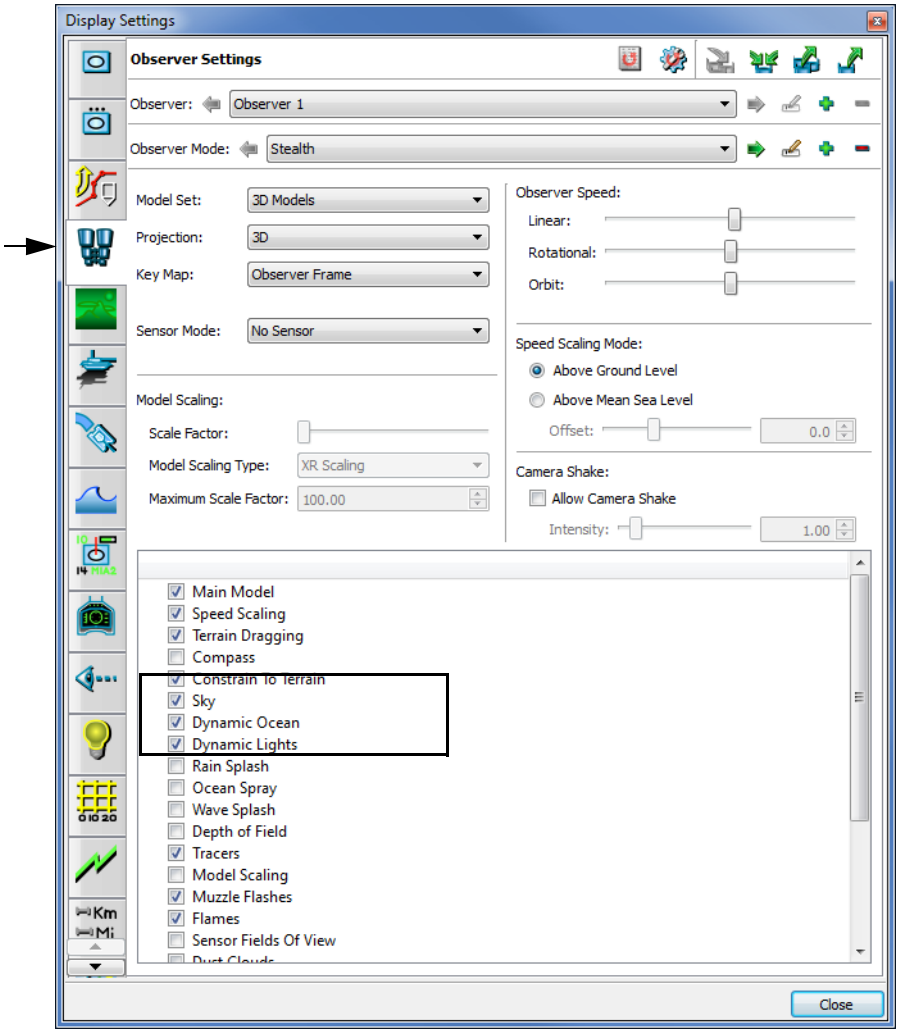


Figure 10-11. Observer Settings page

3. Select or clear the Rain Splash, Wave Splash, or Ocean Spray effect check boxes.

You can also enable or disable these effects by clicking the appropriate button on the Observer Settings toolbar (rain splash ( ), wave splash ( ), ocean spray ( ).

10.6.1. Enabling Sea Spray

To enable sea spray effects:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 10-12).

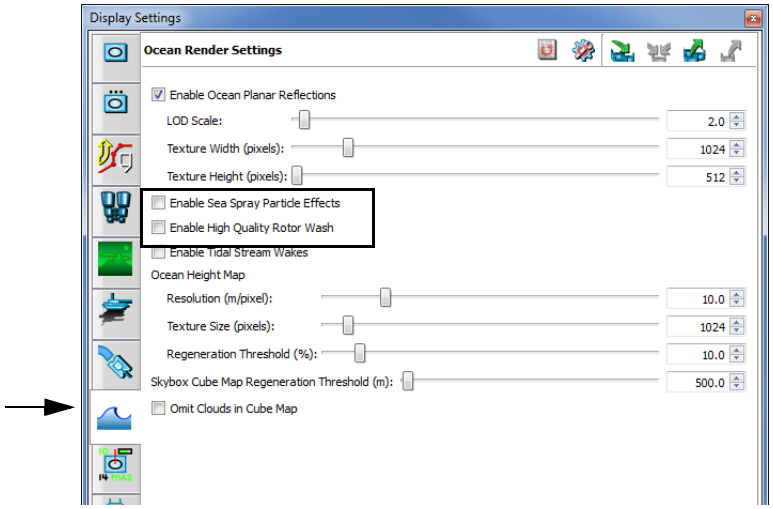


Figure 10-12. Ocean Render Settings page

3. Select Enable Sea Spray Particle Effects.

10.6.2. Enabling High Quality Rotor Wash

To enable high quality rotor wash:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 10-12).
3. Select Enable High Quality Rotor Wash.

10.7. Displaying Remote Environment Settings

The weather effects that you configure in VR-Vantage are just visual effects. They do not correspond to any weather effects in the simulation you are viewing, nor do simulation objects in a simulation interact with them in any way. However, some simulation applications can simulate weather effects and these effects do affect simulation object behaviors, such as calculating line-of-sight. VR-Vantage can display weather effects generated by VR-Forces.

When this feature is enabled, the weather messages from VR-Forces override the settings in VR-Vantage for environment conditions and you cannot make any changes to them in VR-Vantage. If VR-Vantage does not receive any weather messages, it continues to use the environment conditions that were in effect when you enabled listening for remote environment settings.

Changes to fog height or fog color in VR-Forces do not get sent to VR-Vantage.

To enable remote weather effects:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Condition Settings page (Figure 10-4).
3. Select the Listen to Remote Environment Settings check box.
4. Click the Refresh button ( ).

10.8. Disabling Lighting and Clouds

When you are using XR observer mode and you move the observer out from the terrain, the lighting and cloud effects can interfere with your ability to view simulation objects. Therefore, VR-Vantage lets you quickly disable lighting effects and clouds. By default, they are enabled in Stealth observer mode and disabled in XR observer mode.

➤ To enable or disable lighting and clouds, choose **Observer** → **Sky**, or click the Show/Hide Sky button ( ) on the Observer Settings Toolbar.



11. Using Sensors

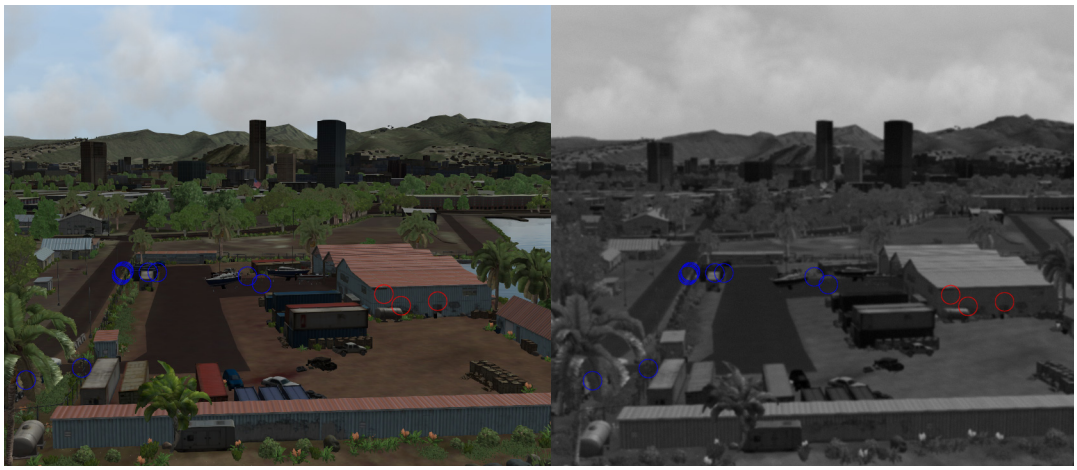
This chapter explains how to use the sensor feature to simulate a night-vision goggle (NVG) or infrared view of the scene.

Using Sensors 11-2
Enabling Sensors 11-3
Configuring Sensors 11-4
Adding New Sensors 11-6

11.1. Using Sensors

VR-Vantage Stealth and VR-Vantage IG can simulate the way that the 3D scene would look if an observer were using visual sensor devices such as night vision goggles or viewing the infrared spectrum. This is an observer-specific setting. You can adjust the contrast, blur, and noise of the view.

VR-Vantage includes one sensor module – CameraFX, which uses the SenSim libraries from JRM Technologies. The sensors do not take into account the materials of the objects that you are viewing. They simply filter the view to produce the desired effect. If you want physics-based sensor effects, you can purchase the SensorFX Plug-in to VR-Vantage, developed by JRM. For details, please contact your MÄK salesperson.



No sensor (daylight) IR sensor

Figure 11-1. CameraFX

11.2. Enabling Sensors

Sensors are observer-specific (Figure 11-2). VR-Vantage includes observer modes that have sensors enabled. The names of the observer modes match the sensor modes that they enable.

- NVG (CameraFX).
- IR (CameraFX).
- IR BlackHot (CameraFX)
- Camera (CameraFX). This mode uses the Visual Camera sensor mode.

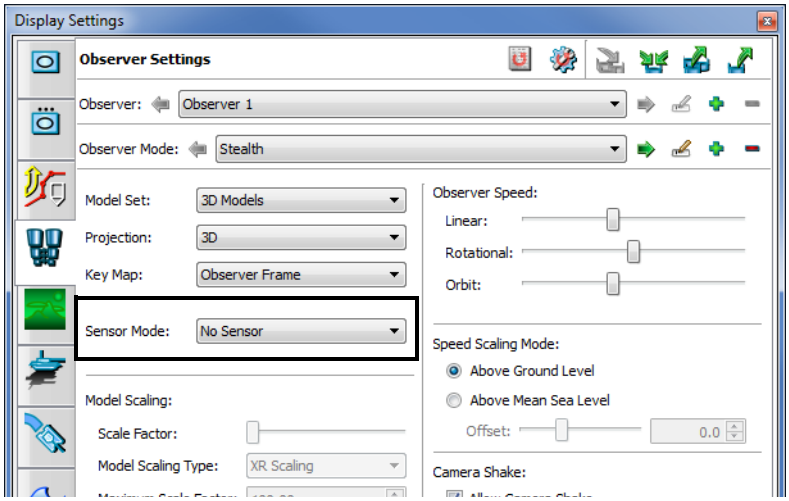


Figure 11-2. Sensor setting for observer mode

The default settings for the Camera observer mode make it look very similar to Stealth observer mode. The difference is that when you use the Camera observer mode, you can change the view by changing the sensor settings, such as blur, noise, and gain.

If you have SensorFX installed, when you run it, the observer modes include the text SensorFX instead of CameraFX. The presence of CameraFX or SensorFX in the observer mode name makes it clear which type of sensor you are using.

You can also specify use of a sensor configuration as a channel attribute.

To enable sensors, do one of the following:

- Select an observer mode that has a sensor configured.
- Edit an observer mode to use a sensor.
- Create a new observer mode and configure it with a sensor.
- Change the Sensor attribute for a channel.

For details about creating and editing observer modes, please see "Creating and Editing Observer Modes," on page 13-4. For details about editing channel attributes, please see "Changing a Channel's Attributes," on page 6-11.

11.3. Configuring Sensors

You can configure the following aspects of sensors:

- Blur. The sharpness of the image.
- Noise. The graininess of the image.
- Gain. The contrast and brightness of the image. (IR only)

You can configure a separate set of settings for each sensor type. VR-Vantage remembers the settings. When you change the settings for a sensor type, they affect the display only if that sensor type is in use. For example, if you select NVG in the sensor list on the Observer Settings page, and select IR in the Sensors list on the Sensor Settings page, the changes you make to the IR configuration do not affect the NVG display you are looking at. If you then switch to IR in the VR-Vantage window, the new IR settings take effect. (This probably sounds obvious, but the Sensor Settings page does not automatically display the configuration for the sensor that is being used. If you want to edit the sensor that you are currently using, you have to be sure that you have selected it to edit.)

To configure sensors:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Sensor Settings page (Figure 11-3).

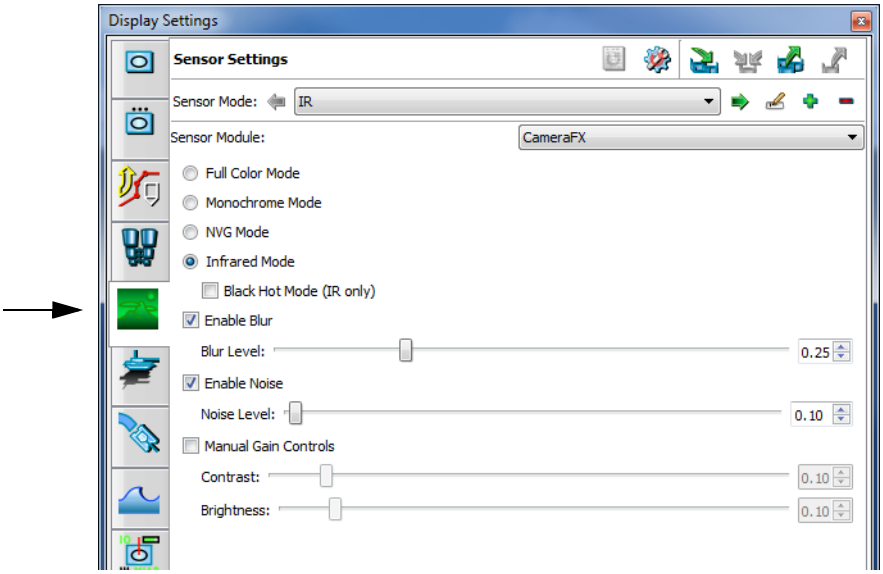


Figure 11-3. Sensor Settings page

3. In the Sensor Mode list, select the sensor that you want to configure.
4. Select the Sensor module from the list.
5. Select the sensor mode (Monochrome, NVG, and so on). If you select Infrared Mode, select or clear the Black Hot Mode check box.

- It may seem obvious that if, for example, you select NVG from the Sensor Modelist, you would select it for the sensor type. However, VR-Vantage lets you add additional sensor configurations to the list and in that case, you would need to specify the correct sensor type for the new sensor. For example, you might create a sensor called NVG-High Contrast. Then you would select NVG as the sensor type and adjust the contrast accordingly.
- Full Color Mode provides natural coloring, as you would see with no sensor modes applied. The benefit of creating a sensor mode using this option is that you can apply noise or blur to the scene.

---

6. Select the check boxes for the effects that you want to be enabled for this sensor configuration.
7. Adjust the values for the enabled effects.

11.4. Adding New Sensors

You can add, rename, and delete sensors.

To add a sensor:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Sensor Settings page (Figure 11-3).
3. On the Sensor Mode line, click the Add button (). A new sensor called sensor_*number* is added. There are no configuration options on the page. (To rename the sensor, click the Rename button () and enter a new name.)
4. In the Sensor Module list, select CameraFX. The available configuration options are added to the page.
5. Select the type of sensor that you want this to be (Full Color, Monochrome, Infrared, or NVG).
6. Set the Blur, Noise, and Gain levels.



12. Lighting Effects

This chapter describes the lighting effects supported by VR-Vantage.

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Enabling and Disabling Lighting 12-3
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12.1. Displaying Lighting Effects

VR-Vantage can simulate a variety of lighting effects, including:

- Dynamic lighting
- Ocean planar reflection
- Lens flare
- Crepuscular (sun) rays.
- Shadows.

Use of lighting effects affects performance. VR-Vantage lets you enable and disable some effects so you can adjust the mixture of performance and effects that best meets your needs.

12.2. Enabling and Disabling Lighting

When lighting is enabled, VR-Vantage takes into account direct and ambient lighting when it renders a scene. During the daytime, objects are brightly lit. At night, you cannot see them unless an object is casting light on them or you use a sensor mode that provides night vision.

If lighting is disabled you can see objects regardless of the time of day. Lighting may not be realistic.

To enable or disable lighting:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 12-1).

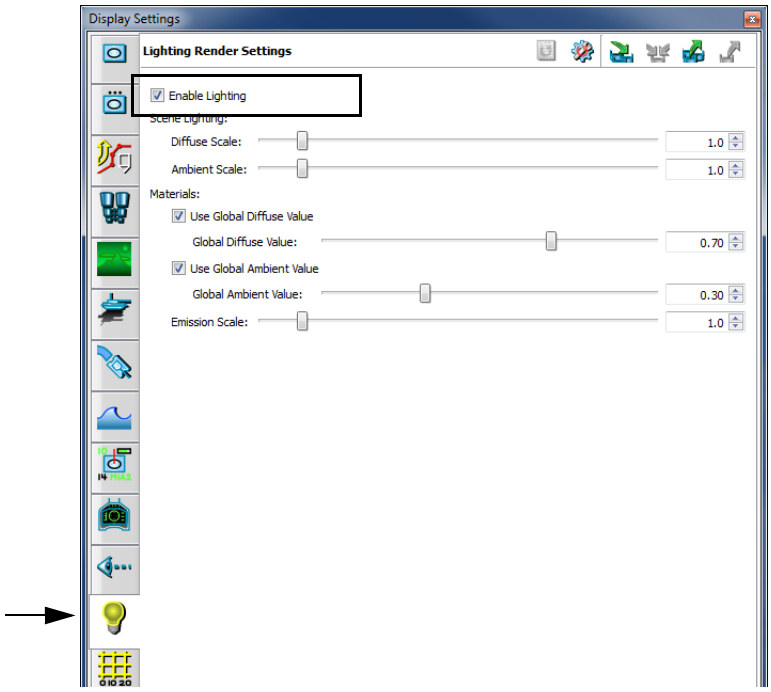


Figure 12-1. Lighting Render Settings

3. Select or clear the Enable Lighting check box.

12.2.1. Configuring Ambient and Diffuse Lighting

Ambient lighting is the lighting available to objects that are not in a direct form of light, such as sunlight. Diffuse lighting is light that is reflected off an object. You can adjust the overall amount of ambient and diffuse lighting in the scene and you can configure whether objects use the material ambient and diffuse values specified in their models or use values provided by VR-Vantage.

Configuring the Ambient and Diffuse Scale Values for Scene Lighting

You can set a scale factor for ambient and diffuse light that is present in the scene. Lower values make objects darker. Higher values make them lighter. The ambient or diffuse scale factor is independent of how material ambient and diffuse values are set.

To specify the ambient and diffuse lighting scale values:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 12-2).
3. Adjust the Diffuse Scale slider or change the value in the box.
4. Adjust the Ambient Scale slider or change the value in the box.

Configuring the Material Ambient and Diffuse Values for Materials

Polygons in a 3D scene have a material and a texture. Polygon materials may specify specular, diffuse, and ambient colors that define the way they respond to incoming light.

The ambient color specifies the color used when it is in indirect light. Sometimes the ambient values for different objects do not work well together. You can specify that objects use the ambient material value, or let VR-Vantage globally specify ambient material values.

In addition to specifying which material ambient and diffuse values to use, you can set a scale factor. Lower values make objects darker. Higher values make them lighter. The material ambient or diffuse scale factor is independent of how ambient and diffuse values are set for scene lighting.

To configure the material ambient value:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 12-2).

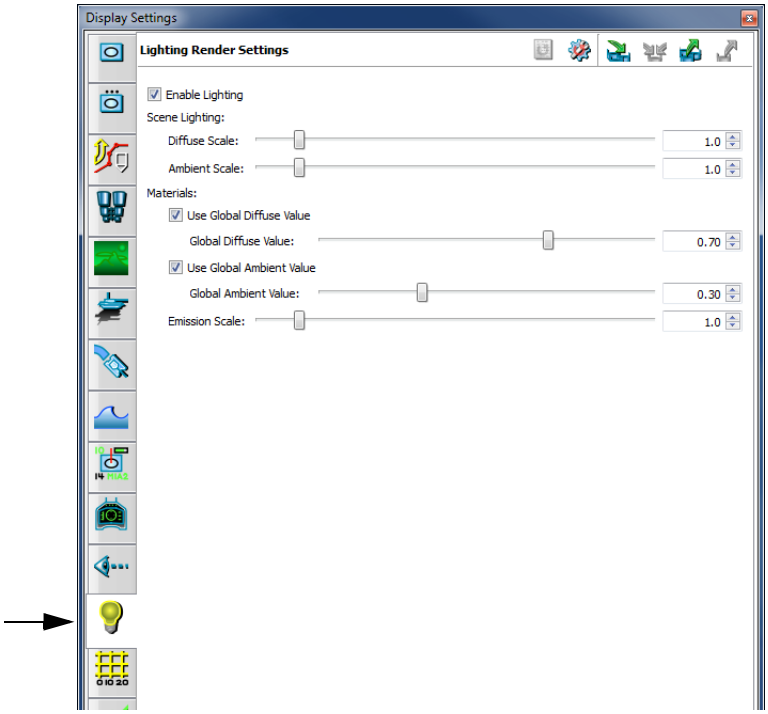


Figure 12-2. Ambient and Diffuse Value settings

3. To use the ambient values specified by objects, clear the Use Global Ambient Value check box. To have VR-Vantage use a global value, select the Use Global Ambient Value check box.
4. If you selected the Use Global Ambient Value check box, optionally, adjust the Global Ambient Value slider or change the value in the box.

To configure the material diffuse value:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 12-2).
3. To use the diffuse values specified by objects, clear the Use Global Diffuse Value check box. To have VR-Vantage use a global value, select the Use Global Diffuse Value check box.
4. If you selected the Use Global Diffuse Value check box, optionally, adjust the Global Diffuse Value slider or change the value in the box.

12.2.2. Specifying the Emissive Lighting Scale

You can change a scale value that controls the brightness of emissive textures. This allows you to make windows, street lights, and other emissive light sources darker or brighter. Increasing the scale value increases the brightness.

To specify the emissive lighting scale value:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 12-1).
3. Adjust the Emission Scale slider or change the value in the box.

12.3. Displaying Dynamic Lighting

VR-Vantage can display light cast by light sources such as headlights, street lamps, and spotlights. Display of dynamic lighting is an observer-specific feature. It is disabled by default.

Dynamic lights are either part of the terrain or part of an entity model. If they are part of an entity model, they can be set permanently on or they can be turned on and off by the appearance bit.

Figure 12-3 shows a night-time scene with dynamic lighting enabled. The HMMWV's taillights cast light to the rear. The headlights cast light forward. Street lamps and windows are also casting light.



Figure 12-3. Dynamic Lighting enabled

- Light points that are part of the terrain, such as runway lights, automatically turn on at dusk and turn off at dawn.
- Emissive lights, such as automobile headlights, are always on.

You cannot change these lighting settings.

To enable dynamic lighting,

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page.
3. In the list of settings, select Dynamic Lights.

You can also enable or disable dynamic lighting by choosing **Observer** → **Dynamic Lights** or clicking the Dynamic Lights button () on the Observer Settings Toolbar.

12.4. Displaying Ocean Planar Reflections

VR-Vantage can show the reflection of terrain and objects on water (Figure 12-4). To see planar reflections, dynamic ocean must be enabled. (For details about enabling dynamic ocean, please see "Enabling Marine Effects," on page 10-14.)

Displaying ocean planar reflections degrades performance.



Figure 12-4. Ocean planar reflection

To enable or disable planar reflections:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 12-5).

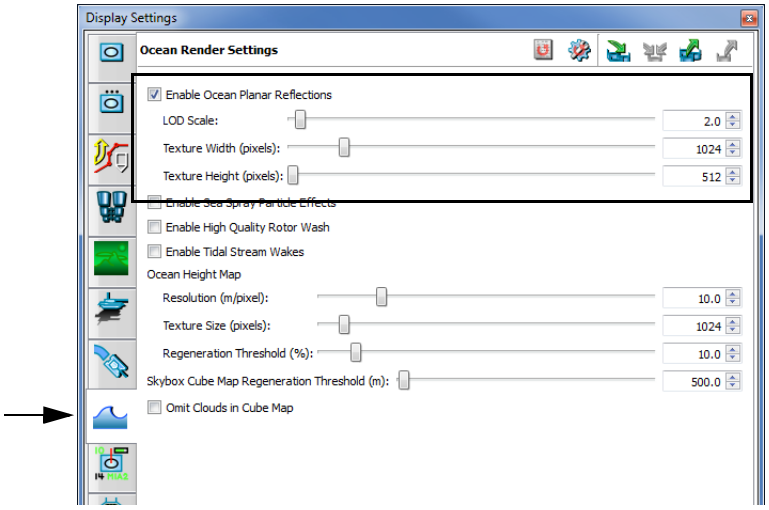


Figure 12-5. Ocean Render Settings

3. Select or clear the Enable Ocean Planar Reflections check box.

12.4.1. Configuring Ocean Planar Reflections

To reduce the performance impact of ocean planar reflections, you can configure the LOD scale. The LOD scale affects the distance from the observer at which VR-Vantage switches LODs. The higher the value, the more quickly LODs are switched.

The Texture Height and Texture Width parameters affect the resolution of the ocean planar reflection texture, in pixels. Higher resolution decreases performance.

To configure ocean planar reflections:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 12-5).
3. To change the ocean planar reflection LOD scale, adjust the LOD Scale slider under Enable Ocean Planar Reflections, or change the value in the box.
4. To change the width or height of the ocean planar reflection texture, adjust the Texture Width or Texture Height slider under Enable Ocean Planar Reflections, or change the values in the boxes.

12.5. Lens Flare

Lens flare is a visual artifact often seen when looking at light sources such as the sun through a camera lens (Figure 12-6). VR-Vantage can simulate lens flare when the observer looks towards the sun.



Figure 12-6. Lens flare

To enable or disable lens flare:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 12-7).

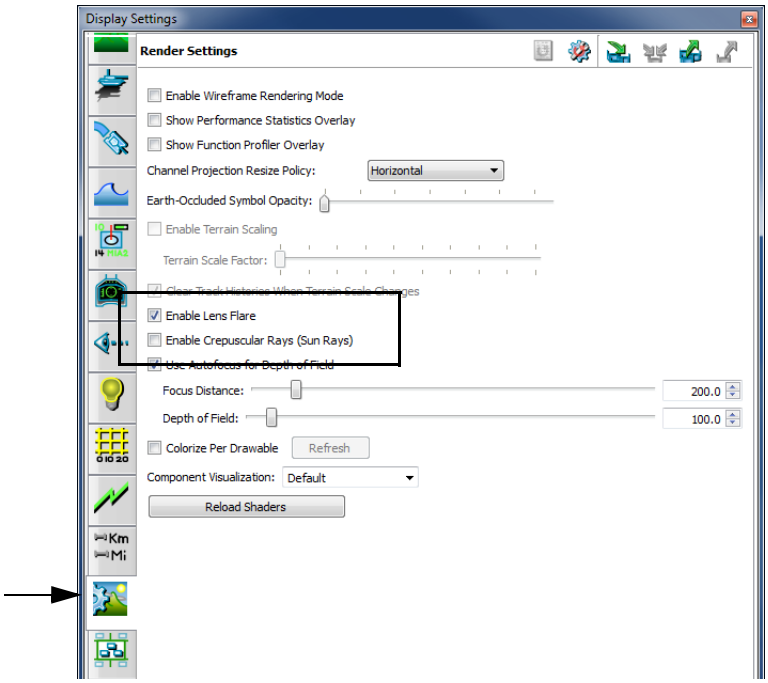


Figure 12-7. Render Settings page

3. Select or clear the Enable Lens Flare check box.

12.6. Displaying Crepuscular (Sun) Rays

VR-Vantage can simulate the effect of crepuscular rays (sunbeams) beaming through clouds (Figure 12-8).

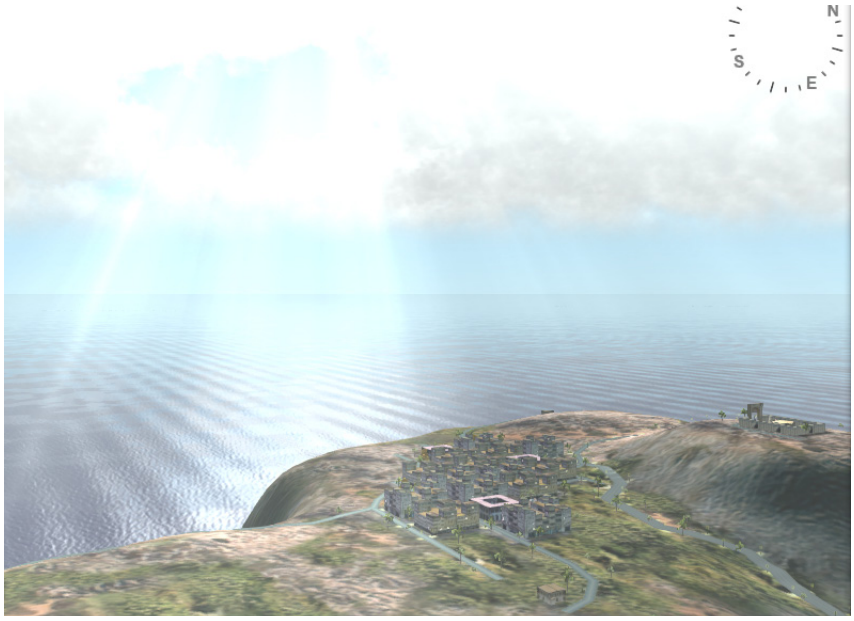


Figure 12-8. Crepuscular rays

To enable or disable crepuscular (sun) rays:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 12-7).
3. Select or clear the Enable Crepuscular Rays (Sun Rays) check box.

12.7. Configuring the Skybox Cube Map

A skybox cube map is a graphics technique used to render reflections and sky effects. The skybox cube map is rendered from the location of the observer. As the observer moves, the cube map needs to be recalculated, which is computationally expensive.

VR-Vantage lets you configure the distance that the observer has to move (the skybox cube map regeneration threshold) before it recalculates the cube map. Increasing the threshold can improve performance, at the cost of visual quality.

You can also choose to omit clouds in the skybox cube map. Omitting clouds can increase performance.

To configure the skybox cube map:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 12-5).
3. Adjust the Skybox Cube Map Regeneration Threshold slider or enter a value in the box.
4. Optionally, select the Omit Clouds in Cube Map check box.

12.8. Flashlight Mode

VR-Vantage can light a circular area as if the observer is using a flashlight. You can move the flashlight beam and increase or decrease the diameter of the flashlight beam.



Figure 12-9. Flashlight mode

- To turn flashlight mode on or off, press **`f`**.
- To move the flashlight beam, hold down **`Alt`** and the right mouse button and move the mouse.
- To change the size of the flashlight beam, hold down **`Alt`** and move the mouse scroll wheel forward or back.

12.9. Displaying Shadows (3D Only)

VR-Vantage can display shadows for entities, props, and terrain features.



Figure 12-10. Shadows

You can enable and disable shadows and you can configure shadow quality.

Enabling shadows can affect performance.

To enable and disable shadows globally:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Shadow Settings page (Figure 12-11).

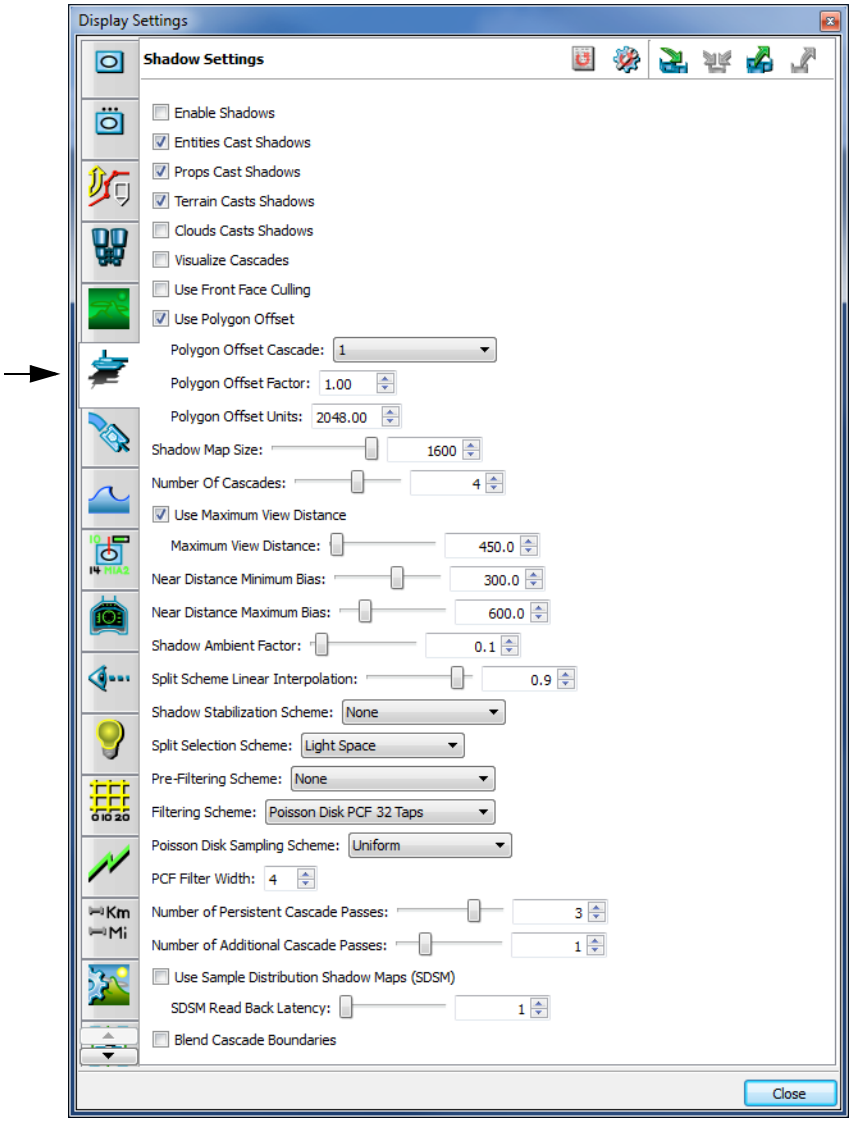


Figure 12-11. Display Settings, Shadow Settings page

3. Select or clear the Enable Shadows check box.



You can also enable and disable shadows by choosing **Settings** → **Shadows** or clicking the Shadows button () on the Display Settings Toolbar.

12.9.1. Configuring Shadows

You can configure which objects cast shadows and parameters that affect performance and the quality of shadows. Shadow parameters include the following:

- Cascades. A scene is split into sections, with those closest to the camera showing the highest resolution shadows. You can configure the number of splits and how the quality of resolution changes as you move away from the camera.
- Polygon offset. These settings shift shadows to minimize Z-fighting.
- Shadow ambient factor. Hides Z-fighting and other visual artifacts.
- Shadow stability. Affects resolution when the camera moves.
- Filtering. These options affect visual quality.
- Sample Distribution Shadow Maps (SDSM). SDSM increases rendering quality at the expense of performance.

To configure how shadows are rendered:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Shadow Settings page (Figure 12-11).
3. To enable or disable shadows for object types, select or clear the Entities Cast Shadows, Props Cast Shadows, or Terrain Casts Shadows check boxes.
4. Change other parameters as desired.



IV. The Observer

The observer, or eyepoint, is the location in the 3D or 2D environment from which you observe the scene. You can move the observer (navigate) through the scene. You can attach the observer to a simulation object or prop. When the observer is attached to a simulation object, it moves automatically with that object. You can also control the observer from a remote application using view control messages.

You can have multiple observers in a VR-Vantage session. They might be associated with different windows. For example you could have an observer for the main window and one for an inset window.



13. The Observer and Observer Modes

This chapter explains how to create, edit, and change the observer mode. For details about moving the observer, please see Chapter 14, *Moving the Observer*. For details about attaching the observer to entities and props, please see Chapter 15, *Attaching the Observer to Objects*.

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13.1. Switching Between the 2D and 3D Projections

VR-Vantage Stealth supports both 2D and 3D projections. You can switch between them simply by changing the observer mode from Stealth or Out-the-Window, to Plan View. (Changing observer modes is described in "Changing the Observer Mode," on page 13-3.) When you go from a 3D observer mode to 2D, VR-Vantage calculates a zoom level so that the observer should appear as if it is roughly the same height above the terrain. When you go from a 2D observer mode to 3D, VR-Vantage calculates an altitude to do the same thing, and keeps the 3D view pointing down (so the change in overall view stays fairly small).

13.2. Observer Modes

Observer modes let you configure VR-Vantage settings that affect how the observer moves and what it sees. You can then quickly change from one group of settings to another by switching between observer modes. An observer mode specifies:

- A model set. A collection of models of a particular type, such as 3D models.
- A key map. A coordinated set of key mappings to movement functions.
- A projection (2D or 3D).
- Settings for simulation object graphics and observer movement.

VR-Vantage includes the following observer modes:

- Stealth. Stealth observer mode is a 3D projection configured for situational awareness.
- Out-the-Window. Out-the-Window observer mode is configured for when you use VR-Vantage IG or if you want to use VR-Vantage Stealth as a desktop image generator. It hides many of the explanatory visual effects present in the Stealth observer mode.
- Plan View. The Plan View observer mode provides a 2D "big picture" view of the terrain.
- XR. XR, or exaggerated reality, observer mode is a 3D mode that helps you understand the relationships between entities and the terrain when the observer is too far away from entities to view them at realistic sizes. It allows you to exaggerate entity size and terrain.
- IR BlackHot (CameraFX). A view using the CameraFX IR (infrared) BlackHot sensor.
- IR (CameraFX). A view using the CameraFX IR sensor.
- NVG (CameraFX). A view using the CameraFX NVG (night vision goggles) sensor.
- Camera (CameraFX). A view using the Visual Camera CameraFX sensor.

You can edit observer modes and add new ones. For details, please see "Creating and Editing Observer Modes," on page 13-4.

13.3. Changing the Observer Mode

When you change the observer mode, terrain may be displayed differently and the model sets used to display simulation objects may change. For descriptions of the observer modes, please see "Observer Modes," on page 13-2.

➤ To change the observer mode, choose **Observer** → **Set Observer Mode** → *mode*, or on the Observer Settings Toolbar (Figure 13-1), choose an option from the Observer Mode list.



Figure 13-1. Observer Settings Toolbar

13.4. Creating and Editing Observer Modes

VR-Vantage comes with 3D and 2D observer modes. (Table 14-1 lists the observer modes available for each VR-Vantage application.) They are configured with the display settings, key mappings, and model sets that users most commonly want to use. However, if they do not meet your needs, you can easily edit them or create new observer modes.

13.4.1. Creating an Observer Mode

To create an observer mode:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).

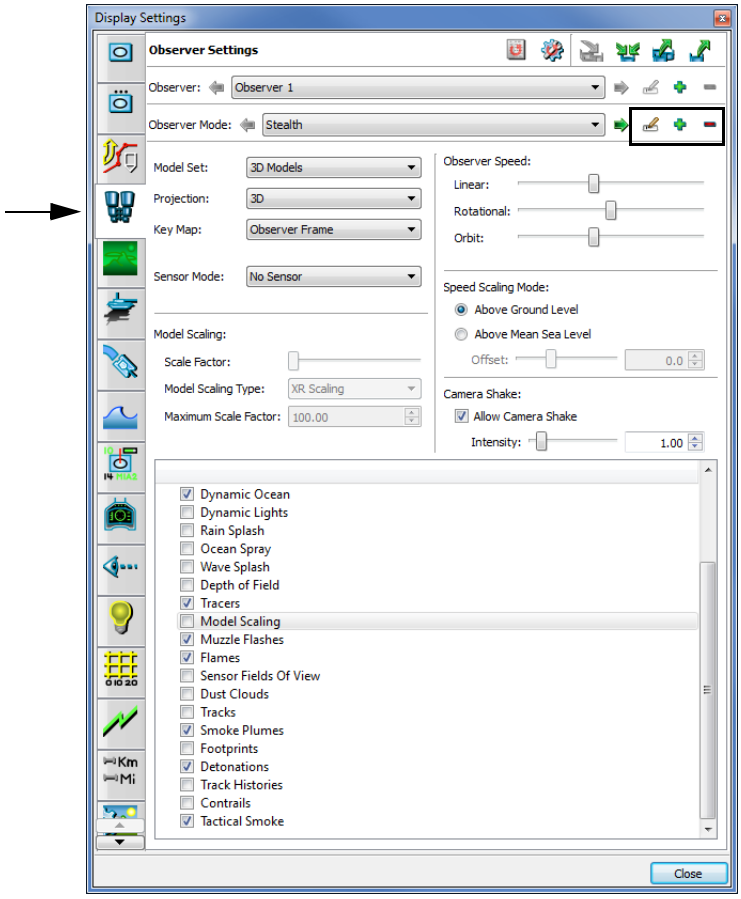


Figure 13-2. Observer Settings page

3. Click the Add button (+) to the right of the Observer Mode list. The Create New Observer Mode dialog box opens (Figure 13-3).

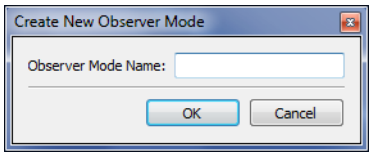


Figure 13-3. Create New Observer Mode dialog box

4. Type a name for the new observer mode.
5. Click OK.
6. In the Model Set list, select a model set. (VR-Vantage Stealth only.)
7. Select a projection (2D or 3D). (VR-Vantage Stealth only.)
8. Select the key map you want to use.
9. Optionally, specify a sensor mode.
10. Optionally, change the observer speed scaling settings and speed scaling mode.
11. Optionally, for 3D model sets, change the Model Scaling settings.
12. Enable or disable the mode-specific settings. The list of settings varies depending on the projection and model set, and application.

13.4.2. Deleting an Observer Mode

To delete an observer mode:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. In the Observer Mode list, select the observer mode that you want to delete.
4. Click the Delete button (−).

13.4.3. Editing an Observer Mode

To edit an observer mode:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. In the Observer Mode list, select the observer mode that you want to edit.
4. Edit the attributes of the observer mode as desired.

13.4.4. Renaming an Observer Mode

To rename an observer mode:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. In the Observer Mode list, select the observer mode that you want to rename.
4. Click the Rename button (). The Rename Observer Mode dialog box opens.
5. Type the new name.
6. Click OK.

13.5. Adding an Observer

You can add and remove observers. Having multiple observers lets you assign different observers to different windows or channels. Changing the position and orientation of the observer in one channel does not affect the view of a different observer in a different channel. (For information about windows and channels, please see Chapter 6, *Windows, Channels, and Display Engines*.)



If you have multiple observers, the observer listed in the Observer Settings Toolbar is the observer assigned to the window that has focus. If you open the Display Engine Configuration Editor Panel and select a different observer in the Channel Attributes list, the data in relevant panels will change to reflect the values for the selected observer. However, as soon as you return focus to a window, the observer selection will change to match that of the window.

You can add observers in the Display Engine Configuration Editor Panel or on the Observer Settings page. (For information about the Display Configuration Editor Panel, please see Chapter 6, *Windows, Channels, and Display Engines*.)

If you want to save your observers, save the display engine configuration in which you created them. (Saving an observer just saves its name. It does not save any information about a particular observer mode or location that you may have used for that observer. To save location information, save an observer view.)

13.5.1. Adding an Observer on the Observer Settings Page

To add an observer on the Observer Settings page:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. Click the Add button (✚) to the right of the Observer list. The Create New Observer dialog box opens.
4. Type a name for the new observer.
5. Click OK. The new observer is added to the list.
6. To save the observer, save the display configuration. (Saving the observer settings does not save observers.) (For information saving a display configuration, please see "Saving a Display Engine Configuration," on page 6-8.)

13.5.2. Adding an Observer in the Display Engine Configuration Editor

To add an observer on the Display Engine Configuration Editor Panel:

1. Choose **View** → **Display Engine Configuration Editor Panel**. The Display Engine Configuration Editor Panel opens (Figure 13-4).

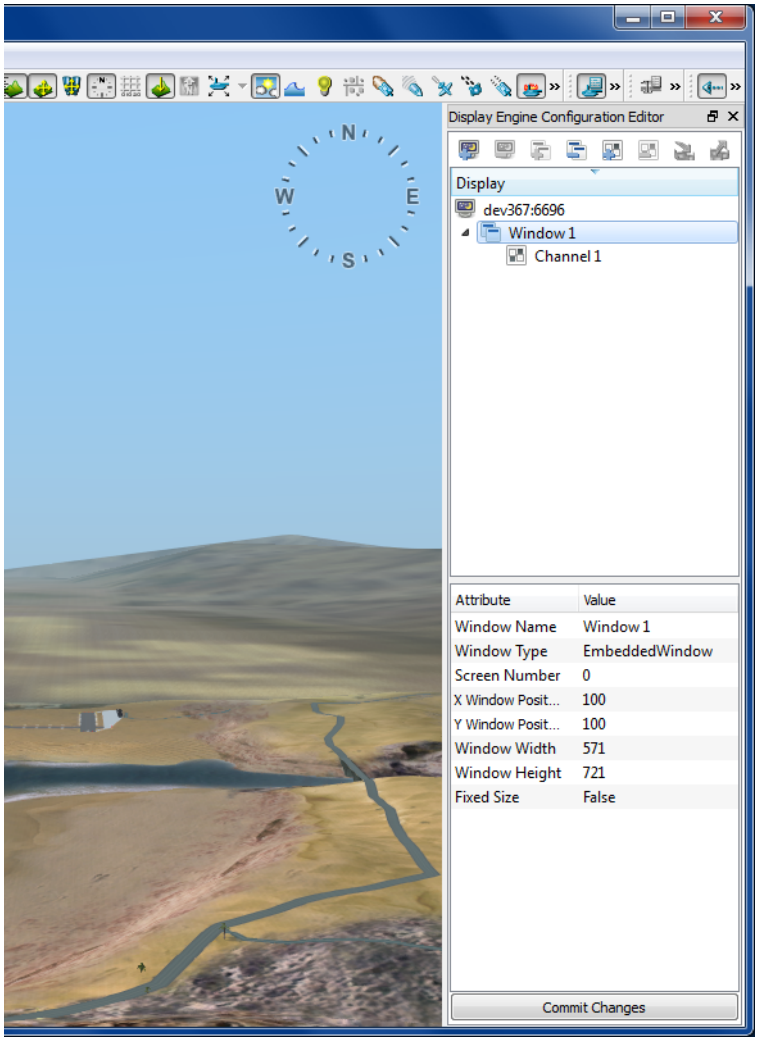


Figure 13-4. Display Engine Configuration Editor Panel

2. Select the channel on which you want to add an observer.
3. Click the Value field for the Observer Name attribute to make it editable.
4. In the list, select New (Figure 13-5).

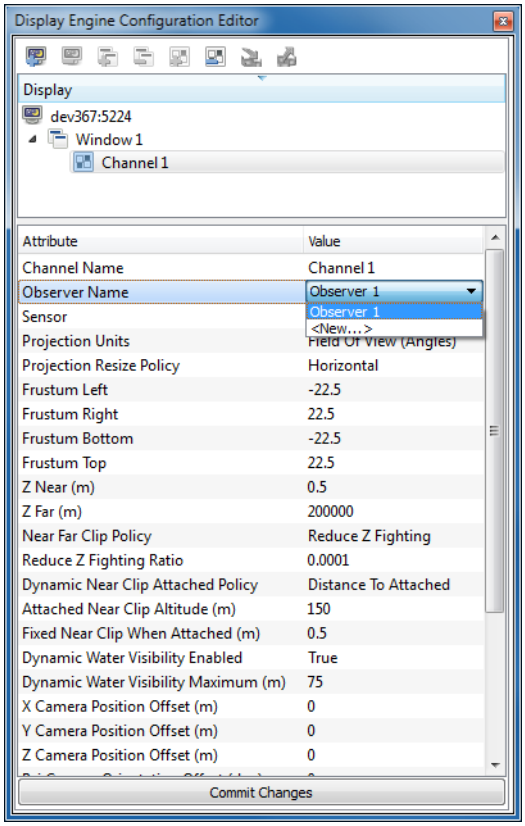


Figure 13-5. Observer Name attribute

5. Click Commit Changes. The Add Observer dialog box opens.
6. Type a name for the new observer.
7. Click OK. The new observer becomes the selected observer on the Observer Settings Toolbar, and is listed in the Observer Name attribute. (You may need to refresh the channel attributes before the observer name is listed.)
8. To save the observer, save the display configuration. (For information about saving a display configuration, please see "Saving a Display Engine Configuration," on page 6-8.)

13.6. Removing an Observer

When you close VR-Vantage, all observers get removed. They are not saved unless you save a display configuration. You can also remove observers during a session.

To remove an observer:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. In the Observer list, select the observer that you want to remove.
4. Click the Delete button (−). The observer is removed.
5. If the observer was saved as part of a display configuration, save the updated display configuration.

13.7. Communicating Information About the Observer

VR-Vantage can transmit state updates describing the observer's position and orientation, and can respond to view control messages sent by other applications.

13.7.1. Making the Observer Visible to Other Applications

By default, VR-Vantage sends state update messages to make its state information known to other applications. This makes it possible for a plan view display to represent VR-Vantage as an icon, or for one VR-Vantage application to synchronize its observer movement with that of another VR-Vantage application.

To enable or disable broadcasting of observer information:

1. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens (Figure 13-6).

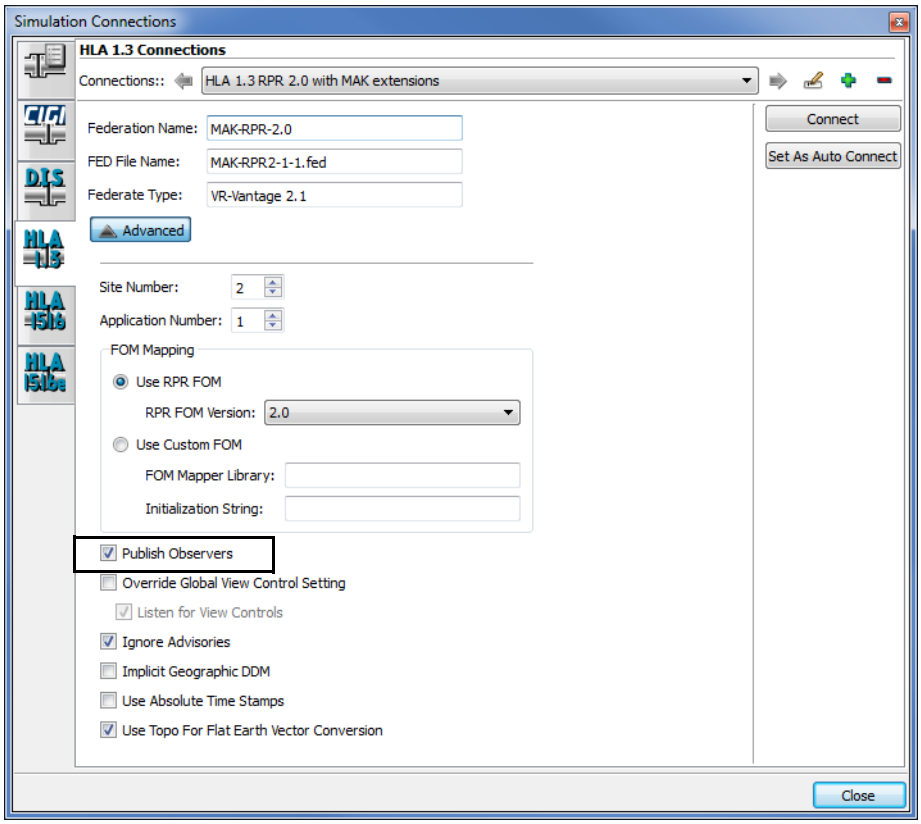


Figure 13-6. HLA 1.3 Connections page

2. Select the page for the connection that you want to configure.
3. Select or clear the Publish Observers check box.
4. Click Close.

Making the Observer Visible to Just One Application (DIS Only)

In DIS you can send observer information to just one other application, rather than to everyone in the exercise. To do this, on the DIS Connections page, instead of using a broadcast address, set the destination address to the address of a specific computer.

13.7.2. Viewing and Attaching to Other Observers

If an exercise includes other stealth applications, and they are sending state updates, VR-Vantage can detect them. A remote observer entity is listed in the object hierarchy, so you can attach the local observer to it just as you would attach to any other simulation object.

Observer icons are not normally visible in the VR-Vantage window, even when they appear in the entity list. If you want to display visual representations of remote observers, map a visual model to the observer's entity enumeration.

For related information, please see "Displaying Models for Remote Observers," on page 18-17.



14. Moving the Observer

This chapter explains how to move the observer (eyepoint) in the VR-Vantage window.

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14.1. Moving the Observer

When you view a simulation, you usually want to move the observer (eyepoint) to different locations to view the terrain and scene elements being simulated. In VR-Vantage, you can move the observer using the keyboard and the mouse. There are two basic contexts in which you can move the observer:

- You can move it independently of any scene element. This is called absolute, or free-fly mode.
- You can attach the observer to a simulation object, in which case it moves with the object. (You can also attach the observer to a prop. For details about attaching the observer to a simulation object or prop, please see Chapter 15, *Attaching the Observer to Objects*.)

Absolute mode and the various attachment types are collectively called attach modes.

Regardless of which attach mode you are using, you can change the position and orientation of the observer. In the 3D projection, position is defined by X, Y, and Z coordinates that identify its location in the 3D world. Orientation describes the observer's yaw (heading), pitch, and roll (Figure 14-1).

In the 2D projection, the Z coordinate is fixed. You can change the X and Y coordinates. You can change the observer's yaw, but pitch and roll are fixed.

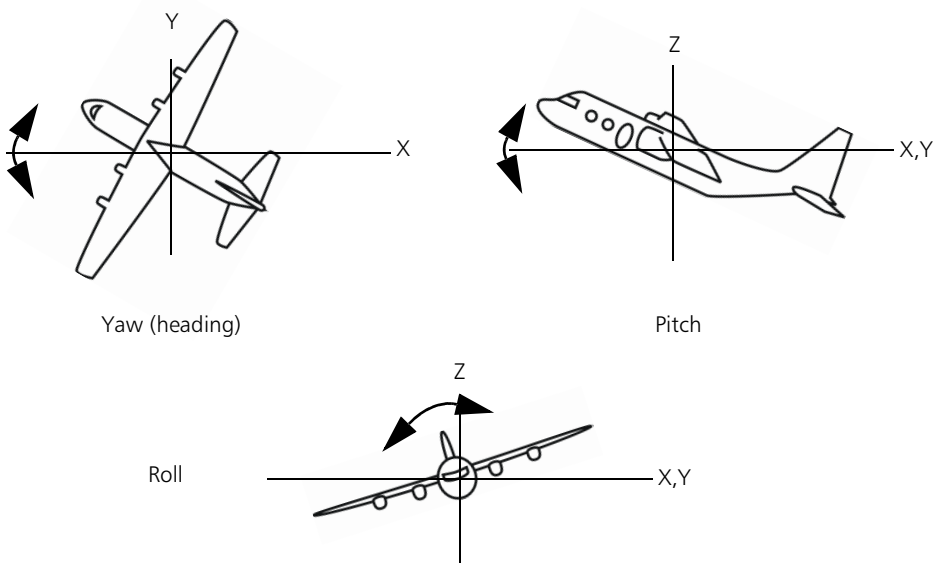


Figure 14-1. Orientation

The Observer Information Panel (Figure 14-4) displays the location and orientation of the observer in whichever coordinate system you select.

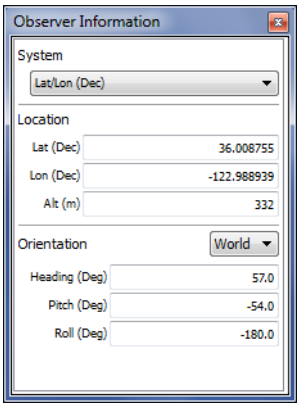


Figure 14-2. Observer Information Panel

14.1.1. Using the Compass to View the Observer's Heading

VR-Vantage can display a compass that always shows the heading of the observer. The compass is an observer mode setting. In Figure 14-3, the observer's heading is approximately Northwest.

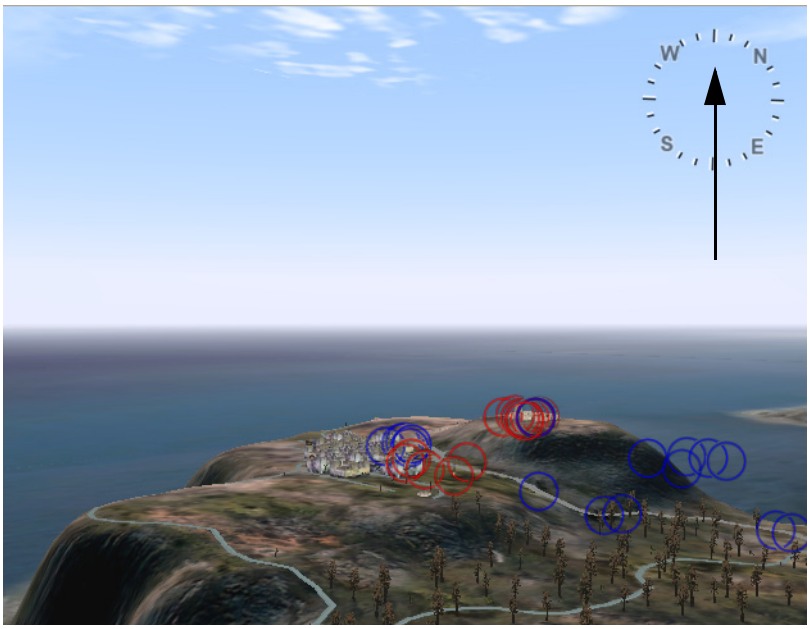


Figure 14-3. Compass

To enable or disable the compass:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. Select the observer mode for which you want to change the compass setting.
4. In the list of observer settings, select or clear Compass.



You can also enable or disable the compass by choosing **Observer** → **Compass** or clicking the Compass button () on the Observer Settings Toolbar.

14.1.2. Editing the Compass's Attributes

You can configure the compass by editing its schema (ChannelCompass) and model definition (smallCompass and largeCompass). (For details about editing schemas, please see "Creating and Editing Schemas," on page 28-7.)

By default, all channels have the largeCompass keyword. To change the style of compass used for a channel, change the keyword in the Keywords attribute for the channel. To completely remove the compass, delete the keyword. For details about setting channel attributes, please see "Changing a Channel's Attributes," on page 6-11.

You can change where the compass is displayed in the window by editing the location attribute. The permissible values are top, topRight, right, bottomRight, bottom, bottomLeft, left, and topLeft.

You can change the color of the compass by editing the darkTickColor and lightTick-Color attributes. The color is defined using the OpenGL scheme for specifying RGBA. The first three values are the RGB color values. The fourth value specifies opacity. Each value can be from 0.0 through 1.0.

14.2. Observer Movement Functions and Keyboard Mappings

When you move the observer, you are executing observer movement functions. An observer movement function is a specific way that the observer can move, such as Move Observer Forward or Move Level Observer Forward. (These functions both move the observer forward, but they use different observer coordinate systems. Observer movement coordinate systems are described in "3D Observer Movement Coordinate Systems," on page 14-7.)

The various movement functions are mapped to the keys on the keyboard and to mouse buttons and the mouse wheel. If you use the default key mappings for the default observer modes, then most of the time, the observer will behave exactly as you would expect it to. However for some types of movement, such as forward and back, the observer can move differently depending on the projection, the observer coordinate system, or the attach mode. Therefore, VR-Vantage provides several key mappings that let you choose which type of observer movement to use. You can change these key mappings and create your own key mappings. (For details about editing key maps, please see Chapter 41, *Creating and Editing Key Mappings*.) This section describes how observer movement can vary based on the observer coordinate system and the attach mode.

Table 14-1 lists the observer modes and key map settings provided with VR-Vantage applications.

Table 14-1: Observer modes

Application	Observer Mode	Projection	Key Map
VR-Vantage IG	Out-the-Window CameraFX modes	3D	Observer Frame
VR-Vantage Stealth	Stealth CameraFX modes	3D	Observer Frame
	XR	3D	Observer Frame
	Plan View	2D	2D Level Observer Frame
VR-Vantage PVD	Plan View	2D	2D Level Observer Frame

14.2.1. 3D Observer Movement Coordinate Systems

In the 3D projection, the observer moves in the context of one of the following coordinate systems:

- Level Observer Coordinates: Movement is with respect to the terrain. The level observer coordinate system is defined by the current up vector (Z), and a plane normal to that vector into which the observer's X and Y axes are projected. (Essentially, this means that the observer's heading is used while its pitch and roll are considered to be 0.0.)



Movement is always with respect to a plane tangent to the earth's surface. However, in a projected terrain database, such as UTM, Lambert Conformal Conic, or flat earth, the plane is fixed, whereas in a geocentric terrain database the up vector (and hence the tangent plan) changes as the observer's position changes, so movement follows the curvature of the earth.

- Observer Coordinates: Movement is with respect to the observer's body coordinate system.
- Entity Level Body Frame Coordinates: Movement is with respect to an entity's body frame, but ignores pitch and roll.
- Entity Body Frame Coordinates: Movement is with respect to an entity's body frame, including pitch and roll.

The practical difference between observer coordinates and level observer coordinates is that in level observer coordinates, if you are looking down at the terrain, when you move forward and backward, you fly over the terrain, looking down. In observer coordinates, when you move forward and backward, you move down towards the terrain or away from it at whatever angle you are oriented towards it.

14.2.2. 2D Observer Coordinate System

When you use the 2D projection (VR-Vantage Stealth and PVD), the observer uses a variation of level observer coordinates. Movement is restricted to two dimensions, so there are no movement functions for changing the altitude, pitch, or roll. You can zoom in and out in the 2D projection, but this does not change the observer's altitude, it changes the field of view and resolution of the terrain image.

14.2.3. The Attached Context and Observer Movement (3D Only)

The key maps control navigation using a particular coordinate system (observer frame or level observer frame). They also support navigation in alternate coordinate systems. The alternate system varies depending on the attached context of the observer. It represents MÄK's opinion of which alternate coordinate system would be most useful given the attach mode that the observer is using.

The Move Attached Context *direction* (forward, back, up, down, left, right) functions move the observer in the context of its attach mode. Movement is modified by attach modes in the following ways:

- Follow mode: movement is in the entity's level body frame.
- Track mode: movement is in the entity's level body frame.
- Mimic mode: movement is in the entity's body frame.
- Tether mode: movement is in level observer frame.
- Unattached: movement is in level observer coordinates.

Figure 14-4 and Figure 14-5 illustrate the differences between moving the observer in an attached context and without an attached context.

Figure 14-4 illustrates movement in entity level body coordinates (Follow and Track modes). The Move Observer Left function (**`A`** in Observer Frame key map) moves the observer to the left in observer coordinates, that is left relative to the observer's heading. The Move Attached Context Left function (**`Shift`** + **`A`**) moves the observer left in the attached context. In entity level body frame, this means the observer moves left relative to the entity's heading.

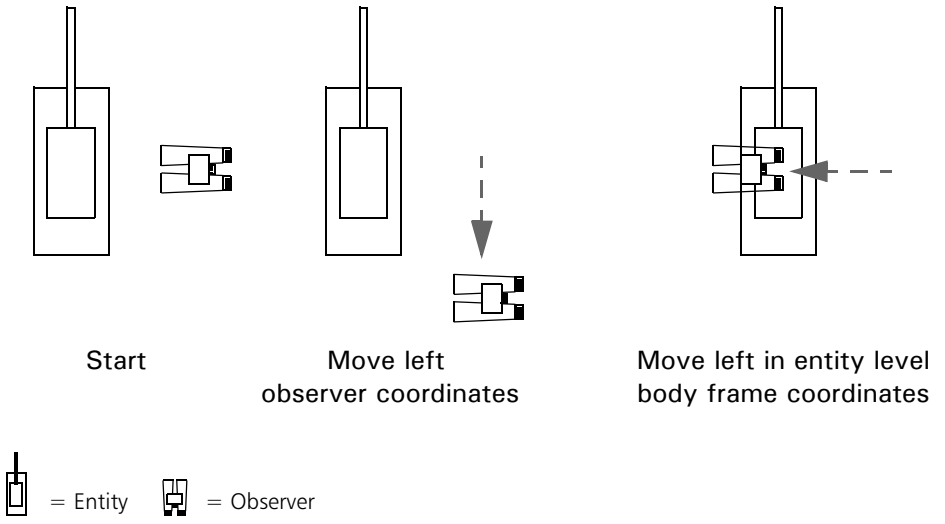


Figure 14-4. Observer movement in entity level body frame coordinates

Figure 14-5 illustrates movement in entity body frame (Mimic mode). The Move Observer Left function moves the observer to the left in observer coordinates, that is left relative to the observer's heading, but ignoring pitch and roll. The Move Attached Context Left function moves the observer left in the attached context. In entity body frame, this means the observer moves left relative to the entity's heading and its pitch and roll.

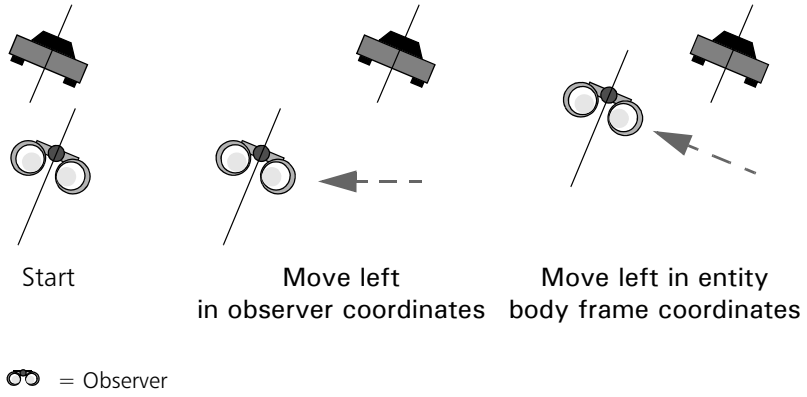


Figure 14-5. Movement in entity body frame coordinates

14.3. Moving the Observer from the Keyboard in the 3D Projection

VR-Vantage maps the observer movement functions to the keyboard using key maps that support the most typical ways that users want to move through the 3D world, either in absolute mode or attached to a simulation object.

! References to movement key combinations use the key mappings provided with VR-Vantage. If you change these key mappings, the instructions may no longer be valid.

As described in "Moving the Observer," on page 14-3, the observer typically moves with respect to the terrain in level observer coordinates or observer coordinates. The corresponding key maps are Level Observer Frame and Observer Frame.

Figure 14-6 illustrates the positional movement keys. Figure 14-7 illustrates the keypad layout for changing orientation and movement speed. For a complete list of movement functions and their keyboard and mouse mappings, please see *VR-Vantage Quick Reference Card* or the Key Mapping Editor.

! To use the keypad for navigation, NumLock must be on.



Figure 14-6. Primary movement keys, observer coordinates (3D)

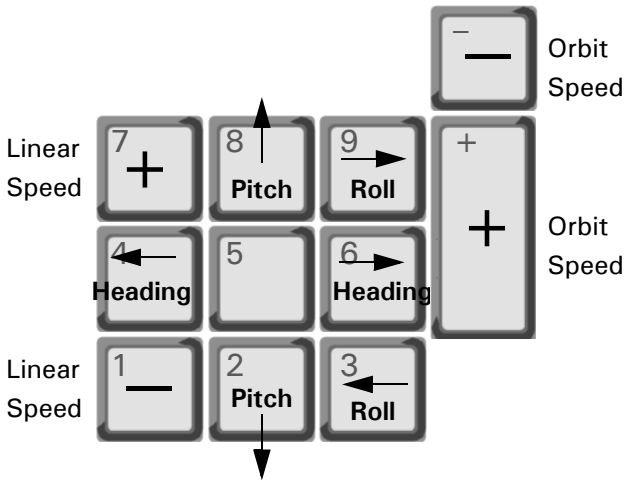


Figure 14-7. Keypad layout, heading, pitch, and roll (3D)

If your keyboard does not have a keypad, as on most laptops, the Laptop key map lets you use the arrow keys to control the left, right, up, and down movement mapped to 4, 6, 8, and 2 on keypads.

➤ To move the observer, press a key combination and hold it for as long as you want the observer to keep moving.

You can press more than one key at a time to combine movement functions. For example, pressing the move forward and move left keys at the same time moves the observer diagonally left and forward.

14.3.1. Navigation Options

This section lists the different ways that you can move the observer using the keyboard. For a complete list of movement functions and their keyboard and mouse mappings, please see *VR-Vantage Quick Reference Card*. You can:

- Move forward and backward (observer, level observer, entity, level entity, and attached context coordinates).
- Move up and down (observer, level observer, entity, level entity, and attached context coordinates).
- Move left and right (observer, level observer, entity, level entity, and attached context coordinates).
- Rotate (heading) left and right (observer and level observer coordinates).
- Rotate (pitch) up and down (observer and level observer coordinates).
- Rotate (roll) left and right (observer and level observer coordinates).
- Orbit left and right.
- Orbit up and down.
- Look (move camera) left and right.
- Look (move camera) up and down.
- Tilt (move camera) left and right.
- Reset the observer to the default position and orientation for the attached mode.
- Reset the camera to the default position and orientation.
- Zoom the view.

For details about orbiting, please see "Orbiting," on page 14-13. For details about moving the camera, please see "Moving the Camera," on page 14-13.



When you view a geocentric terrain and move the observer more than 6 million meters away from the earth's surface, the view is forced to focus toward the center of the earth. The practical effect of this mode is that the left and right movement keys orbit the eyepoint around the earth, rather than moving the entire earth to the left or right.

14.3.2. Orbiting

You can orbit the observer (revolve left, right, up, and down) around an object or the point on the terrain that is at the center of the window. (If the center of the screen is in the sky, orbit does not work.) When you orbit, the observer's heading continuously changes so that it always faces the point or object around which it orbits. You can change the camera to look at something other than the orbit point while you are orbiting.

To orbit around an object:

1. Attach the observer to the object.
2. Press the right or left arrow keys.

To orbit around a point:

1. If you are attached to a simulation object, detach (press **z**).
2. Press the right or left arrow keys.

14.3.3. Moving the Camera

By default, the observer always looks in the same direction as its heading. However, just as the turret on a tank can swivel and fire in directions other than its body's heading, the observer can look in a direction other than its heading. The ability to look around is enabled in the camera. You can move the observer's camera up, down, left, right, tilt left, and tilt right. (The default key mappings are **Ctrl** + *Keypad number*, where *number* is 2, 3, 4, 6, 8, or 9.)

! To use the keypad for navigation, **NumLock** must be on.

---

i You can tell that the camera is moving, but the heading is not, by observing the compass. If you change the heading, the view of the terrain changes and the compass moves. If you move the camera, but keep the heading static, the view of the terrain changes, but the compass does not move.

➤ To move the camera, press the keys mapped to the camera movement functions.

14.4. Moving the Observer Using the Mouse (3D Projection)

You can change the observer's position and orientation with the mouse. (To see the full list of mouse mappings, view the Mouse Mappings page on the Application Settings dialog box.)

Using the mouse, you can:

- Drag the terrain.
- Drag the view.
- Orbit the terrain.
- Change orientation.
- Teleport (jump).

14.4.1. Dragging the Terrain

Dragging the terrain combines the move forward, backward, left, and right functions.

To drag the terrain:

1. Click a point on the terrain and hold down the left mouse button.
2. Drag the mouse left, right, forward, and backward.



Dragging the terrain is most effective when you are moving large distances, such as several kilometers. To move small distances, use the keyboard.

Disabling Terrain Dragging

There may be times when you want to disable terrain dragging.

➤ To disable terrain dragging, on the Observer Control Panel, clear the Allow Terrain Dragging check box (Figure 14-8), or click the Terrain Dragging button ()on the Observer Settings toolbar.

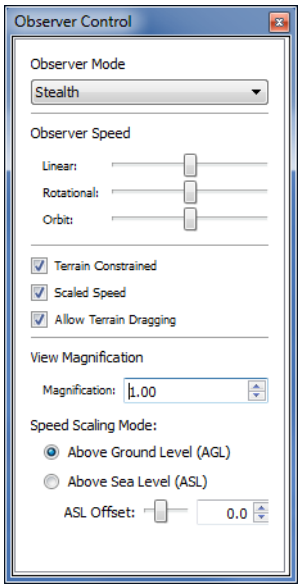


Figure 14-8. Observer Control Panel

14.4.2. Changing the Observer's Orientation with the Mouse

➤ To change the observer's orientation, hold down the right mouse button and drag the mouse. The observer rotates in the direction you drag the mouse.

14.4.3. Dragging the View

Dragging the view combines the observer up, down, left, and right movement functions. Unlike dragging the terrain, which requires you to click a point on the terrain, you can drag the view from any observer location.

➤ To drag the view, hold down the middle mouse button (or wheel) and drag the mouse.

14.4.4. Orbiting the Terrain with the Mouse

➤ To orbit the terrain with the mouse, press **`Ctrl`** and drag the mouse.

14.4.5. Teleporting the Observer

You can teleport the observer to a simulation object, a prop, or a place on the terrain. Teleporting moves the observer 90% of the way from its current position to the location or object clicked on.

To teleport the observer:

- **Shift**+click on the terrain or prop that you want to jump to.
- **Ctrl**+**Shift**+click on the simulation object that you want to jump to.

14.5. Moving the Observer in the 2D Projection

In the 2D projection, you move the observer using the mouse and keyboard just as you do in the 3D projection. Many of the key and button mappings for the 2D projection are the same as those in the 3D projection. However, the 2D mappings do not support movement that is not meaningful in two dimensions, such as up and down (altitude), pitch, and roll.



When Orient North is enabled, you cannot change the heading of the observer. For information about Orient North, please see "Forcing Orientation North (Plan View Mode Only)," on page 14-21.

14.5.1. Moving the Observer from the Keyboard in the 2D Projection

Figure 14-9 illustrates the positional movement keys for the 2D projection. Figure 14-10 illustrates the keypad layout for changing heading and movement speed. For a complete list of movement functions and their keyboard and mouse mappings, please see *VR-Vantage Quick Reference Card*.

! To use the keypad for navigation, NumLock must be on.



Figure 14-9. Primary movement keys, observer coordinates (2D)

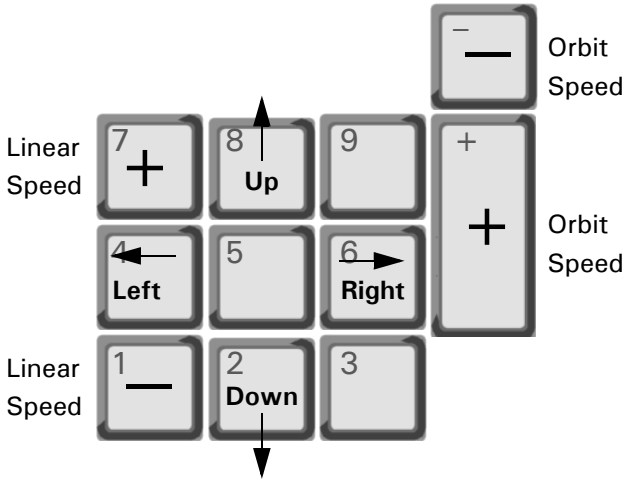


Figure 14-10. Keypad layout, heading, pitch, and roll (2D)

14.5.2. Moving the Observer Using the Mouse in the 2D Projection

You can change the observer's position and heading with the mouse. You can change the observer's position by dragging the terrain, as described in "Dragging the Terrain," on page 14-14. You can change heading by orbiting, as described in the next section. (To see the full list of mouse mappings, view the Mouse Mappings page on the Application Settings dialog box.)

Orbiting the Terrain with the Mouse

When Orient North is enabled, you cannot orbit. For information about Orient North, please see "Forcing Orientation North (Plan View Mode Only)," on page 14-21.

➤ To orbit the terrain with the mouse, press the right mouse button and drag the mouse.

14.6. Zooming the Observer

You can zoom the observer in the 3D and 2D projections. Although the apparent effect is similar for top-down views, they are conceptually and behaviorally different.

14.6.1. Zooming the Observer in the 3D Projection

If you want to see something at a higher level of detail without moving the observer, you can zoom the observer view. Zooming the observer narrows the field of view and magnifies objects in the view. The magnification level is saved in saved views. 3D zoom has the following characteristics:

- When you zoom the observer view, its movement and mouse look speeds are decreased as the magnification increases, to allow for increased control.
- When you switch between 3D and 2D (Stealth only), VR-Vantage calculates a 2D zoom level to match the 3D view. If you then switch back to 3D, it remembers the observer location and zoom level.
- If you zoom in from a very high altitude there may be scene corruption due to insufficient precision in the z-buffer. This can be limited by moving the observer closer to the subject before zooming in. This issue is typically only encountered above 10,000 meters.
- When you zoom, VR-Vantage respects the environmental conditions at the observer's location. For example, if the observer is above the cloud layer, zooming does not let you see below the clouds. Or, if it is raining at the observer's location, the visibility will not improve as you zoom in on a distant object.
- After zooming in, when you zoom out, you can only zoom out to the 0 magnification level. That is, you can only zoom out back to the observer's location. If you want to see more of the terrain, you must move the observer to a greater distance from the terrain.
- Some terrains are not designed to be viewed at higher magnification. Performance may decrease if magnification increases the level of detail of large areas of the terrain. For example, suppose you are looking down a line of trees that is in the center of the view. At the normal magnification level there are a certain number of trees at each quality level, say 10 high, 20 medium, and 100 low (for a total of 130 trees). Suppose also that performance will be acceptable only when visualizing 15 or fewer high quality trees. If you magnify the scene 2x, you may now see 20 high, 40 medium, and 70 low quality trees. You see the same number of trees, but the performance will decrease because you are visualizing more high quality models.

➤ To zoom in, press the **=** key, press **`Ctrl`** and scroll the mouse wheel forward, or on the Observer Control Panel specify a value in the Magnification box.

➤ To zoom out, press the **–** (dash) key, press **`Ctrl`** and scroll the mouse wheel backward, or on the Observer Control Panel specify a value in the Magnification box.

---

i Each press of the **=** or **–** key, or increment of the mouse wheel, increases or decreases magnification by a factor of 1.25.

➤ To reset magnification to 1.0, press zero (**`0`**) or press the middle mouse button.

14.6.2. Zooming the Observer in the 2D Projection

In the 2D projection you can zoom the observer view closer to and away from the terrain. However, unlike in 3D, in which you cannot zoom out past the location of the observer, there is essentially no limit on zooming in and out because in 2D, the observer does not actually have altitude.

➤ To zoom in, press **e**, scroll the mouse wheel forward, or to step the zoom, press the **=** key.

➤ To zoom out, press **q**, scroll the mouse wheel backward, or to step the zoom, press the **–** (dash) key.

➤ To reset the observer to the default zoom level, press the **Space bar**.

14.6.3. Setting the Scale Factor for Paged LODs

When you magnify the view, all distances used for determining LODs (including paged LODs) are scaled by the view magnification. In some cases, this is more aggressive than desired for the paged LODs. To remedy this problem, you can change the amount by which the paged LOD distance is scaled relative to the view magnification. For example, if view magnification is 8.0 and the Paged LOD Magnification Scale Factor is 2.0, then the distance used for paging would be scaled by 4.0 (8.0/2.0) rather than by the full factor of 8.0.

To set the scale factor for paged LODs:

1. Choose **Settings** → **Experimental Features**. The Experimental Features dialog box opens.
2. Adjust the Paged LOD Magnification Scale Factor slider.

14.7. Simulating Camera Jitter

You can simulate the jitter that cameras attached to aircraft or unsteady human hands may experience.

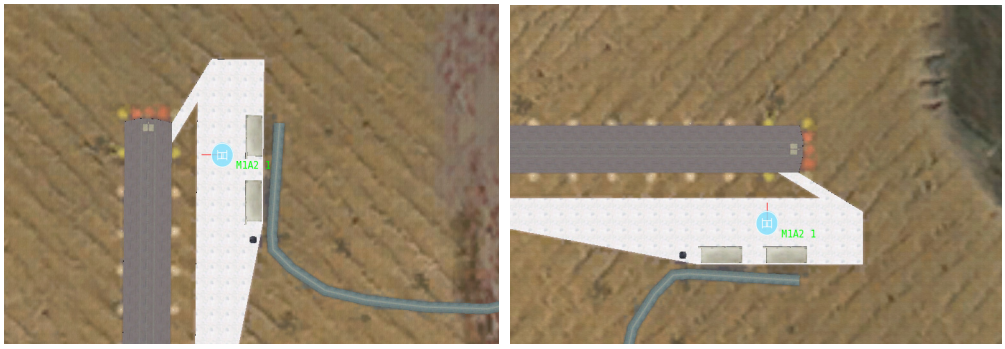
To simulate camera jitter:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. In the Camera Shake section, select Allow Camera Shake.
4. Optionally, adjust the Intensity slider or change the value in the box.

14.8. Forcing Orientation North (Plan View Mode Only)

When you are in Plan View observer mode (VR-Vantage Stealth and VR-Vantage PVD only), by default the observer's heading is forced to stay North (up), regardless of the heading of the simulation object to which it is attached. You can disable this setting, in which case if you attach to a simulation object, the view of the terrain rotates to match the heading of the attached simulation object.

Figure 14-11 illustrates the view when the observer is attached to an entity with orientation forced to North or matched to that of the entity.



Orient North Orient to entity heading

Figure 14-11. Forcing orientation North

To enable or disable a northward orientation:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 20-5).
3. In the Observer Mode list, select Plan View.
4. In the list of observer settings, select or clear Orient North.



You can also enable or disable northward orientation by choosing **Observer** → **Orient North** or clicking the Orient North button () on the Observer Settings Toolbar.

14.9. Enabling and Disabling View Constraints (3D Only)

View constraints control how the observer behaves when it approaches solid objects in the view, such as the ground, buildings, and vegetation. When constraints are enabled, the observer has a 1 meter bounding sphere that prevents it from moving through terrain or props.



If view constraints are enabled, you may not be able to move the observer into buildings to view entities. Changing the near clipping plane or transparency will let you see through walls, but in constrained mode, you will still not be able to move the observer through the walls.

To enable or disable view constraints, use one of the following methods:

- Press **/** (forward slash).
- Choose **Observer** → **Constrain to Terrain**.
- On the Observer Control Panel (Figure 14-8), select or clear the Terrain Constrained check box.
- Click the Constrain to Terrain button () on the Observer Settings Toolbar.

14.10. Controlling Navigation Speed

When you navigate through the terrain, there are times you want to move quickly, covering large amounts of terrain, and times you want to move slowly, such as when you are moving down a street or within a building. VR-Vantage has the following options for controlling navigation speed:

- Set the navigation speed manually. The observer always moves at the specified speed.
- Use speed scaling to automatically move at different speeds under different circumstances. You can change the rate at which speed is scaled.

In either case, the controls for changing speed are the same. Their effect varies depending on whether or not speed scaling is enabled.

14.10.1. Enabling or Disabling Speed Scaling

When speed scaling is enabled, VR-Vantage makes the following assumptions:

- If the observer is unattached, the higher above the terrain it is, the faster you want to move.
- The closer you are to an attached object, the more slowly you want to move.

To enable or disable speed scaling, use any of the following methods:

- On the Observer Control Panel (Figure 14-8), select or clear the Scaled Speed check box.
- Choose **Observer** → **Speed Scaling**.
- Press the multiply key (*) (not the asterisk key).
- Click the Speed Scaling button () on the Observer Settings Toolbar.

Setting the Speed Scaling Mode

When speed scaling is enabled, VR-Vantage scales observer speed based on the its height above the terrain. Even if the observer is higher than all terrain points, speed can still be affected if there are changes to the terrain, such as mountains. This can be annoying if it happens unexpectedly. Therefore, you can choose to base speed scaling on height above ground level, or height above mean sea level. In that latter case, changes to the terrain would not affect the speed at which the observer moves. If you set speed scaling to use height above mean sea level, you can specify an offset.

To set the speed scaling mode, use one of the following methods:

- On the Observer Control Panel (Figure 14-8), set the Speed Scaling Mode to Above Ground Level (AGL) or Above Mean Sea Level (MSL)
- On the Display Settings dialog box, Observer Settings page, set the Speed Scaling Mode to Above Ground Level (AGL) or Above Mean Sea Level (MSL)

14.10.2. Changing the Observer's Movement Speed

You can change the observer's linear, rotational, and orbital speed. If speed scaling is enabled, these controls change the speed gain. If speed scaling is disabled, the controls change the absolute speed.

To change the observer's speed, use any of the following methods:

- Adjust one of the Observer Speed sliders on the Observer Control Panel (Figure 14-8) or on the Observer Settings page on the Display Settings dialog box. The default (center of the slider) is 1. The range is 0.1 to 10.
- Press one of the following keys to change linear speed:
  - **`Keypad 7`** (faster) or **`1`** (slower).
  - **`Ctrl`** + mouse wheel forward or back.
  - Movement key + mouse wheel forward or back.
- Press **`Keypad +`** (faster) or **`-`** (slower) to change orbital speed.



When you change the observer's speed using the keyboard or mouse, if the Observer Control Panel or the Observer Settings page is open, you can see the scale slider moving to the new setting.

14.11. Saving and Recalling Views

At any given moment, the state of the observer is called its view. You can capture views so that you can quickly return to them and you can save them for later use.

If the observer is not attached to a simulation object, its view is its position and orientation in the simulated environment. If the observer is attached to a simulation object, a view saves the following information:

- Attach mode.
- Positional offset.
- Marking text.



When you save a view in the 2D projection, the X and Y values are saved. The zoom level is not saved.

Saved views are managed in the Observer Views Panel (Figure 14-12).

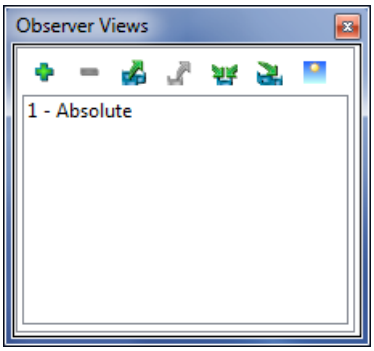


Figure 14-12. Observer Views Panel

Its buttons have the following meanings:

- Save the current view.
- Delete the selected view.
- Save all views to a file.
- Save the selected view to a file.
- Load a saved views file and append it to the list.
- Load a saved views file and replace the current list.
- Clear the list.



Saved views are keyed to the marking text of the object to which the observer is attached.

To save the current view:

1. Choose **View** → **Observer Views Panel**. The Observer Views Panel opens (Figure 14-12).
2. Click the Add button (+). The current view is added to the list.

> Views are remembered only while VR-Vantage remains running. To save a view for future use, you must save it to a file. Please see "Saving Views to a File," on page 14-27.

14.11.1. Recalling a View

➤ To recall a view, select it in the Observer Views Panel. The view changes immediately.

Animating Transitions Between Observer Views

Normally, when you select an observer view, the observer jumps immediately to the new view. However, VR-Vantage can smoothly transition from the current observer view to a saved view.

➤ To transition between observer views, hold down the **`Ctrl`** key and click the view in the Observer Views Panel that you want the observer to move to.

14.11.2. Deleting Views

To delete a view:

1. In the Observer Views Panel, select the view you want to delete.
2. Click the Delete button (−).

Clearing the View List

➤ To remove all views from the list, in the Observer Views Panel, click the Clear List button ().

14.11.3. Saving Views to a File

You can save views to a file and load them at a later time. You can save an individual view or all of the views in the list.

The default location for saved views is *./appData/settings/application*, where *application* is the name of the VR-Vantage application.

To save the selected view to a file:

1. In the Observer Views Panel, click the Save Individual View button (). The Save Selected Observer dialog box opens.
2. Select the file to which you want to save the view, or type the name of a new file.
3. Click OK.

To save all views to a file:

1. In the Observer Views Panel, click the Save All Views button (). The Save Observer Views dialog box opens.
2. Select the file to which you want to save the views, or type the name of a new file.
3. Click OK.

14.11.4. Loading Views

You can load saved views and append them to the list in the Observer Views Panel, or you can replace the list in the panel with the saved views.

To load views and append them to the list of views:

1. In the Observer Views Panel (Figure 14-12), click the Load Views and Merge button (). The Open Observer Views dialog box opens.
2. Select the saved views file that you want to load.
3. Click OK.

To load views and replace the list of views:

1. In the Observer Views Panel, click the Load Views and Replace button (). The Open Observer Views dialog box opens.
2. Select the saved views file that you want to load.
3. Click OK.

14.12. Controlling the Observer from Other Applications

VR-Vantage can respond to view control messages sent by applications such as the MÄK Logger and from VR-Forces plans. You can also write VR-Link-based applications to send view control messages to VR-Vantage using the classes in the VR-Vantage Control Toolkit. You can use view control messages to:

- Specify the attach mode and simulation object.
- Set the observer's position and orientation.

Acceptance of view control messages is a global setting. You can set it per connection.

The view control PDUs are experimental, and are not an official part of DIS. They are of PDU kind 202.

Some legacy applications were created with the Stealth Control Toolkit. The Stealth Control Toolkit is no longer distributed with VR-Vantage. It has been replaced with the VR-Vantage Control Toolkit. VR-Vantage responds to move, absolute, tether, mimic, track, tether track, mimic track, follow, orbit, and compass Stealth Control PDUs. It does not support the other PDUs in the Stealth Control Toolkit.

14.12.1. Enabling the Processing of View Control Messages

➤ To enable or disable the processing of view control messages, choose **Settings** → **View Controls**, or click the View Control button ( ) on the Display Settings Toolbar.

You can specify view control settings when you connect to an exercise that override the setting in the GUI.

14.12.2. Overriding the Global View Control Settings

Processing of view control messages is a global setting. It is either on or off for all observers. However, you can override the setting on a per-connection basis (DIS and HLA only). You might want to do this if you are running VR-Vantage with several connections and want to enable or disable view controls coming from some connections, but not others.

If you override the global view control setting, you will not be able to change the view control setting in the GUI.

To override the global view control setting:

1. On the Simulation Connection page for the protocol for which you want to override the global view control setting, click Advanced.
2. Select Override Global View Control Settings.
3. Select or clear the Listen for View Control Settings check box depending on whether you want to enable view controls or disable them.
4. Set any other connection parameters desired.
5. Click Connect.



15. Attaching the Observer to Objects

This chapter describes attachment modes and how to attach the observer to simulation objects and props.

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- Attaching the Observer in Mimic Track or Tether Track Mode 15-5
- Attaching the Observer in Mimic Location Track or Tether Location Track Mode 15-5
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- Detaching from a Simulation Object 15-6
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15.1. Attaching the Observer to a Simulation Object or Prop

You can attach the observer to a simulation object and follow it as it moves through the simulation. You can also attach the observer to props.



This procedure applies to Follow, Tether, Track, Mimic, and Space Follow modes. To attach in Tether Track or Mimic Track mode, please see "Attaching the Observer in Mimic Track or Tether Track Mode," on page 15-5. To attach in Tether Location Track or Mimic Location Track mode, please see "Attaching the Observer in Mimic Location Track or Tether Location Track Mode," on page 15-5.

To attach the observer to a simulation object or prop, do one of the following:

- Right-click an object in the Objects List Panel (Figure 15-1) or on the terrain and select **Attach** *mode*, where *mode* is one of the supported attach modes. (For details about attach modes, please see "Attach Modes in the 3D Projection," on page 15-7 and "Attach Modes in the 2D Projection," on page 15-15.)

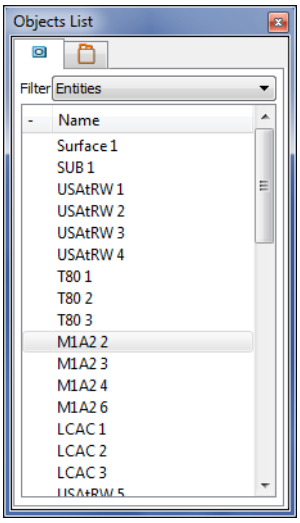


Figure 15-1. Objects List Panel

- Select a simulation object or prop. (For details about selecting simulation objects and props, please see "Selecting Simulation Objects," on page 18-2 and "Selecting Props," on page 24-32.) On the Attachments Panel (Figure 15-2), click the Attach button ( ) to attach with the current attachment mode.

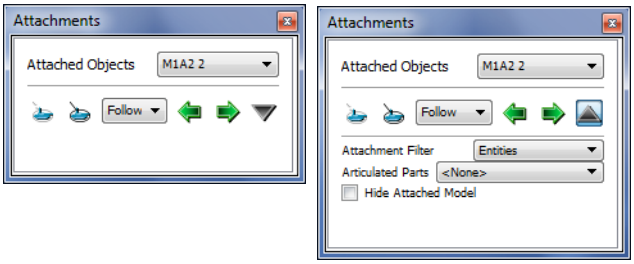


Figure 15-2. Attachments Panel

- On the Attachments Panel, click the next or previous arrows to attach to the next (or previous) object in the object list.
- Press greater than (**>**) to attach to the next simulation object or prop in the object list without regard to the attachment filter. Press less than (**<**) to attach to the previous object. (For details about the attachment filter, please see "Filtering the Object Attachment List," on page 15-6.)
- Press period (**.**) to attach to the next simulation object or prop allowed by the attachment filter. Press comma (**,**) to attach to the previous object.

- When you select the next or previous object, VR-Vantage chooses next and previous based on the order in which the objects were discovered. This may or may not represent the order in which they are listed in the Objects List Panel.
- When you move the attachment from one object to the next, VR-Vantage preserves whatever changes you have made to the observer's view relative to the attached object. So if, for example, you moved the observer so that it is not looking at the attached object, when you attach to the next simulation object, the observer will not be looking at this object. It will be in the same relative position to the object that you previously established. To quickly return to the default offset for the attachment mode, press **Space bar**.

15.1.1. Attaching to an Articulated Part

You can attach the observer to an articulated part on an entity, such as a turret. When you attach to an articulated part, the observer moves with the articulated part instead of the main body of the entity.

To attach to an articulated part:

1. Attach the observer to an entity, as described in "Attaching the Observer to a Simulation Object or Prop," on page 15-3.
2. On the Attachments Panel (Figure 15-2), click the down arrow. The Attachments Panel expands.
3. In the Articulated Parts list, select the part to which you want to attach the observer.

15.1.2. Attaching the Observer in Mimic Track or Tether Track Mode

To attach the observer in Tether Track and Mimic Track modes, you must specify a primary simulation object and a secondary simulation object (the tracked simulation object).

To attach the observer in Mimic Track mode or Tether Track mode:

1. Right-click the primary simulation object in the Objects List Panel or in the window. A popup menu is displayed.
2. Choose **Attach Mimic Track** or **Attach Tether Track**. The cursor changes to show an arrow and a Plus sign.
3. Click the secondary simulation object in the Objects List or in the window.

15.1.3. Attaching the Observer in Mimic Location Track or Tether Location Track Mode

To attach the observer in Tether Location Track and Mimic Location Track modes, you must specify a primary simulation object and a location.

To attach the observer in Mimic Location Track mode or Tether Location Track mode:

1. Right-click the primary simulation object in the Objects List Panel or in the window. A popup menu is displayed.
2. Choose **Attach Mimic Location Track** or **Attach Tether Location Track**. The cursor changes to show an arrow and a Plus sign.
3. Click a location in the display window.

15.1.4. Filtering the Object Attachment List

Although you can attach the observer to simulation objects and props, it is likely that at any given time you will only want to attach to one type of object (usually simulation objects). To reduce the number of objects that you have to iterate through when using Attachments Panel arrows to pick the next or previous object, you can filter the attachment list.

> The filter for buoys and beacons applies to S-57 feature data, not buoys that are simulation objects, such as sonobuoys.

To filter the attachment list:

1. On the Attachments Panel (Figure 15-2), click the down arrow. The Attachments Panel expands.
2. In the Attachment Filter list, select the type of scene element that you want to attach to.

15.1.5. Detaching from a Simulation Object

➤ To detach the observer from the simulation object to which it is attached, on the Attachments Panel (Figure 15-2), click the Detach button (), or press **z**.

15.1.6. Hiding the Attached Model (3D Projection Only)

You can hide the model for the simulation object to which the observer is attached.

To hide the attached model:

1. On the Attachments Panel (Figure 15-2), click the down arrow. The Attachments Panel expands.
2. Select the Hide Attached Model check box.

15.1.7. Attaching to Props

Since props do not move, attaching the observer to a prop does not result in any observer movement. The principal benefit of attaching to a prop is to let you quickly refocus the observer on a particular location in the scene. If you attach in Track mode, using the keyboard movement keys allows you to orbit around the prop.

15.1.8. Improving Performance when Attaching to Ground Objects

When the observer is attached to air entities, Z-fighting can affect visual quality. To prevent this problem, VR-Vantage needs to calculate the entity's height above the terrain. However, the calculation can affect performance. Unfortunately, when this calculation is enabled (the default), it must be applied to all entity types. If you know that you will want to attach the observer to ground simulation objects, but not air simulation objects (or if you do not care about Z-fighting), you can disable the height above terrain calculation, which may improve performance when the observer is attached to simulation objects. To disable the height above terrain calculation, start VR-Vantage with the
`-S | --suppressHatIntersectOnAttach` command line option.

15.2. Attach Modes in the 3D Projection

Attach modes are combinations of position and orientation models and constraints that produce a useful behavior for the observer. Except for Absolute mode, attach modes describe how movement of the simulation object to which the observer is attached affects the position and orientation of the observer.

VR-Vantage supports the following attach modes:

- Absolute: The observer is not attached to a simulation object; it moves in space independently of all simulation objects.
- Follow: The observer position and heading changes with the simulation object's position and heading.
- Mimic: The observer position and orientation changes with the simulation object's position and orientation.
- Mimic Track: The observer's position changes with the simulation object's position while its orientation is focused on a second entity.
- Mimic Location Track: The observer's position changes with the simulation object's position while its orientation is focused on a location.
- Space Follow: The observer is a fixed distance from the simulation object and the simulation object model is scaled to be observable from a great distance.
- Tether: The observer's position changes with the simulation object's position.
- Tether Track: The observer's position changes with the simulation object's position while its heading is focused on a second simulation object.
- Tether Location Track: The observer's position changes with the simulation object's position while its heading is focused on a location.
- Track: The observer's heading changes to track the simulation object's position and heading.

The attach modes are described in detail in the following sections. For details about how to attach the observer to a simulation object, please see "Attaching the Observer to a Simulation Object or Prop," on page 15-3.

15.2.1. Absolute Mode

In Absolute, or free-fly mode, the observer is not attached to a simulation object. Movement of simulation objects does not affect the observer in any way.

15.2.2. Follow Mode

In Follow mode, the observer maintains its relationship to the simulation object as follows:

- When the simulation object's position changes, the observer's position changes to maintain its offset.
- When the simulation object's heading changes, the observer's heading and position change to maintain the offset.
- When the simulation object's pitch or roll change, the observer pitch and roll do not change.

Figure 15-3 illustrates the characteristics of Follow mode.

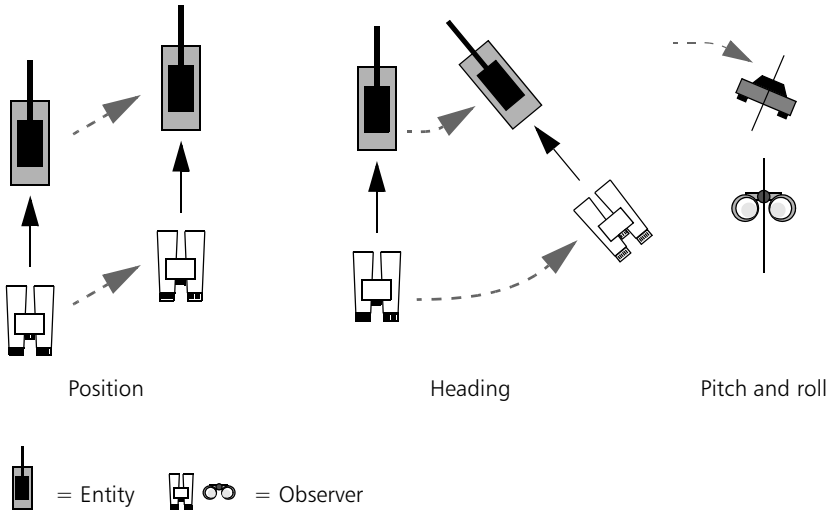


Figure 15-3. Follow mode

15.2.3. Mimic Mode

In Mimic mode, the observer behaves as though it is rigidly connected to the entity. Use Mimic mode to create the effect of riding in a vehicle cockpit, or of following a vehicle from an external location while connected to it by a solid, invisible rod. The observer maintains its relationship to the simulation object is as follows:

- When the simulation object's position changes, the observer's position changes to maintain its offset.
- When the simulation object's heading changes, the observer's heading and position change to maintain the offset.
- When the simulation object's pitch or roll change, the observer's pitch and roll change and the observer's position changes to maintain its offset.



When cockpit displays are enabled, you cannot change the position or orientation of the observer relative to the entity.

Figure 15-4 illustrates the characteristics of Mimic mode.

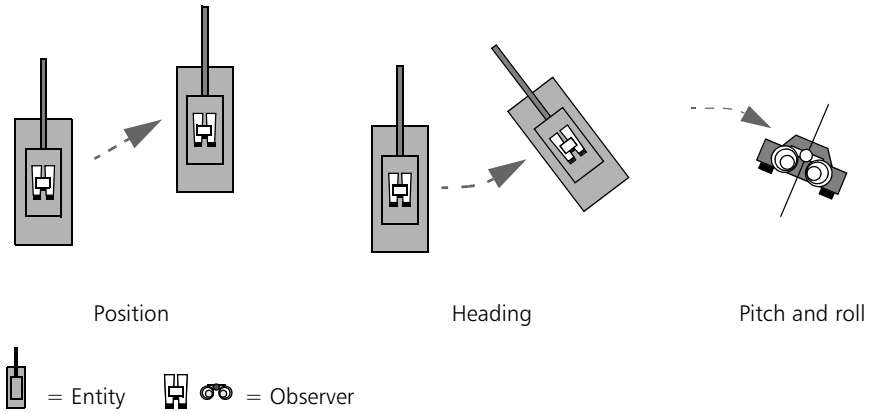


Figure 15-4. Mimic mode

15.2.4. Mimic Track Mode

Mimic Track mode combines Mimic mode and Track mode. The observer's position changes with that of the entity to which it is attached, as in Mimic mode, while its orientation changes to remain focused on a secondary, tracked entity.

Orientation controls are disabled.

Figure 15-5 illustrates the characteristics of Mimic Track mode.

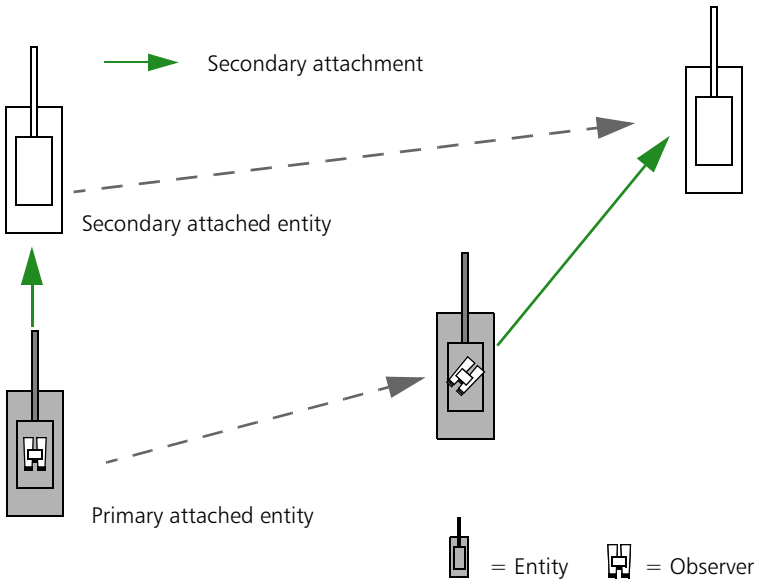


Figure 15-5. Mimic Track mode

15.2.5. Mimic Location Track Mode

Mimic Location Track mode works like Mimic Track mode except it tracks a location on the ground rather than an entity.

15.2.6. Space Follow Mode

Space Follow mode attaches the observer above an entity, looking down at it. Although it can be used with any entity, its primary purpose is for attaching to space objects such as satellites. You can also usefully use it with fixed-wing and rotary-wing entities.

The observer is attached at a fixed distance, determined by the near clipping plane for the object. For a satellite, this distance is approximately 500,000 meters. Since it is not possible to see regular models at that distance, the attached object is scaled to be visible. (You cannot change the scaling of the attached object.) Other objects are not scaled (except to the extent that model scaling might be enabled in VR-Vantage Stealth).

The observer maintains its relationship to the simulation object as follows:

- When the simulation object's position changes, the observer's position changes to maintain its offset.
- When the simulation object's heading changes, the observer's heading changes.
- When the simulation object's pitch or roll changes, the observer's pitch or roll does not change.

You cannot move the observer towards or away from the simulation object. You can rotate the observer around the entity, but you cannot go below the horizontal plane of the entity.

Figure 15-6 illustrates the characteristics of Space Follow mode.

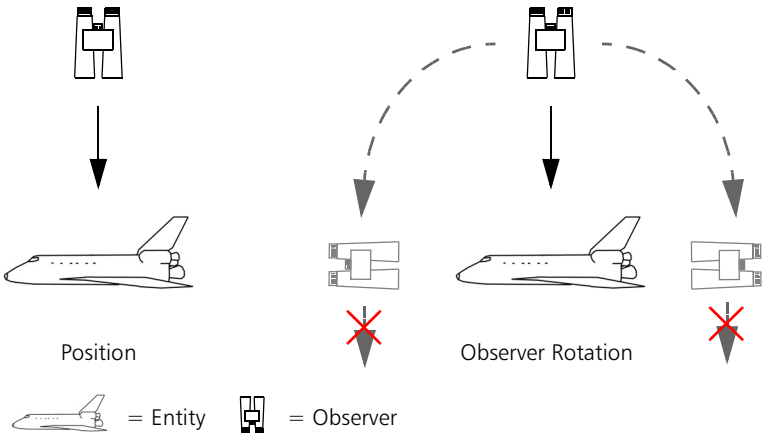


Figure 15-6. Space Follow mode

15.2.7. Tether Mode

In Tether mode, the observer's maintains a constant offset from the simulation object, but it is not affected by the simulation object's heading, pitch, or roll, as follows:

- When the simulation object's position changes, the observer's position changes to maintain its offset.
- When the simulation object's heading changes, the observer's heading does not change.
- When the simulation object's pitch or roll change, the observer's pitch and roll do not change.

Figure 15-7 illustrates the characteristics of Tether mode.

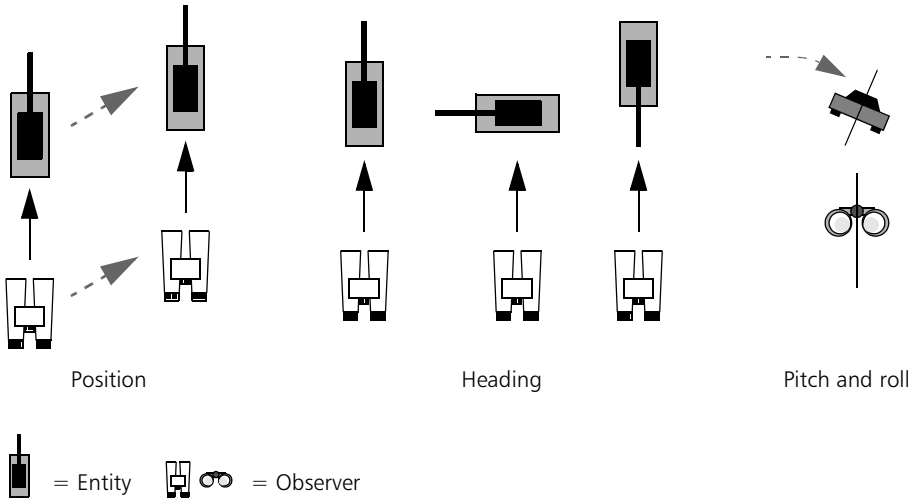


Figure 15-7. Tether mode

15.2.8. Tether Track Mode

Tether Track mode combines Tether mode and Track mode. The observer's position changes with that of the entity to which it is attached, as in Tether mode, while its orientation changes to remain focused on a secondary, tracked entity.

Orientation controls are disabled.

Figure 15-8 illustrates the characteristics of Tether Track mode.

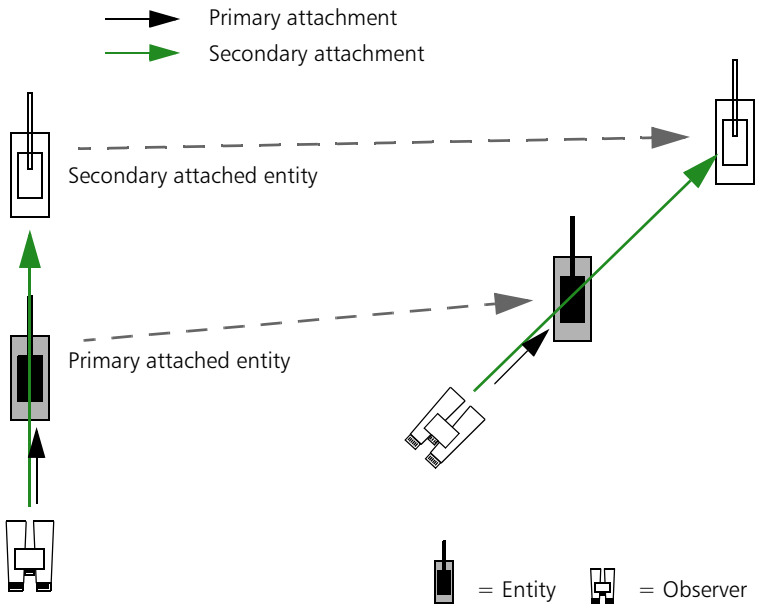


Figure 15-8. Tether Track mode

15.2.9. Tether Location Track Mode

Tether Location Track mode works like Tether Track mode, except that it tracks a location on the ground instead of an entity.

15.2.10. Track Mode

In Track mode, the observer's heading changes to track the simulation object's movement, keeping it centered in the field of view. The observer's position does not change. The observer maintains its relationship to the simulation object as follows:

- When the simulation object's position changes, the observer's heading changes to keep the entity centered in the observer's view; the observer's position does not change.
- When the simulation object's heading changes, the observer's heading does not change.
- When the simulation object's pitch or roll change, the observer's pitch and roll do not change.

Figure 15-9 illustrates the characteristics of Track mode.

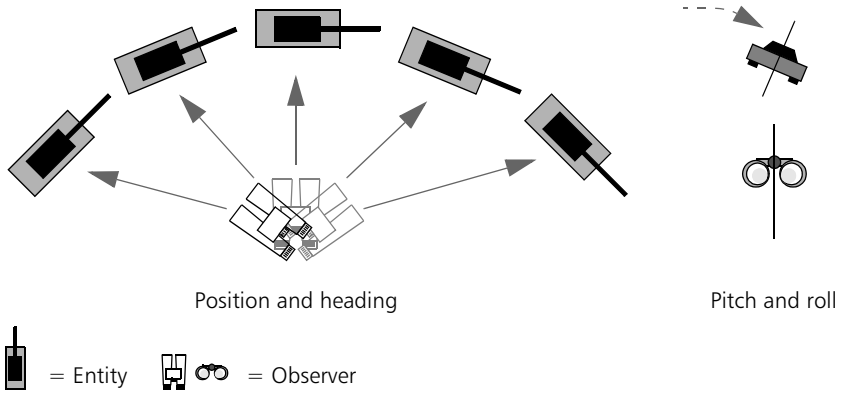


Figure 15-9. Track mode

15.3. Attach Modes in the 2D Projection

The 2D projection supports Follow mode and Tether mode. In Follow mode, the heading of the observer changes with the entity (if Orient North is disabled); in Tether mode, it does not. You can use the standard movement keys (**w**, **a**, **s**, **d**) to offset the observer with respect to the simulation object's position. You can use the orbit keys (left arrow, right arrow) to offset the observer's orientation with respect to the entity's orientation (in Follow mode) or the terrain.

If the observer is attached to an entity in the 3D projection and you switch to the 2D projection, the attach mode is mapped to either Follow or Tether modes, as shown in Table 15-1. If you then switch back to the 3D projection the original attach mode is restored.

Table 15-1: 3D to 2D attachment mode mapping

3D Attach Mode	2D Attach Mode
Follow	Follow
Mimic	Follow
Mimic Track	Follow
Mimic Location Track	Follow
Space Follow	Follow
Tether	Tether
Tether Track	Tether
Tether Location Track	Tether
Track	Tether

15.4. Attaching the Observer at Startup

There may be times when you want to attach the observer to an entity as soon as VR-Vantage starts up. For example, suppose you are using VR-Vantage IG as a flight simulator. You might want it to start up and immediately display the cockpit view for the aircraft. VR-Vantage has a command-line argument, `--bindObservers`, that lets you bind the observer to an entity using saved views.

To start VR-Vantage with the observer bound to an entity:

1. Run a live or recorded simulation.
2. Attach the observer to the entity that you want it to be attached to when you start VR-Vantage. If you have multiple observers, create a saved view for each observer that you want to attach automatically.
3. Save the views.
4. If you have multiple observers, save the display engine configuration.
5. Start VR-Vantage with the `--bindObservers` command-line option and use your saved views file as the argument to `--bindObservers`. If you need to specify more than one observer, use `--dispSetting` to specify the display engine configuration file that defines the observers. You must also specify the terrain file to load.:

```
vrvIG --bindObservers "observer1,...,
  observern,../appData/settings/vantageIG/
  saved_views.osrx" --dispSetting displayconfig.dcx
  terrain_file.mtf
```

If the simulation is running, VR-Vantage attaches the observer to the entity in the saved view. If the simulation is not running, VR-Vantage attaches the observer when the entity is next discovered.



If your display engine configuration has more than one observer, you can save multiple views and automatically bind the observers to the views. The observers are bound to views on a one-to-one basis in the order that the observers are listed in the command and the saved views are listed in the file. If you only have one observer, it is automatically bound to the first view in the file.

15.4.1. Observer Attachment Tutorial

This tutorial implements the procedure described in the previous section using files provided with VR-Vantage and MÄK Data Logger. It attaches the observer to one of the aircraft in the *Raid2013-viewControl-DIS.lgr* recording.

To attach the observer to an entity at startup:

1. Start VR-Vantage IG.
2. Load the *Ala Moana.mtf* terrain.
3. Start MÄK Data Logger (DIS).
4. Load *Raid2013-viewControl-DIS.lgr*.
5. Connect VR-Vantage IG to the simulation network.
6. Choose **Settings** → **View Controls** to disable view controls.
7. Run the *Raid2013-viewControl-DIS.lgr* recording.
8. Attach the observer in Mimic mode to UAV-Predat1.
9. If the Observer Views Panel is not open, choose **View** → **Observer Views Panel**.
10. On the Observer Views Panel, click the Add button (+). The view is listed in the panel window.
11. Save the view to a file, for example *UAV-Predat1.osrx*.
12. Shut down VR-Vantage IG.
13. Start VR-Vantage IG with the following command line:

```
vrvIG --bindObservers "Observer 1,../appData/
  settings/vantageIG/UAV-Predat1.osrx"
  "../userData/terrains/Ala Moana.mtf"
```



In this example, it is not strictly necessary to specify the observer because there is only one observer. The observer name is included to illustrate the complete syntax of the command. If you had more than one observer in your display engine configuration and multiple views to attach them to, you could use a command like the following:

```
vrvIG --bindObservers "Observer 1,Observer A,../appData/settings/
  vantageIG/UAV-Predat1.osrx" --dispSetting displayConfig.dcx
  "../userData/terrains/Ala Moana.mtf"
```

You could also do this:

```
vrvIG --bindObservers "Observer A,Observer 1,../appData/settings/
  vantageIG/UAV-Predat1.osrx" --dispSetting displayConfig.dcx
  "../userData/terrains/Ala Moana.mtf"
```

The observers get bound to views in the order in which they are listed.

VR-Vantage includes an example saved view, *UAV-Predat1.osrx*, that you can use to try out this example.

15.4.2. Binding Multiple Observers Tutorial

This tutorial shows how to bind multiple observer views to multiple windows. The tutorial does the following:

- Creates three windows.
- Saves the display engine configuration.
- Saves different views for each window.
- Loads the terrain, saved views, and display engine configuration from the command line.

VR-Vantage loads the terrain, opens the three windows in the display engine configuration, and assigns a saved view to each window.

The tutorial uses VR-Vantage Stealth and both 2D and 3D windows. However, the same procedure would apply to applications that support just 2D or just 3D windows.

Create the Windows

To bind multiple observer views to multiple windows:

1. Start VR-Vantage Stealth.
2. Load *VR-TheWorldOnline.mtf*.
3. Choose **View** → **Display Engine Configuration Editor Panel**. The panel shows one window with one channel. The observer assigned to the channel is named Observer 1 (Figure 15-10).

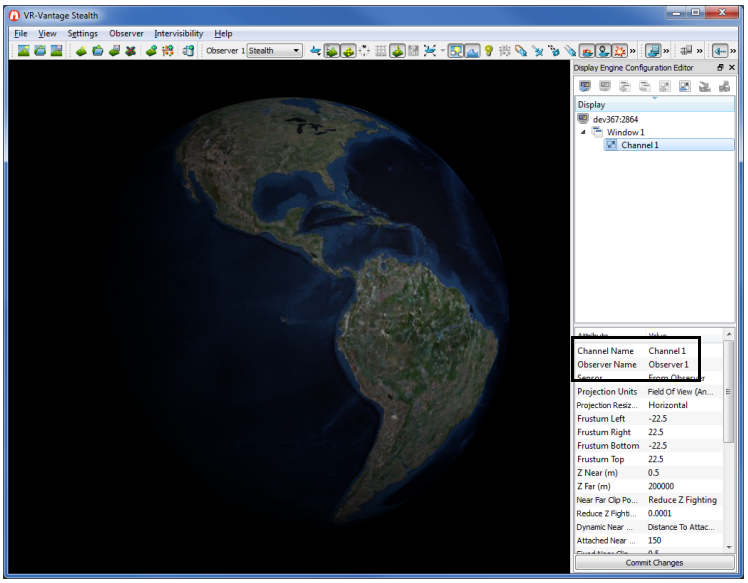


Figure 15-10. Observer 1

4. Choose **File** → **New Stealth Window**. A window titled Stealth Inset 1 opens. It shows the same view as the main window. A window called Stealth Inset 1 is added to the display engine configuration. The channel properties show that the window uses Observer 2 (Figure 15-11).

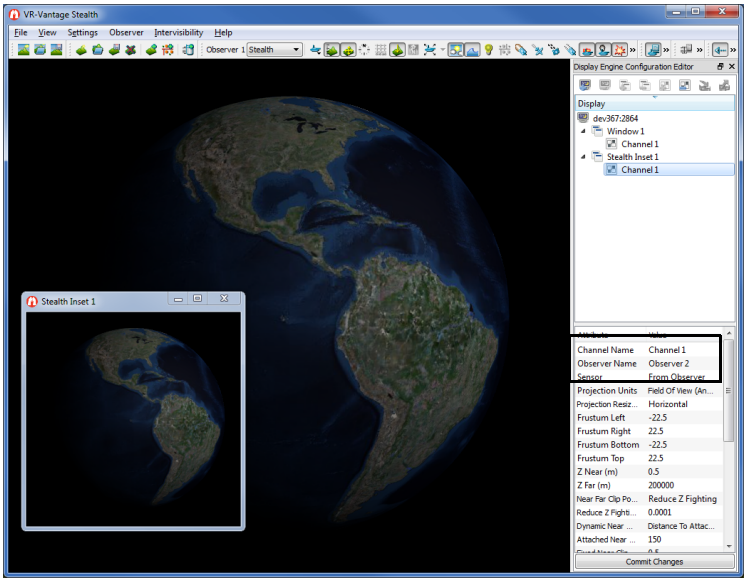


Figure 15-11. Observer 2

5. Choose **File** → **New Plan View Window**. A window titled Plan View Inset 1 opens. It shows a portion of the view in the main window. A window called Plan View Inset 1 is added to the display engine configuration. The channel properties show that the window uses Observer 3 (Figure 15-12).

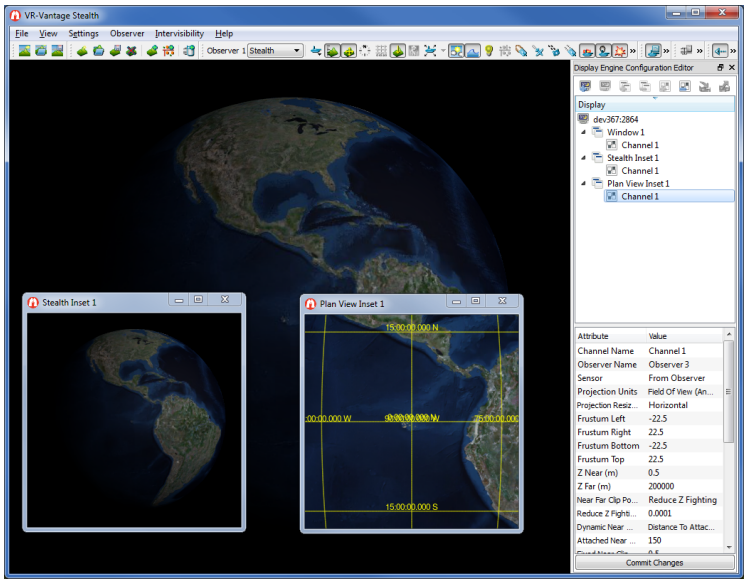


Figure 15-12. Observer 3

Save the Display Engine Configuration

To save the display engine configuration:

1. In the Display Configuration Editor Panel, select the display engine (the top line).
2. Click the Save Display Engine Configuration button ( ). The Save Display Engine Configuration dialog box opens.
3. Type a name for the configuration, for example, *BindObserversTutorial.dcx*.
4. Click Save.

Create and Save the Views

To create observer views for each observer and save them:

1. If the Observer Views Panel is not open, choose **View** → **Observer Views Panel**.
2. Click in the main window to give Observer 1 focus. Confirm this by looking at the observer name displayed on the Observer Settings Toolbar.
3. On the Observer Views Panel, click the Add button ( ). A view called 1 - Absolute is added.

4. Double-click the name of the view to make it editable. Change the name to Western Hemisphere.
5. Click in Stealth Inset 1. Make sure that the Observer Settings Toolbar shows that the active observer is Observer 2.
6. Drag the view of the world to show Africa.
7. Add a new view to the Observer Views Panel.
8. Change the name of the view to Africa.
9. Click in Plan View Inset 1. Make sure that the Observer Settings Toolbar shows that the active observer is Observer 3.
10. Drag the view of the world to show Australia. The various windows should now look something like (Figure 15-13).

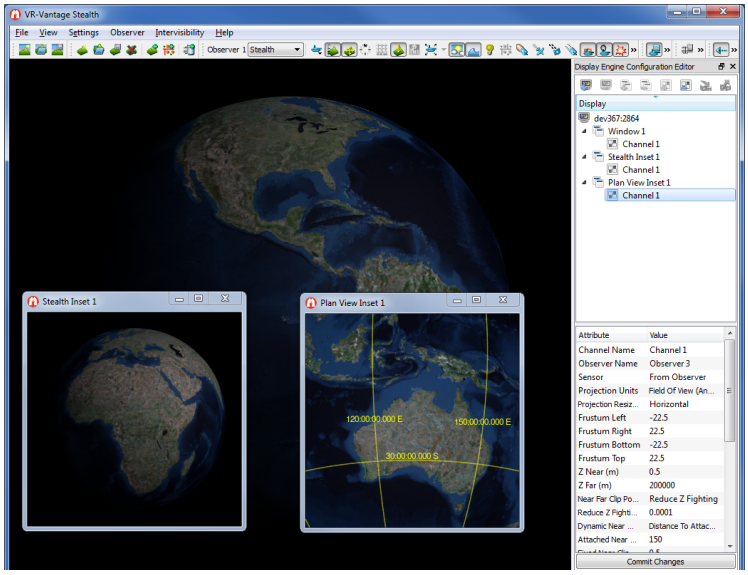


Figure 15-13. VR-Vantage Stealth with saved views assigned

11. Add a new view to the Observer Views Panel.
12. Change the name of the view to Australia.
13. Click the Save Observer Views button ( ). The Save Observer Views dialog box opens.
14. Type a name for the saved views, for example, *BindObserversTutorialViews.osrx*.
15. Click Save.
16. Shut down VR-Vantage.

Start VR-Vantage with the Views and Display Engine Configuration

➤ To load the display engine configuration and bind observers to the saved views, start VR-Vantage Stealth with the following command:

```
C:\MAK\vrvantage2.1\bin\vrvStealth.exe
  --dispSetting ..\appData\settings\stealth\BindObserversTutorial.dcx
  --bindObservers "Observer 1,Observer 2,Observer 3,
  ..\appData\settings\stealth\BindObserversTutorialViews.osrx"
  ..\userData\terrains\VR-TheWorldOnline.mtf
```

VR-Vantage Stealth starts up, loads the display engine configuration, opens the windows, and assigns the saved views to the windows (Figure 15-13).



16. Inset Views, Sensor FOV, and HUDs

This chapter describes special types of inset windows – inset views, instrument panels, and sensor fields of view, and head up displays.

Inset Views 16-2
Displaying Cockpit Displays (3D Only) 16-4
Displaying Instrument Panels 16-6
Configuring Entities to Use Instrument Panels 16-7
Displaying Sensor Views (3D Only) 16-8
Displaying a Sensor Field of View Cone 16-9

16.1. Inset Views

You can display inset views of individual simulation objects. Figure 16-1 shows a helicopter hovering over the Ala Moana area in the VR-TheWorld Online - MAK Earth terrain with an inset view of a car driving through the town.



Figure 16-1. Inset view

! By default, when you create an inset view, the observer in the inset view is attached to the simulation object in Mimic mode. This has the side effect of causing the 3D model in the main window to disappear. (The reverse occurs if you attach the observer in the main window to the simulation object in Mimic mode.) To make the model reappear, select the inset view and change the attach mode or detach the observer.

You can change the observer position and orientation in an inset view using keyboard controls. You can also edit window and channel properties for the window in the Display Engine Configuration Editor. (For information about the Display Engine Configuration Editor, please see Chapter 6, *Windows, Channels, and Display Engines*.)

When you create an inset view, the title bar contains the simulation object's name. However, the window is not actually tied to the simulation object and you can change the view in the inset view and view other simulation objects. The title bar will continue to display the name of the simulation object for which the window was created.

To open an inset view:

1. Right-click a simulation object (or its entry in the Objects List Panel). A menu opens.
2. On the menu, choose **Create Inset View**.

16.2. Displaying Cockpit Displays (3D Only)

VR-Vantage can display cockpit displays created with GL Studio. It includes cockpits for fixed-wing, rotary-wing, and ground vehicle entities. As with other entity effects, cockpits have schemas and model definitions that you map to entity types. For details about cockpit display models, please see "Adding New Cockpit Display Models," on page 30-10.

VR-Vantage supports 2D cockpits (Figure 16-2) and 3D cockpits (Figure 16-3). A 2D cockpit is fixed to the center of the screen and you cannot zoom in or out on the instrument panel. A 3D cockpit is aligned with the front of the vehicle. If you move the eyepoint, the instrument panel moves in or out of view as you would expect. You can zoom in and out on the instruments.



Figure 16-2. 2D cockpit



Figure 16-3. 3D cockpit

- Cockpits are displayed only when the observer is attached to an entity in Mimic mode.
- VR-Vantage includes one 3D cockpit, for the F-16 fighter jet.
- Cockpits are not supported on Linux.

To display cockpits:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Cockpit Display Settings page (Figure 16-4).

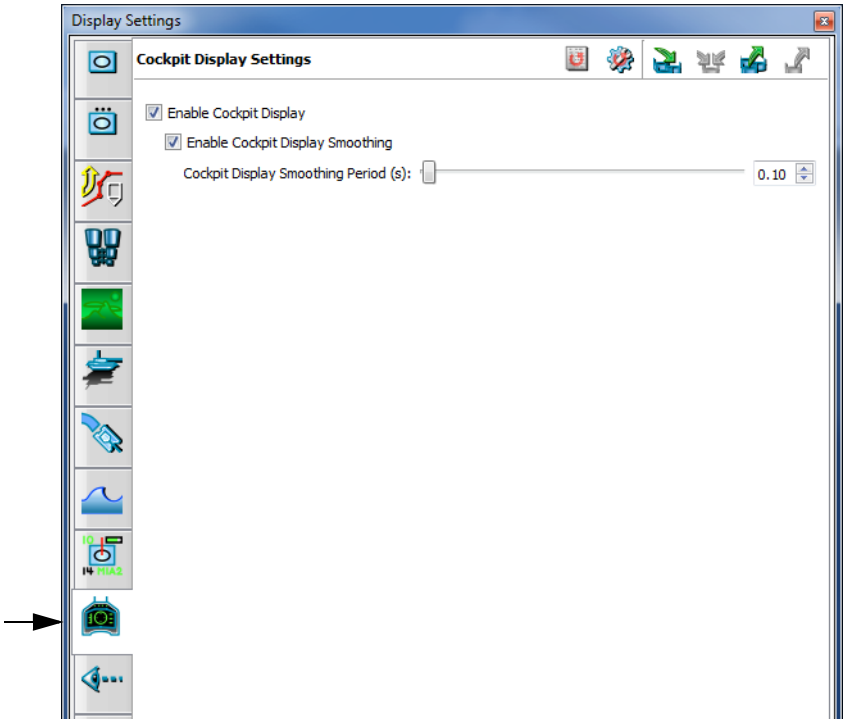


Figure 16-4. Cockpit display settings

3. To enable or disable cockpit displays, select or clear the Enable Cockpit Display check box.
4. Attach the observer to an entity in Mimic mode.

You can also enable and disable cockpit displays by choosing **Settings** → **Cockpit Displays** or by clicking the Cockpit Displays button ( ) on the Display Settings Toolbar.

16.3. Displaying Instrument Panels

Instrument panels are inset windows that display a vehicle instrument such as an altimeter or artificial horizon. Unlike a cockpit display, which is a fixed display that operates in Mimic mode, an instrument panel is an independent window (like an inset view) that you can place anywhere on the screen (Figure 16-5). It does not affect the observer mode. You can organize multiple instrument panels to create your own virtual cockpit.



Figure 16-5. Instrument panels

When you create an instrument panel, the title bar of the window lists the entity for which you created it.

- Instrument panels are GL Studio controls.
- Instrument panels are not supported on Linux.
- If the source of the instrument panel is removed from the exercise, for example when a Logger recording rewinds, the instrument panels are removed from the inset windows. To see them again you must open new instrument panels. Because the relationship between an instrument panel window and an entity is not persistent across multiple runs of an exercise, you cannot save an instrument panel layout for an entity. (You could save the layout of the windows to a display configuration, but they would not display instrument panels when you loaded the configuration.)
- If you want to put multiple instrument panels in one window, like the six-pack panel provided with VR-Vantage, you must use GL-Studio.

To open an instrument panel:

1. Select the entity for which you want to display an instrument panel.
2. On its right-click menu, choose **Create Instrument Panel**. A submenu is displayed.
3. Choose the instrument panel you want to open.

16.3.1. Configuring Entities to Use Instrument Panels

VR-Vantage includes a set of instrument panels for fixed-wing aircraft, although many of them may be appropriate for rotary-wing aircraft, and even for ground vehicles. (For example, you might want to show a compass for a ground vehicle to get its heading or an altimeter to show its height above sea level.) The availability of instrument panels to an entity is determined by the **instrumentPanelCategory** parameter in its model definition.

The instrument panels provided with VR-Vantage have the **instrumentPanelCategory** set to FixedWing. All fixed-wing entities have this parameter set in their model definition. None of the other entities do. If you want other entities to display instrument panels provided with VR-Vantage, you can add this parameter to their model definitions. (You could also copy an instrument panel model definition and change the category to some other value if you want to. Regardless, to use an instrument panel, an entity's model definition must include the **instrumentPanelCategory** parameter and set it to a valid value.)

If you create new instrument panels, you must add instrument panel model definitions for them and specify a value for the **instrumentPanelCategory** parameter. Then you can add the parameter to the appropriate entity model definitions.

16.4. Displaying Sensor Views (3D Only)

VR-Vantage can display the view from gimbaled visual sensors simulated by VR-Forces, such as a camera on a UAV. The view is displayed in an inset window that has information about the observer mode and area being viewed (Figure 16-6). The window has its own observer and you can change the observer mode in the view.

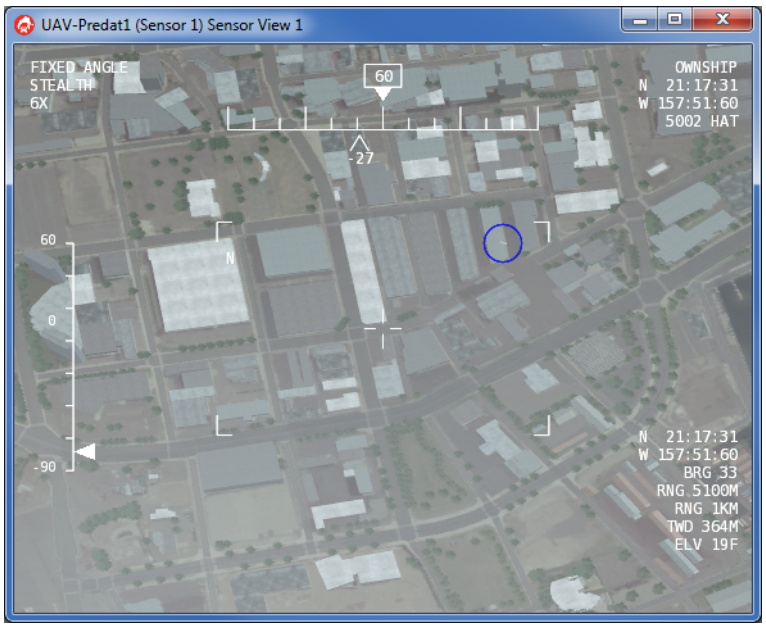


Figure 16-6. Sensor View

To display a sensor view:

1. Select an entity that has a gimbaled sensor.
2. Right-click the entity and on the right-click menu choose **Create Sensor View** → *sensor*, where *sensor* is one of the sensors on the entity.

16.4.1. Displaying a Sensor Field of View Cone

You can display translucent cones that show the area on the terrain that a gimbaled sensor is observing. Each cone is a different color. Figure 16-7 shows two sensor field of view cones. One is focused on an entity and is zoomed in for a tight focus. The other is focused on a point on the terrain.



Figure 16-7. Sensor field of view cones

To display sensor field of view cones:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 13-2).
3. In the list of settings, select the Sensor Fields of View check box.



You can also enable and disable sensor field of view cones by choosing **Observer** → **Sensor Fields of View** or by clicking the Sensor Fields of View button (▲) on the Observer Settings Toolbar.



17. Exaggerating Models and Terrain

This chapter describes terrain scaling and model scaling – features primarily used in XR observer mode.

Exaggerating the Scale of 3D Entity Models 17-2
Exaggerating the Terrain Scale 17-6
Enabling Terrain Scaling 17-7
Scaling the Terrain 17-7
Track Histories and Terrain Scaling 17-8

17.1. Exaggerating the Scale of 3D Entity Models

If you view the terrain in Stealth observer mode, beyond a certain distance most 3D entity models are too small to see. Model scaling lets you exaggerate the scale of entity models to see them at a great distance. Figure 17-1 shows the same scene with model scaling off and on. When model scaling is off, only the largest entities are visible. When models are scaled, they are all visible.



Model scaling and XR mode is only supported by VR-Vantage Stealth.

VR-Vantage supports the following types of model scaling:

- XR scaling. XR scaling tries to give all entities approximately equal visibility. It does not preserve size relationships between entities. The visual effect of model scaling depends on an entity's size and the observer's distance from the entity. When the observer is close to an entity, scaling models may not make any noticeable difference in its size.
- Linear scaling. Linear scaling scales all entities by the current model scale factor. The distance from the observer is not taken into account. A model scale factor of 10 scales all entities to be 10 times normal size.

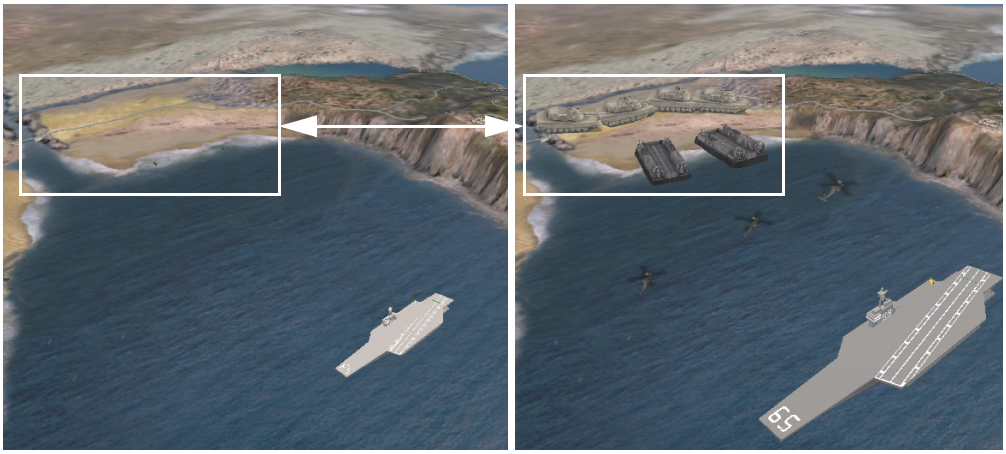


Figure 17-1. Model scaling off and on (Stealth observer mode)

Another way to quickly change the visibility of entities is to switch to XR observer mode. In XR mode, entities are immediately scaled and are represented by colorized 3D models to enhance their visibility.



Figure 17-2. XR mode

To scale entity models:

1. Choose **Observer** → **Advanced Settings**. The Display Settings dialog box opens to the Observer Settings page (Figure 17-3).

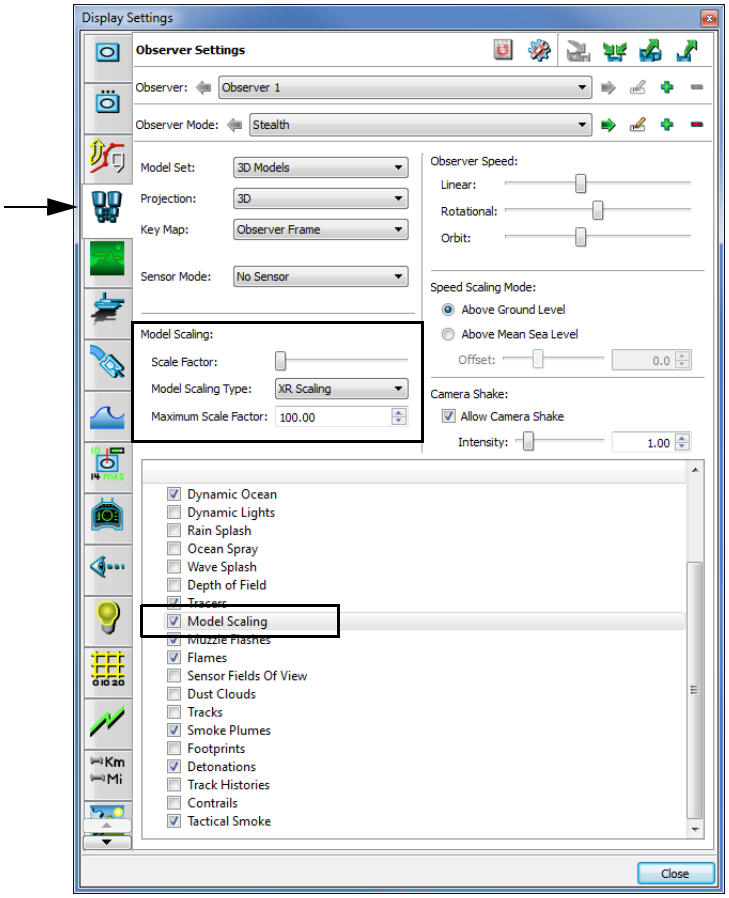


Figure 17-3. Observer Settings page

2. In the list of observer attributes, select Model Scaling.
3. In the Model Scaling Type list, select the type of scaling you want to use – XR or linear.
4. Optionally, change the Maximum Scale Factor.
5. Adjust the Scale Factor slider to the amount of scaling that you want.

You can also scale models from the Observer Settings Toolbar.

To scale models from the Observer Settings Toolbar:

1. If model scaling is not enabled, click the Model Scaling button ( ) on the Observer Settings Toolbar.
2. Click the down arrow on the button. The Scale Factor slider is displayed (Figure 17-4).



Figure 17-4. Scale Factor slider

3. Adjust the slider to scale the models.

The Scale Factor slider is a dockable widget that you can undock and leave visible as long as model scaling is enabled.

17.2. Exaggerating the Terrain Scale

In XR mode, you can exaggerate the terrain scale to improve your sense of line-of-sight issues and other terrain factors that can affect an exercise. Figure 17-5 and Figure 17-6 illustrate terrain from the same observer location with and without terrain scaling. Notice how much easier it is to understand the relationship of the aircraft to the ground in the scaled view.

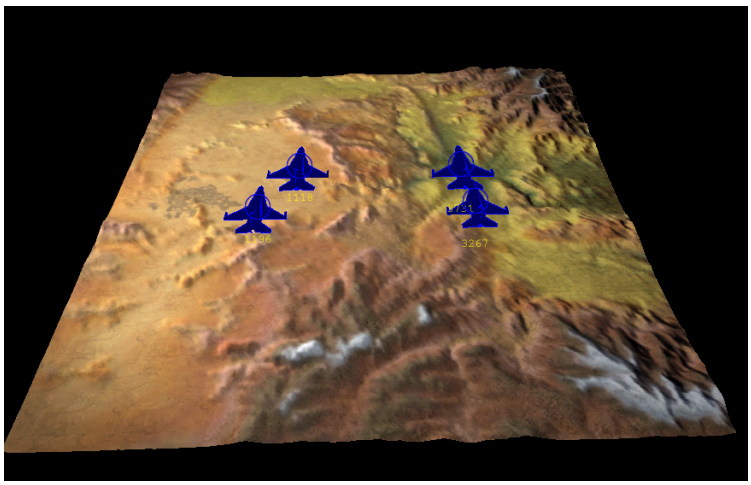


Figure 17-5. No terrain scaling

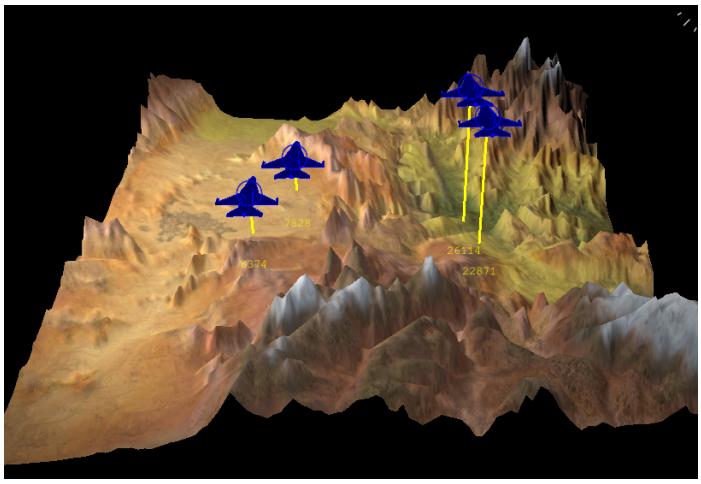


Figure 17-6. Terrain scaling

When you scale the terrain, terrain, props, and SpeedTrees all get scaled. Simulation objects and entity labels get positioned so that they are in the correct position relative to the scaled terrain. However, the text on entity labels and other information panels displays their correct, unscaled location.

When you enable or disable terrain scaling or change the scale factor, track histories get cleared. You can specify that track histories not be cleared when you scale the terrain.

! Terrain scaling is not supported on geocentric terrains.

17.2.1. Enabling Terrain Scaling

➤ To enable or disable terrain scaling, choose **Settings** → **Terrain Scaling**, or click the Terrain Scaling button ( ) on the Display Settings Toolbar.

---

i You can also enable and disable terrain scaling on the Display Settings dialog box, Render Settings page.

17.2.2. Scaling the Terrain

To scale the terrain

1. Enable terrain scaling. (Choose **Settings** → **Terrain Scaling**, or click the Terrain Scaling button ( ) on the Display Settings Toolbar.)
2. Click the arrow next to the Terrain Scaling button. The Terrain Scale Factor slider is displayed (Figure 17-7).



Figure 17-7. Terrain Scale Factor slider

3. Adjust the slider.

---

i You can also scale the terrain on the Display Settings dialog box, Render Settings page.

17.2.3. Track Histories and Terrain Scaling

By default, when you enable or disable terrain scaling or change the scale factor, track histories get cleared and restarted. This is because track histories are not scaled and they would probably misrepresent the simulation object's track after the terrain was scaled. However, you can specify that track histories not be cleared when you scale the terrain.

To specify whether or not track histories are cleared when the terrain is scaled:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 17-8).

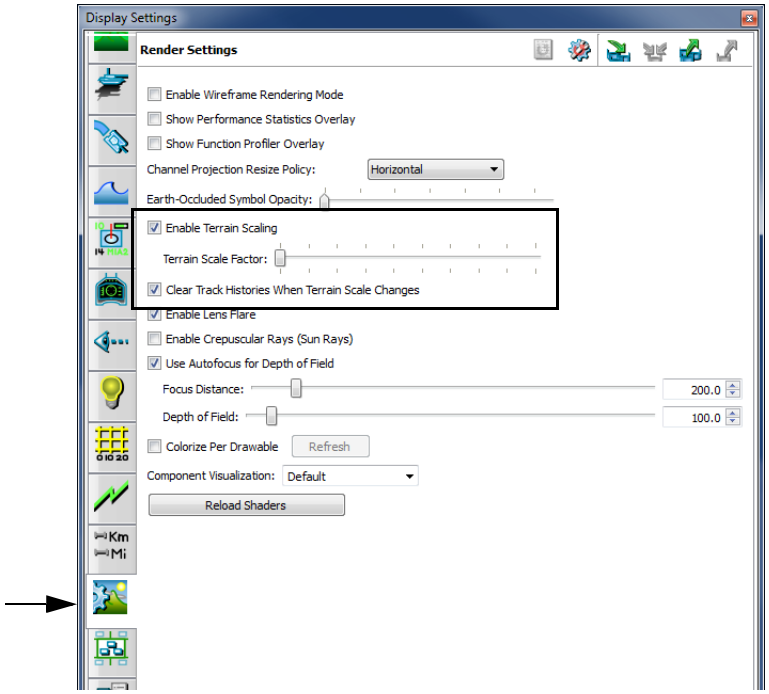


Figure 17-8. Render Settings page

3. Select or clear the Clear Track Histories when Terrain Scale Changes check box.



V. Viewing Simulation Objects

The chapters in this section explain how to manage the display of simulation objects (entities and units) and the information about them that is available.



18. Viewing Simulation Objects

This chapter describes how to select entities and units, and manage how they are viewed.

Selecting Simulation Objects 18-2
Displaying Entity Labels 18-2
Displaying Text Labels for 3D Models 18-5
Turning Entity Labels On and Off 18-6
Pinning 3D Text Labels to the Window 18-6
Displaying Labels for 2D Icons 18-7
Configuring Shadowing and Background Color for 2D Labels 18-9
Inset Views 16-2
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Viewing Object Counts 18-16
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18.1. Selecting Simulation Objects

Many procedures require you to select one or more simulation objects. When a 3D model is selected, a box is drawn around it (Figure 18-1). When a 2D icon is selected, it is highlighted. In either case, the simulation object is highlighted in the Objects List Panel.

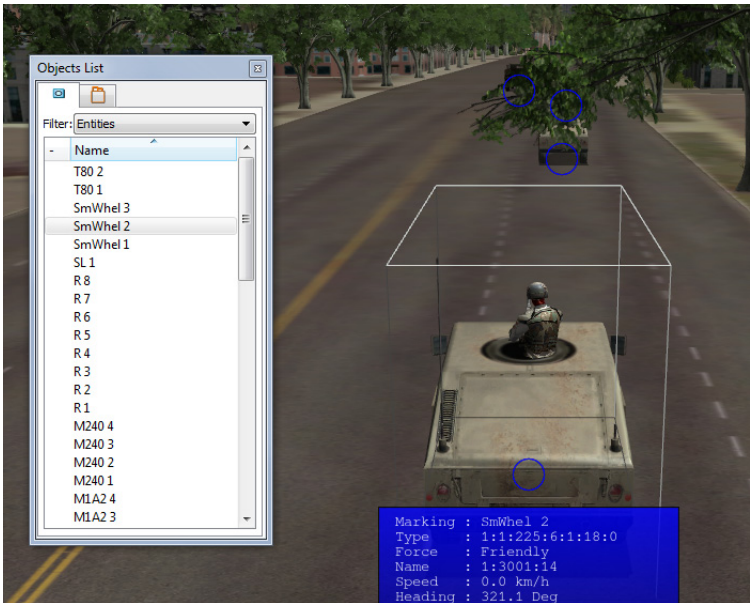


Figure 18-1. Selected 3D model

➤ To select a simulation object, click it in the window, or select it in the Objects List Panel.

For multiple selection, standard conventions for **Shift**-click and **Ctrl**-click apply.

18.2. Displaying Entity Labels

For 3D models, VR-Vantage displays labels that help you locate and identify entities (Figure 18-2). The label consists of a locator circle, which is always visible when labels are enabled, and a text label that is displayed when you mouse over an entity. All entities within the view have locator circles, whether the model is visible or not. The color of an entity's label represents its force – blue for friendly, red for opposing, and green for neutral.

A 3D text label displays the entity's:

- Marking text
- Entity type enumeration
- Force
- Name
- Speed
- Heading
- Latitude and longitude
- Altitude.



You can configure the attributes of the entity label, such as font size, and the height and width of the background by editing the entityInfo model definition in the Visual Models Editor. For details about editing model definitions, please see "Creating and Editing Model Definitions," on page 28-12.

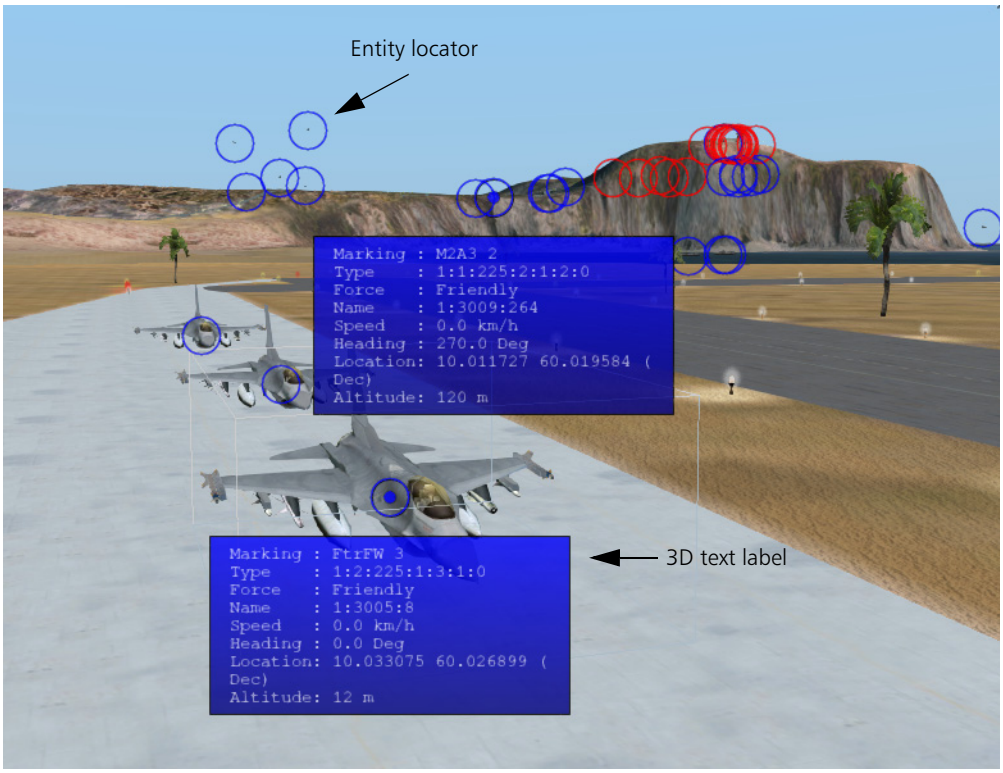


Figure 18-2. Entity labels for 3D models

For 2D icons (VR-Vantage PVD and VR-Vantage Stealth), labels are a set of individually enabled text labels, called symbol decorations (Figure 18-3). In VR-Vantage Stealth, entity labels for 2D icons are supported both in the 2D view and the 3D view. If you resize 2D icons, the labels also get resized. 2D icons can display the simulation object's:

- Acceleration.
- Altitude above mean sea level.
- Altitude above ground level.
- Heading Indicator.
- Label.
- Location.
- Name.
- Orientation.
- Velocity.

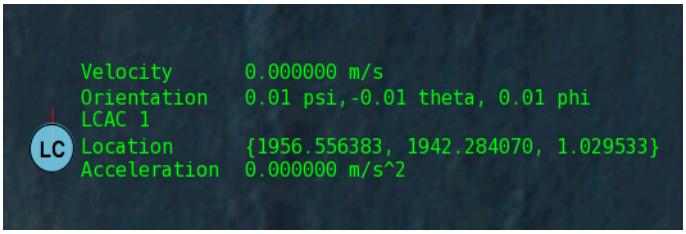


Figure 18-3. Label for a 2D icon

18.2.1. Displaying Text Labels for 3D Models

To view a 3D text label, use one of the following methods:

- Move the cursor over the circle that represents the entity.
- On the Display Settings dialog box, Entity Display Settings page, select Show Information Only For Selected Entities (Figure 18-4). Then select the entity whose label you want to see.

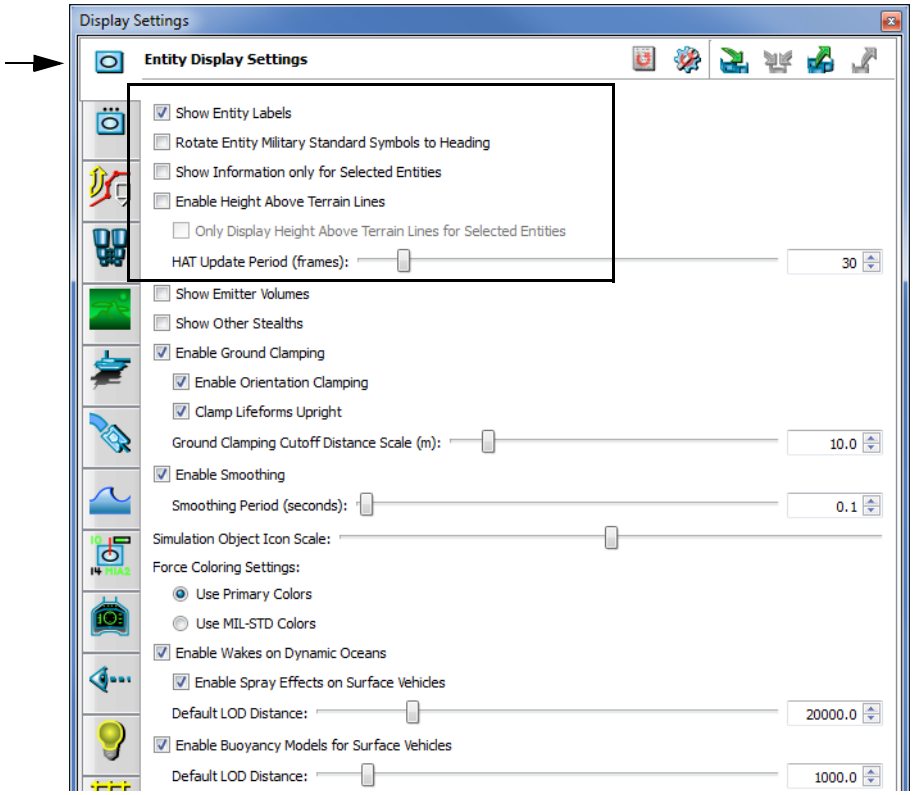


Figure 18-4. Display Settings, Entity Display Settings page

18.2.2. Turning Entity Labels On and Off

To turn the display of entity labels on or off:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 18-4).
3. Select or clear the Show Entity Labels check box.



You can also enable and disable entity labels by choosing **Settings** → **Entity Labels** or by clicking the Entity Labels button () on the Display Settings Toolbar.

18.2.3. Pinning 3D Text Labels to the Window

You can pin 3D text labels to the window, making them stay visible after you move the cursor away from the entity.

To pin a 3D text label to the window or hide a pinned label:

1. Right-click an entity's locator circle. A menu is displayed.
2. Choose **Toggle Pinned Label**.

Pinning Multiple 3D Text Labels

You can display multiple text labels at one time.

To pin multiple text labels use either of the following methods:

- Right-click and choose **Toggle Pinned Label** for each entity whose label you want to pin.
- On the Display Settings dialog box, Entity Display Settings page, select Show Information Only For Selected Entities (Figure 18-4). Then, in the Objects List Panel, multi-select the entities whose labels you want to see.

18.2.4. Displaying Labels for 2D Icons

You can enable and disable the display of labels for 2D icons by label type. This allows you to control how much screen space is taken up by the labels. You can control the display of labels in the Display Settings dialog box or on the Display Settings Toolbar.

To enable and disable display of 2D icon labels:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 18-5).

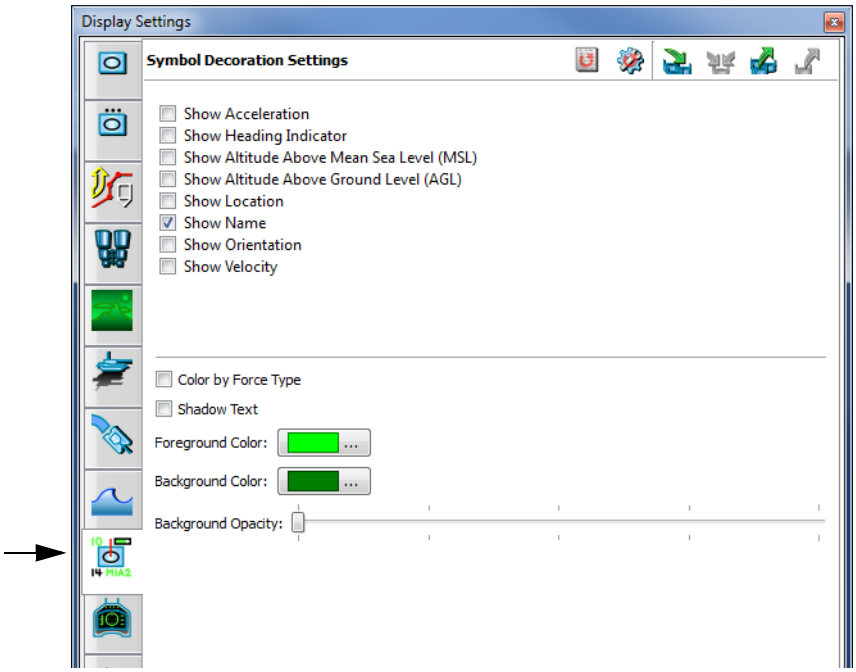


Figure 18-5. Symbol Decoration Settings page

3. Select the check box for each label that you want to display. Clear the check box for each label that you want to hide.

Enabling 2D Labels on the Display Settings Toolbar

The Entity Labels button on the Display Settings Toolbar lets you open a panel that lists the symbol decorations that you can show or hide.

To enable or disable 2D labels on the Display Settings Toolbar:

1. Click the arrow on the Entity Labels button ( ). A small panel is displayed. It is a persistent window.

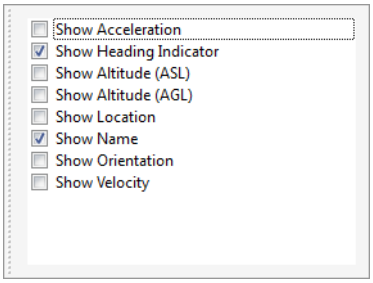


Figure 18-6. Symbol Decoration Panel

2. Select the symbol decorations that you want to display. Clear the ones you want to hide.
3. To hide the Symbol Decorations Panel, click the arrow on the Entity Labels button.

18.2.5. Configuring Shadowing and Background Color for 2D Labels

2D labels are drawn on a background that, by default, is transparent. However, you can increase the opacity of the background to make it visible and can change the background color.

You can add shadowing to the text of 2D labels. This may improve visibility when simulation objects are on light colored terrain.

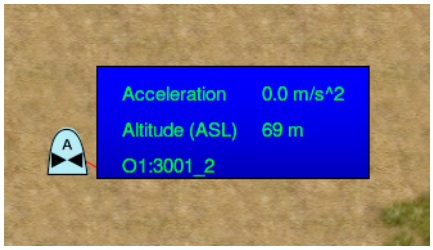


Figure 18-7. 2D label with background

To set the color and opacity of the 2D label background:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 18-5).
3. To change the opacity of the background, adjust the Background Opacity slider.
4. To change the color of the background:
   a. Click the Background Color color swatch. A color picker opens.
   b. Select the color you want to use for the background.
   c. Click OK.

To configure shadows for 2D labels:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 18-5).
3. Select or clear the Shadow Text check box.

18.3. Changing Force Colors

By default, labels, detonation lines, and other force-related simulation object graphics (including the 3D Colorized Model model set in VR-Vantage Stealth) are displayed using primary colors (red, blue, and green). You can change the force coloring to use MIL-STD 2525B colors (light blue, light green, and salmon).

To change force coloring:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 2-4).
3. Select the Force Coloring Settings option that you want.

18.4. Displaying HAT Lines for Entities (3D Only)

Height-above-terrain (HAT) lines are vertical lines that run from an entity to the ground and display the altitude of the entity (using whatever units are configured on the Display Units Settings page) (Figure 18-8). They help you understand the relationship of the entity to the terrain.

HAT lines are shown only for entities that could be above or below the ground, such as fixed and rotary-wing vehicles. You can show and hide these lines globally and you can specify that they be shown only for the selected entities.

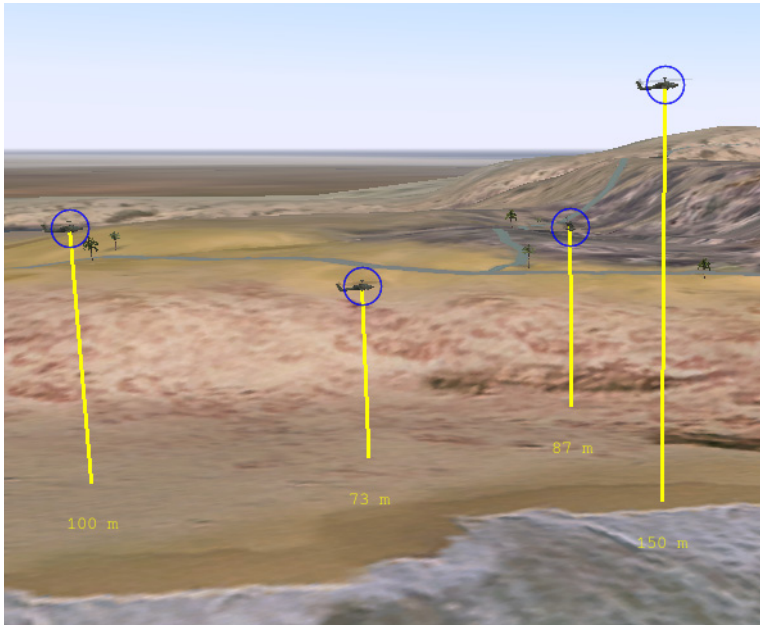


Figure 18-8. Entity height-above-terrain lines

! Displaying height above terrain lines can reduce the frame rate.

To show or hide height-above-terrain lines:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 18-4).
3. To display lines, select the Enable Height Above Terrain Lines check box.
4. To display lines only for selected entities, select the Only Display Height Above Terrain Lines For Selected Entities check box.

i In VR-Vantage Stealth, you can also enable and disable entity HAT lines by choosing **Settings** → **Entity Height Above Terrain Lines** or by clicking the Entity Height Above Terrain Lines button ( ) on the Display Settings Toolbar.

18.5. Changing the Model Set

Each observer mode specifies a model set. You can change the model set associated with an observer mode by editing it (for details, please see "Editing an Observer Mode," on page 13-5), but you can also dynamically change the model set being used.

➤ To change the model set, choose **Observer** → **Set Model Set** → *model_set*, where *model_set* is one of the options on the menu, or select a model set from the Set Model Set button ( ) on the Observer Settings Toolbar. (The button changes to show the currently selected model set.)

18.6. Simulation Object Icons

The 2D Icons model set uses MIL-STD 2525B icons. Figure 18-9 illustrates basic icon shapes for friendly forces.

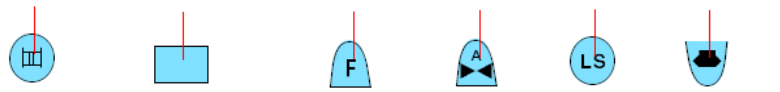


Figure 18-9. MILSTD-2525B icons

The color and shape code for 2D simulation object icons is:

- Light blue – friendly.
- Salmon – hostile.
- Light green – neutral.

Symbols have a black border except as follows:

- If there is no border on the top, the entity domain is subsurface, for example, submarines.
- Selected simulation objects have a white border.

Symbols that represent units have unit identifiers above the symbol, as illustrated in Figure 18-10.

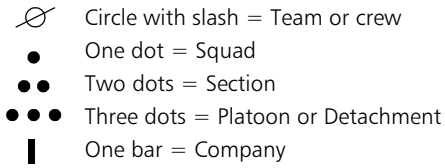


Figure 18-10. Unit echelon indicators

18.6.1. Changing the Size of 2D Icons

The Plan View observer mode (VR-Vantage Stealth and VR-Vantage PVD only) uses the 2D Icons model set for simulation objects. (In VR-Vantage Stealth, you can use these icons in the 3D observer modes too.) You can change the size of 2D icons. When many simulation objects are close together, reducing the size of the icons can reduce overlap.

To change the size of simulation object icons:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 18-11).

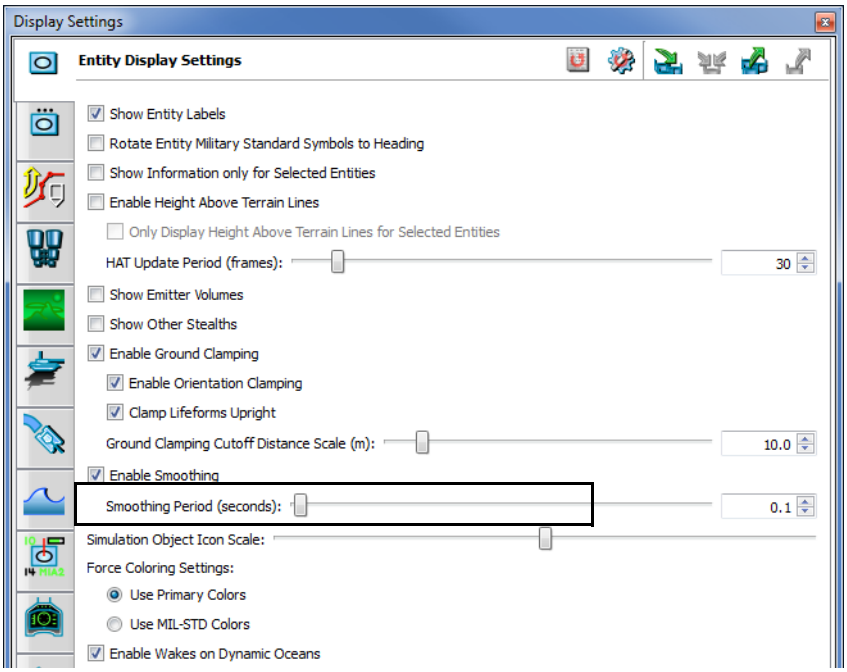


Figure 18-11. Entity Display Settings page

3. Adjust the Entity Icon Scale slider.

18.6.2. Rotating 2D Icons to a Simulation Object's Heading

By default, when a simulation object's heading changes, the heading indicator points to the new heading, but the icon remains oriented towards zero degrees (North). You can specify that icons rotate to the heading of the simulation object.



Figure 18-12. 2D icon rotated to heading

To rotate icons to a simulation object's heading:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 18-11).
3. Select the Rotate Entity Military Standard Symbols to Heading check box.

18.7. Viewing Occluded 2D Icons

If you are using VR-TheWorld or a similar terrain in the 2D projection, it is possible that simulation objects are being simulated on the opposite side of the world from the observer (they are occluded from view by the earth). Since 2D icons are displayed on a layer above the terrain, they do not get hidden from view by the terrain. VR-Vantage lets you configure the visibility of occluded entity icons. By default, occluded icons are displayed as 100% transparent. You can vary transparency from 100% transparent to 100% opaque.

To set the transparency of occluded 2D icons:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 18-13).

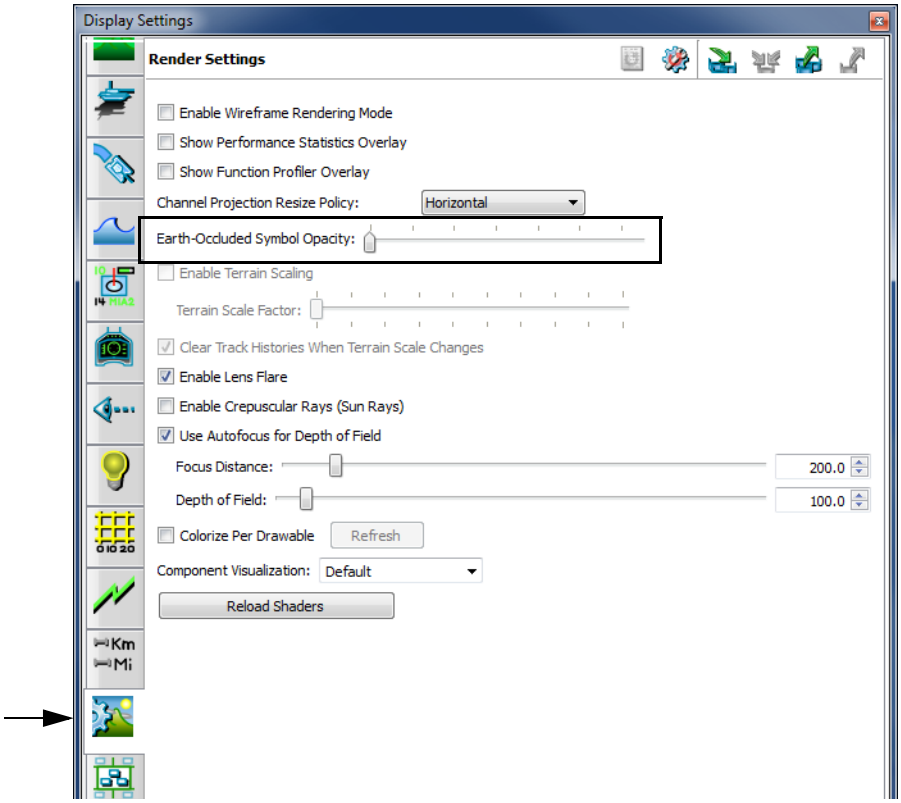


Figure 18-13. Render Settings page

3. Adjust the Earth-Occluded Symbol Opacity slider.

18.8. Hiding 3D Models

You can hide 3D models and 3D colorized models.

To hide 3D models:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 17-3).
3. In the list of observer settings, clear the Main Model check box.

18.9. Display of Embarked Entities

When VR-Vantage renders a scenario generated by VR-Forces, the scenario may include embarked simulation objects. In the 3D projection, embarked entities are displayed just like any other object. In the 2D projection, VR-Vantage does not display icons for embarked entities. However, they are still listed in the Objects List Panel.

18.10. Viewing Object Counts

You can display the number of live and destroyed simulation objects in the simulation you are viewing and the number of VR-Forces control objects, by type.

➤ To display the object counts, choose **View** → **Objects Count Panel**. The Objects Count Panel is added to the display (Figure 18-14).

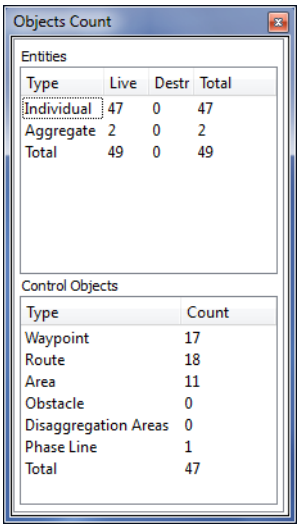


Figure 18-14. Objects Count Panel

18.11. Displaying Models for Remote Observers

VR-Vantage broadcasts the location and orientation of the observer. By default, it does not display a model for the observer. However, if there are other applications in an exercise that are broadcasting a stealth PDU (such as another VR-Vantage application), you might want to represent them with a model.

To display a model for remote observers:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 18-15).

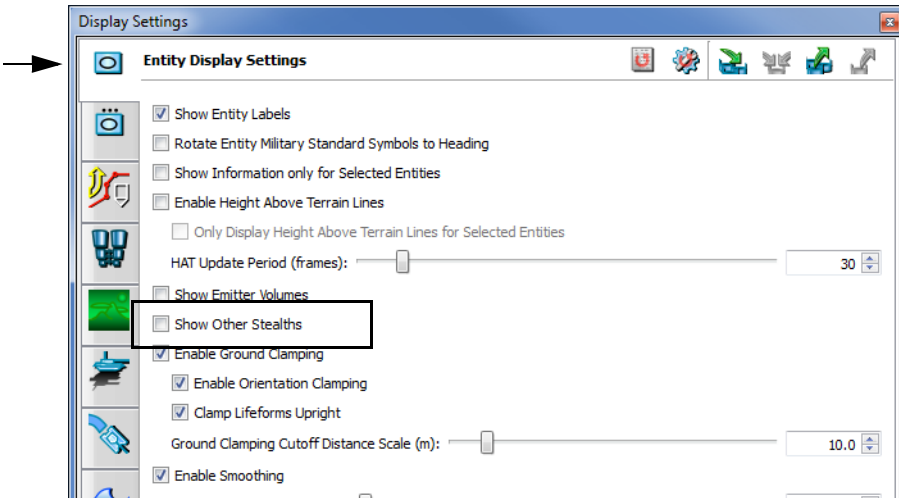


Figure 18-15. Display Settings, Entity Display Settings page

3. Select the Show Other Stealths check box.

18.12. Filtering Simulation Objects Using Interest Management

VR-Vantage can use interest management to improve its performance in simulations that have high simulation object counts. Interest management is an implementation of HLA data distribution management (DDM). When interest management is enabled, VR-Vantage filters out all simulation objects that are more than a specified distance from the observer.

18.12.1. Enabling Interest Management

To use interest management:

- You must use HLA (DIS does not support interest management).
- If you are using the MÄK RTI, you must use MÄK RTI 3.4a or later.
- You must configure your RTI to support DDM. (If you are using the MÄK RTI, you can configure your system to use *ddm-rid.mtl*, which has DDM enabled.)
- When you connect to an exercise, you must enable DDM in the connection settings.

To enable interest management:

1. Choose **Settings** → **Connection**. The Connection Settings dialog box opens.
2. Click Advanced to show all connection parameters.
3. Select the HLA connections page for the version of HLA that you are using.
4. Select the Implicit Geographic DDM check box.
5. Specify any other information required for the simulation.
6. Click Connect.

18.12.2. Configuring Interest Management

Interest management works by filtering out all simulation objects beyond a specified distance from the observer. You can configure this distance (DDM region size) and you can configure the threshold for observer movement (region update threshold) before VR-Vantage recalculates which simulation objects should be displayed.

VR-Vantage uses a geographic DDM scheme. The earth is divided into two dimensional regions, with X pointing north and Y pointing east. When you specify a DDM region size, you specify the length of one side of a region.

The region update threshold is a percentage of the distance from the center of the region to a side. When the observer moves beyond the threshold, the region is recalculated. For example, if the region size is 1000 meters, the distance from the center to a side is 500 meters. If the region update threshold is 50%, when the observer moves more than 250 meters from the center of the region, VR-Vantage recalculates the display region.

DDM regions use a two-dimensional grid, so the altitude of the observer is not considered when filtering simulation objects. However, in 3D observer modes, you usually cannot see entity models once the observer is a certain distance above the terrain (although you can see labels). Therefore, you may want to filter out simulation objects based on the observer's altitude, thereby increasing performance.

To configure interest management:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Interest Management Settings page (Figure 18-16).

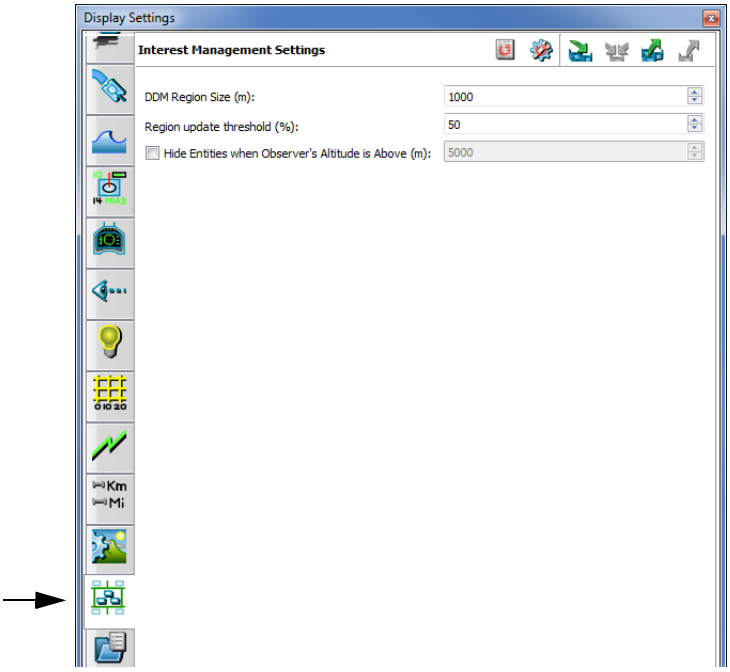


Figure 18-16. Interest Management Settings page

3. In the DDM Region Size box, type a value for the region size.
4. In the Region Update Threshold box, type a value, as a percentage, for the update threshold.
5. Optionally, filter simulation objects based on the observer's altitude, as follows:
   a. Select the Hide Entities When Observer's Altitude is Above check box.
   b. Specify the observer altitude at which to hide simulation objects.
6. Click OK.



19. Displaying Units

If you are using a VR-Vantage application to view a simulation generated by VR-Forces, MÄK's computer generated forces application, you can manipulate the display of the units that are in the simulation.

Introduction to Units 19-2
Expanding and Collapsing Units 19-3
Displaying Ghosted Icons 19-5
Displaying Unit Icons and Bounding Volumes 19-8
Specifying the Color Scheme for Unit Bounding Volumes 19-10

19.1. Introduction to Units

Units are entities that represent organizational groupings of entities in a military hierarchy, such as platoons, companies, and brigades. VR-Vantage Stealth and VR-Vantage PVD can represent the units simulated by VR-Forces. VR-Vantage IG has partial support for displaying units. VR-Forces can simulate units in either of the following states:

- Disaggregated: Subordinates are simulated and published as individual entities (Figure 19-1). Members of the unit are displayed using individual models or icons.
- Aggregated: Subordinates are not simulated separately. The unit is represented by one icon.

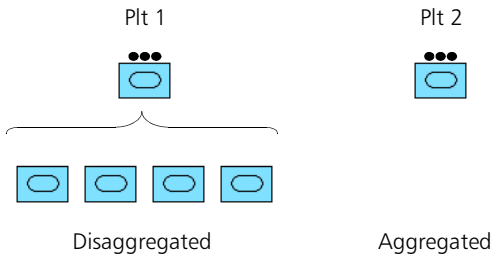


Figure 19-1. Disaggregated and aggregated entities

VR-Vantage can display disaggregated units at the unit level, using a 2D icon (collapsed), or it can display the individual members of a unit (expanded). It can also display translucent volumes that show the bounding volume of the entire unit.

Since aggregated units are sent over the network as one logical entity, VR-Vantage always represents them with one icon.



By default, the Objects List is filtered to just show entities. Therefore, if VR-Vantage is receiving units, there will be unit icons in the display, but no corresponding entry in the Objects List. To see units in the Objects List, change the filter to Units or All.

The rest of this chapter explains how to manage these different display options.

19.2. Expanding and Collapsing Units

You can display disaggregated units in expanded or collapsed mode. When a unit is collapsed, it is displayed as one icon. When a unit is expanded, all the members of the unit are visible as individual entities or subordinate units and the unit icon is hidden. Multi-level units can expand and collapse at each level of aggregation. For example a company could be collapsed to the company level (one icon), the platoon level (an icon for each platoon), or fully expanded.



VR-Vantage IG does not support expanding and collapsing of units because it does not support the 2D Icons model set.

When you Expand or Collapse a unit, you can expand or collapse one level of aggregation or all levels. When you Expand or Expand All, expansion is downward from the current unit and does not affect any sibling units. When you Collapse, contraction is upward in the hierarchy. Collapse All collapses all members of the unit to the topmost level.

Figure 19-2 illustrates these relationships. Assume a company with three platoons, each of which has four vehicles.

- If you Expand the top level unit, it expands to the platoon level. (1)
- If you select Plt C and choose Expand or Expand All, it expands just Plt C. (2)
- If you select the top level unit and expand all, it expands to the leaf level – 12 individual vehicles. (3)
- If the unit is fully expanded and you select one member of Plt C and choose Collapse, just Plt C collapses. (4)
- If you select any member of an expanded unit and select Collapse All, the entire unit collapses. (5)

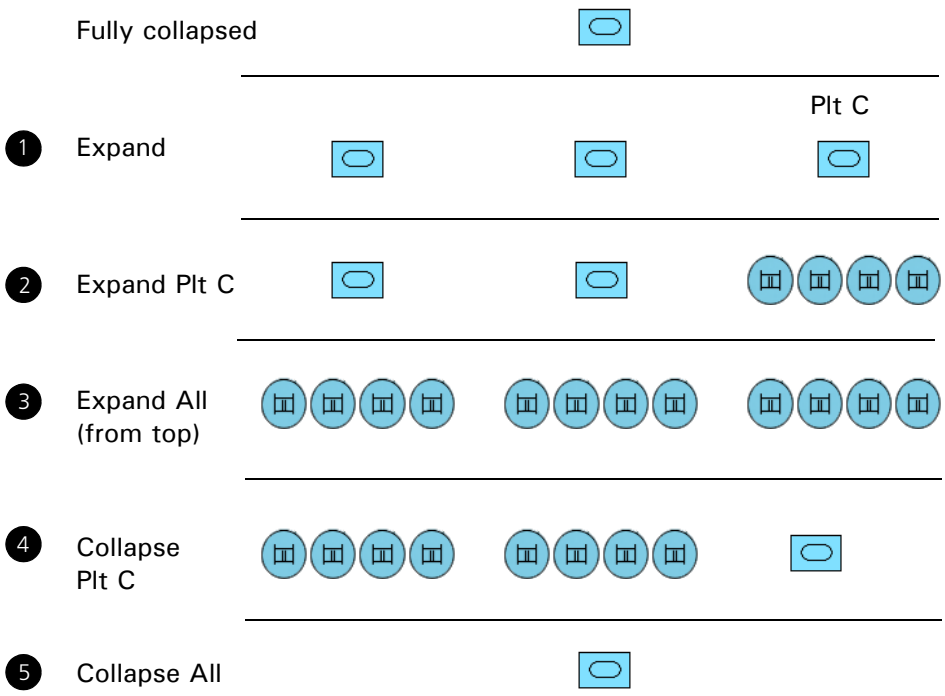


Figure 19-2. Unit expand and collapse

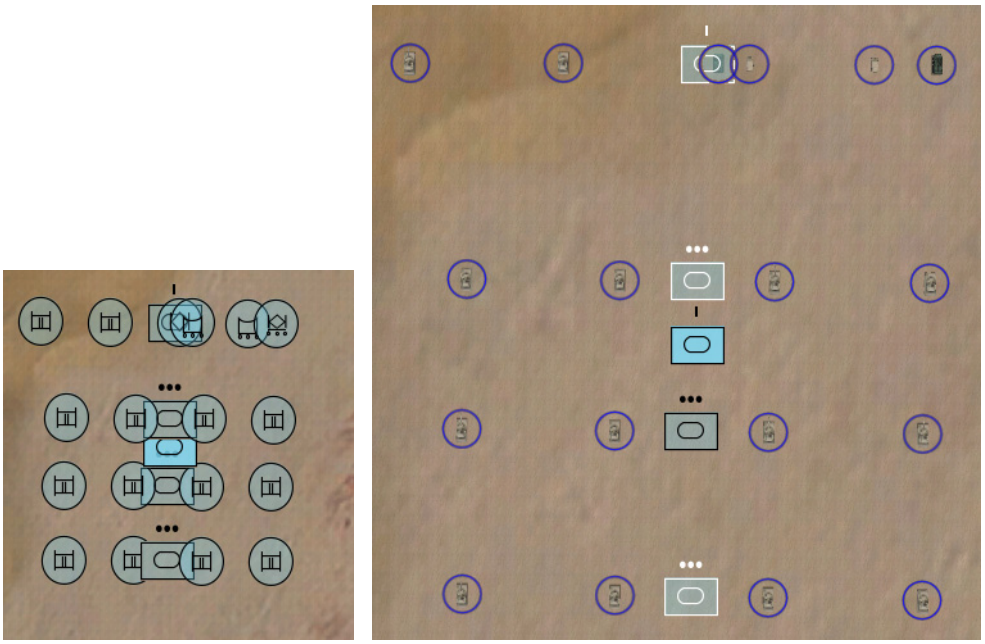
- To expand a unit, right-click the unit icon or its entry in the Objects List Panel and choose **Expand** on the popup menu.
- To expand a unit and all its subordinate units, right-click the unit icon or its entry in the Objects List Panel and choose **Expand All** on the popup menu.
- To collapse a unit one level, right-click any member of the unit and choose **Collapse** on the popup menu.
- To collapse a unit to its root level, right-click any member of the unit and choose **Collapse All** on the popup menu.

19.3. Displaying Ghosted Icons

If you want to select units, you need to collapse them so that you can select the unit icon. However, when you do this, you can no longer see where individual subordinate simulation objects are located and if subordinates are destroyed, you cannot see which ones are destroyed and which are functional. VR-Vantage provides the following options for displaying unit icons so that you can work with them in a way that best meets your visualization and simulation object management needs:

- Display ghosted icons for hidden simulation objects.
- Allow ghosted icons to be selected.
- Display all unit members.
- Manually expand and collapse the display.
- Display leaf-level unit members.

In the Plan View observer mode, when you display ghosted units, the unit icon is displayed normally, and the subordinate members are displayed using semi-transparent icons. In 3D observer modes, units that are subordinate to the top level unit are displayed using semi-transparent icons. Leaf-level entities are displayed using the appropriate model for the observer mode (Figure 19-3).



2D 3D

Figure 19-3. Ghosted icons

To configure the display of unit icons:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 19-4).

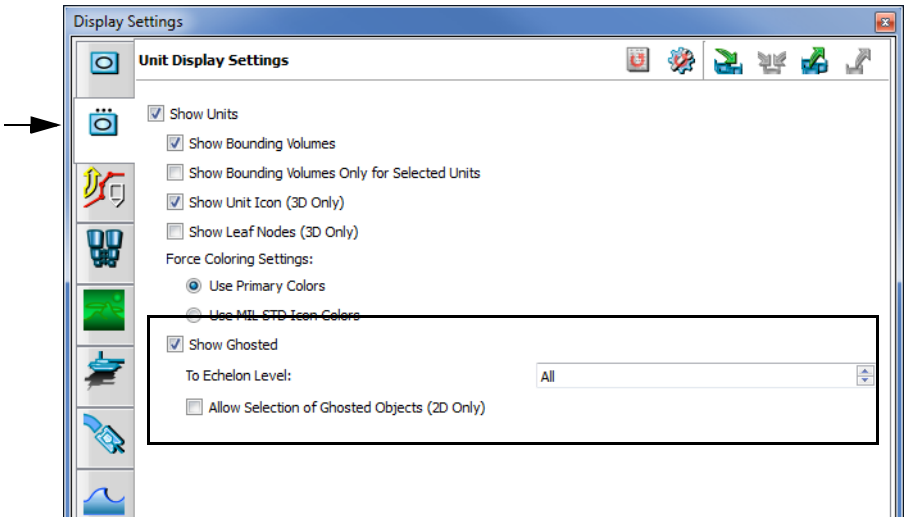


Figure 19-4. Unit Display Settings page

3. To display unit members based on the current level of aggregation only, clear Show Ghosted.
4. To display ghosted icons:
   a. Select Show Ghosted.
   b. In the To Echelon Level box, select the level of aggregation to show ghosted icons for. To show all levels without needing to consider how many levels there are, select All. Figure 19-5 illustrates the effect of changing the echelon level for displaying ghosted icons for the VR-Forces unit hierarchy shown.

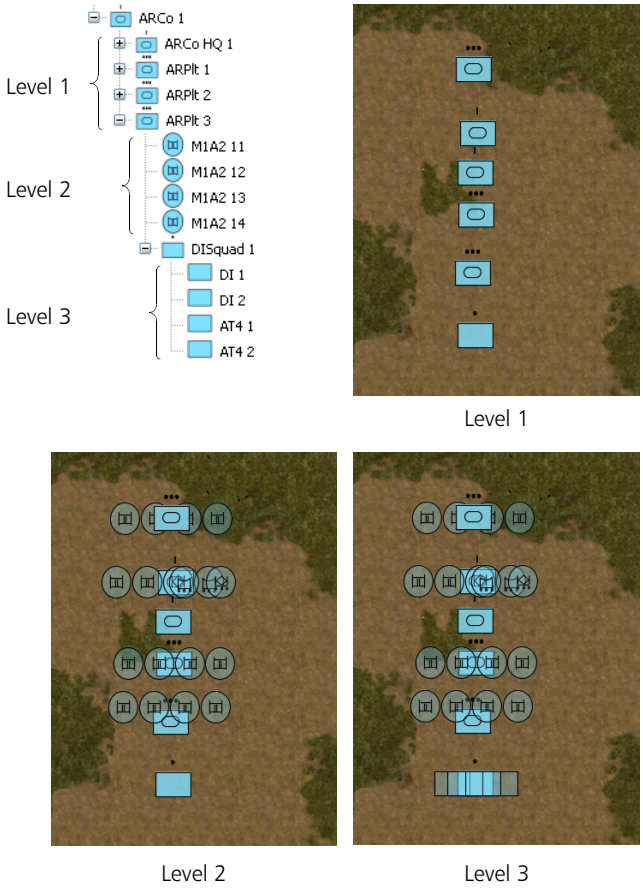


Figure 19-5. Displaying ghosted icons by echelon level

19.4. Displaying Unit Icons and Bounding Volumes

VR-Vantage lets you configure when to display unit icons and bounding volumes. Bounding volumes are translucent polygons that show the extents of the unit. This is useful when the individual entity icons or models are not displayed. You can configure icons and bounding volumes as follows:

- Enable and disable the display of units. When disabled, only the 2D icons or 3D models for leaf level unit members are displayed.
- Enable and disable the display of bounding volumes. Bounding volumes are displayed only for collapsed units. You can restrict the display of bounding volumes to the selected units.
- In 3D observer modes, enable or disable the display of unit icons.

Figure 19-6 shows a unit bounding volume in Stealth observer mode, with leaf nodes displayed.

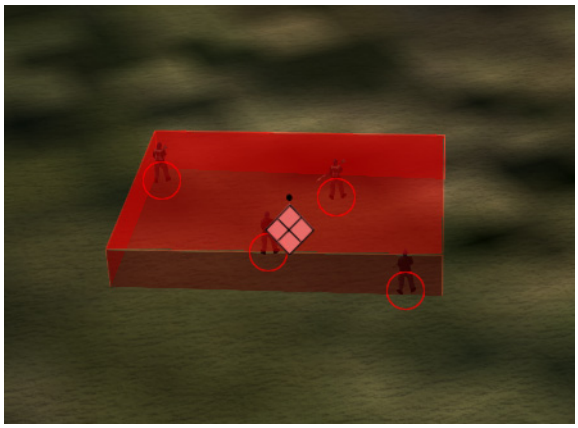


Figure 19-6. 3D bounding volume

Figure 19-7 shows a unit bounding volume in Plan View observer mode, with ghosting enabled.

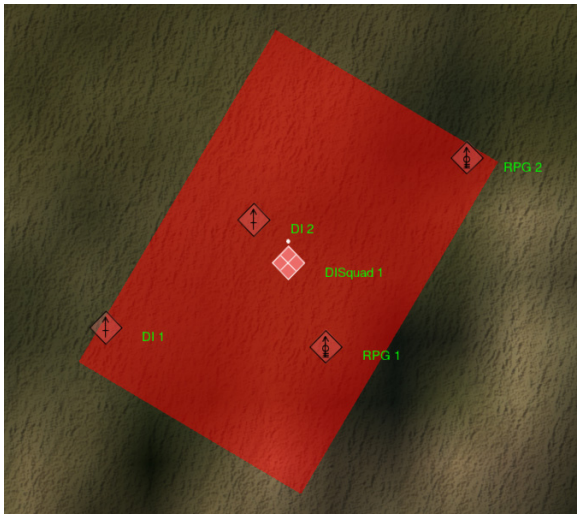


Figure 19-7. 2D bounding volume

You can display unit icons without showing bounding volumes and vice versa.

To configure the display of unit icons and bounding volumes:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 19-4).
3. To enable the display of unit icons, bounding volumes, or both, select Show Units.
4. To display bounding volumes for collapsed units, select Show Bounding Volumes.
5. To restrict the display of bounding volumes to the selected units, select Show Bounding Volumes Only for Selected Units.
6. To display unit icons in 3D observer modes, select Show Aggregate Icon (3D Only).



You can also enable and disable units by choosing **Settings** → **Units** or by selecting the Units button ( ) on the Display Settings Toolbar.

19.4.1. Specifying the Color Scheme for Unit Bounding Volumes

Unit bounding volumes can be displayed using primary colors or MIL-STD colors.

To specify the color scheme to use for unit bounding volumes:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 19-4).
3. Select the Force Coloring Settings option that you want (Use Primary Colors or Use MIL-STD Icon Colors).



VI. Visual and Audio Effects

VR-Vantage has many visual effects that add to your understanding of the interactions between simulation objects. These include fire and detonation lines, communications lines, and emitter volumes. You can test for line-of-sight with the intervisibility feature. You can also display many different lighting effects.



20. Viewing Entity Effects

This chapter describes how to display various types of entity-related graphics.

Using Ground Clamping 20-2
Configuring Ground Clamping 20-3
Trajectory Smoothing 20-4
Configuring Trajectory Smoothing 20-5
Displaying Trailing and Decal Effects (3D Only) 20-6
Specifying Models for Trailing Effects and Decal Effects 20-8
Displaying Track Histories 20-8
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Viewing Fire and Detonation Effects 20-10
Viewing Fire and Detonation Lines 20-11
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Configuring the Lifetime and Display Mode 20-16
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Configuring Depth of Field 20-21
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Enabling Buoyancy for Surface Entities 20-23
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20.1. Using Ground Clamping

Because of differences in terrain databases among exercise participants, entities can sometimes appear to be underground or hovering above the terrain surface. To compensate, VR-Vantage can clamp land and sea entities to the terrain surface. When ground clamping is enabled, VR-Vantage keeps an entity anchored to the terrain surface regardless of the altitude data contained in its state update.



Use of ground clamping can reduce your frame rate. If you correlate the simulation and visualization terrain databases, you can eliminate the need to use ground clamping.

To enable or disable ground clamping:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 20-1).

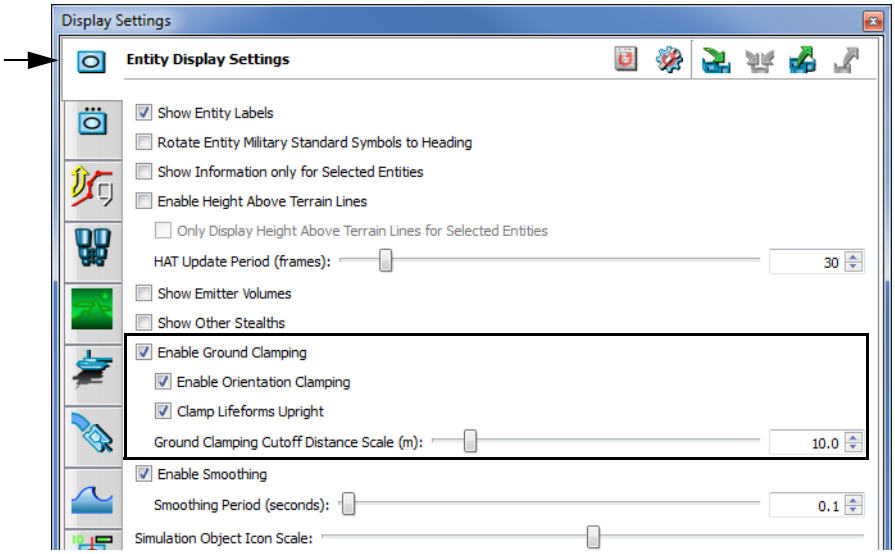


Figure 20-1. Ground clamping settings

3. Select or clear the Enable Ground Clamping check box.



You can also enable and disable ground clamping by choosing **Settings** → **Ground Clamping**, or clicking the Ground Clamping button (▾) on the Display Settings Toolbar.

20.1.1. Configuring Ground Clamping

You can configure the following aspects of ground clamping:

- Enable or disable ground clamping.
- Enable or disable orientation clamping.
- Force lifeforms to remain upright relative to the plane of their location when moving up slopes or steps, rather than being perpendicular to the terrain.
- The distance from the terrain within which entities are clamped.

To configure ground clamping:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 20-1).
3. To enable or disable a ground clamping option, select or clear its check box.
4. To specify the distance from the terrain in which entities are ground clamped, adjust the Ground Clamping Cutoff Distance Scale slider or type a value, in meters, in the box. You can also access the Ground Clamping Cutoff Distance Scale slider by clicking the down arrow next to the Ground Clamping button ( ) on the Display Settings Toolbar.



The setting for the Ground Clamping Cutoff Distance Scale maximizes at 100 meters. If you set it to the maximum, the distance is infinite and all entities are ground-clamped.

20.2. Trajectory Smoothing

From the time VR-Vantage receives a state update message for a simulation object until it receives the next update, it calculates the location of the simulation object based on the heading and acceleration in the most recent state update. This process is called dead-reckoning. When the next state update arrives for the simulation object, VR-Vantage moves it to the new position. If the actual position is significantly different from the dead-reckoned position, the simulation object could appear to jump from the dead-reckoned position to the actual position. VR-Vantage can eliminate these discontinuities by smoothing trajectories and rotation paths.

Figure 20-2 illustrates dead-reckoning and smoothing.

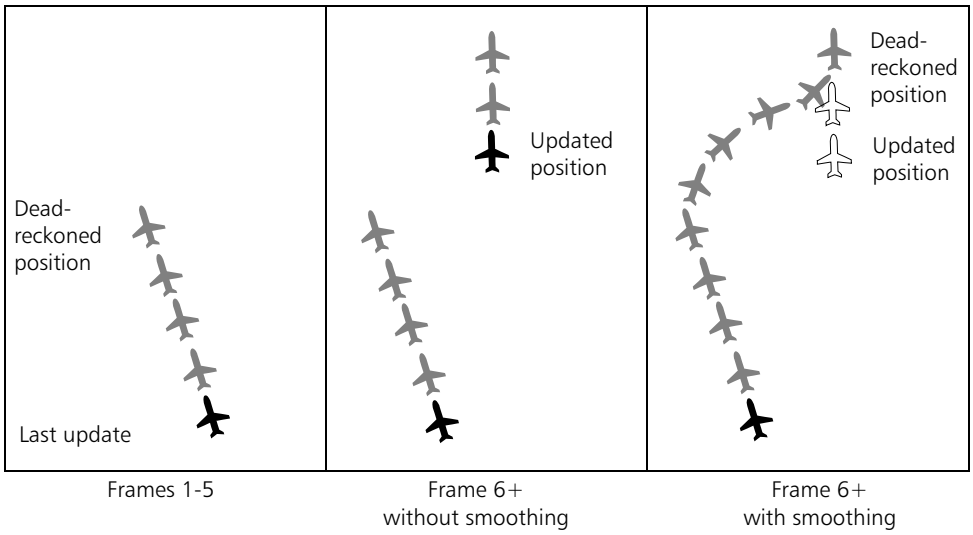


Figure 20-2. Dead-reckoning and smoothing

The smooth period is the period of time over which smoothing takes place. The default period is 1/10 second. If course corrections appear abrupt with this setting, you may want to increase the smooth period.

Smoothing makes fast-moving entities, such as fixed wing aircraft, look better. Slow moving entities, such as dismounted infantry, may look worse. If your simulation is mostly one or the other of these types of entities, enable or disable smoothing as appropriate for the best visualization experience.

20.2.1. Configuring Trajectory Smoothing

To configure trajectory smoothing:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 20-3).

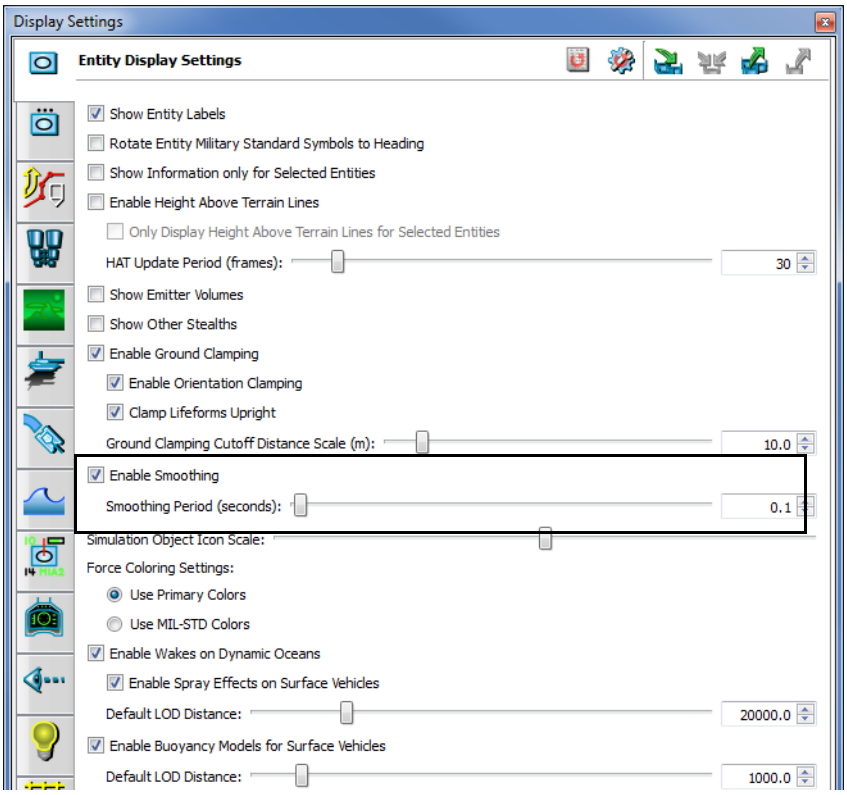


Figure 20-3. Smoothing settings

3. To enable or disable smoothing, select or clear the Enable Smoothing check box.
4. To change the smooth period, adjust the Smoothing Period slider or type a value, in seconds, in the box.

20.3. Displaying Trailing and Decal Effects (3D Only)

VR-Vantage supports trailing effects such as contrails for missiles and aircraft and dust clouds for vehicles. It also supports decal effects, such as tire tracks, footprints, and wakes. In essence, trailing effects are effects that are dispersed through the air, while decal effects are effects that are printed on the ground.

Trailing effects and decal effects are properties of an observer mode. You can enable and disable them on a per-observer basis.

Figure 20-4 illustrates some trailing effects.



Figure 20-4. Tank tracks, dust cloud

To enable or disable trailing effects or decal effects:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 20-5).

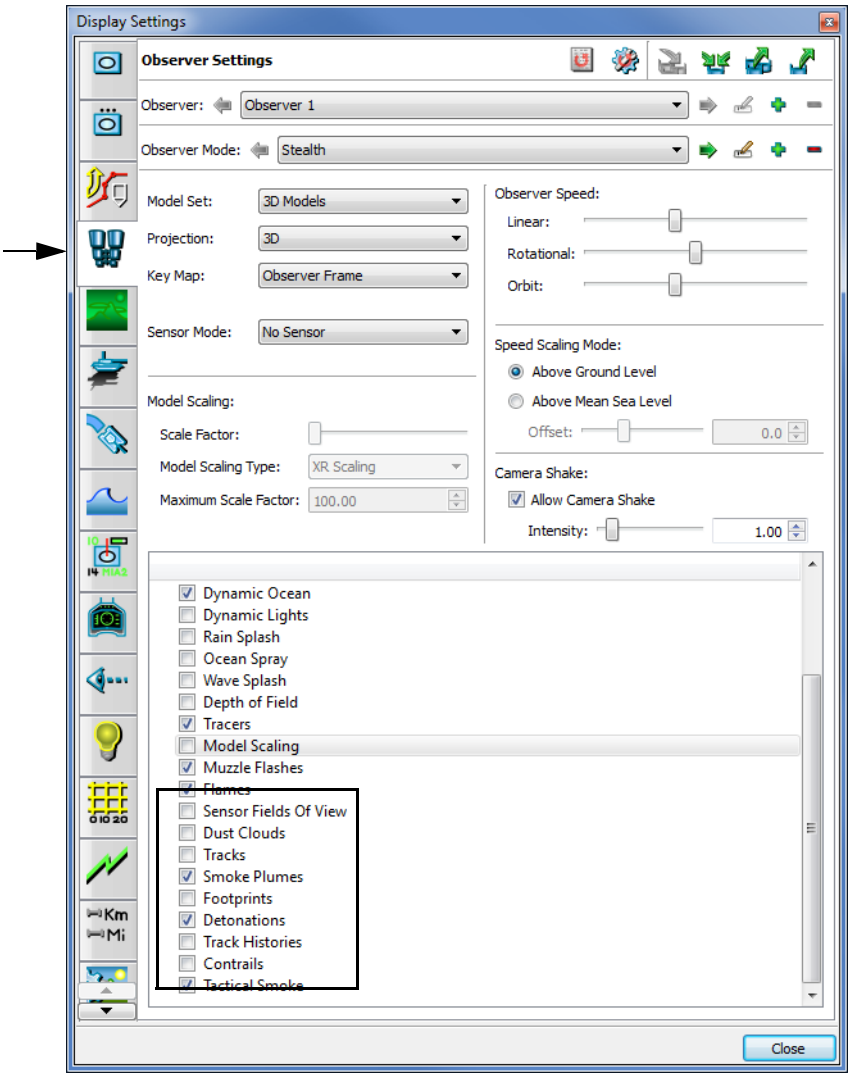


Figure 20-5. Display Settings dialog box, Observer Settings

3. Select or clear the check box for each effect that you want to change.



You can also enable and disable trailing and decal effects by choosing **Observer** → *effect* or clicking the appropriate button on the Observer Settings Toolbar.

20.3.1. Specifying Models for Trailing Effects and Decal Effects

Trailing effects and decal effects are configured through model definitions. (For the purposes of configuration, trailing effects are categorized as decals.) Each effect must have a model definition that uses a decal schema. Then, in an entity's entity definition, you configure a visualizer for the effect. For details about creating model definitions, please see "Creating and Editing Model Definitions," on page 28-12.

20.4. Displaying Track Histories

Track histories allow you to track the paths of simulation objects during an exercise, including the path of munitions as they travel from the shooter to the target. When track histories are enabled, each simulation object leaves a track ribbon. The ribbon is colored based on the simulation object's force. Figure 20-6 illustrates track histories.

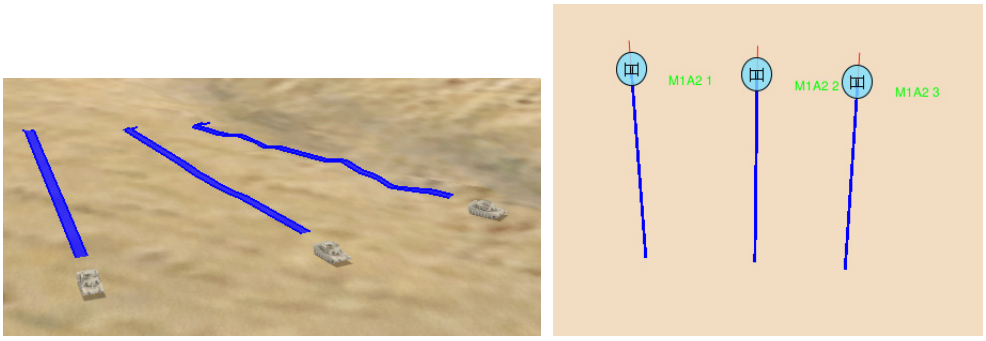


Figure 20-6. Track history

Track histories are a property of an observer mode. You can enable and disable them on a per-observer basis.

> Track histories have a significant performance and memory cost. For simulations with large simulation object counts, turning track histories off can improve performance and memory usage.

To enable or disable display of all track histories:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 20-5).
3. Select the observer mode for which you want to change the Track Histories setting.
4. Select or clear the Track Histories check box.



You can also enable or disable track histories by choosing **Observer** → **Track Histories** or clicking the Track Histories button ( ) on the Observer Settings Toolbar.

20.4.1. Configuring Track Histories

You can configure how long track history ribbons are drawn. A track history is composed of a series of segments, joined together to form a line. You can configure how long each segment is and how many segments at a time can be displayed. Drawing shorter segments improves the accuracy of the track history, but can degrade performance. Increasing the maximum number of segments provides a longer history, but can clutter up the screen if there are many simulation objects and can also affect performance. Figure 20-7 illustrates the visual result of drastically changing the segment length. The left track history uses the default segment length of 0.5 meters. The right track history has a segment length of 5000 meters.



0.5 M segment length

5000 M segment length

Figure 20-7. Track history segment length

When a track history reaches the maximum number of segments configured, it starts dropping segments from the beginning of the history (the oldest segments).

You can specify that track histories have an infinite length. In this case they never drop segments.

If you specify infinite length for track histories, it is possible that you could eventually use up all the memory in your computer and the program would crash.

To configure track histories:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Track History Settings page (Figure 20-8).

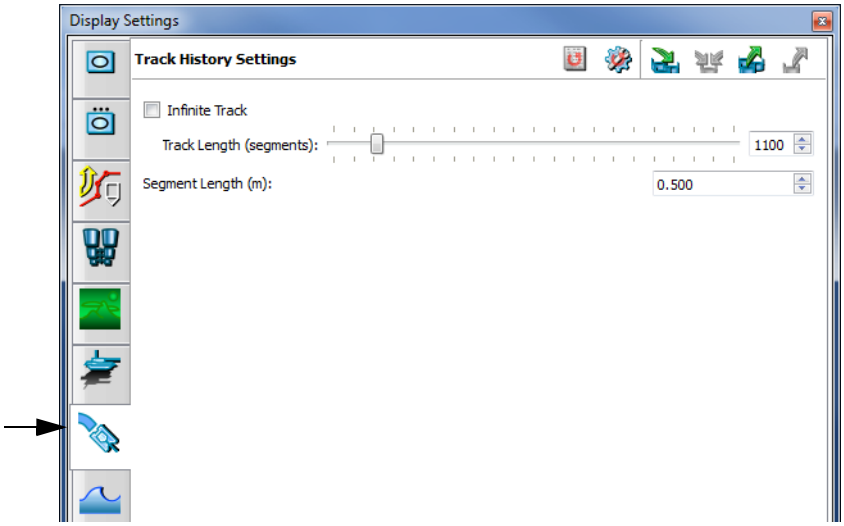


Figure 20-8. Track History Settings page

3. If you want track histories to have an indefinite length, select the Infinite Track check box.
4. To change the number of segments that can be displayed for a track history, adjust the Track Length slider, or enter a value in the box.
5. To specify the length of each track history segment, enter a value in the Segment Length box.

20.5. Viewing Fire and Detonation Effects

VR-Vantage can display the following graphic effects when munitions are fired and detonated:

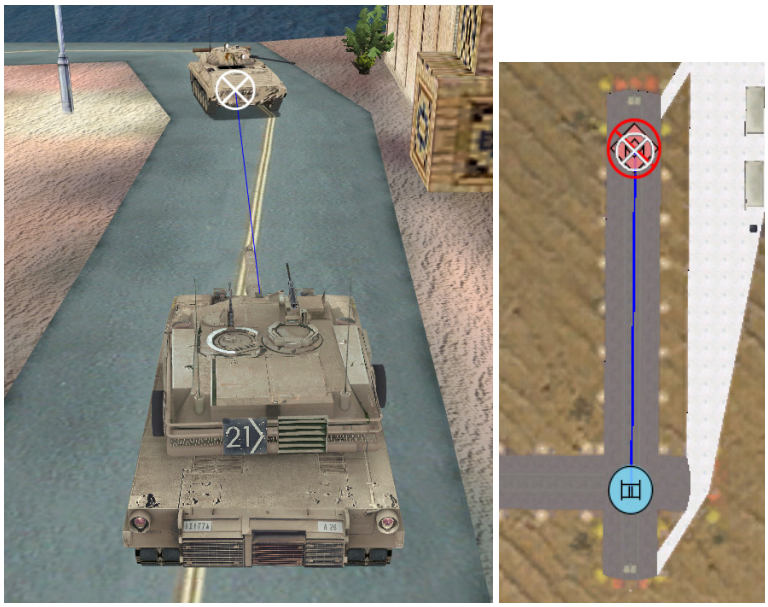
- Flaming effects.
- Smoke plumes.
- Detonations.
- Muzzle flashes.
- Tracers. Tracers are displayed if the munition in a fire interaction is a tracer munition and the munition is mapped to a tracer model. Tracers are not supported in 2D observer modes.

➤ To enable or disable display of a fire or detonation effect, choose **Observer** → *effect*, where *effect* is Flames, Smoke Plumes, Detonations, Muzzle Flashes, or Tracers, or click the appropriate button on the Observer Settings toolbar.

20.6. Viewing Fire and Detonation Lines

If fire and detonation lines are enabled, when an entity fires a munition, a line is drawn between the entity and the location of the detonation. The line is colored for the force of the shooter (Figure 20-9).

Fire and detonation lines are not supported in VR-Vantage IG.



3D 2D

Figure 20-9. Fire line and detonation

A detonation is identified by a circle with an X through it. The detonation color indicates the result of the detonation, as follows:

- Entity impact – white.
- Ground impact – gray.
- Airburst – black.
- Other – white.

➤ To enable or disable display of fire and detonation lines, choose **Settings** → **Fire / Detonate Lines** or click the Fire/Detonate Lines button ( ) on the Display Settings Toolbar.

20.7. Displaying Tactical Smoke

VR-Vantage can display tactical smoke munitions fired by entities. You may want to disable tactical smoke if it obscures the observer's view. Also, if many entities are generating smoke, it could affect performance.



Do not confuse tactical smoke and smoke plumes. Smoke plumes are a visual effect displayed when an entity is on fire. Tactical smoke visualizes a smoke munition.

➤ To enable or disable display of tactical smoke, choose **Observer** → **Tactical Smoke**, or click the Tactical Smoke button () on the Observer Settings toolbar.

20.8. Displaying Electromagnetic Emissions

VR-Vantage can display electromagnetic emissions (emitter volumes) for entities that have emitter systems (Figure 20-10). You can configure the colors used to represent emitter frequencies and you can configure the size of the emitter volumes.

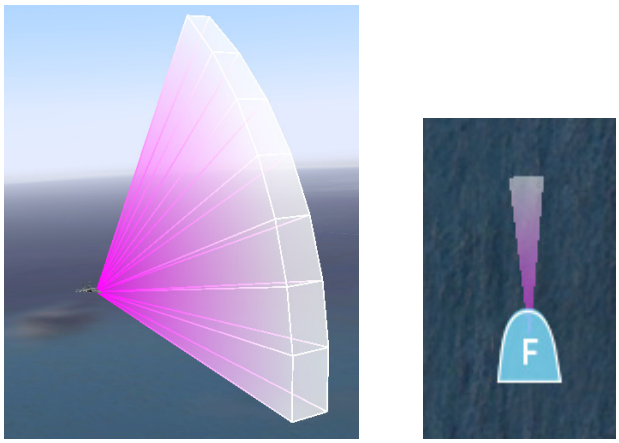


Figure 20-10. Emitter volumes

To enable or disable display of electromagnetic emissions:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 18-4).
3. Select or clear the Show Emitter Volumes check box.



You can also enable or disable emitter volumes by choosing **Settings** → **Emitter Volumes**, or clicking the Emitter Volumes button ( ) on the Display Settings Toolbar.

20.9. Displaying Radio Communication Lines

VR-Vantage can display squawk indicators when a simulation object sends a signal interaction. It can also display communication lines between simulation objects when a VR-Forces simulation object (or a simulation object in an application built with the appropriate MÄK libraries) sends a radio message to another simulation object. You can configure a communication line's color and lifetime. Figure 20-11 displays squawk indicators and a line-of-sight communication line.



Figure 20-11. Radio communication line and squawk indicators

For communications over large distances, a line-of-sight communication line would travel through the earth. Therefore, you can also display communication lines drawn with the curvature of the earth (Figure 20-12).

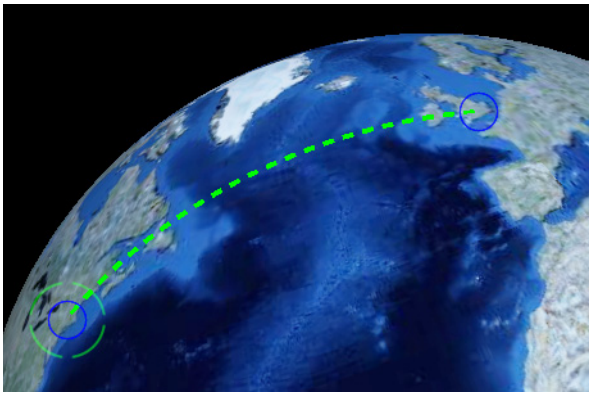


Figure 20-12. Curvature of the earth communication line

20.9.1. Enabling Radio Communications Graphics

You can globally enable or disable the ability to display radio communication lines. When they are enabled, you can enable and disable communication lines and squawk indicators separately.

To enable or disable radio communications graphics:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 20-13).

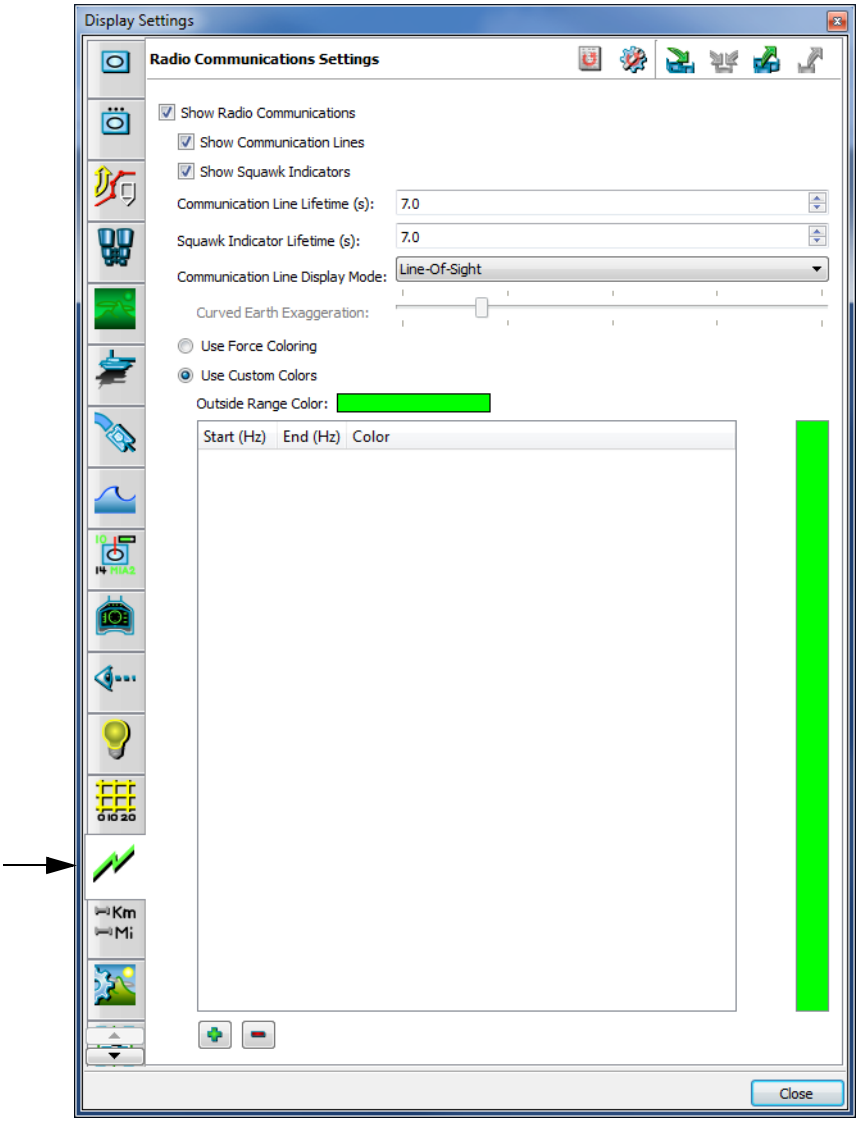


Figure 20-13. Radio Communications Settings page

3. Select or clear the Show Radio Communications check box.



You can also enable and disable communication lines by choosing **Settings** → **Radio Communication Display** or by clicking the Radio Communications button () on the Display Settings Toolbar.

To enable or disable communication lines:

1. Enable radio communication lines.
2. Select or clear the Show Communication Lines check box.

To enable or disable squawk indicators:

1. Enable radio communication lines.
2. Select or clear the Show Squawk Indicators check box.

20.9.2. Configuring the Lifetime and Display Mode

You can configure how long a radio communication line is displayed. You can also configure whether it is displayed using line-of-sight or curvature of the earth.

To configure the lifetime and display mode for radio communication lines:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 20-13).
3. To specify how long a communication line or squawk indicator should be displayed, enter a value, in seconds, in the Communication Line Lifetime and Squawk Indicator Lifetime fields.
4. To specify the display mode, select an option in the Communication Line Display Mode list.
5. If you select Curvature of the Earth, adjust the Curved Earth Exaggeration slider to change the degree to which the curvature is exaggerated.

20.9.3. Configuring the Color of Radio Communication Lines

By default, radio communication lines are green. You can configure communication lines to use force coloring or to be colored based on the frequency of the message. When you color by frequency, you specify colors for the frequency ranges you are interested in and a color to use for all messages outside the specified frequencies.

To configure the color of radio communication lines:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 20-13).
3. To color radio communication lines using the force color, select the Use Force Coloring option.
4. To color radio communication lines by frequency:
   a. Select the Use Custom Colors option.
   b. Click the Add button (+). A range is added to the frequency list with a default color (Figure 20-14).

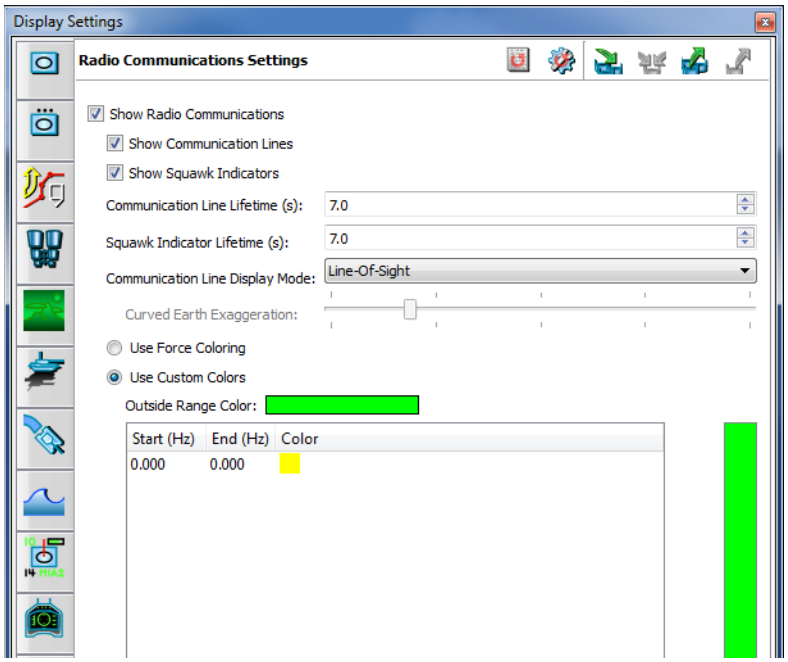


Figure 20-14. New frequency point

   c. Double-click the starting value of the range to make it editable (Figure 20-15).

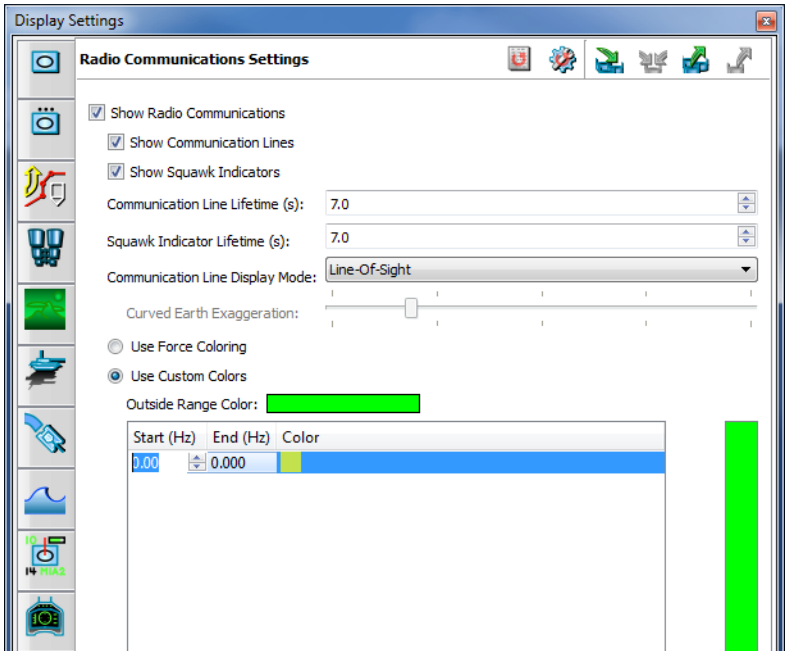


Figure 20-15. Editable frequency point

d. Type the starting frequency you want to use.

e. Edit the end frequency.

f. Double-click the color swatch and select a color for this range.

g. Optionally, add points for different frequency ranges.

h. Optionally, click the Outside Range Color color swatch and specify a color for all frequencies not specified in the frequency list.

If you configure multiple frequency ranges, you cannot add a range whose values are within those of an existing range.

20.10. Using the Depth of Field Effect

Depth of field controls the area in the scene that is in focus. Depth of field is calculated based on a focal depth and a focal range. The focal depth is the distance from the observer that is the center (focal point) of the area in focus. The focal range is the distance from the focal point that is in focus.

In Figure 20-16, the focal depth is about 10 meters, fairly close to the observer, and the focal range is also small, so that the scene is out of focus just past the car (note that the first large tree is out of focus). In Figure 20-17, the focal depth is the same, but the range is much greater, so the scene is in focus to the back of the parking lot.

In Figure 20-18 the focal depth is centered at the second large tree. The focal range is, again, fairly narrow, so that the person and car in the foreground are out of focus.

VR-Vantage lets you set the focal depth automatically or manually. In either case, you can adjust the focal range.



Figure 20-16. Depth of field (close)



Figure 20-17. Depth of field (far)



Figure 20-18. Depth of field, middle distance

To enable depth of field:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 20-5).
3. Select the observer mode for which you want to enable depth of field.
4. Select or clear the Depth of Field check box.



You can also enable or disable depth of field by choosing **Observer** → **Depth of Field** or clicking the Depth of Field button ( ) on the Observer Settings Toolbar.

20.10.1. Configuring Depth of Field

You can enable and disable automatic depth of field and you can adjust the focal depth and focal range.

To configure depth of field:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 20-19).

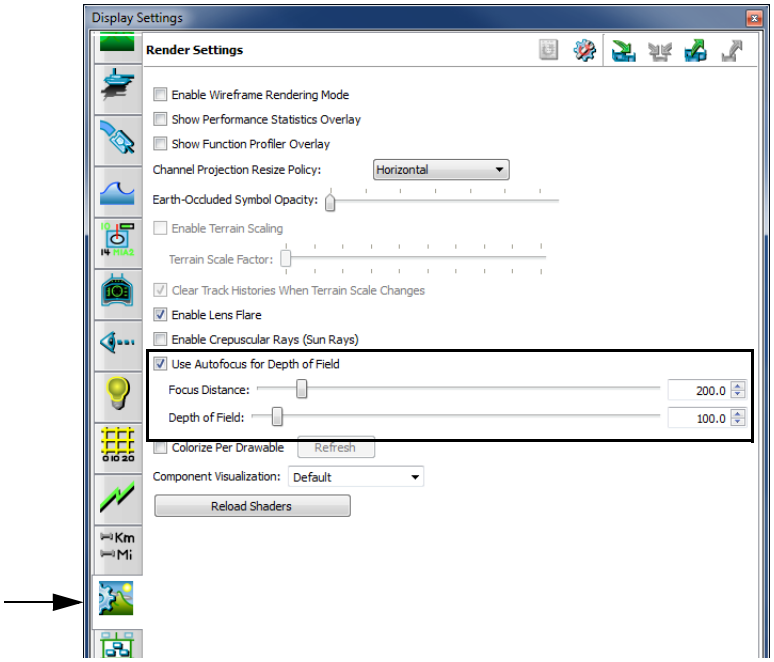


Figure 20-19. Depth of Field settings

3. To use autofocus for focal depth, select the Use Autofocus for Depth of Field check box.
4. To set the focal depth manually, clear the Use Autofocus for Depth of Field check box and adjust the Focus Distance slider or specify a value in the box.
5. To adjust the focal range, adjust the Depth of Field slider or specify a value in the box.

20.11. Displaying Wakes and Spray Effects

When dynamic ocean is enabled, surface entities display wakes and spray effects. However, these effects affect performance. You can disable them if you need to emphasize performance over visual effects.

Wakes have their own schema, with many attributes, including length, offset, the amount of time over which they fade out, and LOD distance. You can edit these attributes for individual entities in the Visual Model Editors dialog box.

To enable or disable wakes and spray effects:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 20-20).

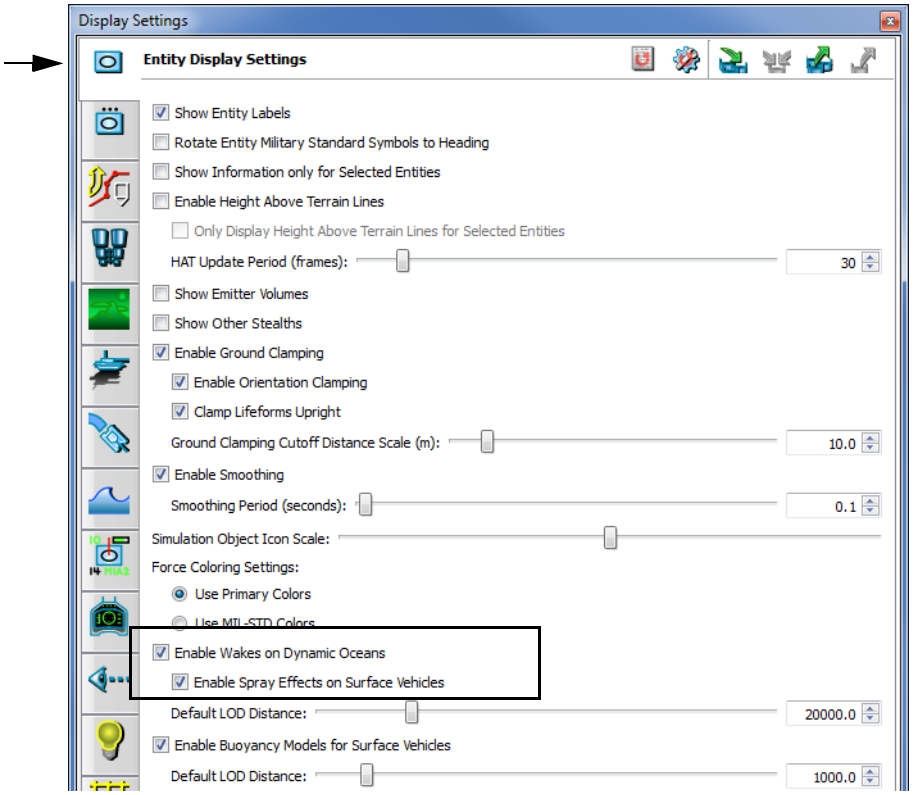


Figure 20-20. Entity Display Settings page

3. To enable or disable wakes, select or clear the Enable Wakes on Dynamic Oceans check box, or toggle the Wake button ( ) on the Display Settings Toolbar.
4. If wakes are enabled, select Enable Spray Effects on Surface Vehicles to enable spray effects. Clear the check box to disable them. Disabling wakes also disables spray effects.

20.12. Enabling Buoyancy for Surface Entities

When dynamic ocean is enabled, surface entities can bob up and down with wave action. However, the buoyancy models affect performance. You can disable buoyancy if you need to emphasize performance over visual effects. You can also control the area in which buoyancy models are calculated.

If buoyancy is enabled, VR-Vantage calculates buoyancy only for models within certain distances of the observer, as follows:

- Buoyancy models are always calculated for entities within the minimum cull distance. This ensures that if the observer turns, entities that are relatively near will show buoyancy immediately.
- Buoyancy models are not calculated for entities that are beyond the maximum buoyancy LOD range. You can set this value on a per-entity basis in its entity model definition. If it is not set in the model definition, VR-Vantage uses the default LOD distance specified on the Entity Display Settings page. If the default distance is set to 0., then entities that do not have an LOD range set in their model definitions will have an infinite buoyancy range (although buoyancy still will not be calculated past the far clipping plane).
- Buoyancy models are not calculated for entities beyond the far clipping plane or nearer than the near clipping plane.

VR-Vantage uses the nearer of the far clipping plane or the maximum buoyancy LOD range to determine the distance at which it stops calculating buoyancy models.

Given the buoyancy modeling constraints described in the previous paragraphs, you have two options for how VR-Vantage decides how to cull processing of buoyancy models:

- Face Front Culling. VR-Vantage calculates buoyancy models for all entities within the minimum range and all entities between the near clipping plane and the far clipping plane or maximum buoyancy LOD range, whichever is closest. In Figure 20-21, the shaded area is the area in which buoyancy models are calculated.

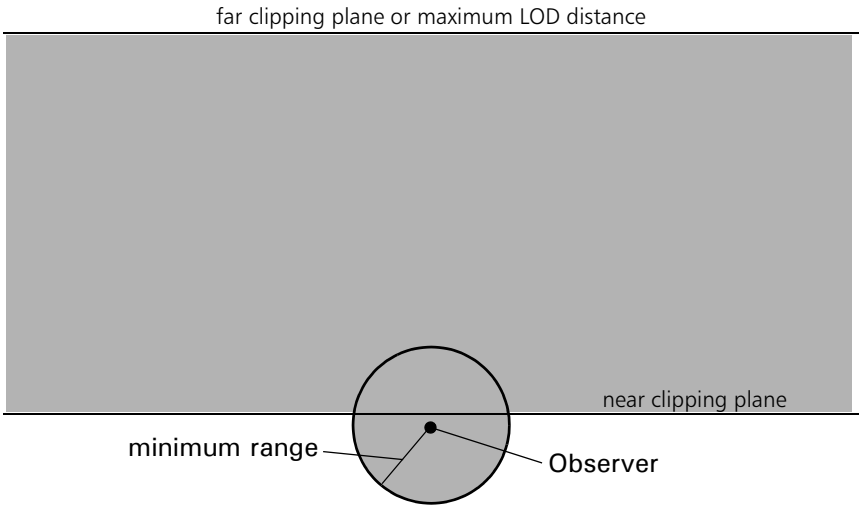


Figure 20-21. Face front culling

- View Frustum Culling. VR-Vantage calculates buoyancy models for all entities within the minimum range and entities within the view frustum of any observer and no further than the far clipping plane or maximum buoyancy LOD range, whichever is closest. In Figure 20-22, the shaded area is the area in which buoyancy models are calculated.

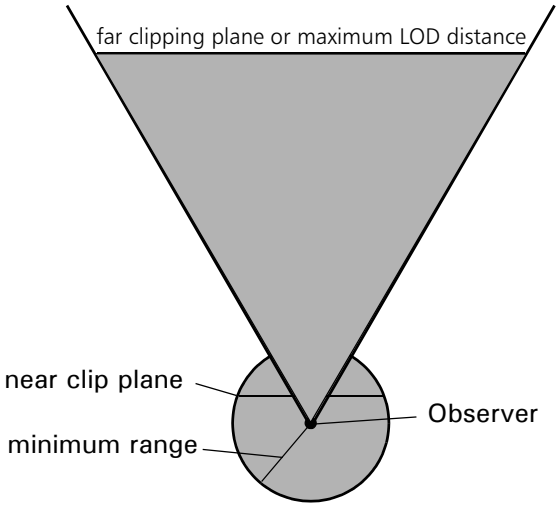


Figure 20-22. Frustum culling

To enable or disable the buoyancy models:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 20-20).
3. Select or clear the Enable Buoyancy Models for Surface Vehicles check box.
4. To specify the distance beyond which buoyancy models are not calculated, adjust the Default LOD Distance slider or change the value in the box. (If the default distance is set to 0, then entities that do not have an LOD range set in their model definitions will have an infinite buoyancy range. However, buoyancy will not be calculated past the far clipping plane.)
5. To specify the radius within which all entities have their buoyancy models calculated, adjust the Minimum Cull Distance slider or change the value in the box.
6. Specify the cull type, either Face Front Culling or View Frustum Culling. Please see the discussion of buoyancy for details.

20.13. Displaying Laser Designators

You can display laser designation information if it is available. VR-Vantage displays a green circle and a range (on top of the entity icon or model) (Figure 20-23).

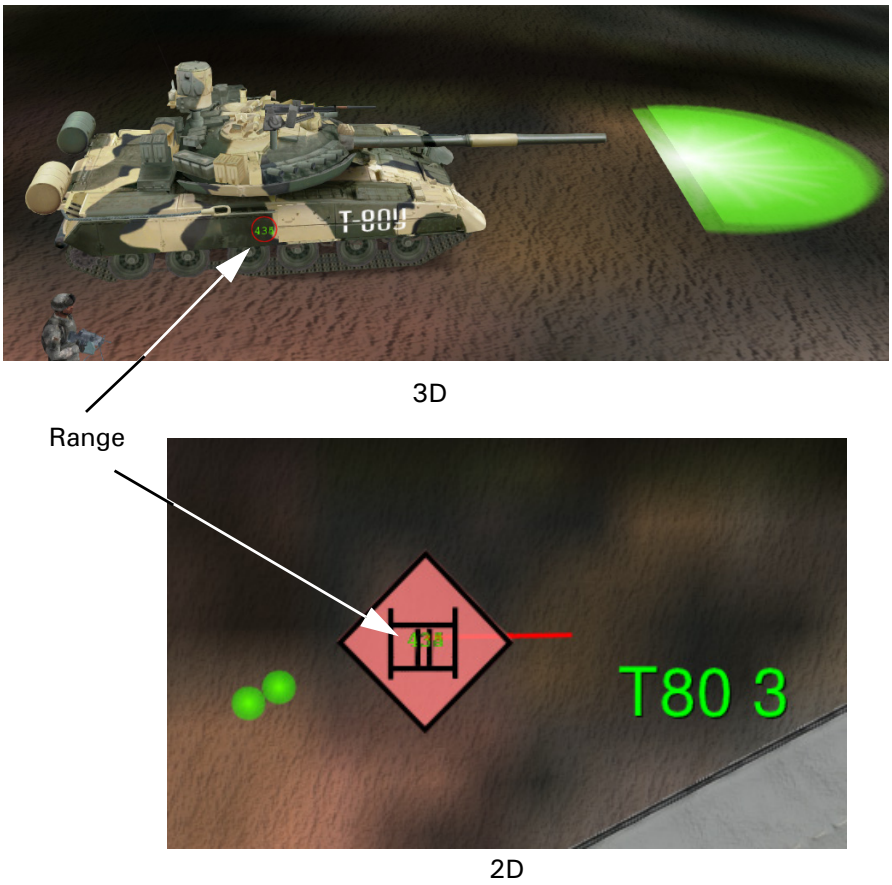


Figure 20-23. Laser designators

➤ To display laser designators, on the Display Settings Toolbar, click the Laser Designator button ( ).



21. Intervisibility Objects

Intervisibility objects show line-of-sight between entities or objects in the simulation.

Intervisibility (Line-of-Sight) 21-2
Types of Intervisibility 21-3
Point-to-Point Intervisibility 21-3
Intervisibility Fan 21-4
Entity Intervisibility 21-4
Intervisibility Objects can be Transient or Permanent 21-5
Creating a Transient Intervisibility Object 21-6
Creating a Permanent Intervisibility Object 21-7
Editing an Intervisibility Object 21-8
Configuring Intervisibility Lines and Fans 21-9
Pinning an Intervisibility Object to a Simulation Object 21-10
Showing and Hiding Intervisibility Lines 21-10
Displaying Intervisibility Line Information 21-11
Deleting Intervisibility Objects 21-12

21.1. Intervisibility (Line-of-Sight)

You can display intervisibility (line-of-sight or LOS) between points, within areas, and between a point and all simulation objects in a defined area. Intervisibility displays can be transient or permanent. Permanent intervisibility displays are objects. You can resize them and move them around the terrain. Intervisibility objects can be tied to a particular simulation object.

VR-Vantage IG does not support intervisibility.

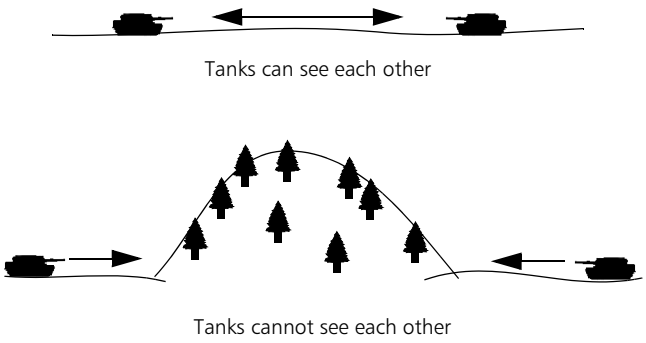


Figure 21-1. Intervisibility

You can configure parameters for intervisibility objects, such as the height above the terrain from which intervisibility is calculated. You can also change the colors used to display intervisibility.

- By default, intervisibility between simulation objects is calculated from the center of their bounding volumes. It is possible that this may not match the line-of-sight calculations used by the simulation application whose output you are viewing. If so, simulation objects may shoot at targets for which they do not appear to have line-of-sight.
- Linear and areal features do not block line-of-sight. Only point features block LOS.

21.2. Types of Intervisibility

VR-Vantage supports the following types of intervisibility:

- Point-to-point (intervisibility line).
- Intervisibility fan.
- Entity intervisibility.

The intervisibility fan and entity intervisibility are displayed as a circular area. However, intervisibility calculations are made within a cylindrical area extending above and below the terrain, so that intervisibility calculations can be made for air platform entities and subsurface entities.

In the 2D projection, intervisibility lines are fully visible on the terrain. In the 3D projection, they may pass through the terrain.

21.2.1. Point-to-Point Intervisibility

Point-to-point intervisibility (Figure 21-2) shows the line-of-sight between any two points. The portion of the line that is visible from the starting point is green. The portion that is not visible is red. You can change the colors used.

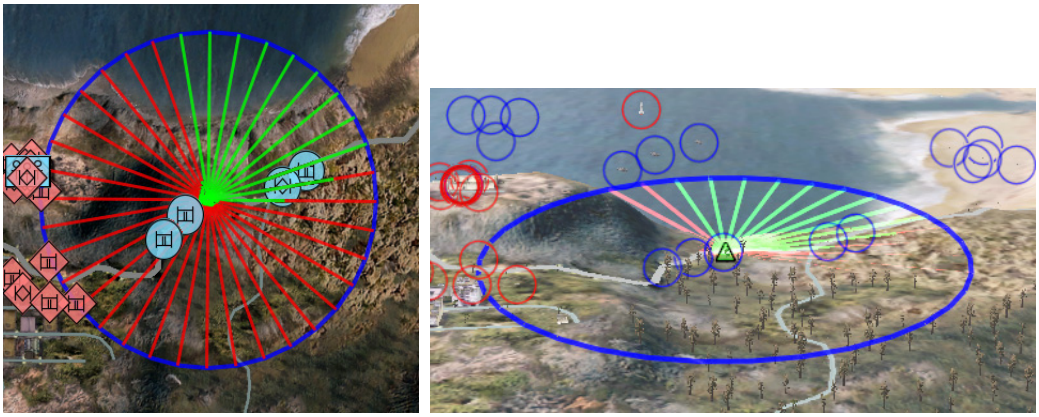


2D 3D

Figure 21-2. Point-to-point intervisibility

21.2.2. Intervisibility Fan

An intervisibility fan (Figure 21-3) shows a series of lines radiating from the center of a circle to its outer edge. Each ray shows intervisibility along its path from the origin to the border. You can configure the distance between rays. (For details, please see "Configuring Intervisibility Lines and Fans," on page 21-9.)



2D 3D

Figure 21-3. Intervisibility fan

21.2.3. Entity Intervisibility

Entity intervisibility (Figure 21-4) shows which simulation objects are visible from the center of a defined area and whether or not the simulation objects can see the center point. If you center the intervisibility circle on a point on the terrain, you can see which simulation objects can see that point. If you lock the circle to a simulation object, you can see which simulation objects can see that object and which it can see. (For details, please see "Configuring Intervisibility Lines and Fans," on page 21-9.)



2D 3D

Figure 21-4. Entity intervisibility

21.3. Intervisibility Objects can be Transient or Permanent

You can configure intervisibility objects to be transient or permanent. (For details, please see "Configuring Intervisibility Lines and Fans," on page 21-9.) A transient intervisibility object displays intervisibility from the origin point (defined by a mouse click) to wherever you move the cursor. If you click the mouse again, you reset the origin. You cannot use the mouse for other actions until you exit intervisibility mode (by right-clicking). This mode is convenient when you want to quickly check intervisibility, but do not want to keep intervisibility objects in the display.

A permanent intervisibility object stays in the display after you create it. You can resize the object, edit drawing options, and move it around the display.

21.3.1. Creating a Transient Intervisibility Object

Transient intervisibility objects do not stay in the display after you quit intervisibility mode.

To display transient intervisibility:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 21-5).

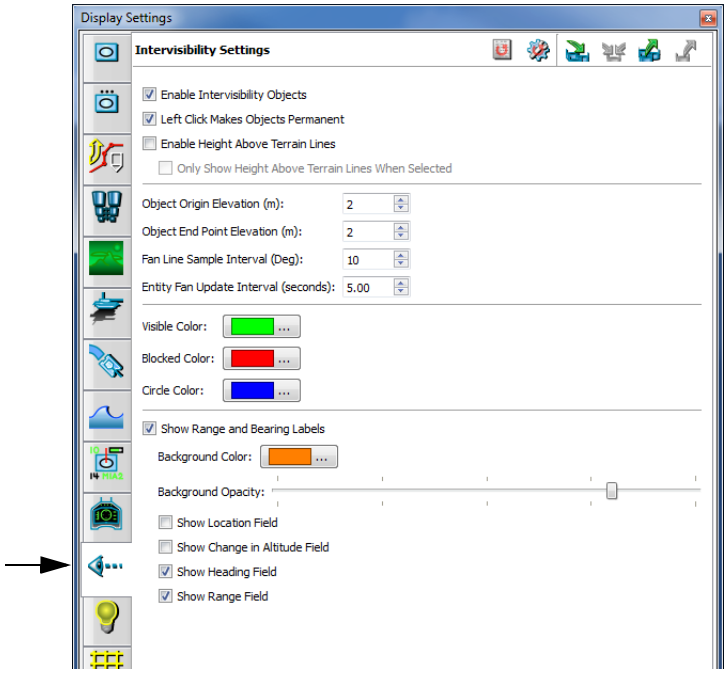


Figure 21-5. Intervisibility Settings page

3. Clear the Left Click Makes Objects Permanent check box.
4. Choose **Intervisibility** → **Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar.
5. Click on the terrain to place the origin of the intervisibility object.
6. Move the cursor around the terrain to expand and contract the object. For point-to-point intervisibility, moving the cursor also changes the direction of the line.
7. To change the origin of the intervisibility display, click another location on the terrain.
8. Right-click to cancel intervisibility mode.

21.3.2. Creating a Permanent Intervisibility Object

Permanent intervisibility objects remain in the display after you create them.

To create a permanent intervisibility object:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 21-5).
3. Select Enable Intervisibility Objects.
4. Select Left Click Makes Objects Permanent.
5. Choose **Intervisibility** → **Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar.
6. Click on a simulation object or on a location on the terrain where you want the origin of the intervisibility object to be located. An intervisibility object is displayed. As you move the cursor closer to the origin, or farther away from it, the circle or line contracts and expands. If you are displaying point-to-point, you can rotate the line around the origin before you specify the end point.
7. Click on the terrain where you want to fix the end point of a line or border of a circle.

21.4. Editing an Intervisibility Object

You can change the following aspects of an intervisibility object:

- Change the location of either end point of an intervisibility line, to change its length and direction.
- Change the origin of an intervisibility fan, thereby moving the entire fan.
- Change the diameter of an intervisibility fan.

If an intervisibility object is anchored to a simulation object, you cannot change the origin.

To change the length or diameter of an intervisibility object:

1. To edit a line, double-click its end point.

   To edit a fan, select the object, then double-click the outer ring of the fan.

   The cursor changes (✣).
2. Drag the end point or circle towards or away from the origin. If you are editing an intervisibility line, you can move the end point to any location.
3. Click to exit edit mode.

To revert to the original size of the intervisibility object, right-click while you are still in edit mode.

To move an intervisibility fan or line:

1. Double-click a fan's center point or any place on a line. The cursor changes.
2. Drag the object to a new location.
3. Click to set the location.

To revert to the original location of the intervisibility object, right-click while you are still in edit mode.

21.5. Configuring Intervisibility Lines and Fans

You can configure the following attributes of intervisibility objects:

- The elevation of the origin and end point.
- The sampling rate for intervisibility fans.
- The update rate for entity intervisibility fans.
- Display of height above terrain lines (3D) and height labels (3D and 2D).
- The colors used to display intervisibility objects.
- Display of range and bearing labels. For more information about range and bearing labels, please see "Displaying Intervisibility Line Information," on page 21-11.

When you change colors or the sampling rate, changes affect all existing intervisibility objects. Changes to the origin and end point elevation only affect newly created objects.

To configure intervisibility objects:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 21-5).
3. Change the settings as desired. Table 21-1 describes the settings.

Table 21-1: Intervisibility settings

Option	Description
Enable Height Above Terrain Lines	Enables or disables display of height above terrain lines (3D) and height labels (3D and 2D).
Show Height Above Terrain Lines Only for Selected	If selected, HAT lines are displayed only for the selected intervisibility objects.
Object Origin Elevation	The height, in meters, above the terrain at the origin point from which to calculate intervisibility.
Object End Point Elevation	The height, in meters, above the terrain at the end point to use to calculate intervisibility.
Fan Line Sample Interval	The distance, in degrees, between each ray in a intervisibility fan. After changing this value, press **`Enter`** or click away from the field.
Entity Fan Update Interval	How frequently, in seconds, to update the entity intervisibility fan.
Visible Color Blocked Color	The colors to use for the portion of an intervisibility line that a simulation object can see and the portion where visibility is blocked.
Circle Color	The color to use for the outer circle of an intervisibility fan.
Show Range and Bearing Labels	Enable or disable display of range and bearing labels.

Table 21-1: Intervisibility settings

Option	Description
Background Color	Specify the background color for range and bearing labels.
Background Opacity	Specify the opacity of the background for range and bearing labels.
Show Location Field	If range and bearing labels are displayed, show the location of the endpoints.
Show Change in Altitude Field	If range and bearing labels are displayed, show the difference in altitude between the endpoints.
Show Heading Field	If range and bearing labels are displayed, show the heading of each endpoint relative to the other point.
Show Range Field	If range and bearing labels are displayed, show the length of the intervisibility line.

21.6. Pinning an Intervisibility Object to a Simulation Object

When you pin an intervisibility object to a simulation object, the intervisibility object moves with the simulation object and you know that its origin is centered on the simulation object.

To pin an intervisibility object to a simulation object:

1. Select the simulation object to which you want to pin the intervisibility object.
2. Choose **Intervisibility** → **Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar. The origin is placed on the simulation object icon or model.
3. Specify the end point for the intervisibility object.

21.7. Showing and Hiding Intervisibility Lines

You can toggle the display of intervisibility lines on and off.

To enable or disable the display of intervisibility lines:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 21-5).
3. Select or clear the Enable Intervisibility Objects check box.



You can also enable and disable display of intervisibility objects by choosing **Intervisibility** → **Enable/Disable Intervisibility**, or by clicking the Enable/Disable Intervisibility button () on the Intervisibility Toolbar.

21.8. Displaying Intervisibility Line Information

You can display the following information about an intervisibility line:

- Location of each endpoint.
- Heading of the line from each endpoint.
- Altitude of each endpoint.
- Length of the line (range).



Figure 21-6. Intervisibility line information (2D)

The information label has a background. You can adjust the color and opacity of the background.

To display information about an intervisibility line:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 21-5).
3. Select or clear the Show Range and Bearing Labels check box.
4. Select the check boxes for the type of information you want to display. For descriptions of the check box options, please see Table 21-1.
5. To change the background color for the label:
   a. Click the Background Color button. A color picker opens.
   b. Select the color you want to use for the background.
   c. Click OK.
6. To change the opacity of the background, adjust the Background Opacity slider.

21.9. Deleting Intervisibility Objects

➤ To delete an intervisibility object, select the object and choose **Intervisibility** → **Delete**.



22. Sound Effects

This chapter explains how to enable and configure sound effects.

Introduction to Sound Effects 22-2
Enabling Sound Effects 22-2
Setting the Sound Volume 22-3
Specifying the Range in which Sounds are Heard 22-3
Associating Sound Files with Entities and Events 22-4
Mapping a Sound File to an Entity 22-5
Mapping Sound Files to Fire and Detonation Events 22-8

22.1. Introduction to Sound Effects

VR-Vantage can associate sound effects with entities, fire events, and detonation events. You can enable and disable use of sound effects and you can specify that sounds will be heard only when the observer is within a certain distance of the entity or event that generates them.

Sound effects are not supported on Linux.

22.2. Enabling Sound Effects

To enable sound effects:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Audio Settings page (Figure 22-1).

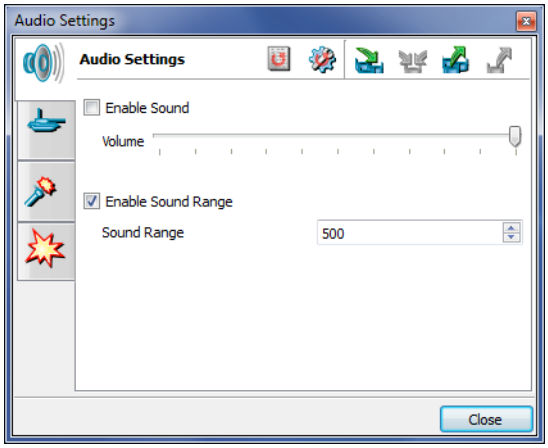


Figure 22-1. Audio Settings page

3. Select the Enable Sound check box.

You can also enable and disable sound effects by clicking the Audio button (▾) on the Display Settings toolbar.

22.2.1. Setting the Sound Volume

You can adjust the volume of sound effects.

To set the sound volume:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Audio Settings page (Figure 22-1).
3. Adjust the Volume slider.

> You can also change the volume by clicking the arrow on the Audio button ( ) (on the Display Settings toolbar) and adjusting the Audio Volume slider.

22.2.2. Specifying the Range in which Sounds are Heard

You can specify that sound effects be played only if the observer is within a certain distance of the entities that can emit sounds. If sound range is enabled, as soon as the observer moves beyond the range from an entity, sound effects are shut off. If this option is disabled, sound effects are played for all entities in the scenario regardless of their distance from the observer. However, even if sound range is not enabled, as the distance between the observer and entities increases, sound levels drop off.

To specify the range in which sounds can be heard:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Audio Settings page (Figure 22-1).
3. Select the Enable Sound Range check box.
4. Specify a value in the Sound Range text box.

22.3. Associating Sound Files with Entities and Events

VR-Vantage includes a set of sound files (WAV format) for generic entity platforms and for fire and detonation events. The files are in *./data/Audio/Sounds*. Sound files are associated with entity type enumerations. You can change the mappings and add new mappings.

You add and edit mappings between entity types, fire events, or detonation events and sound files on pages in the Audio Settings dialog box. You can add or edit mappings using mapping dialog boxes or directly in the mappings windows. The mapping dialog boxes behave differently depending on the state of the mapping window when you open the dialog box, as follows:

- If you click the Add Mapping button and have not selected a mapping in the Entity Mapping Settings window, you are presented with a default entity type (all wildcards).
- If you click the Add Mapping button and have selected an existing mapping, the dialog box displays the mapping you selected. From here, you can edit the existing mapping or create a new one.

When you edit a mapping, the result depends on whether you edit the entity or event enumeration or the sound file. The differences are based on the requirements for uniqueness in a mapping. The uniqueness of an entity type or fire event mapping is based on the entity type enumeration. The uniqueness of a detonation event mapping is based on the entity type enumeration and the detonation result value. Table 22-1 lists the results of different editing actions.

Table 22-1: Editing sound mapping files

Action	Result
Edit enumeration in dialog box.	New mapping is added. The previous mapping is not changed.
Edit enumeration in place.	New mapping replaces previous mapping.
Edit sound file in dialog box or in window.	Mapping to current entity or event is updated.
Edit channel in dialog box or in window.	Mapping to current entity or event is updated.
Edit detonation result in dialog box.	New mapping is added. The previous mapping is not changed.
Edit detonation result in window.	New mapping replaces previous mapping.

22.3.1. Mapping a Sound File to an Entity

An entity type enumeration can only have one sound file mapped to it. A sound file can be mapped to as many entity types as you want.

Adding a New Entity Sound Mapping

To add a new entity sound mapping:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Entity Sound Editor page (Figure 22-2).

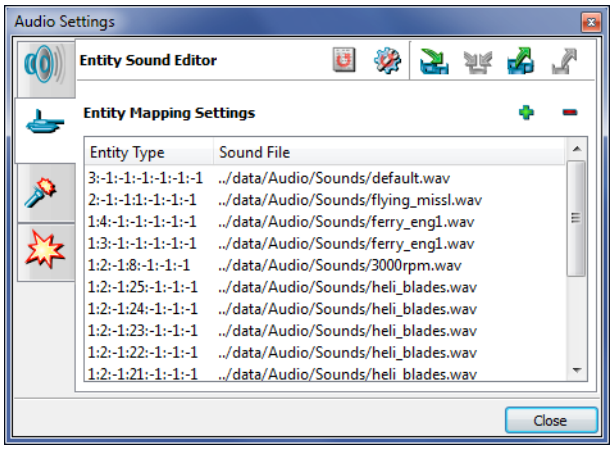


Figure 22-2. Entity Sound Editor page

3. Click the Add button (). The Create New Entity Type Sound Mapping dialog box opens (Figure 22-3).

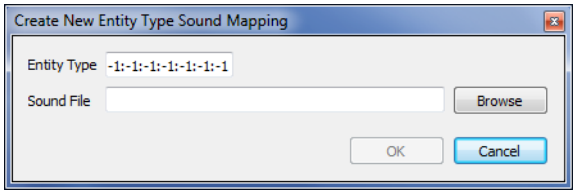


Figure 22-3. Create New Entity Type Sound Mapping dialog box



You cannot open the Create New Entity Type Sound Mapping dialog box with default options if one of the existing mappings is selected. If you have selected a mapping and want to return to the unselected state, click on white space in the mappings window or select one of the other tabs and then select the Entity Sound Editor tab again.

4. In the Entity Type box, type the enumeration for this mapping.

5. In the Sound File text box, type the pathname of a sound file or click Browse and select a file in the file chooser dialog box.
6. Click OK.



The OK button does not become enabled until you specify a valid entity type and sound file name.

Creating an Entity Sound Mapping from an Existing Mapping

When you edit a mapping, you can either change the sound file associated with the current entity type or create a new mapping with a different entity type.

To create a sound mapping from an existing mapping:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Entity Sound Editor page (Figure 22-2).
3. Select the mapping that you want to use as the starting point.
4. Click the Add button (). The Create Entity Type Sound Mapping from Existing Mapping dialog box opens (Figure 22-4).

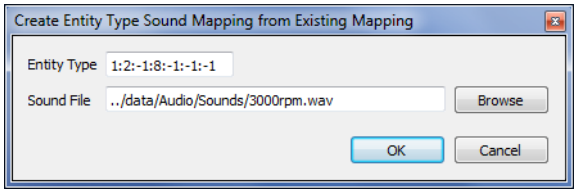


Figure 22-4. Create Entity Type Sound Mapping from Existing Mapping dialog box

5. To change the sound file associated with the entity type, type a new pathname or click Browse and select a sound file.
6. To create a new mapping, change the Entity Type enumeration.
7. Click OK. If you just changed the sound file, the mapping is updated. If you changed the entity type, a new mapping is added to the list.

Editing the Entity Type in the Mappings Window

If you edit the entity type in the mappings window (that is, without using a dialog box), it replaces the previous mapping.

To edit the entity type in the window:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Entity Sound Editor page (Figure 22-2).
3. Double-click the entity type you want to edit. It becomes editable (Figure 22-5).

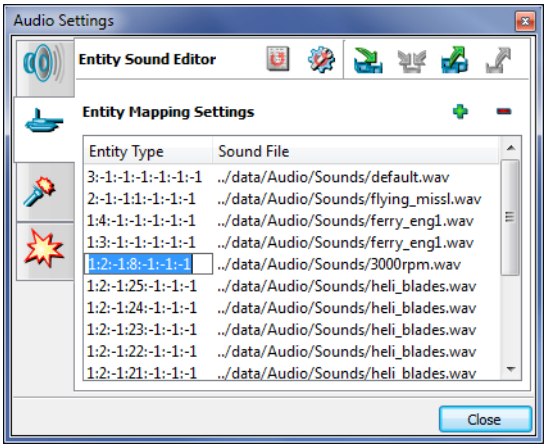


Figure 22-5. Editable entity type

4. Change the entity type enumeration.
5. Press **`Enter`**.

Editing the Sound Mapping in the Mappings Window

When you edit the sound mapping in the mappings window, the change does not affect any other mapping.

To edit the sound mapping in the window:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Entity Sound Editor page (Figure 22-2).
3. Double-click the sound mapping that you want to change. The Sound File dialog box opens.
4. Select the new sound file.
5. Click Open.

22.3.2. Mapping Sound Files to Fire and Detonation Events

When you map a sound file to a weapon fire or a detonation event, you can specify a channel for the sound. When you map a detonation sound, you can specify the detonation result for the mapping.

Specifying a channel for a sound event lets you control the number of sounds that can play concurrently. Sounds that are mapped to channel 0 can all play at the same time. Sounds mapped to any other channel can play only if no other event is using the channel. For example, suppose you map two weapon fire events to channel 1. One of the weapon type fires and the sound is generated. Then the second type of weapon event occurs. Since the first event is using channel 1, the second sound is not generated.

The DIS Enumerations document specifies a list of detonation results, such as Entity Impact, Ground Impact, and Air Hit. The detonation result is part of the detonation message sent over the network. You can specify that a detonation sound be played only for a certain type of detonation result. If you set the result to "any" it plays for any type of detonation. If, for a particular detonation type, you map one sound to "any" and another sound to a specific detonation result, the specific detonation result takes precedence.



You can change fire and detonation mapping settings directly, rather than using the sound mapping dialog box, just like you can change entity type sound mappings. For details, see the sub-procedures under "Mapping a Sound File to an Entity," on page 22-5.

To map a sound file to a weapon fire or detonation:

1. Choose **Settings** → **Audio Settings**. The Audio Settings dialog box opens.
2. Select the Fire Sound Editor page or Detonation Sound Editor page (Figure 22-6), as appropriate.

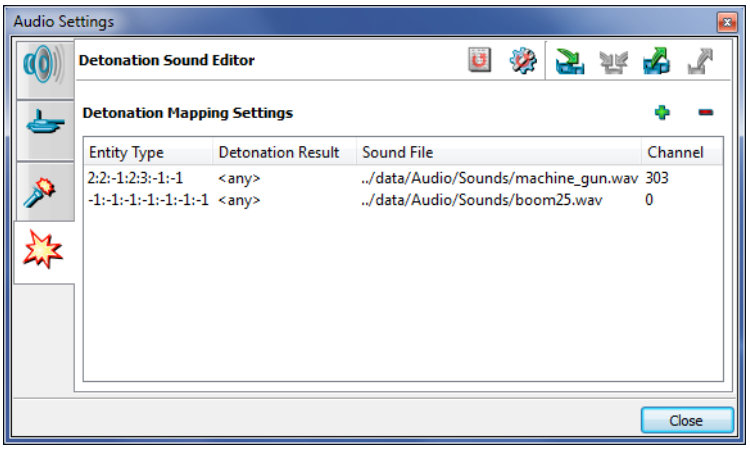


Figure 22-6. Detonation Sound Editor page

3. Click the Add button (). The Create New Detonation (or Weapon Fire) Sound Mapping dialog box opens (Figure 22-7).

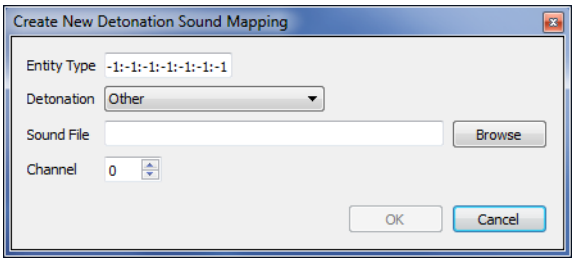


Figure 22-7. Create New Detonation Sound Mapping dialog box

When you click the Add button, if you have selected a mapping in the list, the Create New Sound Mapping from Existing dialog box displays the values for the selected mapping. If you change the entity type or detonation result, a new mapping is added with the new values.

4. In the Entity Type box, type the enumeration for this mapping.
5. Optionally, for detonation sounds, select an option on the Detonation list.
6. In the Sound File text box, type a pathname for the sound file you want to use or click Browse and select a file in the file choose dialog box.
7. Optionally, specify a channel in the Channel box.
8. Click OK.



VII. Terrain

A terrain is a representation of the earth or a portion of it on which simulated entities move about. VR-Vantage allows you to build your terrain at runtime using a variety of database and vector formats. It can load OpenFlight, DTED, CTDB, CDB, Meta-Flight, and GDB (MÄK terrain format) databases. It can load feature data from shape-files and GDB files. You can also superimpose geospatial images such as GeoTiffs or other raster image files on the terrain. You can save these composed terrains in the VR-Vantage MTF file format.



23. Changing How the Terrain is Displayed

This chapter explains how to find out information about a terrain by changing how it is displayed.

Displaying Feature Data (2D) 23-2
Displaying a List of Vector Features 23-3
Changing the Colors Used for Feature Data 23-4
Displaying Grid Lines 23-6
Configuring Grid Lines 23-7
Configuring Visible Surfaces (GDB Soil Types) 23-8
Coloring Terrain Based on Elevation 23-10
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Configuring Contour Lines 23-13
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23.1. Displaying Feature Data (2D)

If a terrain contains feature data, you can display it in the Plan View observer mode. Figure 23-1 shows a section of the Little Pond terrain with features disabled and enabled.



Figure 23-1. Feature data

This setting only displays features imported from GDB files or shapefiles. It does not display features streamed from a terrain server. If you load features using an earth file, they are drawn (or not drawn) based on the configuration information in the file.

If your terrain has many features, displaying them can take a long time.

➤ To display feature data, choose **Observer** → **Features**, or click the Feature Data button ( ) on the Observer Settings Toolbar.

23.1.1. Displaying a List of Vector Features

If a terrain has vector features, they are listed on the Vector Network tab of the Terrain Information Panel. If you select a feature in the list, it is highlighted in the display, and vice versa (Figure 23-2).

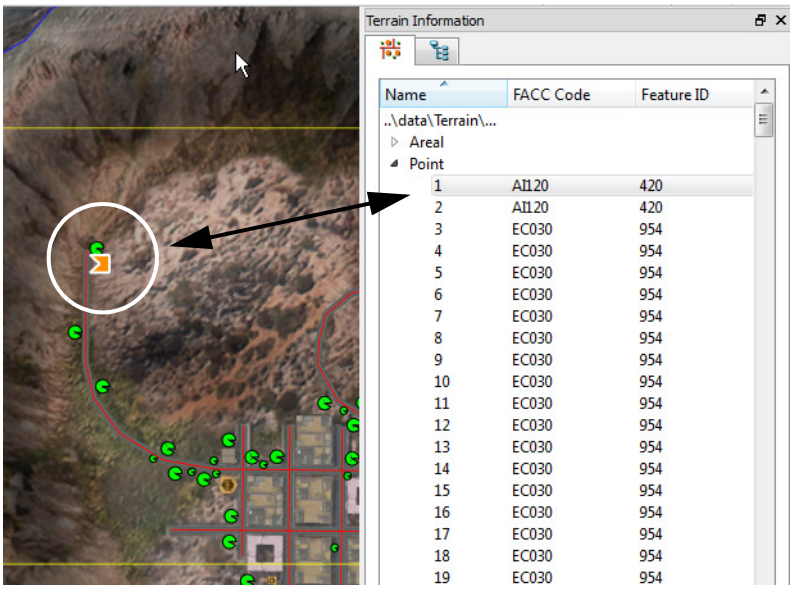


Figure 23-2. Vector feature selected

To display the feature list:

1. Choose **View** → **Terrain Information Panel**. The Terrain Information Panel opens.
2. Select the Vector Network tab (Figure 23-2).
3. Expand the top-level categories to see the lists of individual features.

23.1.2. Changing the Colors Used for Feature Data

If a terrain database contains feature data, you can change the colors used to display it. In Figure 23-3, the Woodland feature in the Little Pond terrain was changed to pink. Compare it to the default color (Figure 23-1).



Figure 23-3. Feature data with color change

To change the color of feature data:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Feature Settings page (Figure 23-4).

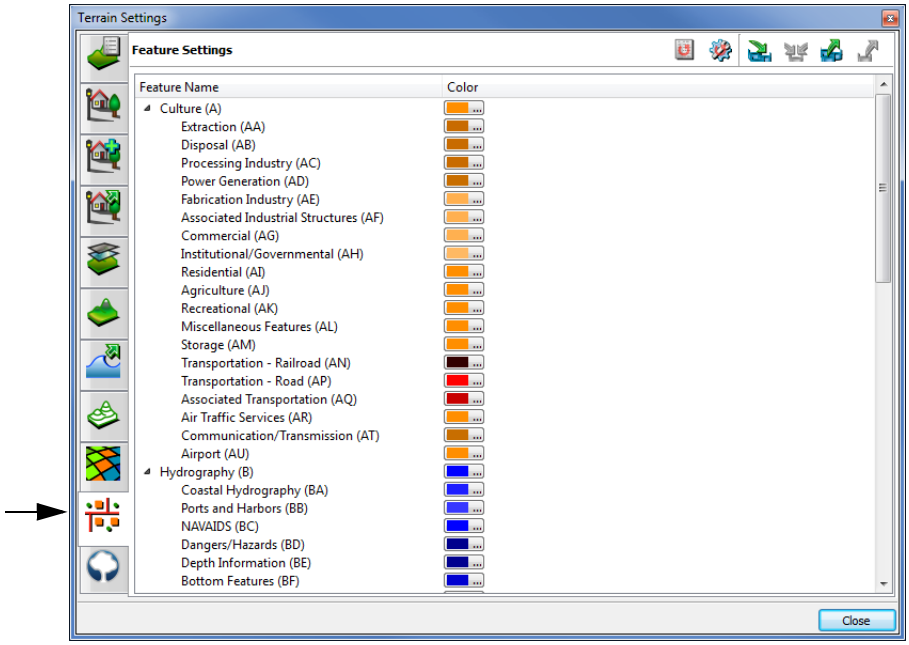


Figure 23-4. Feature Settings page

3. Click the color swatch for the feature that you want to change. A color picker dialog box opens.
4. Select the color that you want to use.
5. Click OK.

23.2. Displaying Grid Lines

VR-Vantage can display grid lines in the 2D view. Grid-lines are an observer-specific setting.

To enable or disable grid lines:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 23-5).

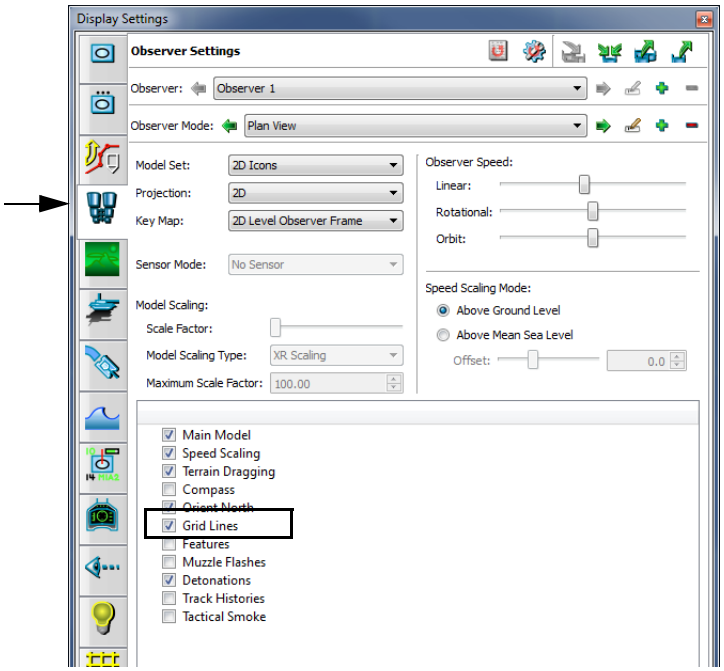


Figure 23-5. Observer Settings page

3. Select Plan View mode (or a locally created 2D observer mode).
4. Select or clear the Grid Lines check box.

> You can also enable or disable grid lines by choosing **Observer** → **Grid Lines** or clicking the Grid Lines button (▦) on the Observer Settings Toolbar.

23.2.1. Configuring Grid Lines

You can configure the coordinate system used for grid lines, the precision, and the spacing. Spacing can be fixed, in meters, or determined by VR-Vantage using a specified number of screen pixels. Fixed spacing can result in a very tight grid and unreadable labels as you zoom out. Auto spacing does not have this problem. However, the grid lines will constantly recalculate as you zoom in and out.

To configure grid lines:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Grid Lines Settings page (Figure 23-6).

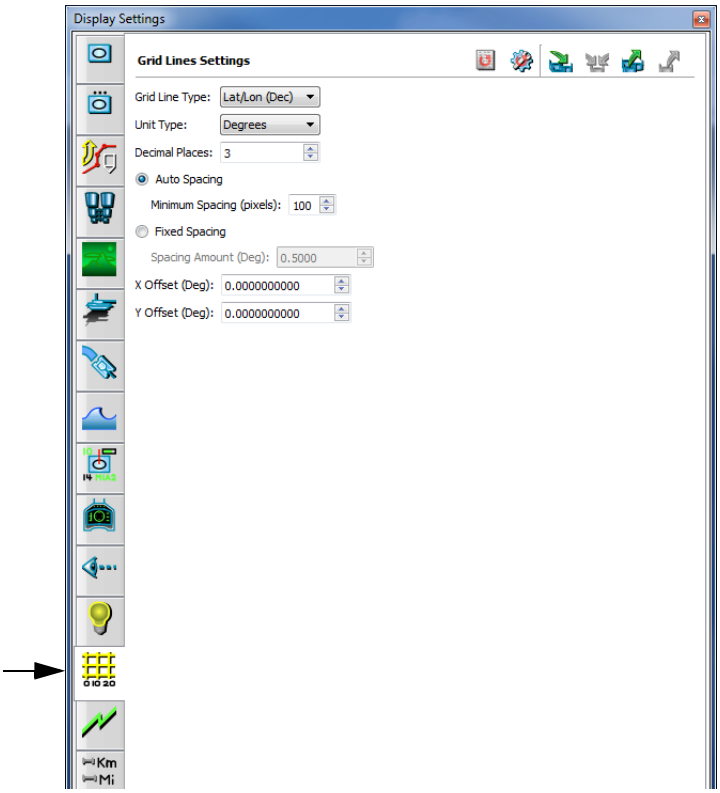


Figure 23-6. Grid Lines Settings page

3. To change the coordinate system used for grid lines, select an option in the Grid Line Type list. The list displays grid line types that are appropriate for the type of database loaded. (If no database is loaded, the coordinate system is set to Flat Earth.)
4. To specify the unit type for the grid line labels, select an option on the Unit Type list.
5. To specify the precision of the grid line labels, type a value in the Decimal Places box.

6. To change the spacing type, select AutoSpacing or Fixed Spacing and specify a value for the chosen spacing type.
7. To specify an offset from the origin, change the values for X Offset and Y Offset.

23.3. Configuring Visible Surfaces (GDB Soil Types)

If a terrain patch was loaded from a GDB file, you can display or hide GDB soil types. Figure 23-7 shows the *makland.gdb* terrain file. The view on the left shows all soil types. The view on the right has Building, Grass, Ocean, and Rock surfaces hidden.

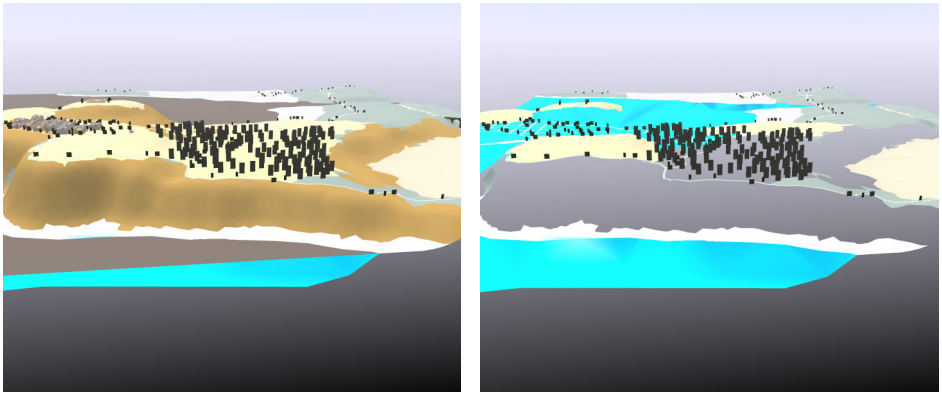


Figure 23-7. Visible surfaces toggled off

To display or hide GDB soil types:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Visible Surfaces page (Figure 23-8).

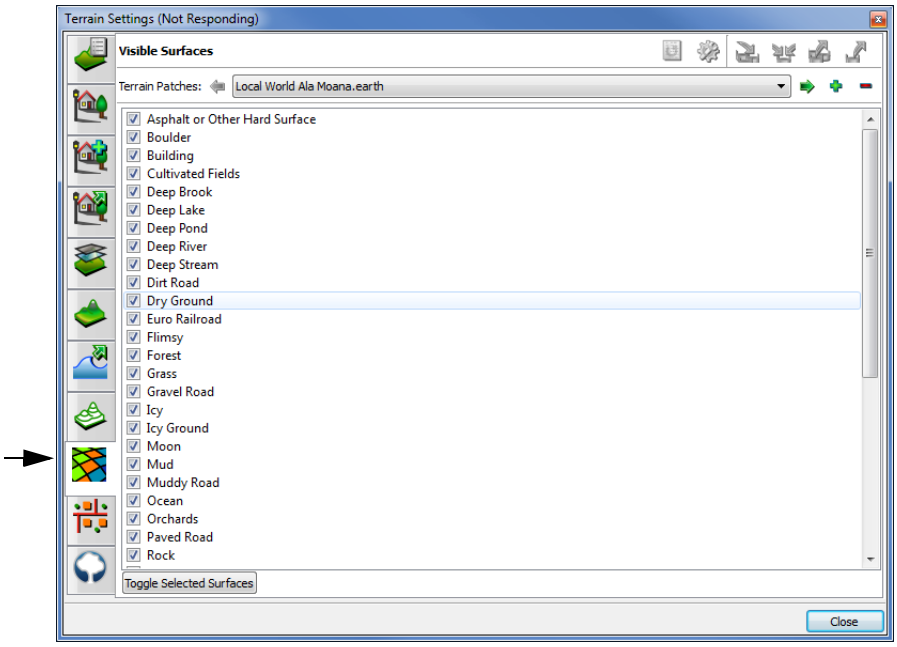


Figure 23-8. Visible Surfaces page

3. In the Terrain Patches list, select the terrain patch that you want to configure.
4. Select the check box for each soil type that you want to be visible.
5. Clear the check box for each soil type that you want to hide.
6. To change the state of multiple soil types at one time:
   a. Select (highlight) the names (not the check boxes) of the soil types whose state you want to change.
   b. Click Toggle Selected Surfaces.

23.4. Coloring Terrain Based on Elevation

You can color the terrain based on elevation.

To enable or disable coloring of terrain by elevation:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Elevation Color page (Figure 23-9).

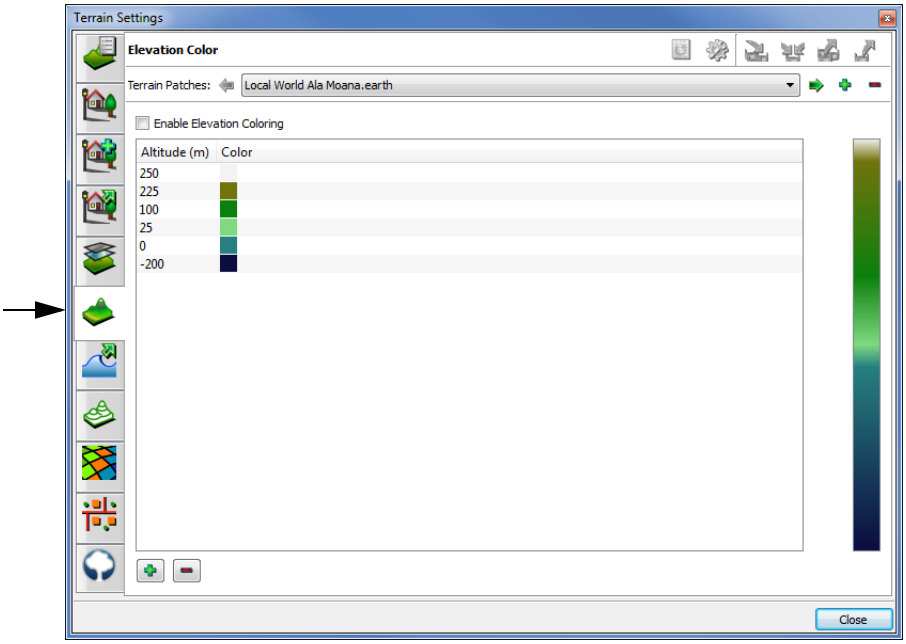


Figure 23-9. Elevation Color page

3. In the Terrain Patches list, select the terrain patch for which you want to enable elevation coloring.
4. Select or clear the Enable Elevation Coloring check box.

23.4.1. Configuring Elevation Color Settings

You can specify the color applied to terrain at a given altitude. You can add altitude points and remove them.

Inserting an Altitude Point

To insert an altitude point:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Elevation Color page (Figure 23-9).
3. In the Terrain Patches list, select the terrain patch for which you want to insert an altitude point.
4. Select an altitude point in the list that is above or below the altitude point you want to add.
5. Click Insert Point. A new point is added with the same altitude as the one you selected.
6. Double-click the new altitude point to make it editable.
7. Set the altitude point to the altitude that you want.
8. Click away from the altitude point to set it.

Deleting an Altitude Point

To delete an altitude point:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Elevation Color page (Figure 23-9).
3. In the Terrain Patches list, select the terrain patch for which you want to delete an altitude point.
4. Select the altitude point that you want to delete.
5. Click Delete Point.

Changing the Color of an Altitude Point

To change the color of an altitude point:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Elevation Color page (Figure 23-9).
3. In the Terrain Patches list, select the terrain patch for which you want to change the color of an altitude point.
4. Double-click the color swatch for the altitude point whose color you want to change. A color chooser dialog box opens.
5. Select or specify a new color.
6. Click OK.

23.5. Displaying Contour Lines

You can display contour lines and intermediate contour lines on the terrain. Intermediate contour lines divide the contour line interval into fifths (Figure 23-10). You can configure the thickness of contour lines and the interval between them.

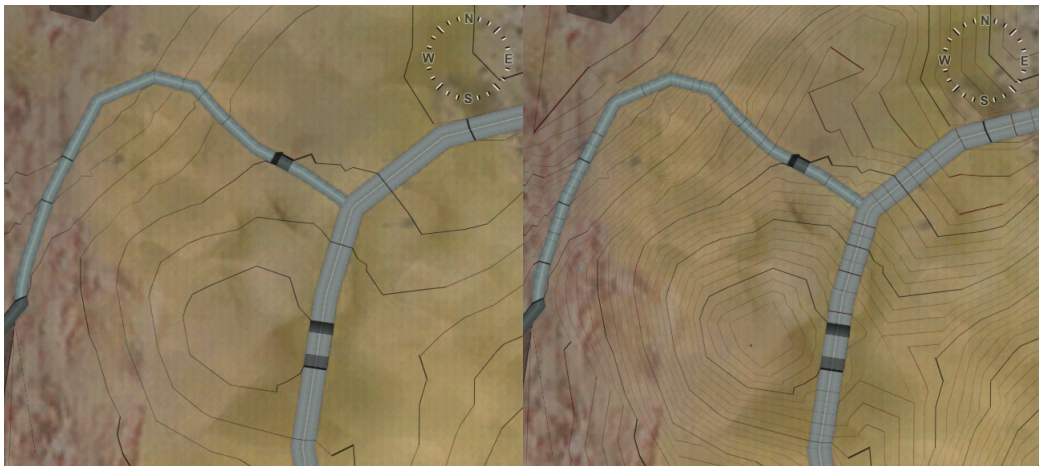


Figure 23-10. Contour lines and intermediate contour lines

To display contour lines:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Contour Lines page (Figure 23-11).

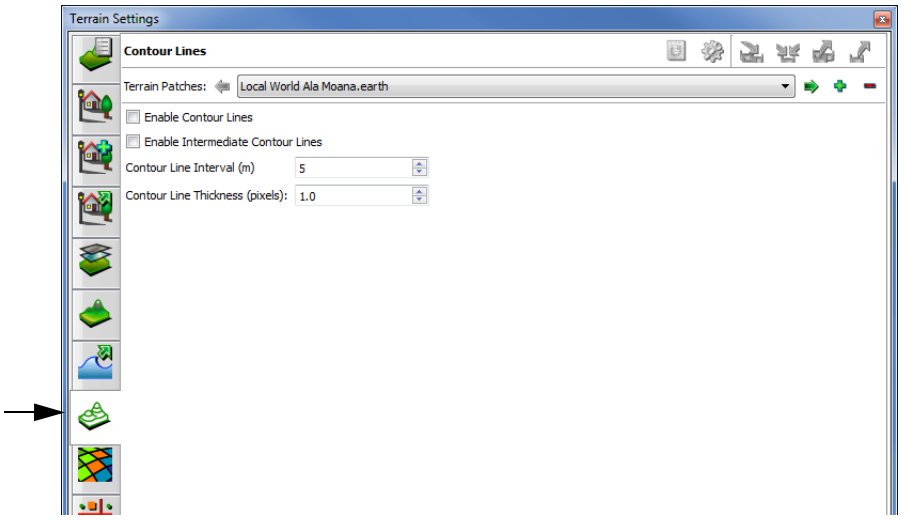


Figure 23-11. Contour Lines page

3. In the Terrain Patches list, select the terrain patch for which you want to enable or disable the display of contour lines.
4. Select Enable Contour Lines.
5. To enable intermediate contour lines, select Enable Intermediate Contour Lines.

23.5.1. Configuring Contour Lines

You can configure the thickness of contour lines and the interval between them.

To configure contour lines:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Contour Lines page (Figure 23-11).
3. In the Terrain Patches list, select the terrain patch for which you want to configure the thickness and interval of contour lines.
4. In the Contour Line Interval text box, specify the distance, in meters, between contour lines.
5. In the Contour Line Thickness text box, specify the thickness, in pixels, for contour lines.

23.6. Displaying Models and Terrain in Wireframe Mode

In wireframe mode, VR-Vantage displays the polygons that make up the terrain and objects (Figure 23-12).



Figure 23-12. Wireframe off and on

To enable or disable wireframe mode:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 23-13).

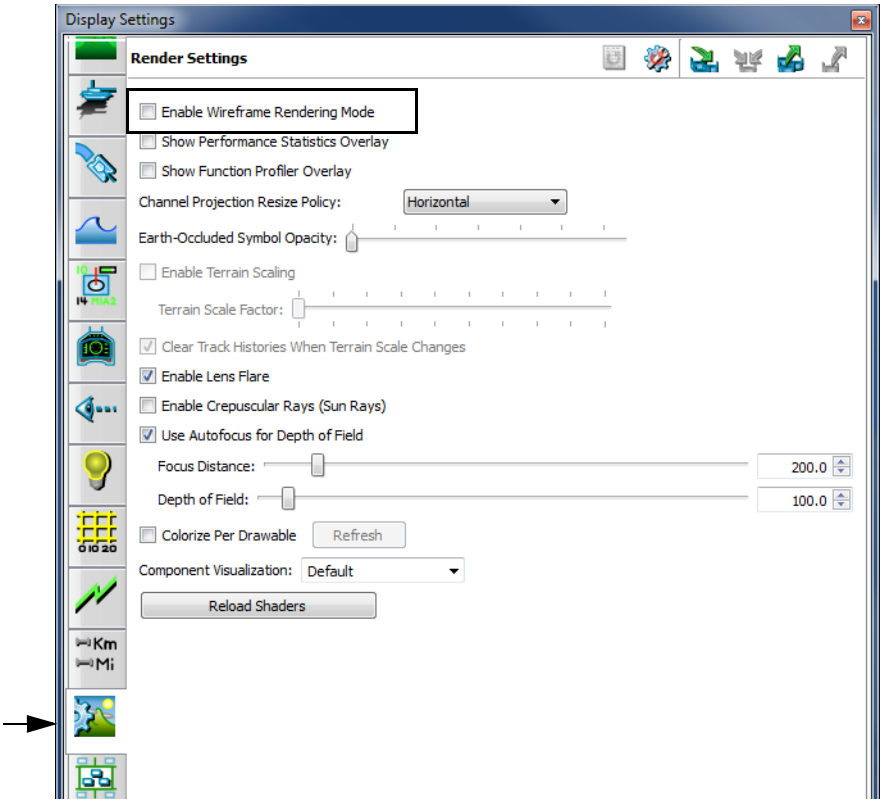


Figure 23-13. Render Settings page

3. Select the Enable Wireframe Rendering Mode check box.

> You can also enable and disable wireframe mode by choosing **Settings** → **Wireframe Rendering** or clicking the Wireframe Rendering button ( ) on the Display Settings Toolbar.



24. Composing Terrains

This chapter explains how to combine various types of data to build a terrain. "Composing a Terrain through the GUI," on page 26-2 is a tutorial that steps you through the entire process of creating a terrain.

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24.1. Terrain Agility and Composability

VR-Vantage applications are terrain-agile. Rather than being restricted to loading terrains in a limited number of formats that have been created using various terrain-creation software, VR-Vantage lets you compose terrains from a variety of supported data formats. You can combine elevation data (terrain patches), imagery, and feature data to create terrains.

VR-Vantage offers the following basic methods for creating terrains:

- Compose a terrain by loading individual elevation, image, and feature data files. This method is best for relatively small terrains that do not require paging. It supports all of the coordinate systems that VR-Vantage supports. The Makland (*Makland.mtf*) and VR-Village (*VR-Village.mtf*) terrains provided with VR-Vantage are examples of this method. For more information, please see "Creating a Composed Terrain," on page 24-6.
- Specify a set of files to load using an earth file. Use this method to stream terrain data from local or remote sources. This method is best for terrains with large amounts of elevation or image data, which would benefit from paging. For more information, please see "Connecting to Terrain Servers," on page 24-24.

When you compose a terrain, you can save it as a MÄK terrain file (MTF), which is essentially a description of all of the data used to visualize the simulated 2D and 3D environment. Later, you can open the MTF file and VR-Vantage will automatically load all of the data that you loaded manually when you first created the terrain.

These two methods of loading terrain data are not mutually exclusive. You can stream terrain using an earth file and also load hand-modeled terrains as terrain patches. *VR-TheWorld Online - MAK Earth.mtf* is an example of combining streamed terrain, from VR-theWorld Server, and hand-modeled terrain (the Ala Moana inset in Honolulu, Hawaii, USA).

You can save terrains in a cached format that loads terrain data more quickly than if the terrain is created from the source data. For details, please see "Configuring File Caching," on page 24-35.

24.1.1. Supported File Formats

VR-Vantage can import elevation, terrain, images, models, and feature data. Some types of files can contain more than one type of information. For example GeoTiff files can have elevation data or just have image data. The following sections list the supported formats.



In theory, VR-Vantage can load any format supported by osgEarth if you use the earth file format to load them. However, VR-Vantage does not include drivers for all of the formats supported by osgEarth. Furthermore, when using osgEarth, VR-Vantage only supports geocentric terrains. If you are uncertain about support for a particular format, please contact support@mak.com.

Terrain Data

VR-Vantage imports terrain data directly as terrain patches. It supports the following formats:

- MÄK terrain database (*.gdb*).
- MÄK encrypted data format (*.medf*).
- MÄK Stealth (6.2 and earlier) format (*.mtl*).
- MÄK terrain project or terrain descriptor file (*.mtp*, *.mtd*).
- OpenFlight (*.flt*).
- MetaFlight (*.mft*).
- CTDB 4, 7, 7L (*.c4b*, *.c7b*, *.c7l*).
- Shape terrain data (*.shp*).
- TerraPage (*.txp*).
- Collada (*.dae*).
- 3DS.
- OBJ.
- OSG.
- LWO.

Elevation Data

VR-Vantage supports the following types of elevation data:

- DTED (*.dt0*, *.dt1*, *.dt2*, *.dted*).
- GeoTiff.
- DEM.
- Arc/Info Binary Data (*.adf*).
- Other formats supported by osgEarth.

Supported Image Formats

You can import images in the following formats:

- GeoTiff (*.tif*, *.tiff*).
- JPEG (*.jpg*, *.jpeg*).
- PNG.
- RGB.
- Windows bitmap (*.bmp*).
- GIF.
- ECW.
- Other formats supported by osgEarth using the GDAL driver. For a list of formats supported by GDAL, go to http://www.gdal.org/ and select the Supported Formats link. For more information about earth files, please see "Connecting to Terrain Servers," on page 24-24 and Chapter 25, *Streaming Data Using Earth Files*.

Supported Feature Data Formats

VR-Vantage supports the following feature data formats:

- Shape files.
- S-57.
- OGR vector formats referenced in earth files.

24.1.2. Feature Layers and Props

A terrain can have objects such as buildings and trees embedded in it. These objects cannot be manipulated in this format. However, VR-Vantage lets you extract these types of objects from the terrain and render them independently as props.

Props are terrain elements that you can manipulate as separate objects. You can add props to a terrain by extracting them from a terrain patch or from a feature layer.

A feature layer is a file that contains feature data such as point features, linear features, and areal features. You can extract point features as props. You can extract props from MÄK Terrain Format (GDB) files, shapefiles (SHP), or DFAD data (DFD).

For more information, please see "Adding Props to a Terrain," on page 24-28.

24.2. Creating a Composed Terrain

The most common ways to compose a terrain in VR-Vantage are as follows:

- Load individual terrain components through the VR-Vantage GUI and then save the terrain as an MTF file.
- Create an earth file that specifies all the terrain components to load. Then load the earth file and save it as an MTF file.
- Load an earth file and add local terrain components. Then save the terrain as an MTF file.

This section describes the first option, creating a terrain by loading individual elevation, imagery, and feature files. (Using earth files is the preferred method. For details about using earth files, please see Chapter 25, *Streaming Data Using Earth Files*.) The general procedure for composing a terrain this way is as follows:

1. Choose **File** → **New Terrain**, or click the New Terrain button () on the Terrain Toolbar. If any terrain data is loaded, it is removed.
2. Add elevation data, as described in "Adding Elevation Data (Terrain Patches) to a Terrain," on page 24-8.
3. Optionally, add imagery, as described in "Adding Images to a Terrain," on page 24-10.
4. Optionally, add feature data, as described in "Adding a Feature Layer," on page 24-14.
5. Optionally, add a dynamic ocean layer, as described in "Adding a Dynamic Ocean Layer," on page 24-15.
6. Optionally, add props or extract props, as described in "Adding Props from a Feature Layer," on page 24-30 and "Extracting Props from a Terrain Patch," on page 24-28.
7. Save the terrain, as described in "Saving a Terrain," on page 24-7.

"Composing a Terrain through the GUI," on page 26-2, demonstrates how to create a composed terrain.

24.2.1. Considerations and Limitations for Building Terrains

As you compose a terrain, consider the following issues:

- VR-Vantage supports DTED level 0, 1, and 2. DTED is loaded using a Flat Earth projection. The default post spacing for DTED level 0 is 1. For other levels it is 5. You can load a 1 degree cell.
- If you load more than one DTED cell, they will be placed on top of each other. If you need to load multiple DTED cells, you can do so using an earth file. For details, please see "Loading Multiple DTED Files," on page 25-5.
- The larger a terrain database is (as measured by the number of polygons), the more it will affect performance.

Loading DTED

By default, when you load DTED files as terrain patches, the files are loaded with their altitude referenced to WGS84. If you want the altitude to reference a different vertical datum (most likely EGM96), you must provide a geoid grid file for that vertical datum. If you use a geoid grid file, the altitudes in the DTED file are adjusted based on the information in the grid file.

To use a geoid grid file, set the environment variable MAK_GEOID_GRID to the path of the file.



This section does not apply to terrains loaded using an earth file.

For information about EGM96 and geoid files, please see the following URL:

http://earth-info.nga.mil/GandG/wgs84/gravitymod/egm96/egm96.html

24.2.2. Saving a Terrain

When you save a terrain, VR-Vantage saves information about the terrain patches, imagery, and feature layers that you used to create the terrain. Saving a terrain does not save out data to a file format comparable to OpenFlight or GDB that can be loaded into other applications or converted into other formats. If accelerated file loading is enabled, the data gets saved in a format that can be loaded more quickly than from its native format. (For details about accelerated file loading, please see "Configuring File Caching," on page 24-35.) Terrains get saved with the extension *.mtf*.

To save a terrain:

1. Choose **File** → **Save Terrain**, or click the Save Terrain button () on the Terrain Toolbar. The Save Terrain dialog box opens.
2. Type a name for the terrain.
3. Click Save.

24.3. Adding Elevation Data (Terrain Patches) to a Terrain

To build a terrain database, you load elevation data, imagery, and feature data. Then you save the data collection in MTF format. Elevation data is added as terrain patches. Note the limitations in "Considerations and Limitations for Building Terrains," on page 24-7.

! Each time you add a terrain patch, VR-Vantage resets the origin and coordinate system. Therefore, if you add multiple terrain patches, any patches whose origin and coordinate system do not match the patch that is loaded last will not be usable.

To add a terrain patch to a terrain database:

1. Choose **File** → **Add Terrain Patch**, or click the Add Terrain Patch button ( ) on the Terrain Toolbar. The Add Terrain Patch dialog box opens and an Open dialog box opens on top of it.

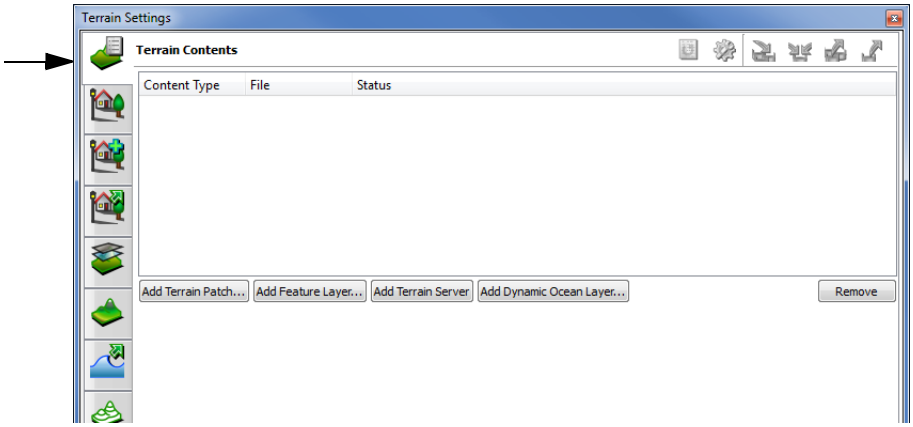


Figure 24-1. Terrain Contents page

2. Select a file in a supported format.
3. Click Open. The Add Terrain Patch dialog box displays details about the terrain patch (Figure 24-2).

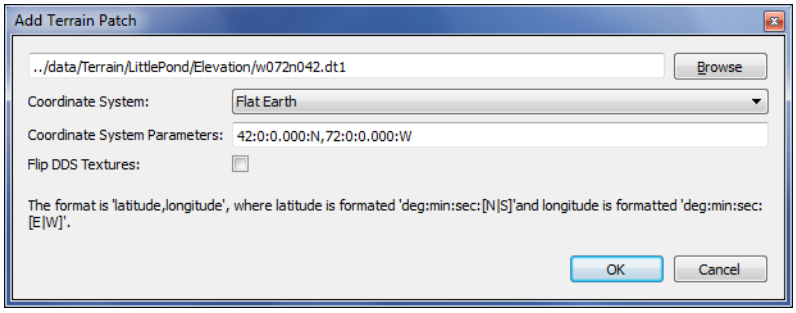


Figure 24-2. Add Terrain Patch dialog box

4. If the terrain patch has DDS textures that are upside down relative to VR-Vantage's expectations, select Flip DDS Textures. This setting does not affect paged terrains. (For information about DDS textures, please see "Displaying DDS Textures Correctly," on page 24-38.)
5. Click OK. The terrain patch is added.
6. Optionally, add additional terrain patches.
7. Save the terrain.

24.4. Adding Images to a Terrain

Depending on your terrain source, you may have terrain polygonal data, but no texture data or feature data to provide a realistic 3D display. You can drape images (raster maps) over the terrain to provide a more pleasing display.

> Adding very large images (multi-100 GB) may cause VR-Vantage to crash. If you need to load very large images, load them using an earth file and the GDAL driver. The *SanLuisObispo-Imagery.earth* file demonstrates how to load an image using this method. You can also use the GDAL driver to load raster formats that VR-Vantage cannot load directly. For a list of formats supported by GDAL, go to http://www.gdal.org/ and select the Supported Formats link.

To add raster maps to the terrain:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Raster Maps page.
3. Click the Add button (+) that is above the list of raster maps. A line is added to the Raster Maps list (Figure 24-3).

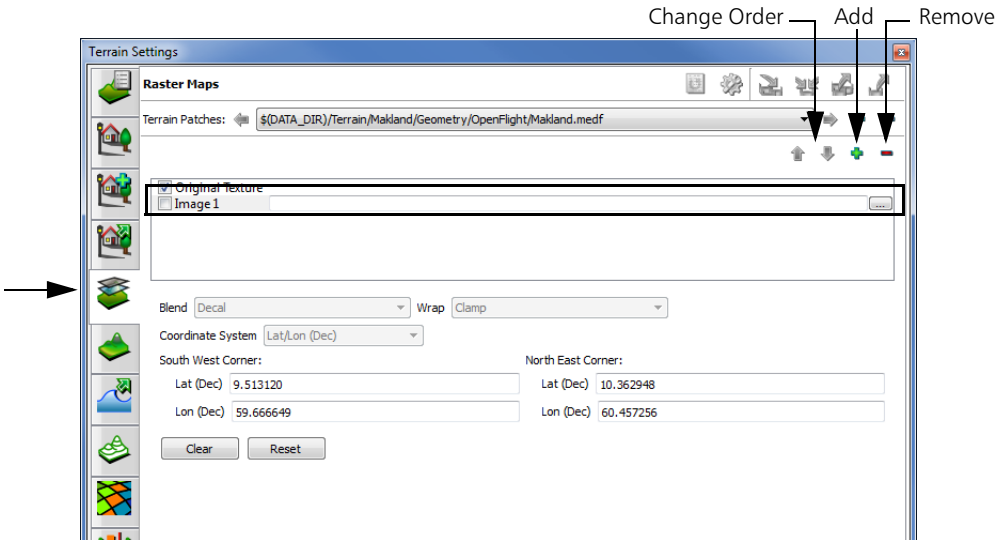


Figure 24-3. Raster Maps page

4. Click the Browse button to the right of the new line. The Image File dialog box opens.
5. Select the raster image that you want to add to the terrain.

6. Click OK. The image is listed in the Raster Maps window. To view it in the main window, select the check box to the left of the entry (Figure 24-4).

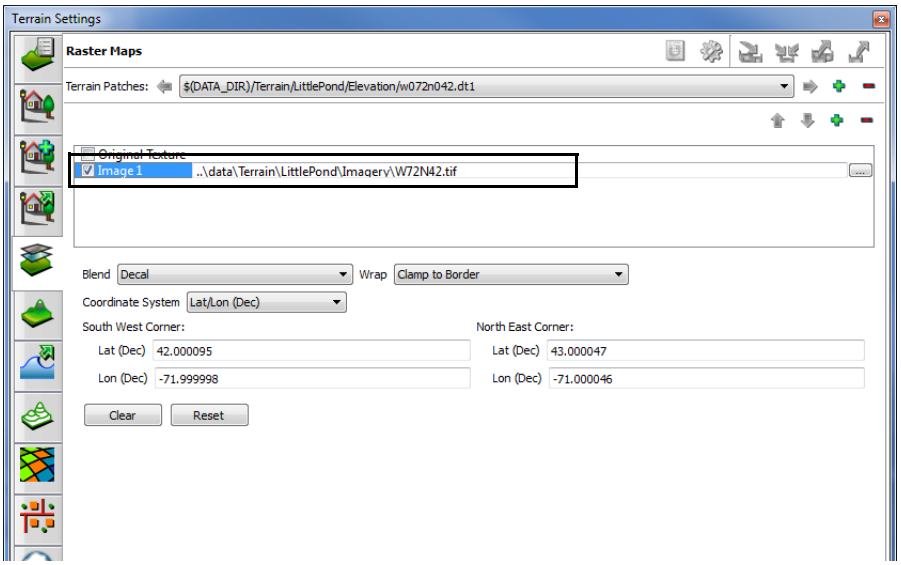
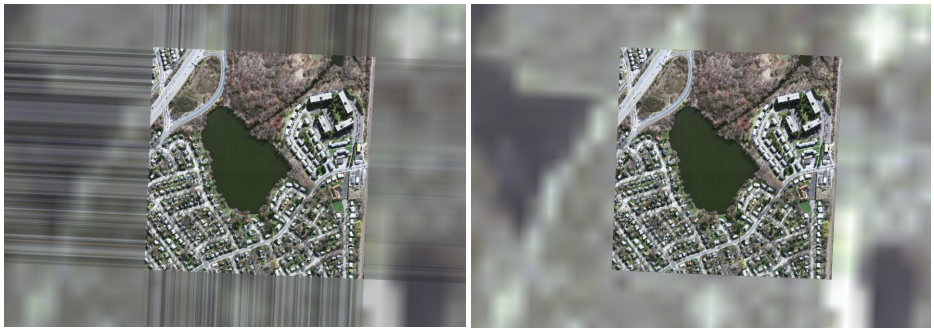


Figure 24-4. Making an image visible

7. Optionally, specify the attributes of the image, as follows:
   - Blend specifies how the image interacts with underlying images, as follows:
     - Decal: covers the polygons with the image. Use it to apply an opaque texture or a texture with transparency. (This is done using an alpha channel.)
     - Modulate: color values of the image modify the intensity of the colors of the polygon.
     - Blend: blends polygon and texture colors.
     - Replace: similar to decal.
     - Add: adds the pixel values of the source and base colors.
   - Wrap specifies whether or not the image is repeated, and if so, how it is repeated, as follows, and as illustrated in Figure 24-5 and Figure 24-6:
     - Clamp: extends the border pixels of the image to the edge of the terrain or the next continuous image, blending them with the pixels of other images. It does not obscure underlying images.
     - Clamp to Edge: extends the border pixels over the entire terrain, obscuring any other image.
     - Clamp to Border: places the image once, at the specified coordinates.
     - Repeat: tiles the image onto the terrain.
     - Mirror: tiles the image onto the terrain, alternating between the true image and a mirror image.

– Coordinate System specifies the coordinate system to use to place the image. Most options are self-explanatory. The Texture coordinate system specifies UV (X,Y) coordinates for placing textures on the terrain.
– Location specifies the coordinates for the Southwest (SW) and Northeast (NE) corners of the image. If the image is a GeoTIFF, the coordinates are in the image file. If the image file does not have coordinates, VR-Vantage stretches it to cover the terrain patch. If you do not want the image to cover the entire terrain, you can specify the coordinates.



Clamp | Clamp to border

Figure 24-5. Raster image wrap effects (Clamp and Clamp to Border)



Clamp to edge | Mirror



Repeat

Figure 24-6. Raster image wrap effects (Clamp to Edge, Mirror, Repeat)

24.4.1. Changing the Display Order of Raster Maps

Raster maps are displayed in the order in which they are listed in the Terrain Settings dialog box, Raster Maps page. If they overlay the same portion of the terrain, the topmost image is displayed. You can change the order in which image files are listed, thereby changing which one is displayed in VR-Vantage.

Figure 24-7 shows two views of the detailed portion of the LittlePond terrain, one with the default image order, and one with the order of raster images reversed.



Figure 24-7. Changing the raster map order

To change the order of a raster map.

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Raster Maps page (Figure 24-3).
3. Select the raster image whose order you want to change.
4. Click the Up Arrow or Down Arrow above the upper right corner of the list of raster maps. The image moves in the list and the window changes as appropriate.

24.5. Adding a Feature Layer

A feature layer is a file that contains data about geographic features on the terrain. This includes linear features, such as roads, and point features, such as trees and buildings. You can create props from point features. A feature layer can be a MÄK Terrain Format (GDB) file, a shapefile (SHP), or DFAD data (DFD).

When VR-Vantage imports a shapefile, it uses the name of the shapefile to indicate what type of feature it contains. Filenames are mapped to feature types in *./appData/importConfig/filename_shp_map.txt*. For example, the file name *ROADL.shp* is mapped to feature 129, which is a road. If the shapefiles that you need to import are not listed in *filename_shp_map.txt*, you can add them by editing the file.

- Adding a feature layer does not, by itself, make any visible difference to a terrain. To see the feature data, you must extract the data as props and map the props to model definitions. For details, please see "Adding Props to a Terrain," on page 24-28.
- The number of layers you can add depends on your graphics card. If you add a layer and it does not appear, try reducing the number of layers you have.

To add a feature layer:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Terrain Contents page (Figure 24-8).

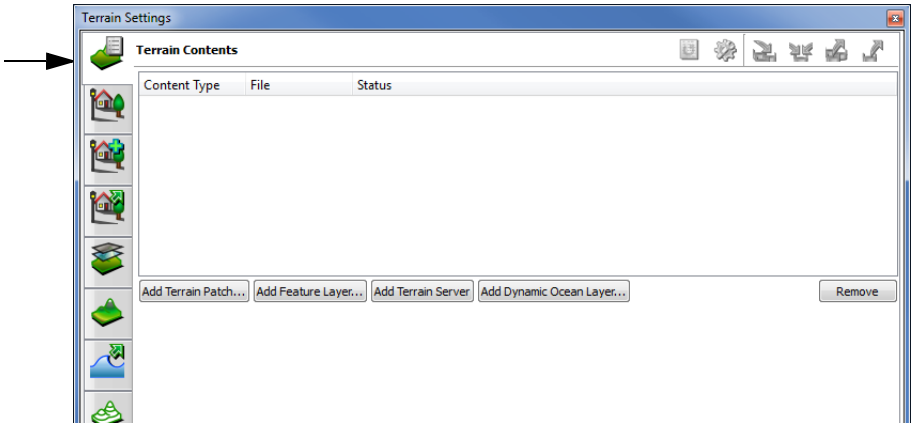


Figure 24-8. Terrain Contents page

3. Click Add Feature Layer. The Select Source File for Feature Layer dialog box opens.
4. In the Select Source File for Feature Layer dialog box, select the file that you want to use for this feature layer.

5. Click Open. The source file is added to the list of terrain contents.

24.6. Adding a Dynamic Ocean Layer

VR-Vantage can simulate dynamic ocean effects, such as waves, swell, and chop. To simulate the ocean, your terrain must have a dynamic ocean layer. You can add an ocean layer directly or you can add one as part of the process of extracting water textures.

If your terrain has textures assigned to water polygons, then you should extract them. They will be replaced by the ocean layer. If you do not extract the water textures and you simply add an ocean layer, the ocean layer and the water texture will interfere with each other in a process called Z-fighting and create an unacceptable display (Figure 24-9). This problem occurs because the ocean layer and the texture are both at the same height (0, or sea level).

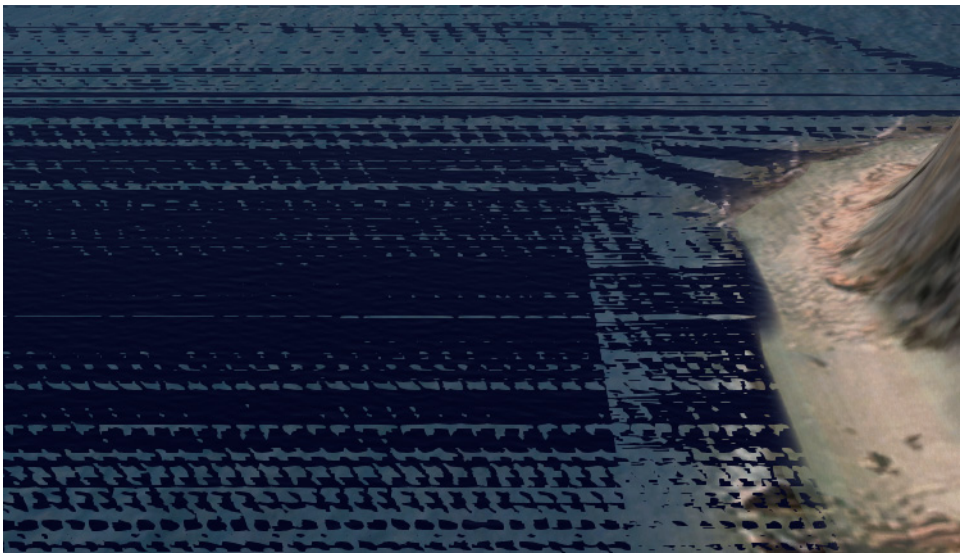


Figure 24-9. Z-fighting

If your terrain does not have a specific water texture assigned to polygons, your only option is to add an ocean layer directly. However, since the ocean layer will be at the same elevation as the terrain texture, you may experience Z-fighting. You may also have to raise the ocean height to actually see the ocean effects.

Figure 24-10 shows the Makland terrain with a water texture and an ocean layer. In the left view, the ocean layer has a height of 0 meters. You cannot see it. In the right view, the ocean layer is set to 1 meter. Now it is visible.

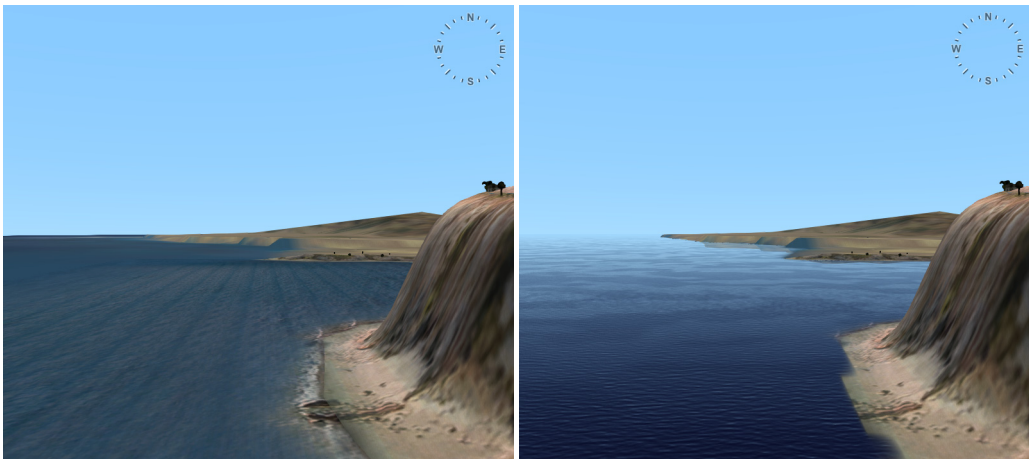


Figure 24-10. Ocean height

24.6.1. Extracting Water Textures and Adding an Ocean Layer

To extract textures and add an ocean layer:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Extract Ocean page (Figure 24-11).

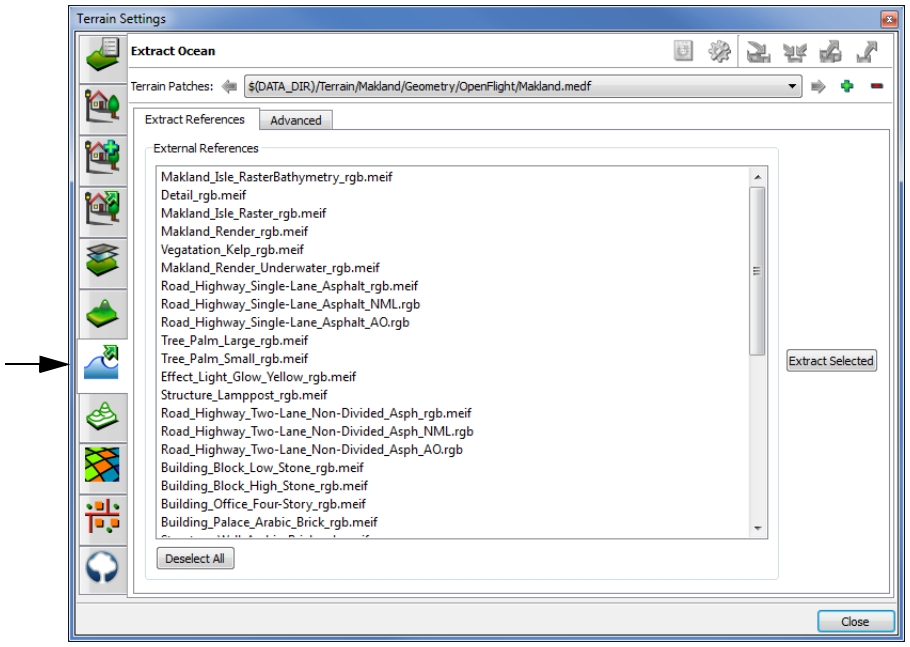


Figure 24-11. Terrain Settings dialog box, Extract Ocean page

3. In the External References list on the Extract References tab, select the water textures that you want to extract.
4. Click Extract Selected. The textures are removed and an ocean layer is added to the Terrain Contents page.
5. Select the Terrain Contents page (Figure 24-12).
6. Adjust the Ocean Height so that the dynamic ocean is visible. This might require raising the ocean above sea level.
7. Optionally, adjust the Ocean LOD Elevation. For information about the Ocean LOD Elevation, please see "Setting the Ocean LOD Elevation," on page 24-18.

24.6.2. Adding a Dynamic Ocean Layer Directly

Ocean layers get created at a height of 0 meters, that is, mean sea level.

To add a dynamic ocean layer:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Terrain Contents page "Terrain Contents with dynamic ocean layer," on page 24-18.
3. Click Add Dynamic Ocean Layer. (You can only have one ocean layer.) A layer is added to the Terrain Contents list and two parameters are added to the bottom of the dialog box (Figure 24-12).

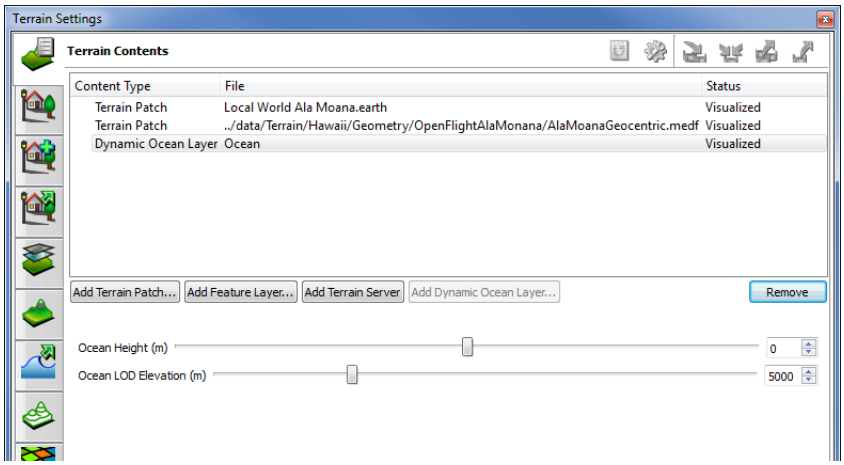


Figure 24-12. Terrain Contents with dynamic ocean layer

4. Adjust the Ocean Height so that the dynamic ocean is visible. This might require raising the ocean above sea level.
5. Optionally, adjust the Ocean LOD Elevation. For information about the Ocean LOD Elevation, please see "Setting the Ocean LOD Elevation," on page 24-18.

24.6.3. Setting the Ocean LOD Elevation

Enabling dynamic ocean affects performance. Since the effects are hard to see once the observer is high above the ocean, VR-Vantage stops displaying them when the observer is more than 5000 meters above sea level. You can change this cutoff point by adjusting the Ocean LOD Elevation.

To set the ocean LOD elevation:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Terrain Contents page (Figure 24-12).
3. Adjust the Ocean LOD Elevation slider or change the value in the box.

24.6.4. Configuring the Ocean Height Map

The ocean height map is used to blend the dynamic ocean with the coastline. You can configure the height map resolution, its texture size, and the threshold for regenerating the height map. All of these settings interact to affect visual quality and performance.

Height map resolution is specified as meters per pixel. The height map texture size is specified in pixels. Therefore these two settings determine the length of one side of the (square) area that the height map covers. For example, if the value for height map resolution is 10 meters per pixel and the texture size is 4096 pixels, this results in a height map that is 40960 meters on a side.

As height map resolution increases and texture size decreases, visual quality may improve, but performance can degrade. Conversely, decreasing resolution and increasing the texture size can improve performance at a cost of visual quality. You will need to experiment to determine the best values for your simulation.

If you are working with a small terrain or scenes in which the observer is close to sea level, you may want to use a higher resolution. If you are less interested in how the coastline looks, you can use a lower resolution. Figure 24-12 shows a coastline at different levels of resolution.

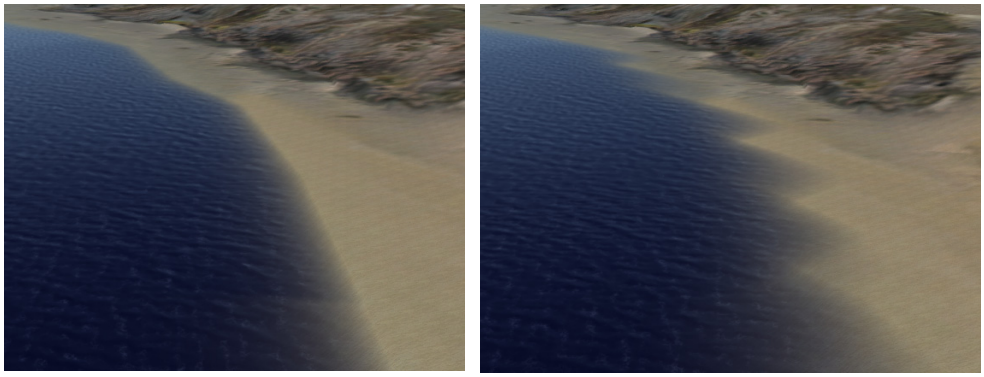


Figure 24-13. Ocean height map resolution



Setting the surface transparency also affects visualization of the coastline. Experiment with these values to achieve the best results. For details about water transparency, please see "Configuring Marine Conditions," on page 10-14.

Setting the Ocean Height Map Resolution

The ocean height map resolution is specified at meters per pixel.

To set the ocean height map resolution:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 24-14).

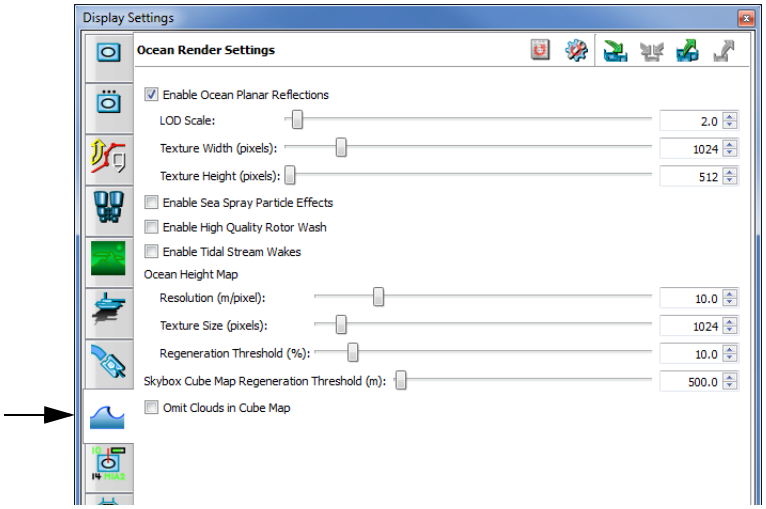


Figure 24-14. Ocean Render Settings

3. Adjust the Ocean Height Map Resolution slider, or enter a value in the box.

Setting the Ocean Height Map Texture Size

The ocean height map texture size is specified in pixels.

To set the ocean height map texture size:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 24-14).
3. Adjust the Ocean Height Map Texture Size slider, or enter a value in the box.

Setting the Ocean Height Map Regeneration Threshold

The ocean height map is recalculated as the observer moves. Generating the height map is computationally expensive. Therefore, it is done only when the observer moves by more than a specified threshold. You can adjust this threshold if you want to recalculate the height map more frequently. The default is 10% (0.1). This means that the observer must move by 10% of the length of one side of the height map before the height map is regenerated.

To set the ocean height map regeneration threshold:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Ocean Render Settings page (Figure 24-14).
3. Adjust the Ocean Height Map Regeneration Threshold slider, or enter a value in the box.

24.7. Using Shader-based Effect Maps

VR-Vantage supports several types of shader-based effect texture maps. Shaders are computer programs that run on the graphics processing unit (GPU). VR-Vantage makes extensive use of them for lighting effects.

Effect maps are raster images that apply highly realistic textures to the terrain and models. By applying different types of effect maps to terrain and models, you can improve the visual qualities of your simulation without the overhead of high polygon counts.

VR-Vantage supports the following types of shader-based effect maps:

- Normal, or bump, maps. Normal maps give terrains the appearance of relief, such as a rocky landscape.
- Specular maps. Specular maps affect the highlight color of objects.
- Ambient occlusion maps. Ambient occlusion maps model areas that do not receive direct light, such as cracks and crevices and shaded areas of terrain and models. These areas are lit only by ambient light.
- Reflection maps. Reflection maps affect the reflectivity of surfaces, such as windows. Reflection maps reflect objects in the sky, not the terrain.
- Emissive maps. Emissive maps control the emissivity of whatever they are applied to based on the current ambient light values. The alpha channel is an ID that is set from 0-255. All the pixels that should light together (like a window, and perhaps a surrounding sill) should have the same ID. When the ambient light level drops below a given ID level, those pixels are emissive. Channel 2 (green) is used to indicate the intensity of the emissivity. These textures need to use a lossless compression scheme, such as PNG. *LittlePond.mtf* has sample emissivity textures on many of the houses.

You can include effect maps as part of an OpenFlight model or terrain or as raster maps (on the Raster Maps page of the Terrain Settings dialog box). VR-Vantage uses a naming convention for effect map files that lets it process the files properly without any additional configuration. To specify the type of map file, use the following naming conventions:

- Normal map: *filename_NML.png*
- Ambient Occlusion map: *filename_AO.png*
- Specular map: *filename_SPC.png*
- Reflection map: *filename_RFL.png*
- Emissive map: *filename_EMM.png*.

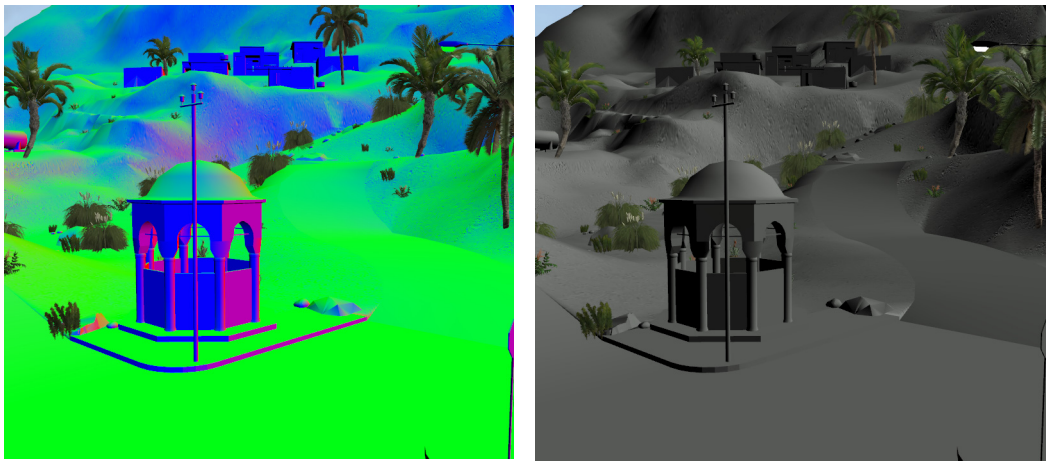


The map code must be uppercase on Linux.

To see the effect of effect maps, you must enable lighting. For details, please see Chapter 12, *Lighting Effects*.

24.7.1. Debugging Shaders

VR-Vantage provides some shader debugging capabilities within its lighting shaders. The shaders are instrumented such that setting different flags (through uniforms) changes the behavior of the shader. Typically it changes fragment colors based on some parameter or parameters. Figure 24-15 shows a view of VR-Village with two different shader debug settings.



Bumpmap Normals Diffuse Light

Figure 24-15. Shader component visualization

To debug shaders:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 24-16).

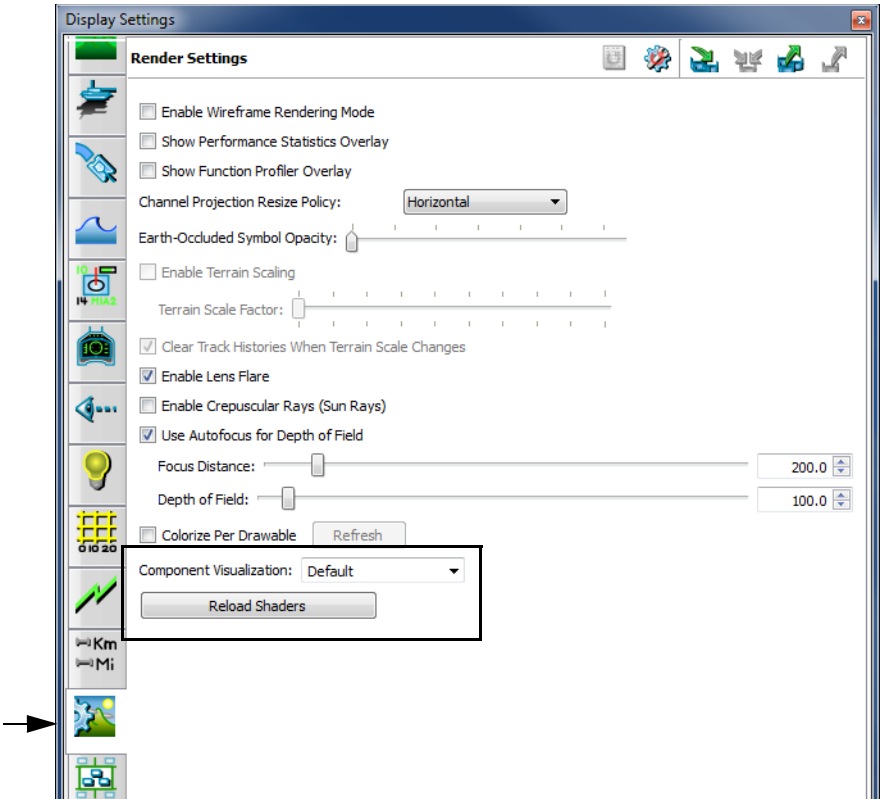


Figure 24-16. Render Settings page

3. Select an option from the Component Visualization list. (If you have SensorFX installed, the list includes options for visualizing materially classified textures.)

24.7.2. Reloading Shaders

Developers who are fine tuning shaders for terrain and object models do so by editing text files that configure the shaders. They can load their new shaders without shutting down VR-Vantage.

To dynamically reload shaders:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 24-16).
3. Click Reload Shaders.

24.8. Connecting to Terrain Servers

VR-Vantage supports the osgEarth libraries for creating terrains from remote or local data sources (Figure 24-17). Terrain servers are configured in earth (*.earth*) files. They support streaming of terrain data and are, therefore, ideal for displaying terrains that have large amounts of data.



Figure 24-17. Geocentric terrain

You can manipulate streamed terrains with the keyboard and mouse and can save them as an MTF terrain for quick loading.

VR-Vantage includes several terrain server configurations for VR-TheWorld Online, a server hosted by VT MÄKVT MÄK. You must have an internet connection to connect to these servers. It also includes server configurations that stream terrain files included with VR-Vantage. These servers, such as, *Local World.earth* and *SanLuisObispo.earth*, are examples of how you can use earth files to load local data.

! Integration of osgEarth into VR-Vantage allows you to connect to data sources. However, it does not provide a license to use any data sources. It is your responsibility to comply with the licensing provisions of any site to which you connect.

"Creating a Terrain with an Earth File," on page 26-13, is a tutorial that shows how to create a terrain server connection that serves local data.



When you view a geocentric terrain and move the observer more than 6 million meters or so from the earth's surface, the view is forced to focus toward the center of the earth. The practical effect of this mode is that the left and right movement keys orbit the observer around the earth, rather than moving the entire earth to the left or right.

To connect to a terrain server:

1. Choose **New** → **Scene**. The current terrain closes.
2. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
3. Select the Terrain Contents page (Figure 24-18).

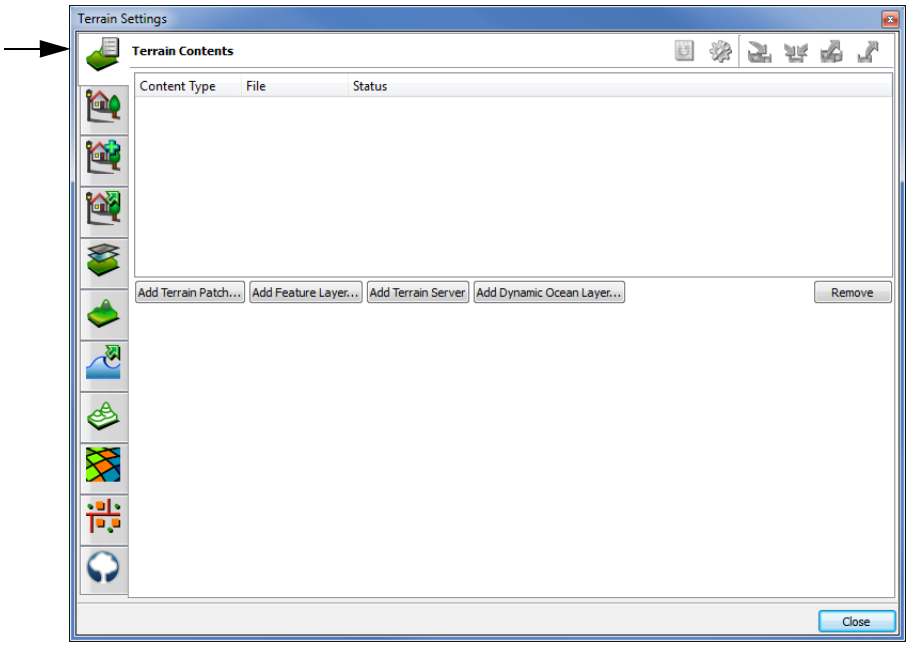


Figure 24-18. Terrain Contents

4. Click Add Terrain Server. The Add Terrain Server dialog box opens (Figure 24-19).

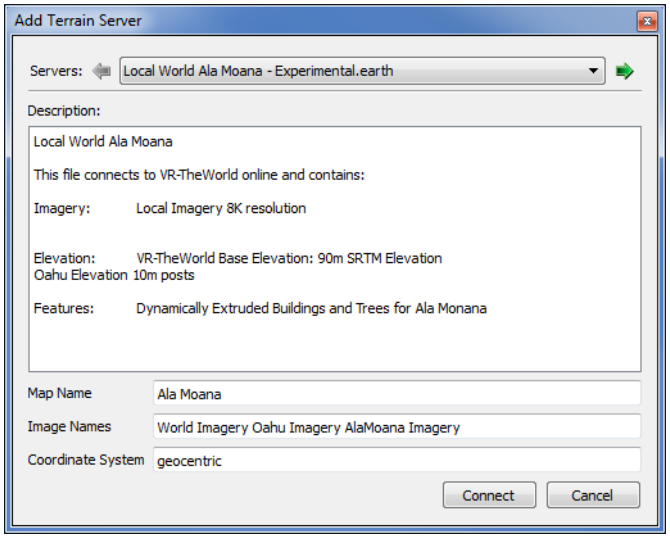


Figure 24-19. Add Terrain Server dialog box

5. Select a server from the Servers list. The dialog box displays information about the selected terrain server. It is not editable.
6. Click Connect. If the terrain data is available (remote sources might not always be accessible), it is displayed.

You can save a terrain server as part of a terrain or scene. For details, please see "Saving a Terrain," on page 24-7.

24.8.1. Adding Terrain Server Connections

You can add additional terrain server connections to the list provided with VR-Vantage. Terrain server connections are configured in XML files according to the requirements of the osgEarth libraries. It is beyond the scope of this manual to fully describe the configuration process. However, the server configurations included with VR-Vantage are examples of what you can do. We recommend that you add new servers by copying an existing configuration that is similar to what you want and then editing it to point to your data. (Chapter 25, *Streaming Data Using Earth Files*, provides a brief introduction to earth file syntax.)

"Creating a Terrain with an Earth File," on page 26-13, is a tutorial that shows how to create a terrain server that serves local data.

24.8.2. Connecting to Terrain Servers through a Proxy

If you connect to the network through a proxy, you may need to set some environmental variables to be able to connect to external terrain servers. VR-Vantage has limited proxy capability. It supports basic authentication and may support domain authentication if your proxy allows it to be accessed through basic authentication. To set up authentication, set the following environmental variables:

- OSG_CURL_PROXY. Specifies the proxy machine.
- OSG_CURL_PROXYPORT. Specifies the proxy port.
- OSGEARTH_CURL_PROXYAUTH=username:password. Specifies the user name and password for the proxy.

24.9. Loading MetaFlight Terrains

VR-Vantage supports MetaFlight terrain databases. To load a MetaFlight terrain, add a terrain patch, as you would for any other terrain. However, before you can load a MetaFlight file, you must process it using the mftTool and medfTool. For details, please see Chapter 27, *Processing MetaFlight Files*.

When you load a MetaFlight file, VR-Vantage is actually loading many individual OpenFlight files. If file caching is enabled, VR-Vantage caches the OpenFlight files to disk in a quick-loading, encrypted format so that the files can load more quickly the next time you load the terrain. The cached files are handled the same way that any other cached files are handled. For details, please see "Configuring File Caching," on page 24-35.



Geometry files referenced by a MetaFlight file must be in OpenFlight format, and not in Vega Prime's binary format (*.vsb*). MÄK's terrain libraries do not support *.vsb* files.

24.10. Adding Props to a Terrain

Props are objects like buildings, lampposts, or trees that exist independently of the underlying terrain elevation data. You can extract props from a terrain patch or add them from a feature layer. You can view a list of the props in the terrain, specify their opacity, and enable or disable their visibility. You can change a prop's type and you can change the model definition used to render it. You can also create new prop types to meet your simulation needs.

24.10.1. Extracting Props from a Terrain Patch

When you extract props from a terrain patch, you have to tell VR-Vantage where to find prop data, what type of prop to use, and what model definitions to map the props to, as follows:

- Where to search: A terrain patch, such as an OpenFlight terrain, often references multiple files that define models that are incorporated into the geometry of the terrain. VR-Vantage lets you specify the external files from which to extract props or you can specify a search expression that looks in all referenced files. If you select a referenced file, the process is quicker because VR-Vantage searches for props only in the specified file.
- What prop type to use: You can select a prop type from a list, specify a type of your choice, or let VR-Vantage auto-generate prop types. If you choose Auto Generate, VR-Vantage makes the prop type match the name of the referenced file. For example, a prop extracted from the file *Bridge_Arch_Stone.flt* would be given the prop type *Bridge_Arch_Stone.medf*.
- Model definition to use: You can select a model definition from a list, or choose Use Extracted Geometry. If you accept the default value, Use Extracted Geometry, VR-Vantage creates props using the geometry in the terrain patch. For example, if you chose *Trees.flt* as the referenced file, VR-Vantage creates props using the tree geometry in that file.

VR-Vantage extracts props only from the selected terrain patch. If your terrain has multiple terrain patches, you must repeat the procedure for each terrain patch from which you want to extract props.

For an example of how to extract props from a terrain patch, please see "Extracting Props from a Terrain," on page 26-19.

To extract props from a terrain:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Extract Props page (Figure 24-20).

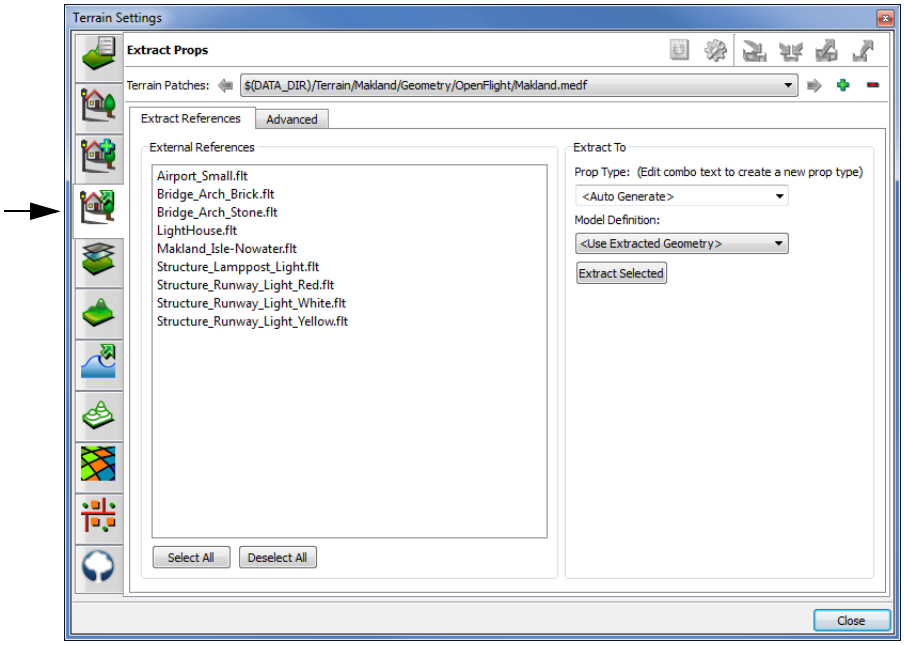


Figure 24-20. Extract Props page

3. In the Terrain Patches box, select the terrain patch from which you want to extract props.
4. To extract props by specifying external files, select the Extract References tab. To extract props using a search expression, select the Advanced tab.
5. If you chose the Extract References tab, in the External References list, select the files from which you want to extract props.

   If you chose the Advanced tab, type the search expression in the Search Expression box. Select the Regular Expression check box if you are using a regular expression.

VR-Vantage uses perl regular expression syntax.

---

6. Optionally, in the Prop Type box, select the type that you want to assign to the extracted props or type a prop type.
7. Optionally, in the Model Definition box, select the model definition that you want to apply to the extracted props.
8. If you are using the Advanced tab, click Extract. If you are using the Extract References tab, click Extract Selected. VR-Vantage extracts the props, if any. You can view the list of props in the Props list on the Edit Existing Props page.

24.10.2. Adding Props from a Feature Layer

A feature layer source file contains information about point, line, or areal features. Feature information is stored in a table in which each row is a feature and each feature is defined by the values in an arbitrary number of columns. To add a prop from a feature layer, you must build a rule that specifies the column headings and values for the feature you want to import. Then you must associate a prop type and model definition with the prop. You also must specify whether or not to ground clamp the prop.

Please see "Add Props," on page 26-9 for an example of adding props from a feature layer.

To add a prop from a feature layer:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Add Props page (Figure 24-21).

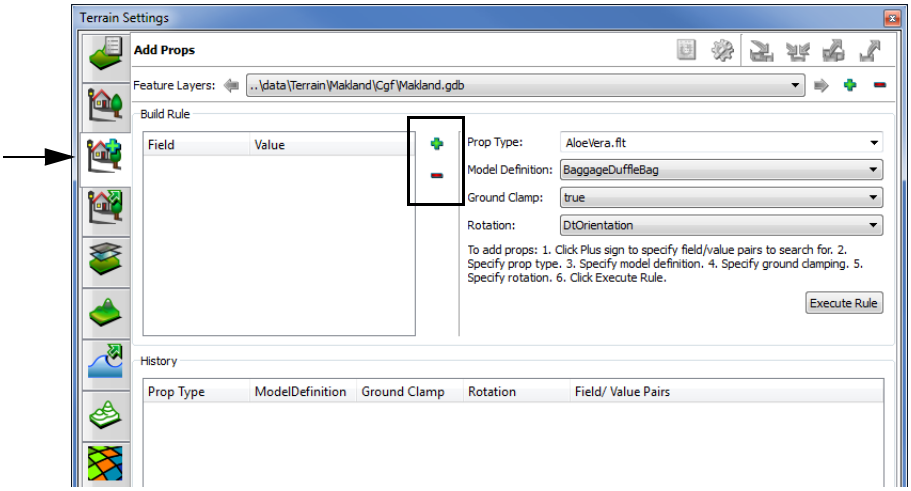


Figure 24-21. Terrain Settings, Add Props page

3. In the Feature Layers list, select the feature layer from which you want to import the props.
4. Click the Add button (+) to the right of the Field/Value window (Figure 24-21). The Build Field/Value Pair dialog box opens (Figure 24-22).

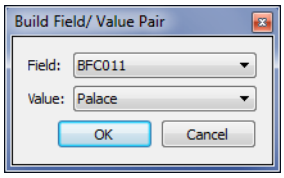


Figure 24-22. Build Field/Value Pair dialog box

5. In the Field list, select a field. Fields are the column headings in the feature definition.
6. In the Value list, select a value. Values are one or more values from the definition table that are available for the column heading.



It is your responsibility to understand the feature definitions for the features that you want to import as props.

7. Click OK. The Field/Value pair is added to the window (Figure 24-23).

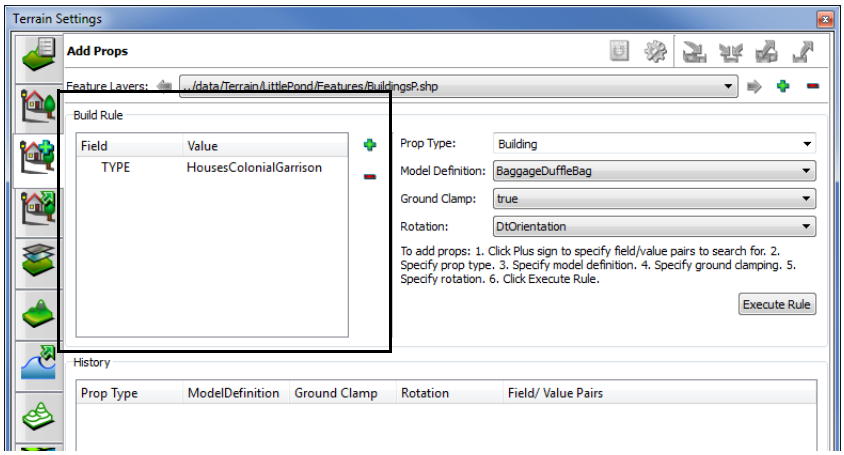


Figure 24-23. New Field/Value pair

8. Add additional Field/Value pairs as needed to define the prop that you want to add.
9. In the Prop Type list, select the prop type to assign to the prop you want to add.
10. In the Model Definition list, select the model definition you want to use for this prop.
11. In the Ground Clamp box, specify whether or not to ground clamp this prop.
12. Optionally, set the rotation.
13. Click Execute Rule. The prop is extracted from the feature layer and is listed in the History window.

24.10.3. Viewing a List of Props

To view a list of the props in the terrain:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Edit Existing Props page (Figure 24-24).

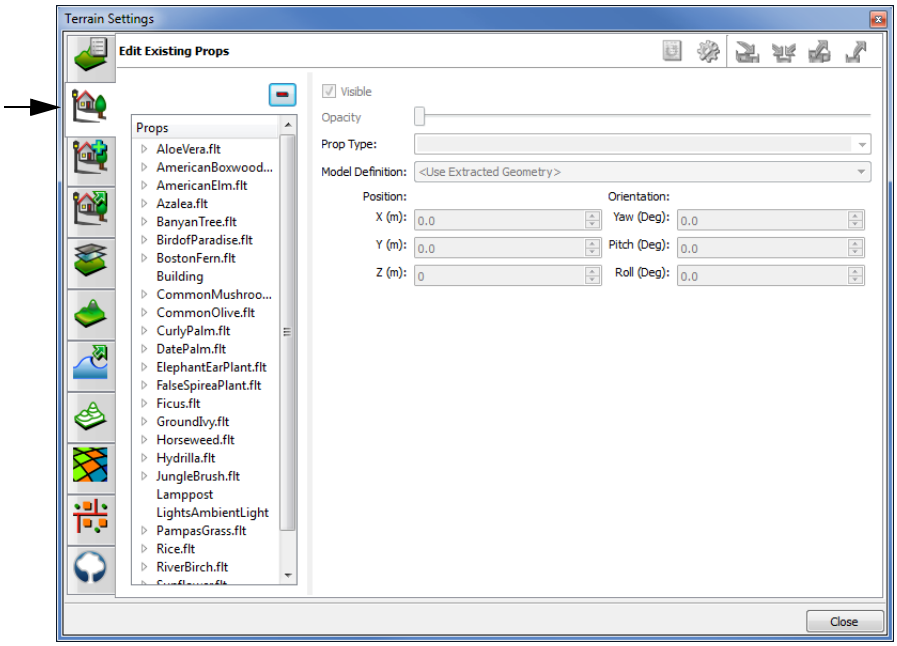


Figure 24-24. Edit Existing Props page

3. Expand the list to view the entries under a particular type of prop.

24.10.4. Selecting Props

➤ To select a prop, click it in the window or in the Objects List Panel, or select it in the list of props on the Terrain Settings dialog box, Edit Existing Props page.

Press **`Ctrl`**+click to select multiple props.

By default, the Objects List Panel just lists Entities. To see props in the list, change the filter.

24.10.5. Setting the Opacity of Props

You can set the opacity of props. This can be useful if you want to see what is inside a building or behind a prop. Figure 24-25 illustrates a building at two levels of opacity.



100% 40%

Figure 24-25. Prop opacity

To set a prop's opacity:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Edit Existing Props page (Figure 24-24).
3. In the list of props select the props whose opacity you want to change, or select a prop in the window. The Opacity slider is enabled.
4. Slide the Opacity slider to the right to increase opacity. Slide it to the left to decrease opacity.

Making a Prop Fully Transparent or Opaque

You can quickly set a prop to be fully transparent or opaque.

➤ To make a prop fully transparent, right-click the prop and on the popup menu, choose **Make Transparent**.

➤ To make a transparent prop fully opaque, right-click the prop and on the popup menu, choose **Make Opaque**.

24.10.6. Changing a Prop's Type

Every prop has a type. Props are organized by type in the list on the Edit Existing Props page.

To change a prop's type:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Edit Existing Props page (Figure 24-24).
3. In the list of props, select the props whose type you want to change.
4. Select a prop type from the Prop Type list, or type a new type name. The selected props are moved to the new prop type in the Props window.

24.10.7. Changing a Prop's Position or Orientation

You can change a prop's position and orientation. You can change the orientation of multiple props at the same time without affecting their position. However, if you select multiple props and change position, they are all placed in the same position.

To change a prop's position or orientation:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Edit Existing Props page (Figure 24-24).
3. In the list of props, select the prop whose position or orientation you want to change.
4. To change position, type or select new values in the X, Y, or Z boxes.
5. To change the orientation, type or select new values in the Yaw, Pitch, or Roll boxes.

24.10.8. Changing a Prop's Model Definition

You can change the model definition used to render a prop. For information about model definitions, please see Chapter 28, *Model and Element Definitions*. For an example of changing a prop's model definition, please see "Test the Model Mapping," on page 33-11.

To change a prop's model definition:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Edit Existing Props page (Figure 24-24).
3. In the list of props, select the prop whose model definition you want to change.
4. In the Model Definition list, select a model definition. The selected props are rendered using the new model definition.

24.11. Configuring File Caching

When file caching is enabled, VR-Vantage stores information about the terrain and models in a format that enables it to be loaded quickly. This improves loading time the next time the cached objects are loaded. If caching is disabled, terrains and models must be loaded from their native formats, which may take longer.



When VR-Vantage processes a request to load a a file, such as an external reference in a terrain, it checks the cache and the directory of the requested file for an MEDF version of the file. If it does not exist, it loads the file in the original format.

To enable or disable file caching:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the File Caching Settings page (Figure 24-26).

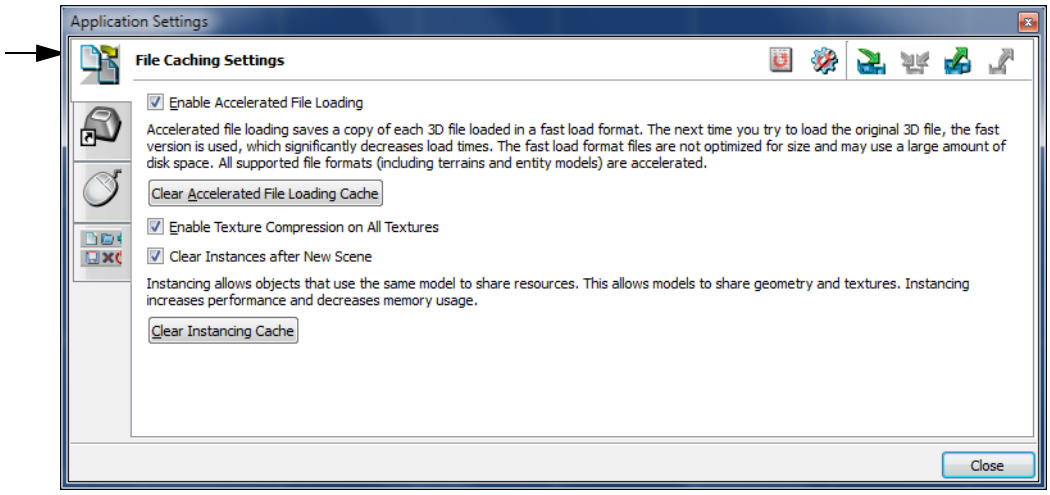


Figure 24-26. File Caching Settings page

3. Select or clear the Enable Accelerated File Loading check box.

24.11.1. Caching Terrain Server Data

When file caching is enabled, VR-Vantage caches data from terrain servers in the default locations. You can override this by specifying an alternative caching location in the OSGEARTH_CACHE_PATH environment variable. (Do not use the `cache` element in the earth file.)

24.11.2. Caching osgEarth Terrain Data Offline

VR-Vantage includes a tool, *./bin64/osgearth_cache*, that you can use to cache terrain data offline. When you need to use the terrain, the data will have already been cached. osgearth_cache caches imagery and elevation. It does not cache feature data. The syntax is as follows:

```
osgearth_cache --list file.earth | --seed file.earth
  [--estimate --min-level level --max-level level
  --bounds xmin ymin xmax ymax* --index shapefile --mp
  --mt --concurrency --verbose]| --purge file.earth
```

where:

- `--list` lists information about the cache in an earth file.
- `--seed` seeds the cache for an earth file.
- `--estimate` prints out an estimation of the number of tiles, disk space, and time it will take to perform the seed operation.
- `--min-level` *`level`* specifies the lowest LOD level to seed. Default: 0.
- `--max-level` *`level`* specifies the highest LOD level to seed. Default: highest available.

! We strongly recommend that you specify `--max-level` and seed just the areas that you want.

- `--bounds` *`xmin ymin xmax ymax`* specifies the geospatial bounding box to see, in map coordinates. You can include multiple instances of this option. Default: entire map.
- `--index` *`shapefile`* tells osgearth_cache to use the feature extents in the specified shapefile to set the bounding boxes for seeding.
- `--mp` specifies use of multiprocessing to process the tiles. This is useful for GDAL sources because it avoids the global GDAL lock.
- `--mt` specifies use of multithreading to process the tiles.
- `--concurrency` specifies the number of threads or processes to use if `--mp` or `--mt` are used.
- `--verbose` displays the progress of the seed operation.
- `--purge` purges a layer cache in an earth file. This command is interactive.

The following example caches a file named *VR-TheWorldOnline.earth*:

```
osgearth_cache.exe --seed ../userData/servers/VR-TheWorld-
  Online.earth --max-level 2
```

The following example caches a portion of a file named *HawaiiLocalServer-mak.earth*:

```
osgearth_cache.exe --seed ..\userData\servers\HawaiiLocal-
  Server-mak.earth --max-level 18 --bounds
  -162.0013879999999915 14.9985579999999992
  -149.9985580000000027 25.0013879999999986
```

24.11.3. Enabling Texture Compression

When texture compression is enabled, textures are converted internally to a compressed format (DXT). Compressing textures decreases memory use and increases rendering performance.

To enable or disable texture compression:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the File Caching Settings page (Figure 24-26).
3. Select or clear the Enable Texture Compression On All Textures check box.

24.11.4. Clearing the File Cache

You can clear the file cache if you need to free disk space.

The cache is normally configured to be in *./appData/cache*. You can delete files from this directory if you want to. The most likely reason to do this is if you load a terrain and realize that it should have had its DDS textures flipped, but has now been saved with them oriented the wrong way. You could delete the cache, then reload the terrain and toggle DDS Textures to the opposite setting.

To clear the file cache:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the File Caching Settings page (Figure 24-26).
3. Click Clear Accelerated File Loading Cache.

24.12. Displaying DDS Textures Correctly

DDS is a DirectX bitmap format that is often used for textures. DirectX expects the origin of the image to be at the top left corner. OpenGL expects the image origin to be at the bottom left corner. By default, VR-Vantage assumes that images have the OpenGL orientation. However, sometimes images are not oriented properly and therefore you may have to tell VR-Vantage to flip them.

You can change the DDS textures setting as follows:

- On a per-model basis. (For details, please see "Flipping DDS Textures for a Model," on page 30-18.)
- When you add a terrain patch. (For details, please see "Adding Elevation Data (Terrain Patches) to a Terrain," on page 24-8.)
- As a global setting. (For details, please see "Flipping DDS Textures Globally," on page 24-38.)

24.12.1. Flipping DDS Textures Globally

You can specify that the DDS textures setting apply to all terrains. This setting is primarily beneficial for paged terrains because you cannot know ahead of time if textures need to be flipped, as you could for a model or terrain patch. If a paged terrain has DDS textures that are upside down relative to VR-Vantage's expectations, the textures can be flipped when the terrain gets paged in.

To enable or disable DDS texture flipping for all terrains:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Loader Settings page (Figure 24-27).

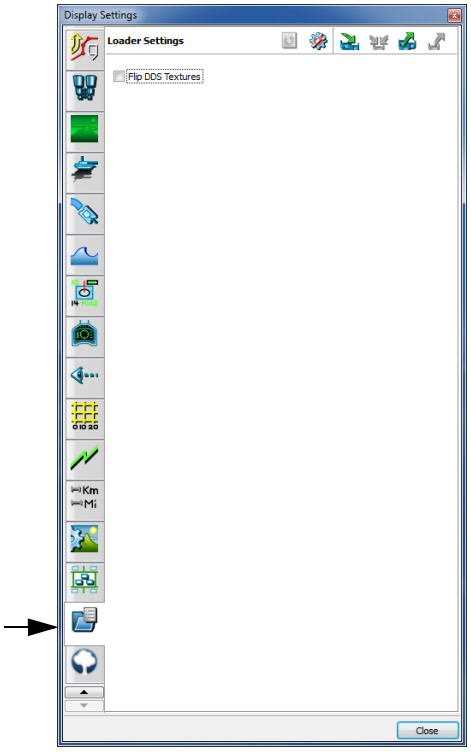


Figure 24-27. Loader Settings page

3. Select the Flip DDS Textures check box.
4. Click Close.

24.13. Building Efficient MetaFlight Terrains for VR-Vantage

VR-Vantage can only load MetaFlight terrains built with certain tools. All MetaFlight files must be preprocessed by VR-Vantage tools before they can be loaded. The following are recommendations for constructing MetaFlight terrains that can be processed and loaded into VR-Vantage:

- The MetaFlight terrain can contain one or more Geometry Grid Datasets (GGDS).
- The MetaFlight terrain can contain one or more Virtual Texture Datasets.
- The MetaFlight terrain can contain one or more Cultural Feature Datasets.
- The MetaFlight terrain can be built in the following coordinate systems: Geodetic, Geocentric, UTM, or Flat Earth.
- For the best conversion of Virtual Textures into a tiled texture GGDS, match every Virtual Texture layer with a geometry layer.
- For optimal performance the GGDS should be set up in a Pyramid structure (Level 1: 1x1, Level 2: 2x2, Level 3: 4x4, and so on).
- For optimal performance levels 1-4 should be made of FILE LOD GEOM tiles only. Do not put any children LOD GEOM tiles in these levels.
- For optimal performance the terrain should be balanced so that any single FILE LOD GEOM is not too large and can be paged in real-time (based on machine speed and video card). In other words, keep any single file small.
- For optimal performance any single FILE LOD GEOM should not contain too many LOD GEOM nodes as children.
- Geometry Grid Tile size (in meters) should match Virtual Texture Tile coverage (in meters.)
- For optimal performance limit the number of external references. This will reduce cull times. (For example, instead of having 10 individual buildings, externally reference one city block with all 10 buildings.)

24.14. Preprocessing Paged Terrains

VR-Vantage supports preprocessing external references used by paged terrains. VR-Vantage does not require terrain formats such as TerraPage or pageable IVE to be preprocessed. However these terrains may use external references in formats such as OpenFlight, which load slowly. Although VR-Vantage can accelerate these files at run-time using the accelerated cache feature, the first time you load one of these terrains you can experience significant performance issues. You can use the medfTool to preprocess these external references and save them in MEDF format. Thereafter, VR-Vantage will load the accelerated version at all times.

For example, if a TerraPage terrain references */externals/tree.flt*, preprocessing creates a file called */externals/tree.medf*. When VR-Vantage loads the terrain, it loads the MEDF version instead of the OpenFlight version.

We recommend that you preprocess all data to minimize load times and maximize run-time performance. For details about the medfTool, please see "Compressing Model Files," on page 30-24.

24.15. Configuring Paged and Streaming Terrains

You can improve performance for some terrains by configuring the following environment variables:

- OSG_MAX_PAGEDLOD. OSG_MAX_PAGEDLOD specifies the target maximum number of paged LODs to maintain. Default: 200. Set it to a lower value if you need to reduce memory consumption when using paged terrains.
- GDAL_CACHEMAX. GDAL_CACHEMAX specifies the maximum cache size for streaming terrain. The default value is 200 MB, which is often adequate. However, if you are using a highly detailed terrain, increasing the cache size to a larger value, such as 2000, can significantly improve performance.

24.16. Terrain Databases Provided with VR-Vantage

Table 24-1 describes the terrain databases provided with VR-Vantage. Some have variants, which indicate the coordinate system or other variations.

Table 24-1: Terrain databases shipped with VR-Vantage (Sheet 1 of 2)

Database	Variation	Description
Ala Moana	Ala Moana.mtf	A high-resolution area of Honolulu, Hawaii, USA, set into a raster map of the world. This terrain is stored locally and does not require an internet connection.
Ground	ground-db.mtf	UTM. OpenFlight. A generic relatively flat ground terrain.
Little Pond	LittlePond.mtf	Flat earth. DTED. Shape data. Imagery. A detailed suburban inset in a larger, less detailed terrain covering Boston, Massachusetts, U.S.A. and points west. This terrain was created in VR-Vantage using source data as described in "Composing a Terrain through the GUI," on page 26-2.
Makland	Makland.mtf	UTM. OpenFlight. A fictional terrain created by MÄK. It includes a variety of terrain and feature data, including underwater features. It is placed in the Indian Ocean.
ProceduralEarth	ProceduralEarth	Examples of procedurally generated terrain.
SanLuisObispo	SanLuisObispo.mtf	Flat earth. DTED. Imagery. A terrain that covers a portion of California, U.S.A.
	SanLuisObispo-TopoGdal.mtf	Geocentric. San Luis Obispo in topographic coordinates as local streaming terrain using an earth file.
VR-TheWorldOnline	VR-TheWorldOnline - Bakersfield Topo Map.mtf	VR-TheWorldOnline with topographical maps for the area around Bakersfield, California, USA. This terrain contains some feature data that simulation objects in aggregate-level scenarios can take advantage of.
	VR-TheWorldOnline - Little Pond.mtf	Little Pond features inset into VR-TheWorld Online.

Table 24-1: Terrain databases shipped with VR-Vantage (Sheet 2 of 2)

Database	Variation	Description
	VR-TheWorldOnline - MAK Earth - Base.mtf	The base VR-TheWorld Online terrain plus a high resolution inset for Honolulu, Hawaii, USA and the surrounding area. Does not include streaming feature data.
	VR-TheWorldOnline - MAK Earth.mtf	The base VR-TheWorld Online terrain plus a high resolution inset for Honolulu, Hawaii, USA and the surrounding area. Includes streaming feature data.
	VR-TheWorldOnline - Massachusetts S-57.mtf	VR-TheWorldOnline with S-57 data (as shapefiles) for Boston harbor.
	VR-TheWorldOnline - VR-Village Afghanistan.mtf	Geocentric. The high resolution data from *VR-Village.mtf* is inset in Afghanistan in VR-TheWorld online server.
VR-Village	VR-Village.mtf	GDB. Feature data. OpenFlight terrain. VR-Village is a fictional database created by VT MÄK. It has a highly detailed small town in a larger, sparsely detailed desert environment. The town includes multi-level buildings, underground tunnels, and a road that tunnels through a mountain. The coordinates place it off the west coast of Africa.
World	WorldFlatEarthNoElevation.mtf	Flat earth. Low resolution projected image of the world.
	WorldGeocentric.mtf	Geocentric. Low resolution projection of the world.
	WorldGlobalWater.mtf	A terrain with no elevation data for land masses.



25. Streaming Data Using Earth Files

This chapter provides an introduction to the syntax of Earth files and explains how to configure them to stream various types of terrain and feature data.

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25.1. Earth Files

An earth file is an XML format configuration file used to display terrain databases using osgEarth. The file format is documented at http://docs.osgearth.org/en/latest/. This chapter supplements the information on the osgEarth web site. In particular, it explains how to configure streaming features, for which there is no GUI in VR-Vantage.



VR-Vantage only supports geocentric terrains in earth files.

25.2. A Simple Earth File

The *VR-TheWorldOnline.earth* file is an example of a simple earth file. It has one image layer and one elevation layer:

```
<!--
VR-TheWorld Online
This file connects to VR-TheWorld online and contains:
Imagery:VR-TheWorld Base Imagery: 15m SRTM 90 Imagery for the World
     Boston Inset Imagery
     Washington DC Imagery
     Austin, TX Imagery
     Afghanistan Imagery

Elevation:VR-TheWorld Base Elevation: 90m SRTM Elevation
-->
<map name="VR-TheWorld" type="geocentric" version="2">

<image name="VR-TheWorld Base Imagery" driver="tms"
 lod_blending="true" cacheid="VR-TheWorldBaseImagery">
    <url>http://vr-theworld.com/vr-theworld/tiles/1.0.0/22/</url>
</image>

<elevation name="VR-TheWorld Base Elevation" driver="tms"
 max_data_level=13 max_level=13 cacheid="VR-TheWorldBaseElevation">
    <url>http://vr-theworld.com/vr-theworld/tiles/1.0.0/34/</url>
</elevation>

<options>
  <lighting>true</lighting>

  <elevation_interpolation>triangulate</elevation_interpolation>
  <terrain>
    <min_tile_range_factor>3</min_tile_range_factor>
  </terrain>
  <cache type="filesystem">
    <path>../../appData/cache</path>
  </cache>
</options>
</map>
```

Table 25-1 describes the XML elements in the file and their attributes.

Table 25-1: Earth file elements and attributes

Element	Attribute	Description
<!-- -->		Comment block.
map		Root level element. All other elements must be in the map block.
	name	The name of the map.
	type	The projection. VR-Vantage only supports geocentric terrains, which can be specified as `geocentric` or `globe`.
	version	The VR-TheWorld Server version.
image		Specifies an image layer.
	name	The name of the layer.
	driver	The driver to use to fetch tiles, for example, TMS, WMS, or GDAL.
	url	The location of the files. This could be a web address or a local path.
elevation		Specifies an elevation layer.
	name	The name of the layer.
	driver	The driver to use to fetch tiles, for example, TMS, WMS, or GDAL.
	url	The location of the files. This could be a web address or a local path.
options		Specifies options that affect the entire map. For more information, please see "Earth File Options," on page 25-16.

25.2.1. Including External Files into Earth Files

Earth files can include external files. This can make management of complex terrains easier. The included files must be XML files. There are two ways to include external files, the `xi:include` element and use of earth file templates.

The following example shows how to use `xi:include`:

```
<map name="readymap.org" type="geocentric">
  <xi:include href="readymap_imagery.xml"/>
  <xi:include href="readymap_elevation.xml"/>
</map>
```

When you reference a document using `xi:include`, it can only contain a single XML node, for example:

```
<image>
  ...
</image>
```

Since using an `xi:include` element for each node that you want to import might require many such elements, you can include multiple nodes in a single file by using an alternative include format. Use the syntax `{% include` *`filename`* `%}`. This syntax is used in some of the earth files shipped with VR-Vantage. The following lines are from *VR-TheWorld Online - MAK Earth.earth*:

```
<!-- Boston area models -->
  {% include vrtheworld-streaming.buildings-boston.xml %}

<!-- Hawaii area models -->
  {% include localdata.hawaii-maritime-navigation.xml %}
  {% include vrtheworld-streaming.buildings-oahu.xml %}
  {% include vrtheworld-streaming.airport-hnl.xml %}
```

25.3. Loading Multiple DTED Files

You can load multiple DTED files from an earth file. To do so, in the `heightfield` element, specify a directory instead of a specific file, for example (from *SanLuisObispo-Topo.earth*):

```
<heightfield name="SanLuisObispo Elevation" driver = "gdal">
  <url>../../data/Terrain/SanLuisObispo/Elevation</url>
  <extensions>dt0;dt1;dt2</extensions>
  ...
</heightfield>
```

The `extensions` element lets you specify which files to load based on their file extensions. If you do not include an extensions list, the GDAL driver tries to load every file in the directory.

25.4. Processing Streamed Data

VR-Vantage has several "processors" that search through streamed-in data looking for things like SpeedTrees, objects that need effects textures attached, buoys, beacons, and so on. In order to do this efficiently, processors register feature names that they want to process. The registration data is in *./importConfig/registrant_feature_list.csv*.

For example, in *registrant_feature_list.csv*, it states that the processor for SpeedTrees, speedTreeManager, is mapped to Vegetation. In *VR-TheWorld Online - MAK Earth.earth*, SpeedTrees are configured as follows:

```
<model name="trees" driver="feature_custom">
  <features name="Vegetation" driver="wfs">
```

The feature name is Vegetation. This means that it will be processed by the speedTree-Manager.

Similarly, the featureDataBroker, which is responsible for creating streamed buoys, beacons, and the lights and marks that might be attached to them, is mapped to `s57-data` and `dynamicFeatures`. (Processors can be mapped to more than one feature type.) Examples of using this processor are:

```
<model name="LateralBuoysUS5HA52M" driver="feature_custom"
  enabled="true">
  <features name="s57-data" driver="ogr">
```

and

```
<model name="TaxiwayLights" driver="feature_custom">
  <features name="dynamicFeatures" driver="ogr">
```

registrant_feature_list.csv file is fully commented and provides additional information about this scheme.

25.5. Adding Feature Layers to an Earth File

You can add the following types of features to a terrain:

- Point features, such as trees, buoys, and buildings.
- Linear features, such as roads and waterways.
- Areal features, such as forests (areal trees), bodies of water, and extruded buildings.

You can add the XML for feature layers to an earth file.

Feature layers are added to an earth file using the `model` element. Table 25-2 describes the `model` element, its attributes, and sub-elements.

Table 25-2: `model` element attributes

Element	Attribute	Description
model		Base element for specifying a feature layer.
	name	Name of the layer. This can be any text.
	driver	Driver to use for creating models.
The `features` and `layout` elements specify how to get and load the feature data. The `features` block is mandatory. `layout` is optional.		
features		Specifies source of data.
	name	Name of the element.
	driver	Driver to use to get the data.
	url	Location of the feature data.
layout		Specifies how to load the data.
tile_size_factor		The data specified in the features element gets cut into tiles. This attribute specifies how aggressively to tile it.
level	name	The level specifies the level (LOD) beyond which not to display the features.
	max_range	Distance beyond which the feature is not displayed.
selector	class	Specifies the type of feature.
styles		The `styles` element and sub-elements specify how to render the scene. This element is mandatory.
library		A texture library.
	name	Name of the texture library.
	url	The location of the library.

Table 25-2: `model` element attributes

Element	Attribute	Description
style		A specific style. The name, which precedes the curly brace ({) can be any text you want. For information about the attributes that you can specify in a style, please see http://docs.osgearth.org/en/-latest/references/symbology.html.
lighting		Specifies whether or not to enable lighting. Usually true.
vrfsim:enabled		Optional. For use in terrains used by VR-Forces if the simulation engine needs a different value for an attribute than that used by the front-end. If present, it is ignored by VR-Vantage and the VR-Forces front-end. For details, please see xxxxx



When you load a file using the OGR driver, OGR decides what the layer names will be. For shapefiles it is always the name of the file (minus the extension). Other files (like S-57) can have multiple layers, and the names are decided by a format-specific algorithm. For example, an S-57 file has an enumerated list of layer names.

25.5.1. Configuring Point Features

Point features, such as trees, use the `model` element. The following code, from *VR-TheWorld Online - MAK Earth.earth*, adds point trees:

```
<model name="Alamoana point trees" driver="feature_custom">
  <!-- streaming point trees -->

  <features name="Vegetation" driver="ogr">


  <url>../../data/Terrain/Hawaii/Features/AlaMoanaVegetationP.shp</url>
    <typename>5</typename>
  </features>
  <layout>
    <tile_size_factor>3</tile_size_factor>
  </layout>

  <styles>
    <style type="text/css">
        Vegetation {
        marker:              "Trees" + [veg] + "ST" ;
        marker-scale:        1;
        marker-placement: vertex;
        altitude-clamping:   terrain;
        altitude-resolution: 0.00008583068847656250;
        altitude-offset:     0;
        }

    </style>
  </styles>
  <clustering>True</clustering>
    <lighting>true</lighting>
</model>
```

25.5.2. Configuring Linear Features

Linear features, such as roads, rivers, or railways, use the `model` element. The following code, from *VR-TheWorld Online - MAK Earth.earth*, configures roads:

```
<model name="Oahu_Roads" driver="feature_geom" overlay="true"
  enabled="false">

  <features name="Roads" driver="wfs">
    <url>http://vr-theworld.com/vr-theworld/features/wfs</url>
    <typename>55</typename>
  </features>

  <!-- Sets the name property on each geometry to the value of the "name"
  attribute -->
  <feature_name>[name]</feature_name>

    <!-- Appearance details -->
    <style type="text/css">
      Oahu_Roads {
      stroke: #ff0000;
      stroke-width: 10.0;
      altitude-offset: 10;
      }
    </style>
</model>
```

25.5.3. Configuring Areal Features

Areal features, such as forests, use the `model` element. The following code, from *VR-TheWorld Online - MAK Earth.earth*, configures a forest with three types of trees:

```
<!-- Forest -->
<model name="trees" driver="feature_custom">
  <features name="Vegetation" driver="wfs">
    <url>http://vr-theworld.com/vr-theworld/features/wfs</url>
    <typename>7</typename>
  </features>
  <layout>
    <tile_size_factor>3</tile_size_factor>
    <crop_features>true</crop_features>
    <level max_range="8000" class="trees-1"> </level>
    <level max_range="2000" class="trees-2"> </level>
    <level max_range="1000" class="trees-3"> </level>
  </layout>
  <styles>
    <style type="text/css">
      trees-1 {
      marker:              "TreesNorwaySpruceST";
      marker-placement:    random;
      marker-density:      800;
      marker-scale:        1;
      altitude-clamping:   terrain;
      altitude-resolution: 0.0001;
      marker-random-seed:  1;
      }
      trees-2 {
      marker:              "TreesColoradoBlueSpruceST";
      marker-placement:    random;
      marker-density:      800;
      marker-scale:        1;
      altitude-clamping:   terrain;
      altitude-resolution: 0.0001;
      marker-random-seed:  2;
      }
      trees-3 {
      marker:              "TreesAmericanElmST";
      marker-placement:    random;
      marker-density:      800;
      marker-scale:        1;
      altitude-clamping:   terrain;
      altitude-resolution: 0.0001;
      marker-random-seed:  3;
      }</style>
    </styles>
    <clustering>true</clustering>
    <lighting>true</lighting>
</model>
```

25.6. Using Cut-in Sites for High Resolution Insets

Users of terrain servers, such as VR-TheWorld Server, often want to add high resolution sites of particular interest while using the lower resolution terrain provided by the terrain server for the rest of the world. You can add a high resolution terrain patch to a terrain server, but it overlays the terrain provided by the server and this can cause unexpected visual problems. Ideally, you should cut out the relevant areas of terrain provided by the server and add your high resolution terrain to the cut out area. For example, the VR-Vantage terrain *VR-TheWorld Online - MAK Earth.mtf* has two terrain patches, *VR-TheWorld Online - MAK Earth.earth*, which provides the base terrain from VR-TheWorld Server, and *./data/Terrain/Hawaii/Geometry/OpenFlightAlaMoana/AlaMoana-ModifiedGeocentricProxy.osg*, which is a locally stored high resolution inset.

The `mask` element lets you cover the base terrain data with your hand-modeled data. A mask element in an earth file looks similar to the following:

```
<mask name="HonoluluRunway26R-8L-mask" driver="feature" >
  <features driver="ogr">
    <geometry>
      POLYGON((-157.91489143 21.32914026 3.016, -157.91525638
  21.32914026 3.016, -157.91666238 21.32912541 3.016, -157.91697822
  21.32934847 3.016, -157.91709263 21.32968744 3.016, -157.91709263
  21.32968744 7.016, -157.91709263 21.32968744 11.016, -157.91709263
  21.32968744 15.016, -157.91710262 21.32968706 15.016, -157.91697822
  21.32934847 16.016, -157.91709263 21.32968744 16.016, -157.91710262
  21.32968706 15.016))
    </geometry>
  </features>
</mask>
```

VR-Vantage includes a tool, the osgEarth Boundary Generation Tool, that can calculate the geometry of an OpenFlight file. To cut out a section of terrain from the terrain server, add a `mask` element to the earth file. Use the output from the boundary tool for the data in the geometry element.

Table 25-3 describes the `mask` element and its sub-elements.

Table 25-3: `mask` element

Element	Attribute	Description
mask		Element for cutting in geometry.
	name	Name of the mask.
	driver	The driver to use.
features		List of features in the mask.
	driver	The driver to use. OGR reads raw vector feature data from shapefiles and other formats.
geometry		Specifies the 3D boundaries of the site. You must know this information.
	geometry_url	The location of the file with the feature data.

25.6.1. Using the Boundary Generation Tool

The Boundary Generation Tool takes an OpenFlight file and calculates the bounding geometry of the file. It returns the coordinates in a text file. The general process of cutting in a site is as follows:

1. Run the Boundary Generation Tool against an OpenFlight file.
2. Insert the output of the of the boundary generation tool in a `mask` element in your earth file. (For details about `mask` elements, please see "Using Cut-in Sites for High Resolution Insets," on page 25-12.)
3. Load the terrain.
4. Add the FLT file as a terrain patch.
5. Save the terrain.

Running the Boundary Generation Tool

The output from the Boundary Generation Tool tool, in *boundary.txt* or the output file you specify, looks similar to the following:

```
POLYGON((-157.91489143 21.32914026 3.016, -157.91525638 21.32914026
  3.016, -157.91666238 21.32912541 3.016, -157.91697822 21.32934847
  3.016, -157.91709263 21.32968744 3.016, -157.91709263 21.32968744
  7.016, -157.91709263 21.32968744 11.016, -157.91709263 21.32968744
  15.016, -157.91710262 21.32968706 15.016, -157.91697822 21.32934847
  16.016, -157.91709263 21.32968744 16.016, -157.91710262 21.32968706
  15.016))
```

The first two vertices are the latitude and longitude. The third vertex is the height, in meters. The remainder of the vertices map the outline of the geometry.

To run the boundary generation tool:

1. Open a console window.
2. Change directory to *./bin64*.
3. Run the tool:

   ```
   osgearth_boundarygen [--out file_name --no-geocentric
     --convex_hull --verbose --view --precision precision --
     tolerance tolerance] model_file
   ```

   Table 25-4 describes the options.

Table 25-4: osgEarth Boundary Generation Tool command-line options

Option	Description
`--convex_hull`	Calculate a convex hull instead of a full boundary.
`model_file`	The input model file.
`--no-geocentric`	Skips geocentric reprojection. Use for flat databases.

Table 25-4: osgEarth Boundary Generation Tool command-line options

Option	Description
`--out` *`file_name`*	Specifies the output file for boundary geometry. Default: *boundary.txt*.
`--precision` *`precision`*	Specifies the number of significant digits in the output coordinates. Default: 12.
`--tolerance` *`tolerance`*	Specifies the tolerance for combining similar vertices along a boundary. Default: 0.005.
`--verbose`	Prints progress messages to the console.
`--view`	Show the result in a 3D window.

25.7. Extruded Buildings

If you are simulating in an urban environment, you want your terrain to have realistic 3D buildings. However, modeling hundreds or thousands of buildings by hand would be an arduous and expensive task. osgEarth can extrude buildings from areal features and apply textures to them to create a realistic environment with relatively little work. Publicly available GIS data that has footprint and height data can provide the input.

The following code (from *VR-TheWorld Online - MAK Earth.earth*) adds extruded buildings to the terrain:

```
<!-- Extruded buildings Oahu -->
<model name="buildings" driver="feature_geom">

  <!-- Streamed buildings -->
  <features name="buildings" driver="wfs">
    <url>http://vr-theworld.com/vr-theworld/features/wfs</url>
    <typename>65</typename>
  </features>

  <layout>
    <tile_size_factor>3</tile_size_factor>
  </layout>

  <styles>
    <library name="us_resources">
      <url>http://vr-theworld.com/vr-
  theworld/filemanager/download/public/Library/catalog.xml</url>
    </library>

    <style type="text/css">
      buildings {
        extrusion-height:      [hgt2d];
        extrusion-flatten:     true;
        extrusion-wall-style:  building-wall;
        extrusion-roof-style:  building-rooftop;
        extrusion-random-seed: 1;
        altitude-clamping:     terrain;
        altitude-resolution: 0.0001;
      }
      building-wall {
```

```
            skin-library: us_resources;
            skin-tags:    building;
            skin-random-seed: 1;
            fill:         #ffffff;
          }
          building-rooftop {
            skin-library: us_resources;
            skin-tags:    rooftop;
            skin-tiled:   true;
            skin-random-seed: 1;
            fill:         #ffffff;
          }
        </style>
      </styles>
      <lighting>true</lighting>
      <cluster_culling>false</cluster_culling>

    </model>
```

For descriptions of the elements in a model block, please see Table 25-2.

25.8. Loading CDB Databases

VR-Vantage supports image and elevation data in CDB databases. CDB databases define a file structure. MÄK products load the data using an earth file. The earth file entries point to the files and specify the CDB driver.

Because MÄK uses osgEarth to load CDB databases, you have the same flexibility with CDB databases that you do with other database types. For example, you can:

- Use streaming data (from VR-TheWorld Server), or other source imagery to build a skirt around a CDB inset.
- Place an OpenFlight inset into a CDB database.
- Add lights, buildings, forests, grass, and other clutter on top of an existing CDB database.

The following code shows how to configure elevation and image data in an earth file:

```
<image name="cdb_imagery" driver="CDB">
  <cdb_root>C:\CDB\CampPendelton\CDB\CDB_CMPP_1_0</cdb_root>
</image>

<elevation name="cdb_elevation" driver="CDB">
  <cdb_root>C:\CDB\CampPendelton\CDB\CDB_CMPP_1_0</cdb_root>
</elevation>
```

Be sure to set <cdb_root> to the top level of your CDB database.

25.8.1. Preprocessing CDB Databases

VR-Vantage treats CDB databases as a streaming terrain source. When it loads the data, it organizes and tiles the imagery in a way that promotes long term optimal performance. However, this tiling process can be time consuming. Once the data has been processed, VR-Vantage caches the data so that it can be loaded quickly the next time you load the database.

This initial processing means CDB loading can be very slow and halting. Often, this delay is not acceptable in a run-time environment. To optimize the process and eliminate run-time delays you can preprocess the terrain.

VR-Vantage includes a tool, *./bin64/osgearth_cache*, that you can use to cache terrain data offline. For details about how to use osgearth_cache, please see "Caching osgEarth Terrain Data Offline," on page 24-36.

25.9. Earth File Options

An earth file can have `option` elements that affect the entire map. Table 25-5 describes the option elements.

Table 25-5: `option` element

Element	Attribute	Description
lighting		Enables or disables lighting for the entire map. This is usually true.
elevation_interpolation		Specifies how OSG interprets elevation between grid posts. If you are using VR-Forces or visualizing a VR-Forces simulation, set this to triangulate to ensure correlation.
cache		Specifies caching for terrain data.
	type	The type of caching to use.
	path	The location of the data cache.

25.10. Streaming Buoys and Beacons

VR-Vantage can display models of buoys and beacons specified in shapefiles and S-57 data, which is streamed in using earth files.

Streamed features (including buoys) are organized into layers. In the earth file, the names in the **styles** block specify the layer the streamed features will belong to. By default, VR-Vantage defines seven layers for buoys. They correspond to the different buoy layers in an S-57 file. These layers are named LateralBuoys, SafeWaterBuoys, ISDBuoys, RegulatoryBuoys, InstallationBuoys, CardinalBuoys, and SpecialPurpose-Buoys.

The configuration file *./appData/importConfig/s57_layer_list.csv* specifiesy which style names in an earth file correspond to recognized streamed feature types. The file currently contains two lines. The first starts with the keyword “Buoys” and is followed by a comma-separated list of all the style names that will be recognized (and streamed in) as buoys. The second line starts with the keyword “Beacons” and is followed by the list of recognized beacon styles. They can be anything you like, but need to correspond with whatever style names you use in the earth file.

The following is an example of a **style** block for a buoy (Special Purpose Buoys):

```
<model name="buoys" driver="feature_custom">
  <features name="Special Purpose Buoys" driver="ogr">
   ...
  </features>
  <layout>
   ...
  </layout>
  <styles>
    <style type="text/css">
        <!-- | | | This is the layer name -->
        <!-- v v v                        -->
      SpecialPurposeBuoys {
      ......
      }
    </style>
  </styles>
```

25.10.1. Specifying Model Definitions for Streamed Buoys

Within each style block, you specify the model definition to use for a streamed buoy or beacon. Since buoys and beacons have different styles and within each style have different colors and markings, VR-Vantage can map the S-57 data to buoy and beacon models in the following ways:

- Specify a model definition for each type of buoy. Buoy color and numbering is the same for all buoys.
- Generate a model definition name using a pattern and S57 attributes.
- Specify a model definition for a unique buoy based on the buoy's name.
- Use a texture atlas to model buoys.

All of these methods are supported by VR-Vantage and are described in this section. However, VR-Vantage uses texture atlases for all streaming buoys and beacons.

Specifying a Model Definition for a Type of Buoy

To specify the model definition for a type of buoy, you specify it as the marker name:

```
<styles>
   <style type="text/css">
    SpecialPurposeBuoys {
    marker: "BuoysSpecialPurpose" ;
    ...
```

In this case, the model definition “BuoysSpecialPurpose” is used for all buoys streamed in for that SpecialPurposeBuoys layer.

This approach is the simplest way to specify model definitions for buoys.

Generating a Model Definition Name for a Buoy

Instead of specifying a model definition, you can have VR-Vantage build a model definition using the buoy’s attributes. This approach is more complex than specifying one model definition for a type of buoy, but it is more flexible. You can accommodate many variations of a given type of buoy without having to specify many model definitions.

Buoy attributes can be strings or enumerated values (such as shape (BOYSHP), color (COLOUR), and color pattern (COLPAT)).

The following code results in model definitions like “Buoys352”.

```
<styles>
  <style type="text/css">
    SpecialPurpose {
    marker: "Buoys" + [BOYSHP] + [COLOUR] + [COLPAT];
```

Creating and managing model definitions with coded numbers in this way is difficult. Therefore, VR-Vantage provides a mechanism to map the numeric attribute values to strings.

The enumerated value-to-string mappings are in *./appData/importConfig/s57_attr_map.csv*. You can change them to any strings that you want to use. Given this information, you can specify your model definition as a pattern and provide the enumerated attribute values. VR-Vantage uses them to decode and build the requested model definition. The pattern and attribute values are specified as a colon (:)-separated list of the following form:

```
"pattern:Attribute1=value:Attribute2=value" ...
```

The pattern itself indicates where attribute values should be replaced using '[Attribute]' substrings. For example, consider an input string such as:

```
"Buoys[COLOUR][BOYSHP]:COLOUR=5:BOYSHP=3"
```

The default mappings for COLOUR and BOYSHP in *s57_attr_map.csv* are as follows:

```
BOYSHP,,Nun,Can,Spherical,Pillar,Spar,Barrel,Super,Ice
COLOUR,,White,Black,Red,Green,Blue,Yellow,Grey,Brown,Amber,Violet,Orange
  ,Magenta,Pink
COLPAT,,HorizontalStriped,VerticalStriped,DiagonalStriped,Squared,Stripe
  d,BorderStriped
```

Therefore, the model definition would be BuoysBlueSpherical, since the enumerated COLOUR value '5' (the fifth value in the list) is mapped to "Blue", and the BOYSHP value '3' is mapped to "Spherical". Some of these attributes, such as COLOUR, may be lists of enumerated values. The strings for enumerated lists are concatenated. The following input string:

```
"Buoys[BOYSHP][COLOUR][COLPAT]:COLOUR=3,1:BOYSHP=2:COLPAT=2
```

results in the model definition "BuoysCanRedWhiteVerticalStriped".

To generate the input string like the one above from an earth file, you would use:

```
marker: "Buoys[BOYSHP][COLOUR][COLPAT]"
            + ":COLOUR=" + [COLOUR]
            + ":BOYSHP=" + [BOYSHP]
            + ":COLPAT=" + [COLPAT]
```

The order that the actual attribute/value pairs are encoded (after the pattern) does not matter.

Designators

Many buoys have some form of one to three numbers, letters, or both that appear on the buoy itself. S-57 does not provide an attribute that indicates what this symbol is, but it is usually found at the end of the OBJNAM attribute, such as "Boston South Channel Buoy 13" or "President Roads Junction Lighted Buoy PR". If the OBJNAM attribute is provided, the model definition builder tries to extract this symbol. It must be 3 characters or less, and be all numerics, all capital letters, or a mix of the them. You can add this to a model definition pattern using the [DESIGNATOR] substring, for example:

```
marker: "Buoys[BOYSHP][COLOUR][COLPAT][DESIGNATOR]"
+ ":COLOUR=" + [COLOUR]
+ ":BOYSHP=" + [BOYSHP]
+ ":COLPAT=" + [COLPAT]
+ ":OBJNAM=" + [OBJNAM]
```

This code, when streaming in "Boston South Channel Buoy 13", would result in a model definition of "BuoysCanGreen13", since the BOYSHP attribute for that buoy maps to "Can" and COLOUR attribute to "Green".

Unique Buoys

There may be cases where you want to use a specific model definition for a particular buoy. The buoy might be a special landmark that needs to be recognizable. The file *appData/importConfig/s57_modeldef_by_name_map.csv* contains a list of buoy names (the OBJNAM attribute) and model definition pairs. If the OBJNAM attribute value is provided in the marker string and if it matches one of the buoy names in *s57_modeldef_by_name_map.csv*, then the specified model definition is used instead of a generated definition.

25.10.2. Modeling Buoys Using Texture Atlases

This approach is more complex than specifying a model definition per type of buoy or building one from attributes. It requires understanding how to use texture atlases. However, this method allows you to have a large number of buoys in a scene with a wide variety of colors, patterns, and designators using a very limited number of models. This dramatically reduces the scene complexity (thereby increasing frame rate) when you use instancing. This is the approach that VR-Vantage uses for all buoys and beacons it ships with.

Each buoy shape (can, pillar, nun, and so on) is a separate model. Each model has a texture atlas that has all the different colors and patterns needed for that buoy shape. In the `marker` field (in the `model` statement) a simple model definition pattern is used:

```
Buoy[BOYSHP]
```

The other attributes are passed in the same fashion as described in "Generating a Model Definition Name for a Buoy," on page 25-18 when mapping attributes to model definition substrings:

```
marker: "Buoys[BOYSHP]"
  + ":BOYSHP=" + [BOYSHP]
  + ":COLOUR=" + [COLOUR]
  + ":COLPAT=" + [COLPAT]
  + ":OBJNAM=" + [OBJNAM] ;
```

In this example, all the attributes are mapped to strings, but the COLOUR and COLPAT strings are used to look up the appropriate uv texture coordinate offsets for the buoy. The texture-uv mapping file has the same name as the buoy model plus the extension *dtxc* (for example, *PillarBuoy.dtxc* and *Can.dtxc*).

The *.dtxc* files can support multiple atlases that may be used on the same model. VR-Vantage uses multiple atlases for buoys with topmarks, and beacons with daymarks and topmarks. (For information about topmarks and daymarks, please see "Streaming Daymarks," on page 25-25 and "Streaming Topmarks," on page 25-25.) The model definition for the buoy specifies a key (found in the *.dtxc* file) to be used for the main texture (`mainTextureKey`) and for the topmark's texture (`topmarkTexturekey`).

The buoy is also built with special geometry and a texture atlas for displaying the alphanumeric designator. The geometry includes a switch to select between sites for placing one, two, or three alphanumeric characters. The characters themselves are then mapped from a texture atlas using the designator string found and a uv-coordinate texture mapping file that is shared by all buoys (and daymarks), named *LettersNumbers.ctxc*.

25.10.3. Configuring Streaming Beacons

You can specify beacon feature styles the same way you specify buoys. You can add any number of beacon styles names. The S57 attribute enumeration-to-string mappings for beacons are in *s57_layer_list.csv*.

The following code is an example of a beacon model block:

```
<model name="beacons" driver="feature_custom" enabled="true">
  <features name="Lateral Beacons" driver="ogr">
    <!-- From S-57 data -->
    <ogr_driver>S57</ogr_driver>
    <url>../../data/Terrain/Massachusetts/Features/US5MA10M.000</url>
    <layer>BCNLAT</layer>
  </features>
  <layout>
    <tile_size_factor>3</tile_size_factor>
  </layout>
  <styles>
    <style type="text/css">
      LateralBeacons {
      marker: "Beacons[BCNSHP]"
           + ":BCNSHP=" + [BCNSHP]
           + ":COLOUR=" + [COLOUR]
           + ":COLPAT=" + [COLPAT]
           + ":PERSTA=" + [PERSTA]
           + ":PEREND=" + [PEREND]
           + ":OBJNAM=" + [OBJNAM] ;
           marker-scale:        1;
           marker-placement: vertex;
           altitude-clamping:   terrain;
           altitude-resolution: 0.00008583068847656250;
           altitude-offset:     0;
      }
    </style>
  </styles>
</model>
```

Model definitions for beacons work the same way as for buoys. They are configured in *s57_attr_map.csv*. It can contain enumeration mappings for any enumerated S-57 attribute that you want to use to create model definitions. Default values are in *s57_defaults.csv*. This contains the default name and default model definition for each style group specified in *s57_layer_list.csv*. The delivered *s57_defaults.csv* contains:

```
# If the final model definition generated does not exist, one of these
  model definitions will be used
Buoys,DefaultModelDefinition,BuoysGreenPillar1
Beacons,DefaultModelDefinition,BuoysRedPillar2

# If the feature has no name, use one of these
Buoys,DefaultName,Unnamed Buoy
Beacons,DefaultName,Unnamed Beacon
```

25.10.4. Configuring Streamed Navigation Lights

Navigation lights are managed somewhat differently from other streamed features. These lights do not result in actual objects added to the scene. The information is used to create and attach light controllers to existing objects. The lights themselves need to already exist as part of the buoy or beacon model they appear on.

Each model that has a light should have a comment-tagged switch for choosing a light group of the specified color. Each light in turn has a switch for turning the light itself on or off. We use the tag `@dis light_color` to tag a color switch, with values 0-3 corresponding to white, green, red, and yellow. The switch to turn lights off and on is `@dis navigation_lights`.

VR-Vantage streams in light data using model blocks similar to those used for buoys and beacons. Again, style names can be applied and *light_layer_list.csv* controls which styles will be read. *VR-TheWorld Online - Massachusetts S-57.earth* uses a single style name for all lights, **NavigationLights**. An example light model block is shown below:

```
<model name="LightsUS5MA10M" driver="feature_custom"  enabled="true">
  <features name="s57-data" driver="ogr">
    <!-- From S-57 data -->
    <ogr_driver>S57</ogr_driver>

    <url>../../data/Terrain/Massachusetts/Features/US5MA10M.000</url>
    <layer>LIGHTS</layer>
<!--  From a Shape file -->
<url>../../data/Terrain/Massachusetts/Features/US5MA10M/LIGHTS.shp</url>
  </features>
  ...
  <styles>
    <style type="text/css">
      NavigationLights {
        marker: "COLOUR=" + [COLOUR] + ":SIGSEQ=" + [SIGSEQ] +
  ":EXCLIT=" + [EXCLIT];
        marker-scale:        1;
        marker-placement: vertex;
        altitude-clamping:   terrain;
        altitude-resolution: 0.00008583068847656250;
        altitude-offset:     0;
      }
    </style>
  </styles>
</model>
```

Since we are not building model definitions, we do not need to map enumerated values to strings. However, we do map S-57 light colors to the colors that we support. This mapping is in *light_attr_map.csv*. VR-Vantage associates light controllers with other streamed features based on the S-57 or shape file locations of the lights and features, as follows:

- If the COLOUR attribute is provided, the attached light controller sets the light color using the light color switch.
- If the SIGSEQ attribute is provided, the light will be turned on and off according to the specified sequence.
- If the EXCLIT attribute is provided, the light controller enables or disables the light based on daylight and fog conditions.

The light color switch and light switch values can be changed by specifying different ones through the API, specifically using:

```
de.scene().terrain().navigationLightManager().
    setLightColorSwitchNumber()
```

and

```
de.scene().terrain().navigationLightManager().setLightSwitchNumber()
```

25.10.5. Configuring Seasonal Buoys and Beacons

Seasonal buoys and beacons are supported. Include the PERSTA/PEREND attributes in the earth file as part of the marker field, and buoys and beacons will only appear during the correct season. Example:

```
marker: "Buoys[COLOUR][COLPAT][BOYSHP][DESIGNATOR]"
  + ":BOYSHP=" + [BOYSHP]
  + ":COLOUR=" + [COLOUR]
  + ":COLPAT=" + [COLPAT]
  + ":PERSTA=" + [PERSTA]
  + ":PEREND=" + [PEREND]
  + ":OBJNAM=" + [OBJNAM] ;
```

25.10.6. Streaming Daymarks

VR-Vantage supports streamed daymarks for beacons. A limited number of daymark models and textures are provided as examples. *VR-TheWorld Online - Massachusetts S-57.earth* has a model statement to stream daymarks from the Boston Harbor S-57 data. As with buoys and beacons, the model entry specifies a style name (Daymarks), which corresponds to a layer specified in *daymark_layer_list.csv*. OSGEarth models that use the feature_custom driver and have a style name that is in the layer list file, are processed as daymarks. S-57 attribute values can be mapped using the *daymark_attr_map.csv* file.

The beacon models provided with VR-Vantage contain multiple daymark placard shapes (Diamond, Square, and Triangle), which are selected based on the TOPSHP attribute. The TOPSHP attribute is mapped to '0', '1', or '2', which are the switch values for the diamond, square, or triangle shaped marks. Other attribute values, including TOPSHP, COLOUR, COLPAT, and CATSPM are used to look up UV coordinates in the model's texture atlas using a uv-texture coordinate mapping file similar to the one described for buoys. The mappings are in *./data/Objects/Beacons/daymark.dtxc*. These daymark shapes, plus textures provided, represent all the daymarks attached to beacons in Boston Harbor. The model definition for daymarks includes a parameter that specifies a string key to use in the *.dtxc* file ("daymarkTextureKey").

25.10.7. Streaming Topmarks

Topmarks can be streamed in and attached to buoys and beacons similarly to daymarks. The shape is determined by the TOPSHP attribute. The attribute is mapped to a switch value using the *topmark_attr_map.csv* file. Textures for the topmarks can be selected from a texture atlas similarly to buoys and daymarks. The model definition for a buoy or beacon that needs to map attributes to uv-texture coordinates using that model's *.dtxc* file will have a string key (`topmarkTextureKey`) that identifies the mapping entries in the file that pertain to the topmark texture atlas.

25.10.8. Generating Signal Sequences

The S-57 attribute SIGSEQ (signal sequence) specifies the flashing sequence that a navigational aid light on a buoy or beacon displays. These sequences (along with color) are used to distinguish among different buoys and beacons at night. However, this is not a required S-57 attribute. If the SIGSEQ attribute is not present, VR-Vantage tries to generate a signal sequence using the LITCHR (light characteristic), SIGPER (signal period) and SIGGRP (signal group) attributes for the most commonly seen sequences.

As part of the class responsible for generating these sequences, the VR-Vantage API includes a virtual function for each sequence type that is not implemented, so that a developer can implement it. The assumption is that not many of the other sequence types will be used, but it is data-specific. Once we know what sequences are needed for the S-57 data in use, it should be relatively straight-forward to implement those additional sequence generation methods.

The class used to generate signal sequences is *DtLightSignalSequenceGenerator*, in the vrvCore library. *DtLightSignalSequenceGenerator.h* provides documentation, including which methods are implemented and which are not. To extend this class, a creator is provided, *DtLightSignalSequenceGeneratorCreator*, an extended instance of which can be registered through a plug-in with the display engine.



26. Terrain Tutorials

Although the individual procedures for managing terrain are fairly straightforward, understanding how they fit together to help you achieve your visualization goals is not always obvious. This chapter contains tutorials that demonstrate how to combine various procedures to create terrains and how to create a local terrain server.

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26.1. Composing a Terrain through the GUI

This tutorial shows how to compose a terrain by combining elevation data, imagery, and feature data in the VR-Vantage GUI. It recreates a portion of the LittlePond terrain that is included with VR-Vantage. Little Pond is a small detailed area in a suburb of Boston, Massachusetts, U.S.A.



- This tutorial shows you how to add props to the LittlePond elevation and image data. However, the tutorial does not ask you to add every type of prop that the complete LittlePond terrain contains. Therefore, at the completion of the tutorial, your terrain will not look exactly like the LittlePond terrain provided with VR-Vantage. If you want to completely recreate the LittlePond terrain, you will have to continue to add props on your own.
- To see a set of brief videos that illustrate this tutorial, on the Start menu, choose **VR-Vantage 2.1** → **Documentation** → **VR-Vantage Video Tutorials**, open *./doc/vrvantage_tutorialvideos.htm*, or click the camera icon next to the procedure whose video you want to view.

The basic steps for composing a terrain are:

1. Add elevation data (a terrain patch) ("Add Elevation Data (Add a Terrain Patch)," on page 26-3).
2. Add imagery ("Add Imagery," on page 26-4).
3. Add a feature layer ("Add a Feature Layer," on page 26-8).
4. Add props ("Add Props," on page 26-9).

26.1.1. Add Elevation Data (Add a Terrain Patch)

The first step in building a terrain is to add elevation data. Elevation data is added using terrain patches. The terrain patch in this tutorial is DTED data that covers about 1° east of Boston, Massachusetts, U.S.A.

To add the terrain patch:



1. Choose **File** → **New Scene**. This results in an empty window (Figure 26-1).



Figure 26-1. No terrain loaded

2. Choose **File** → **Add Terrain Patch**. The Add Terrain Patch dialog box opens and an Open dialog box opens on top of it.
3. In the Open dialog box, navigate to *./data/Terrain/LittlePond/elevation*.
4. Select *w072n042.dt1*.
5. Click Open. Information about this terrain patch is displayed in the Add Terrain Patch dialog box (Figure 26-2).

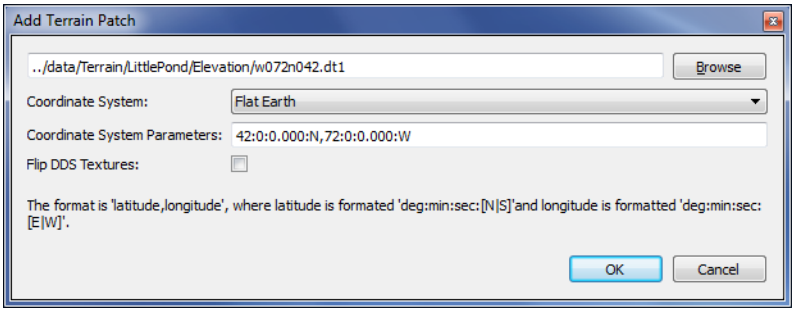


Figure 26-2. Add Terrain Patch

6. Click OK. The terrain is added to the scene (Figure 26-3).

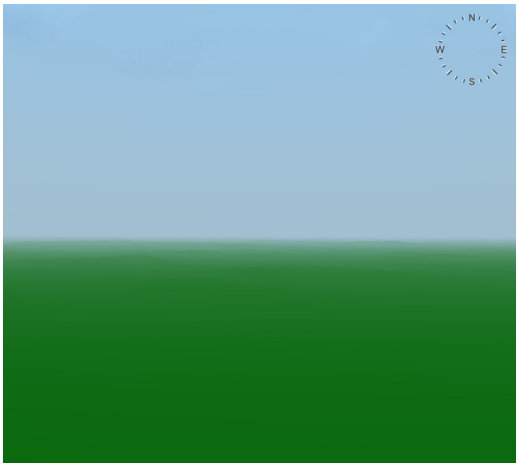


Figure 26-3. Terrain patch added

26.1.2. Add Imagery

The terrain patch you added in the first step of this tutorial is just elevation data. It has no texture and no features. You can get some sense of its contours by enabling elevation coloring (Figure 26-4). However, this still does not provide the rich 3D environment you expect to see in a product like VR-Vantage. Now we will add image data.

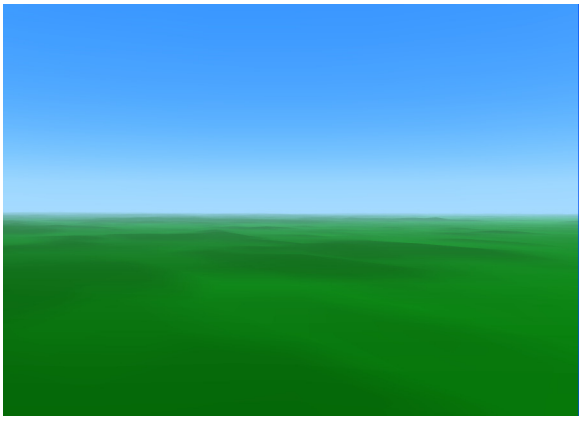


Figure 26-4. Elevation coloring

To add image data:



1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Raster Maps page (Figure 26-5).

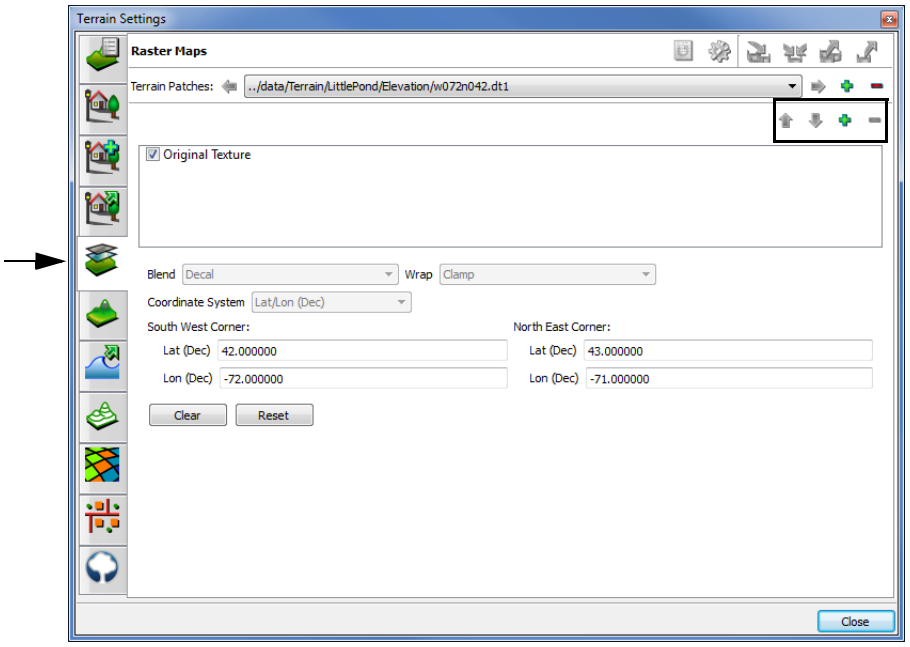


Figure 26-5. Raster Maps page

3. Clear the Original Texture check box. (If you leave this selected, the terrain will be green.)
4. Click the Add button (+) that is at the upper right of the list window (Figure 26-5). A line labeled Image 1 is added to the list in the window (Figure 26-6).

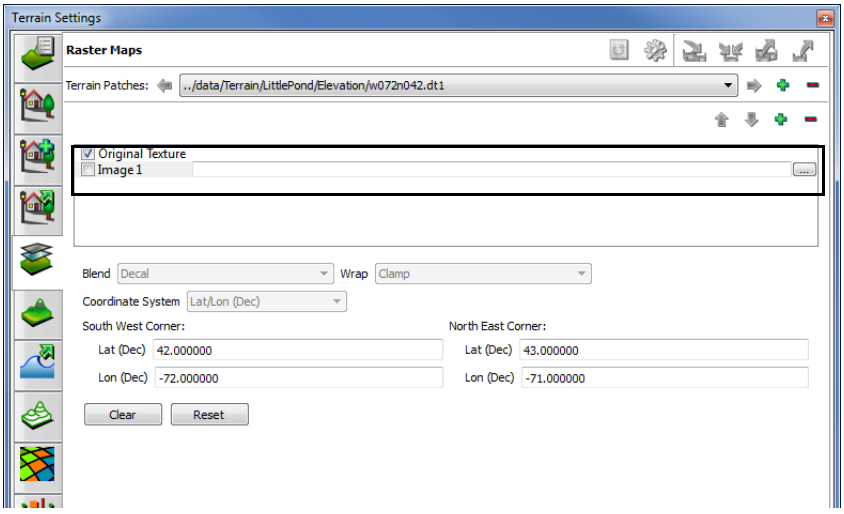


Figure 26-6. New image

5. Click the Browse button at the right end of the image entry. The Image File dialog box opens.

6. In the Image File dialog box, navigate to *./data/Terrain/LittlePond/imagery*.
7. Select *W72N42.tif*.
8. Click Open. The image is listed in the Raster Maps window. To view it, select the check box at the left end of the entry. This image adds low resolution imagery over the entire terrain (Figure 26-7).

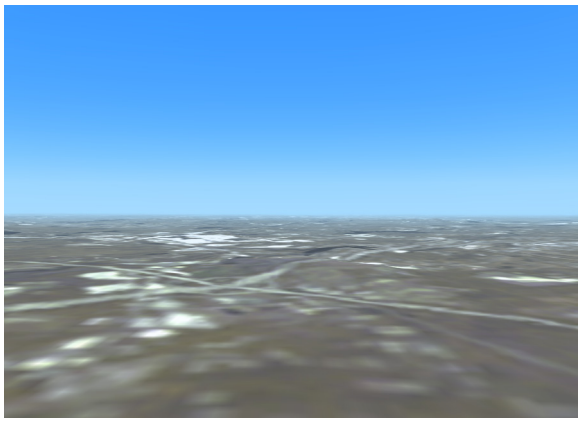


Figure 26-7. Low resolution image

9. Add another image. This time, select *LittlePond.tif*.
10. Select the check box for the *LittlePond.tif* image (Figure 26-8). A high resolution image is added to the Little Pond Area of the terrain (Figure 26-9). (The high resolution image might be hard to find. The next section explains how to find it quickly.)

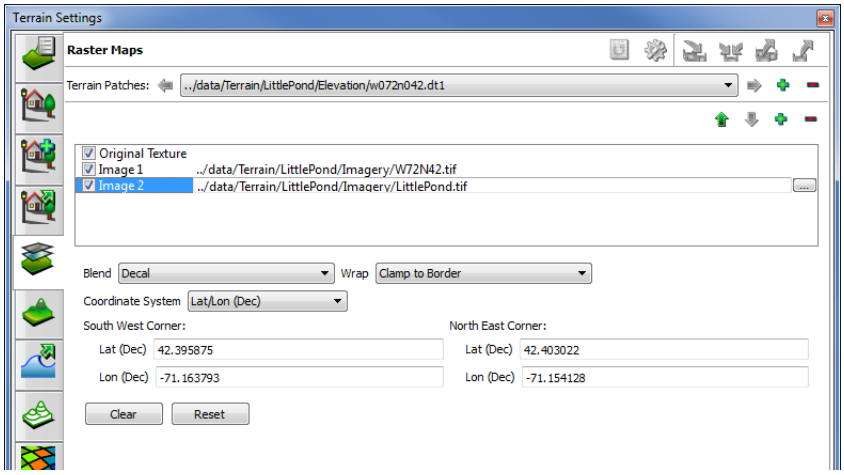


Figure 26-8. Raster Maps page with both images added

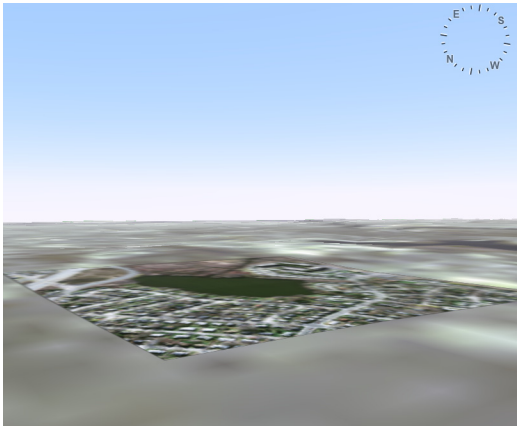


Figure 26-9. Little Pond image

Finding the High Resolution Image

It is not easy to find the Little Pond image unless you know where to look. To make things easier, we have saved an observer view of the Little Pond image. It will be the starting point for the rest of the tutorial.

To view the Little Pond image:

1. If the Observer Views Panel is not already displayed, choose **View** → **Observer Views Panel**.
2. On the Observer Views Panel, click the Load View button ( ). The Load and Set Observers dialog box opens.
3. Select *LittlePondTutorial.osrx*.
4. Click Open. The view should jump to an image similar to Figure 26-9.



As an alternative to this procedure, you could hide the low resolution image by clearing its selection on the Raster Maps page. Then you could scroll through the terrain until you find the high resolution image.

26.1.3. Add a Feature Layer

The image of Little Pond shows lots of buildings and greenery, but these are just images, not 3D objects. Now we want to add props to the terrain. To do that, we need to add a feature layer that has objects that we can extract.

To add the feature layer:



1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Add Props page (Figure 26-10).

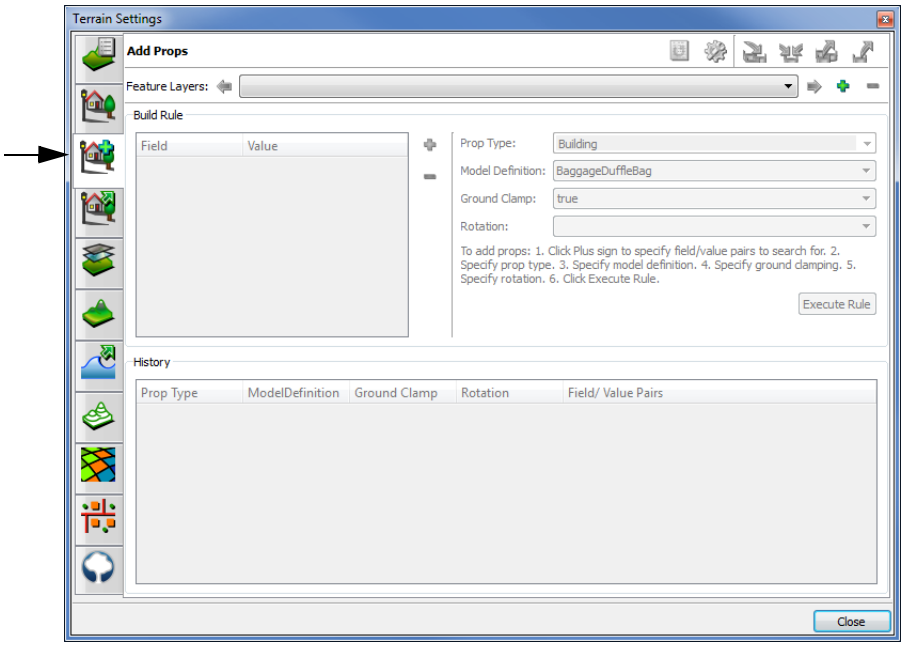


Figure 26-10. Add Props page

3. Click the Add button (+) next to the Feature Layers list. The Select Source File for Feature Layer dialog box opens.
4. Navigate to *./data/Terrain/LittlePond/Features*.
5. Select *BuildingsP.shp*.
6. Click Open. The layer is added to the Add Props page.

26.1.4. Add Props

When you add a prop, VR-Vantage extracts data from a feature layer and maps it to a model definition. You have to tell VR-Vantage what to extract and what to map it to. You do this by building a rule.

To build a rule and extract feature data:

1. In the Terrain Settings dialog box, on the Add Props page, in the Build Rule group box, click the Add button (+) (Figure 26-11). The Build Field/Value Pair dialog box opens.

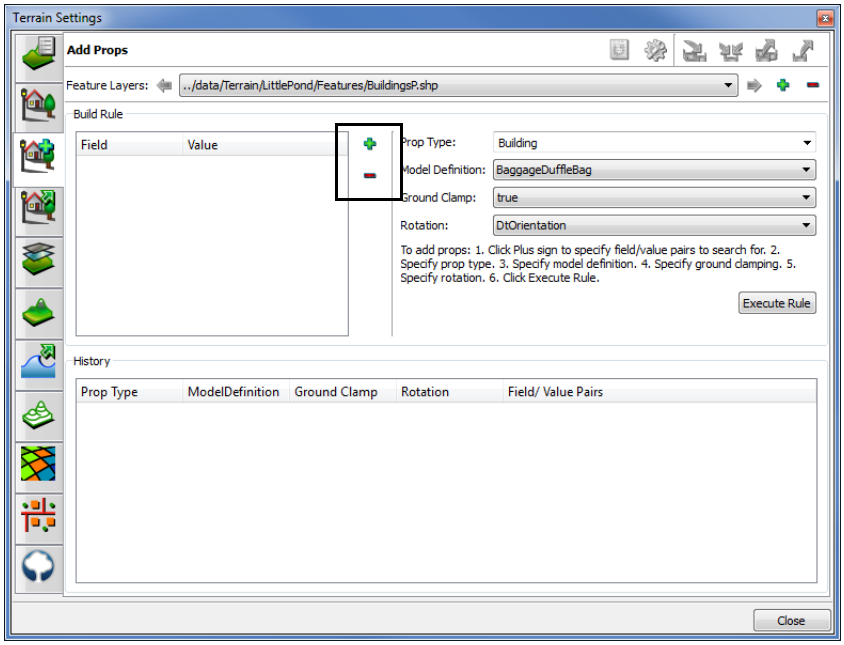


Figure 26-11. Add build rule

2. In the Field list, select TYPE.
3. In the Value list, select HousesColonialGarrison (Figure 26-12).

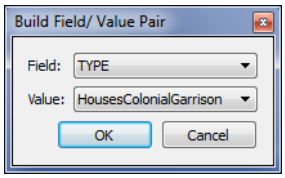


Figure 26-12. Build Field/Value Pair dialog box

4. Click OK.
5. On the Add Props page, in the Prop Type list, select the prop type for the rule. In this case, select Building.

6. In the Model Definition list, select HousesColonialGarrisonClapboardGreen.
7. In the Ground Clamp box, specify whether or not you want the prop to be ground-clamped.
8. In the Rotation list, select the orientation of your model. By default, if the GDB or Shapefile has a field called Rotation or DtOrientation, it is automatically selected. The completed rule is illustrated in Figure 26-13.

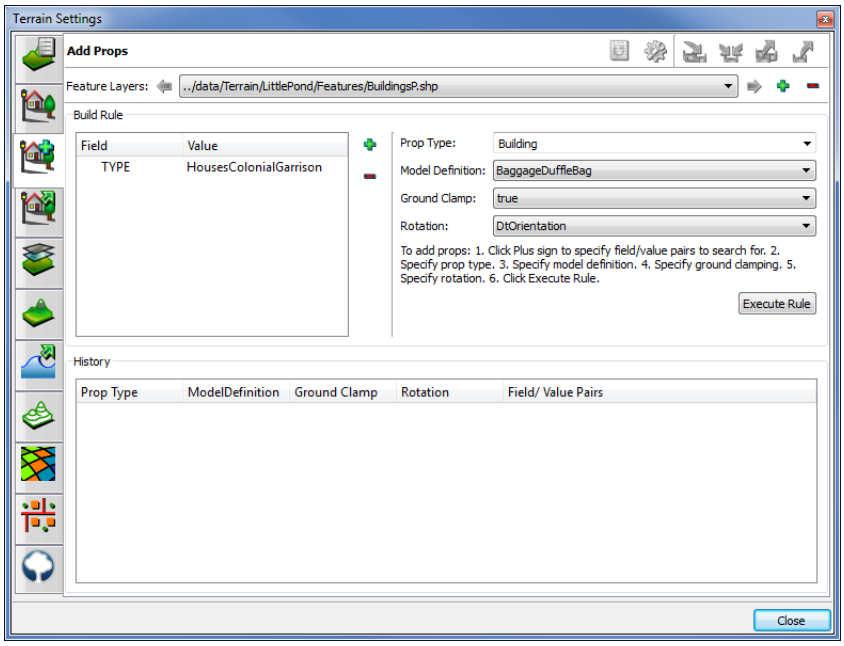


Figure 26-13. Completed rule

9. Click Execute Rule. The rule is executed. The Add Props page is updated (Figure 26-14) and houses are added to the terrain. Zoom in for a better look at them (Figure 26-15). (You might need to close the Terrain Settings dialog box or move it out of the way to see the terrain.)

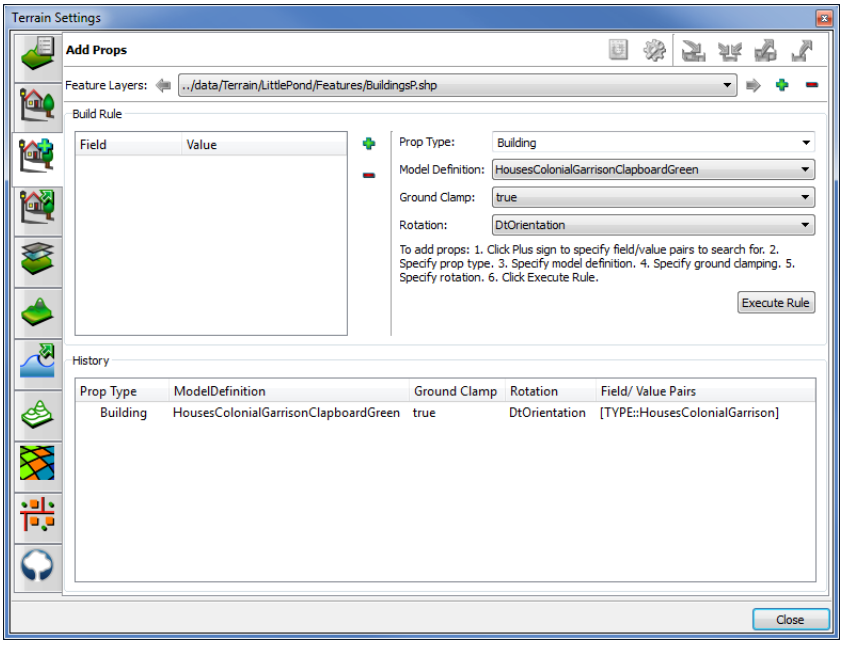


Figure 26-14. Build rule implemented

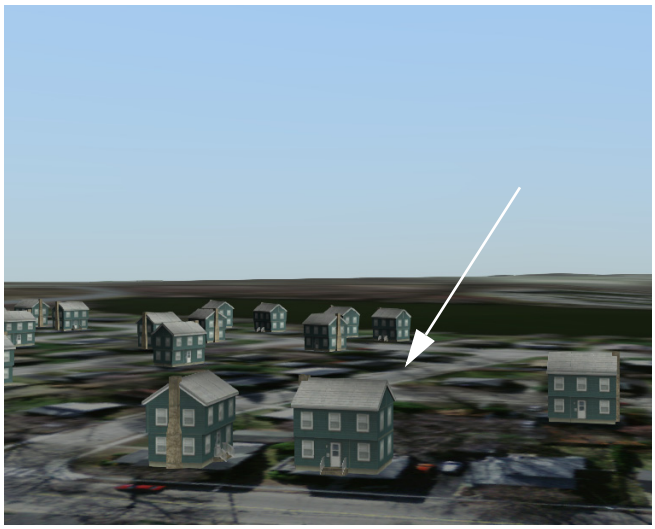


Figure 26-15. Props added to terrain

If you want to, you can add more buildings by creating rules for some of the other building types available.

Add Vegetation

We will continue the tutorial by adding another feature type.

To add vegetation to the terrain:

1. If the Terrain Settings dialog box is not open, choose **Settings** → **Terrain**.
2. Select the Add Props page.
3. Click the Add button (+) next to the Feature Layers list. The Select Source File for Feature Layer dialog box opens.
4. Select *./data/Terrain/LittlePond/features/VegetationP.shp*.
5. Click Open. A new feature layer is added to the list.
6. In the Build Rule group box, click the Add button (+). The Build Field/Value Pair dialog box opens.
7. In the field list, select VEG.
8. In the Value list, select TreesBigLeafMaple.
9. Click OK.
10. In the Prop Type list, select Tree.
11. In the Model Definition list, select TreesBigLeafMapleST. The build rule should look like Figure 26-16.

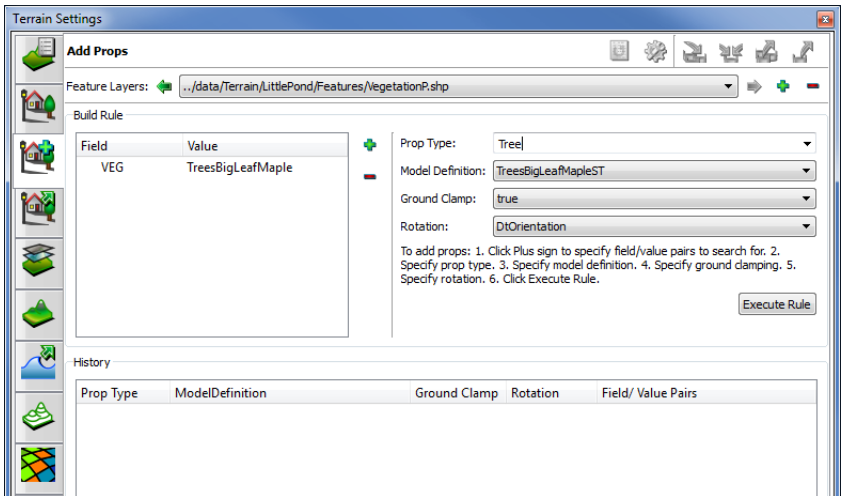


Figure 26-16. Rule for big leaf maples

12. Click Execute Rule. The page is updated and trees are added to the terrain (Figure 26-17).

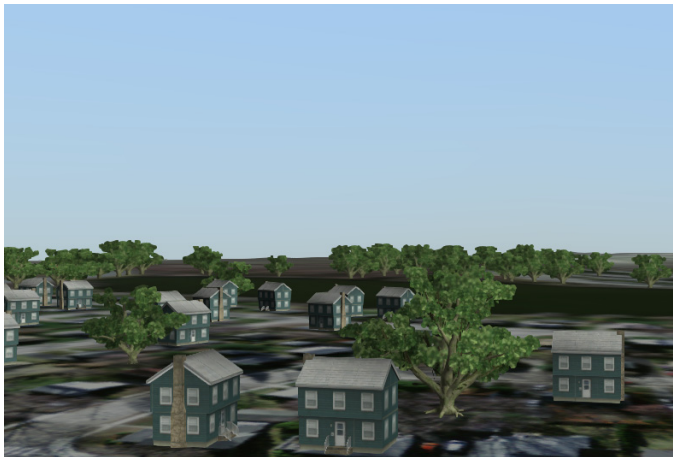


Figure 26-17. Little Pond with maples

13. Save the terrain.

You can build additional rules to add other types of vegetation to the terrain. When you are done, you can create another feature layer with the architecture shapefile (*InfrastructureP.shp*) and add light posts, fire hydrants, and street signs to the terrain.

26.2. Creating a Terrain with an Earth File

In "Composing a Terrain through the GUI," on page 26-2, we showed you how to compose a terrain by adding various terrain components in the VR-Vantage GUI and saving the resulting terrain as an MTF file. Another way to load terrain into VR-Vantage is by using a terrain server. Terrain servers are configured in earth files, which are XML files using osgEarth syntax. All the information that VR-Vantage needs to load elevation, imagery, and feature data is provided. The data can be stored locally or elsewhere on a network or the internet. Data is streamed over the network and paged in as needed.

In this tutorial we use the same local data we used for the Little Pond terrain in the previous tutorial, except that instead of adding the data through the GUI, we create an earth file to load it.

VR-Vantage comes with a terrain *VR-TheWorld Online - Little Pond.earth* that merges the local Little Pond data with streaming terrain from VR-TheWorld Server. For this tutorial we will ignore the rest of the world and focus on Little Pond.

One approach to creating an earth file is to start with one of the earth files provided with VR-Vantage, keep the basic structure, and add, edit, or replace elements as needed. For this tutorial, we will start from an empty file and build all the major elements.

26.2.1. Add a Map Element

The root element in an earth file is the `map` element. It encloses all other elements. Open a text editor and add the following code:

```
<map name="Little Pond" type="geocentric" version="2">

</map>
```

26.2.2. Add Elevation Data to the Earth File

Elevation data is configured using an `elevation` element. We want to specify the same elevation data here that we did in the previous Little Pond tutorial. Add the following text after the opening of the `map` element:

```
<elevation name="Little Pond Elevation" driver = "gdal">
  <url>../../data/Terrain/LittlePond/Elevation/w072n042.dt1</url>
  <tile_size>32</tile_size>
</elevation>
```

The location of data in an earth file is provided in a `url` element. We need to use the gdal driver to load elevation data.

26.2.3. Add Imagery to the Earth File

Image data is configured using `image` elements. Add the following text after the `elevation` block:

```
<image driver="composite">
  <image name="Little Pond Imagery" driver="gdal">
    <url>../../data/Terrain/LittlePond/Imagery/W72N42.tif</url>
  </image>

  <image name="Little Pond Imagery" driver="gdal">
    <url>../../data/Terrain/LittlePond/Imagery/LittlePond.tif</url>
  </image>
</image>
```

The Little Pond terrain has two image files, a large low-resolution image and a smaller higher resolution image. If we were to simply add two `image` elements to the earth file, only the last one listed would be loaded. We would only see one of the images.

To use more than one image, we place an `image` element for each image file inside an `image` element that uses a composite driver. List the images from bottommost to topmost. If you list them in the opposite order from the code, *LittlePond.tif* would be underneath *W72N42.tif* and you would not be able to see it.

We use the gdal driver to load the images.

26.2.4. Add Feature Data to the Earth File

In earth files, you add feature data, such as buildings and vegetation, using a `model` element. You can add as many `model` elements as you need. A `model` element specifies the location of a shapefile. Then it adds `style` elements for each feature type to add from the shapefile. In the previous Little Pond tutorial, we added feature layers using *BuildingsP.shp* and *VegetationP.shp*. Then we added one kind of building (green colonial garrison house) and one kind of plant (big leaf maple tree). In this tutorial we will add one kind of house and all of the vegetation in the shapefile.

Add a Building to the Earth File

Add the following code to your earth file after the `image` block:

```
<model name="Little Pond Buildings" driver="feature_geom">
  <features name="Buildings" driver="ogr">
    <url>../../data/Terrain/LittlePond/Features/BuildingsP.shp</url>
  </features>
  <layout>
    <tile_size_factor>3</tile_size_factor>
  </layout>
  <styles>
    <style type="text/css">
    HousesColonialGarrison {
    model:
  "../../data/Structures/HousesColonialGarrisonClapboardGreen.medf";
    model-heading:       0-[rotation];
    model-scale:        1;
    model-placement: vertex;
    altitude-clamping:   terrain;
    altitude-resolution: 0.00008583068847656250;
    altitude-offset:     0;
    }
    </style>

    <selector class="HousesColonialGarrison">
      <query>
        <expr>TYPE = 'HousesColonialGarrison'</expr>
      </query>
    </selector>
  </styles>
  <clustering>false</clustering>
  <lighting>true</lighting>
</model>
```

As in the other elements, the `url` element specifies the location of the shapefile. To load buildings, you need to use the feature_geom driver for the `model` element and the ogr driver for the `features` element.

The `styles` element lets you specify a `style` for each building you want to display. This example shows just one building. Take a look at *VR-TheWorld Online - Little Pond.earth* to see the other buildings that can be configured from this shapefile.

Each style has a name, in this case HousesColonialGarrison. The `model` attribute specifies the model used to display the object. The `selector` element matches the style to an entry in the TYPE column in the database file that accompanies the shapefile (*BuildingsP.dbf*).

To better understand this relationship, open *BuildingsP.dbf* in a spreadsheet application (Figure 26-18). Remember that in the first Little Pond tutorial, you built a rule for extracting props from the feature layer. You chose TYPE in the field list. That is because the TYPE column lists the different types of buildings in the shapefile. You do the same thing with the `selector` element.

	A	B	C	D	E
1	LENGTH	WIDTH	HEIGHT	ROTATION	TYPE
203	8.21000000000	11.02000000000	9.00000000000	345	HousesColonialGarrison
204	8.21000000000	11.02000000000	9.00000000000	35	HousesColonialGarrison
205	8.21000000000	11.02000000000	9.00000000000	320	HousesColonialGarrison
206	8.21000000000	11.02000000000	9.00000000000	230	HousesColonialGarrison
207	8.21000000000	11.02000000000	9.00000000000	230	HousesColonialGarrison
208	8.21000000000	11.02000000000	9.00000000000	250	HousesColonialGarrison
209	8.21000000000	11.02000000000	9.00000000000	155	HousesColonialGarrison
210	8.21000000000	11.02000000000	9.00000000000	325	HousesColonialGarrison
211	8.21000000000	11.02000000000	9.00000000000	250	HousesColonialGarrison
212	8.21000000000	11.02000000000	9.00000000000	140	HousesColonialGarrison
213	8.21000000000	11.02000000000	9.00000000000	335	HousesColonialGarrison
214	8.21000000000	11.02000000000	9.00000000000	65	HousesColonialGarrison
215	8.21000000000	11.02000000000	9.00000000000	210	HousesColonialGarrison
216	8.21000000000	11.02000000000	9.00000000000	125	HousesColonialGarrison
217	8.21000000000	11.02000000000	9.00000000000	335	HousesColonialGarrison
218	8.21000000000	11.02000000000	9.00000000000	30	HousesColonialGarrison
219	8.21000000000	11.02000000000	9.00000000000	335	HousesColonialGarrison

Figure 26-18. *BuildingsP.shp*

Add Vegetation to the Earth File

To add vegetation to the terrain, add the following code to the earth file after the `model` block for the buildings:

```
<model name="Little Pond Vegetation" driver="feature_custom">
  <features name="Vegetation" driver="ogr">
    <url>../../data/Terrain/LittlePond/Features/VegetationP.shp</url>
  </features>
  <layout>
    <tile_size_factor>3</tile_size_factor>
  </layout>
  <styles>
    <style type="text/css">
      Vegetation {
      marker:              [veg] + "ST" ;
      marker-scale:        1;
      marker-placement: vertex;
      altitude-clamping:   terrain;
      altitude-resolution: 0.00008583068847656250;
      altitude-offset:     0;
      }
    style>
  </styles>
```

```
    <clustering>true</clustering>
    <lighting>true</lighting>
  </model>
```

The vegetation in VR-Vantage uses SpeedTree models. To load SpeedTrees from an earth file, you need to use the feature_custom driver in the `model` element. You use the ogr driver in the `features` element. Similar to the buildings, the `model` block for vegetation specifies a shapefile and styles. However, unlike with the buildings, we do not specify individual models to load. The marker attribute indicates that VR-Vantage should take every entry in the VEG column of *VegetationP.shp*, append ST to it, and look for a model of that name. For example, the column has several entries named TreesBigLeafMaple. VR-Vantage adds ST to form TreesBigLeafMapleST, finds the model definition TreesBigLeafMapleST, and loads the model specified in the model definition.

26.2.5. Add Options to the Earth File

Finally, add some common options to the file. In particular, this section specifies a location for the cache. Add this block just before the closing of the `map` element:

```
<options>
  <lighting>true</lighting>
  <elevation_interpolation>triangulate</elevation_interpolation>
  <terrain>
    <min_tile_range_factor>3</min_tile_range_factor>
    <skirt_ratio>0.1</skirt_ratio>
  </terrain>
  <cache type="filesystem">
    <path>../../appData/cache</path>
  </cache>
</options>
```

26.2.6. Save the Earth File

The convention for saving earth files is to save them in the *./userData/servers directory*. Save the file as *LittlePond.earth*.

26.2.7. Load the Earth File and Save is as an MTF File

Your earth file for Little Pond is complete. Now you can load it in VR-Vantage and compare it to the terrain you created through the GUI. After you load it, you should save it as an MTF file.

To load the earth file:

1. Start VR-Vantage.
2. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
3. Select the Terrain Contents page.
4. Click Add Terrain Server. The Add Terrain Server dialog box opens.
5. In the Servers list, select *LittlePond.earth*.
6. Click Connect. The terrain loads. It is visible as a small patch on the earth's sphere (Figure 26-19).

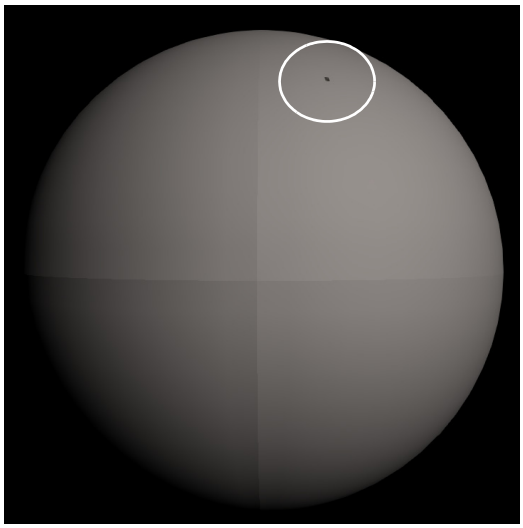


Figure 26-19. Little Pond terrain

7. Zoom in on the terrain (Figure 26-20). Compare it to the terrain you created in the first Little Pond tutorial. Notice that the buildings are the same, but there are more types of vegetation.

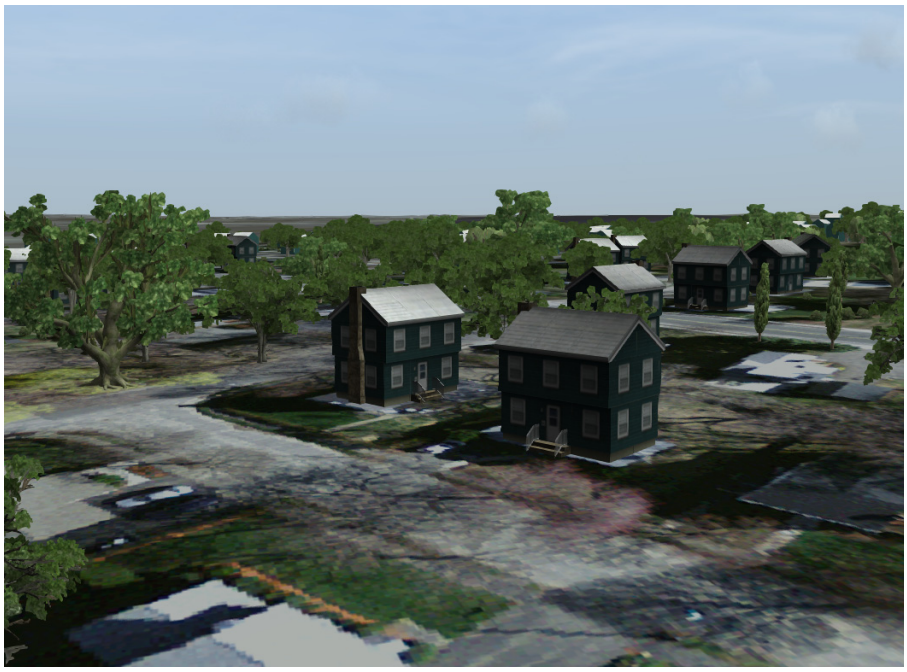


Figure 26-20. Little Pond terrain

8. Choose **File** → **Save Terrain**. The Save Terrain dialog box opens.
9. Give the terrain a name. Do not use Little Pond unless you want to overwrite the Little Pond terrain provided with VR-Vantage.

26.3. Extracting Props from a Terrain

In the tutorial "Composing a Terrain through the GUI," on page 26-2, we extract props from a feature layer by building a rule in the Add Props page. In this tutorial, we demonstrate the other way to create a prop – by extracting information from a terrain.

The general steps for extracting props from a terrain are:

1. Create a new terrain with a terrain patch ("Create a New Terrain and Add a Terrain Patch," on page 26-20).
2. Select the external references that you want to extract as props and extract them ("Extract the Props," on page 26-20).
3. Optionally, change the model definitions ("Change the Model Definition for a Prop," on page 26-22).

26.3.1. Create a New Terrain and Add a Terrain Patch

To create the new terrain and add a terrain database:

1. Choose **File** → **New Terrain**. If any terrain data is loaded, it is removed.
2. Choose **File** → **Add Terrain Patch**. The Add Terrain Patch dialog box opens and an Open dialog box opens on top of it.
3. Navigate to the *./data/Terrain/Makland/Geometry/OpenFlight* directory.
4. Select *Makland.flt*.
5. In the Add Terrain Patch dialog box, click OK. The terrain is loaded.

26.3.2. Extract the Props

To extract the props:

1. Move the observer so that you have a view of the plateau in Makland similar to Figure 26-21.



Figure 26-21. Makland

2. Click on the trees or buildings in the scene. Notice that you cannot select them. They are part of the terrain; they do not exist as props.
3. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
4. Select the Extract Props page (Figure 26-22). On the Extract References tab, the External References window lists all of the objects in the terrain that are incorporated into the terrain by reference. These are the objects that you can extract as props. You can extract them individually. For this tutorial, we will extract all of them.

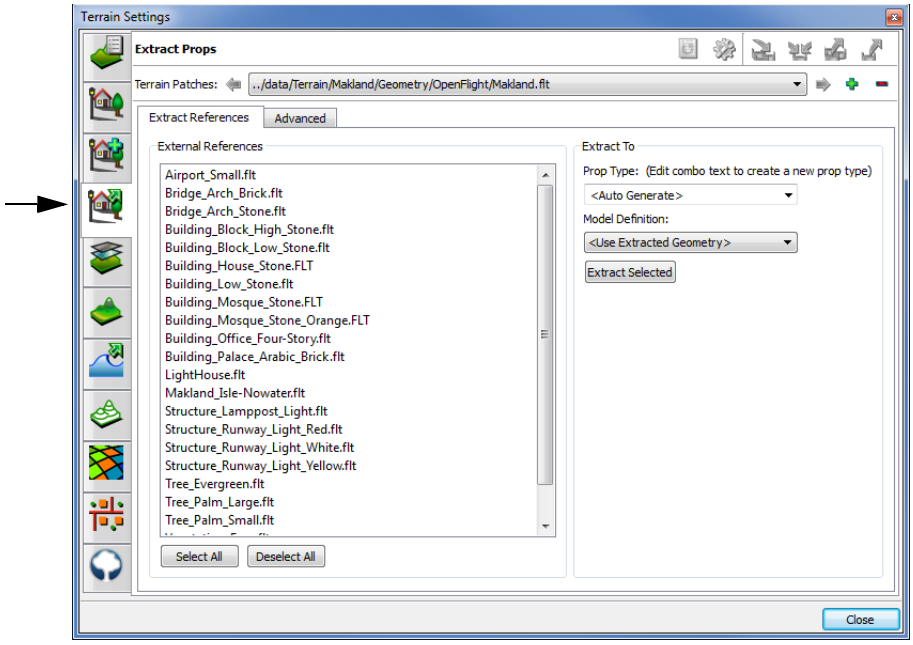


Figure 26-22. Extract props page

5. Click Select All. All of the references are selected.
6. In the Extract To group box, click Extract Selected. The objects are extracted as props. The list of external references is cleared.
7. Click the trees and buildings on the plateau. You can now select them because they are props, not part of the terrain (Figure 26-23). They are displayed using the geometry in the OpenFlight files from which they were referenced. You can change the models that the props use if you want to. For example, you might want to change the trees to SpeedTrees.



Figure 26-23. Selected props

26.3.3. Change the Model Definition for a Prop

To change the model definition for a prop:

1. Select one of the trees.
2. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
3. Select the Edit Existing Props page. The selected prop is highlighted in the list of props (Figure 26-24).

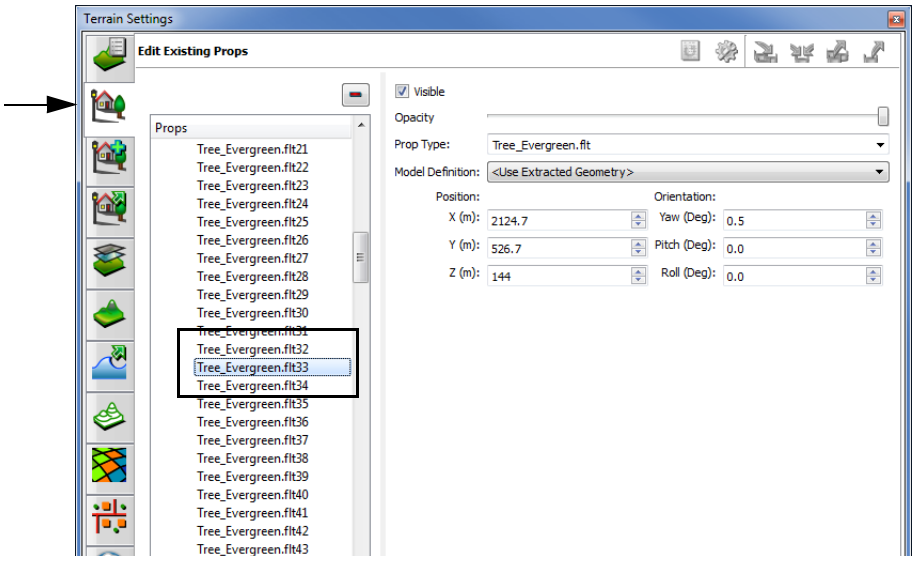


Figure 26-24. Edit Existing Props page

4. In the Model Definition box, select a model definition from the list, such as Trees-GiantRedwoodST. The tree changes to the new model definition (Figure 26-25).



Figure 26-25. New model definition for tree

5. To restore the tree to its original model, on the Edit Existing Props page, change the model definition to Use Extracted Geometry.



27. Processing MetaFlight Files

To display MetaFlight files in VR-Vantage applications, you must first process them. This chapter explains how to do so.

Processing MetaFlight Files for Use in VR-Vantage 27-2
Splitting Datasets into Individual MetaFlight Files 27-2
Converting Virtual Texture Datasets to Tiled Textures 27-3
The mftTool 27-3
Using the mftTool to Process MetaFlight Files 27-5
Convert Geometry Grid Datasets with Tiled Textures 27-6
Convert Source Data into MEDF Format 27-6
Create an MTF File for the MetaFlight Terrain 27-7

27.1. Processing MetaFlight Files for Use in VR-Vantage

Before you can load a MetaFlight file in a VR-Vantage application, you must process it as described in this chapter. If you try to load an unprocessed MetaFlight file, VR-Vantage displays an error message. If you run the MÄK processing tools on a Meta-Flight database that does not conform, an error message is sent to the console window.

To process a MetaFlight file, you must:

1. Convert source data into MEDF and MEIF format.
2. Split each dataset into its own MetaFlight file.
3. Convert geometry from using virtual texture datasets into using tiled textures. (If the terrain does not use virtual textures, you can skip this step.)
4. Use the VR-Vantage terrain composition process to combine the MetaFlight terrain files and save them in MTF format.



Geometry files referenced by a MetaFlight file must be in OpenFlight format, and not in Vega Prime's binary format (*.vsb*). MÄK's terrain libraries do not support VSB files.

27.2. Splitting Datasets into Individual MetaFlight Files

MÄK tools work on one Geometry Grid Dataset (GGDS) at a time. Some MetaFlight files contain multiple GGDSs, so each one has to be moved into its own file. It is your responsibility to understand the syntax of the MetaFlight file and to know whether or not you need to split up datasets.

To split datasets:

1. Create a copy of the original file for each dataset. Give each a name that identifies the dataset it contains.
2. Open each copy of the original file in a text editor.
3. In each file, delete all of the <GeometryGridDataset> XML element blocks except the one for the dataset you want to have in this file.

When you are finished, each MetaFlight file will have only one GGDS and possibly one or more Virtual Texture Datasets (VTDS).

27.3. Converting Virtual Texture Datasets to Tiled Textures

The display engine does not handle virtual textures at runtime. Therefore you must convert the virtual texture datasets into tiled textures.

27.3.1. The mftTool

The mftTool is a command-line tool for converting virtual texture datasets into tiled textures so that they can be loaded by VR-Vantage. It creates the highest resolution textures possible from the virtual texture dataset and binds them to individual tiles.

The syntax for mftTool is as follows:

```
mftTool -f filename [-c index -w index -l index -m string
   -r path -x size -s directory -t filename -A -g -e -u
   -p threads --processEmats --extendLevelZero distance --
   -v -h]
```

Table 27-1 describes the command-line options.

Table 27-1: mftTool command-line options

Option	Description
`(-- | --ignore_rest)`	Ignore all arguments after this one.
`(-A | --regenerateAll)`	Forces the regeneration of all tiled textures. This can be much slower and is needed less frequently if the virtual texture dataset does not change.
`(-c | --col)` *index*	The column to convert, using a zero-based index.
`(-e | --encryptImages)`	The tiled textures are generated in the MEIF file format. If not specified the file format will be DDS.
`--extendLevelZero` *distance*	Specifies the page-in range (in meters) of grid level zero in the MEDF and MetaFlight files that the mftTool creates. Use this option if the terrain disappears when you zoom out, particularly in Plan View mode. Increasing the range causes the terrain to page in at a greater distance.
`(-f | --file)` *filename*	The name of the MetaFlight file that contains the GGDS.

Table 27-1: mftTool command-line options

Option	Description
(-g | --generateFiles)	Generate tiled textures from the virtual texture and generate tiles in MEDF format from the FLT tiles that use the new textures. An MFT file is published. The output name will be equal to the MetaFlight file specified with the -f option with the string _medf appended to the end before the extension. For example, converting a file named *yourTerrain.mft* creates a new MetaFlight file named *yourTerrain_medf.mft* in the same directory as *yourTerrain.mft*. If the generated tiled texture already exists, the file is not regenerated. The -u and -g arguments are mutually exclusive.
(-h | --help)	Displays usage information.
(-l | --level) *index*	The level to convert, using a zero-based index.
(-m | --missing) *string*	The missing texture placeholder.
(-p | --threads) *threads*	Specifies the number of threads to run. Specifying zero results in the number of threads equaling the number of logical processors the host machine has.
--processEmats	Find materially classified (emat) versions of the virtual textures and generate new emat textures.
(-r | --searchDir) *directory*	Adds a directory to the search path when resolving external references. During processing any external references not found are removed from the generated files.
(-s | --subDir) *directory*	The path to the substitution texture specified by the VTDS. The arguments -s and -t are mutually exclusive
(-t | --vtFile) *file*	The name of the MetaFlight file that contains the VTDS. The arguments -s and -t are mutually exclusive.
(-u | --publishMftOnly)	Publish a new MetaFlight file that can be loaded by VR-Vantage applications. The output name will be equal to the MetaFlight file specified with the -f option with the string _medf appended to the end before the extension. Converting a file named *yourTerrain.mft* creates a new MetaFlight file named *yourTerrain_medf.mft* in the same directory as *yourTerrain.mft*. The -u and -g arguments are mutually exclusive.
(-v | --version)	Display version information and exit.

Table 27-1: mftTool command-line options

Option	Description
`(-w | --row)` *index*	The row to convert, using a zero-based index.
`(-x | --textureSize)` *size*	Specifies the maximum texture size to generate in pixels per dimension. Larger textures use more memory and are slower to page in, but allow for greater virtual texture resolution.

If neither the generate (`-g`) or the publish only (`-u`) argument is specified, mftTool prints out information regarding the MetaFlight terrain.

27.3.2. Using the mftTool to Process MetaFlight Files

To process a terrain with a single MetaFlight terrain file that has one GGDS and one VTDS, run the mftTool as follows:

```
mftTool -f C:\yourTerrain\yourTerrain.mft -s
  C:\yourTerrain\ds200-vt-otw-virtual-texture -g -A -e
```

The following example shows how to process a terrain with two MetaFlight terrain files, one with the GGDS and one with the VTDS. In this case, the tiles also contain external references to other OpenFlight models.

```
mftTool -f C:\yourTerrain\ds100-flight-terrain\ds100-
  flight.mft -t C:\yourTerrain\ds200-vt-otw-virtual-tex-
  ture\ds200-vt.mft -r C:\yourTerrain\textures -r C:\your-
  Terrain\objects -m C:\yourTerrain\MissingTexture.png -x
  4096 -g
```

This creates a new MetaFlight file that references the new geometry grid dataset with virtual textures bound to it.

27.3.3. Convert Geometry Grid Datasets with Tiled Textures

The mftTool only needs to publish the MFT when the GGDS uses tiled textures. Cultural feature datasets are often built this way. These can be converted using the medfTool like all other files. The command syntax for the medfTool is described in "Compressing Model Files," on page 30-24.

To only publish a new MetaFlight for the cultural dataset, do the following:

```
mftTool C:\yourTerrain\flt\
   ds7_culture_db5_building_area_new-hier_cult\
   ds7_culture_db5_building.mft -u -p 0
```

To convert a MetaFlight with tiled textures into a compressed format, use the medfTool, as follows:

```
medfTool -s C:\yourTerrain\flt\textures
   -s C:\yourTerrain\flt\objects
   --directory C:\yourTerrain\flt\
   ds7_culture_db5_building_area_new-hier_cult -x flt
   -m rgb -m rgba -m jpg -m bmp -p 0 -z 1
```

! The medfTool should never be run on a directory that contains GGDS tiles that use Virtual Textures.

27.4. Convert Source Data into MEDF Format

Many file formats, including OpenFlight files, are often slow to load, so it is best to convert them to the fast loading MEDF (MAK Encrypted Data Format) format. Do this for terrains that do not have virtual textures (it is done automatically when creating geometry grid datasets from virtual texture datasets) and on cultural feature datasets. This should be done on all data files being loaded, but is required for all external references used by MetaFlight terrains.

! You must convert the files to MEDF and MEIF before you run the mftTool.

To convert external references in separate directories:

```
medfTool -s C:\yourTerrain\flt\textures --directory
   C:\yourTerrain\flt\objects -x flt -m rgb -m rgba -m jpg
   -m bmp -p 0 -z 1
```

To convert external reference textures that are in the same directory:

```
medfTool --directory C:\yourTerrain\flt\textures -m rgb
   -m rgba -m jpg -m bmp -p 0 -z 1
```

27.5. Create an MTF File for the MetaFlight Terrain

Once you have processed all of the MetaFlight files, create an MTF file for the terrain.



Any missing models or white objects usually indicate missing external references. Fixing any missing search paths passed to the tools should resolve most problems.

To create an MTF file for the MetaFlight terrain:

1. Start any VR-Vantage application.
2. Add each MetaFlight terrain as a terrain patch.
3. Save the terrain as an MFT terrain.



VIII. Modeling Simulation Objects

When VR-Vantage discovers a simulation object (entity or unit) on the network, it must decide how to represent it in the GUI. This is accomplished by mapping 3D models and 2D icons to object type enumerations. The chapters in this section explain how models and iconography are configured and mapped to object types.



28. Model and Element Definitions

This chapter describes the interplay of schemas, model definitions, element definitions, and model mapping. It also explains how to create and edit model definitions, element definitions, and model schemas. "Adding a Model to VR-Vantage," on page 33-2 walks you through the process of adding a model.

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28.1. Introduction to VR-Vantage Object Modeling

The objects that VR-Vantage can display that are not part of the terrain, such as simulation objects, tactical graphics, detonations, and cockpit displays, are generically called scene elements. Scene elements are defined in element definitions. When VR-Vantage joins an exercise, it receives information about objects over the network. The objects are identified using object type enumerations. VR-Vantage maps these object types to element definitions. (For more information about object type enumerations and mapping them to element definitions, please see "Introduction to Object Type Mapping," on page 29-2.)

An element definition is a set of visual definitions that tell VR-Vantage how to render (display) the object. Visual definitions specify the 3D model, 2D icon, or graphic, and the visual effects that the object supports, such as trailing effects, height-above-terrain lines, track histories, and so on. A scene element can have up to three different element definitions – one for each model set (3D, 3D Colorized, 2D Icon). VR-Vantage chooses the correct element definition to use based on the model set being used by the observer. (For more information about model sets, please see "Model Sets," on page 28-5.)

Element definitions are created and edited in the Visual Model Editors dialog box. In addition to letting you manage element definitions, this dialog box lets you create and manage model definitions and schemas. Model definitions specify values for some basic object parameters. Most importantly for most VR-Vantage users, model definitions specify the 3D model to use for element definitions in the 3D Models model set. What this means is that if you want to add a new model to VR-Vantage, you will specify the model file, such as an OpenFlight file, in a model definition and then specify that model definition in the element definition for the simulation object you want to add.

Schemas define the most basic scene elements, such as entity, SpeedTree, or line. Most VR-Vantage users will never have to create or edit a schema. However, if you create a new model definition, you must make sure it uses the correct schema and that it includes all required parameters.

Figure 28-1 illustrates these relationships using an M1A2 entity. VR-Vantage receives the object type 1:1:225:1:1:3:-1 over the network (callout 1). In the Simulation Object Type Mappings dialog box, this object type is mapped to the M1A2 Abrams entity definition (2). (An entity definition is a specific type of element definition.) The M1A2 Abrams entity definition (in the Visual Model Editors dialog box) specifies all of the visual definitions for this entity (3). The Main Model visual definition has a **modeldefinition** parameter. The value for this parameter is TrackedM1A2DESERT (4). The TrackedM1A2DESERT model definition has a **filename** parameter that specifies *M1A2.medf* as the model to use for entities that use this model definition. The TrackedM1A2DESERT model definition has a **filename** parameter because it uses the Entity schema and the Entity schema requires a **filename** (5).

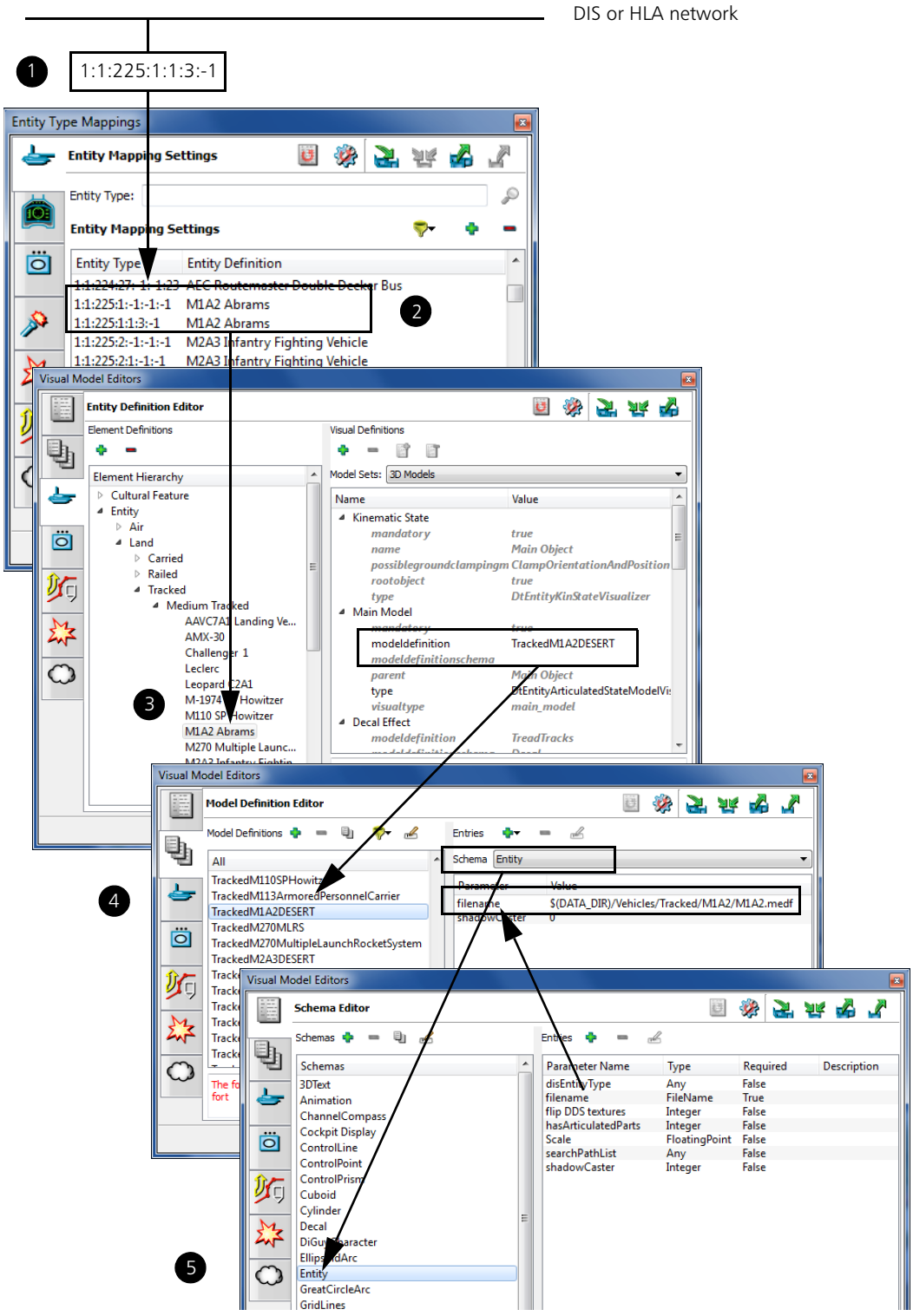


Figure 28-1. Element definitions and model mapping

28.1.1. Model Formats for 3D Entities, Objects, and Effects

VR-Vantage includes 3D models for vehicles, lifeforms, environmental objects, and effects. The models are in a compressed, encrypted format (extension *.medf*).



VR-Vantage includes a utility, the MEDF Tool, that lets you encrypt files in MEDF format. You cannot use it to decrypt encrypted files. For more information, please see "Compressing Model Files," on page 30-24.

You can provide your own models if they are in one of the following supported formats:

- OpenFlight.
- 3ds.
- OBJ.
- COLLADA (*.dae*).
- OSG (*.osg*, *.osgb*, and *.ive*).
- NewTek LightWave (*.lwo* and *.lws*).
- MÄK GDB.

28.1.2. Model Sets

The model or icon that is used for an object is determined by its element definition. For convenience, element definitions are organized into model sets. For example, all of the element definitions that specify 3D models are in the 3D Models model set, and so on. As a result, when you choose the 3D Models model set for an observer mode, all of the entities use a 3D model. (The model set is an observer-specific setting. This is not really an issue in VR-Vantage PVD and VR-Vantage IG, which each support only one model set. VR-Vantage Stealth lets you change model sets.)

Each VR-Vantage application includes one or more of the following types of object models and icons:

- 3D Models. Realistic 3D models. This is the default model set for the Stealth observer mode.
- 3D Colorized Models. 3D colorized models are cartoon-like models that create an exaggerated notional view of the world. This is the default model set for XR observer mode.
- 2D Icons. 2D MIL-STD 2525B font-based icons. This is the default model set for the Plan View observer mode. You can also configure VR-Vantage to use 2525a images or any arbitrary images for 2D icons.

Table 28-1 lists the VR-Vantage model sets and the VR-Vantage applications that support them.

Table 28-1: VR-Vantage model sets

Model Set	Application
3D Models	VR-Vantage Stealth VR-Vantage IG
3D Colorized Models	VR-Vantage Stealth
2D Icons	VR-Vantage Stealth VR-Vantage PVD



The model sets available in each VR-Vantage application are fixed. You cannot add model sets.

For information about changing model sets, please see "Changing the Model Set," on page 18-11.

28.1.3. Mapping Object Types to Element Definitions

Object type mapping is the process of associating an object type enumeration for a simulation object or other scene element with an element definition.

DIS and HLA objects are specified by an object type enumeration. An object type enumeration is a list of seven components as specified by the DIS protocol and HLA RPR FOM. If none of the seven components contains a wildcard (-1) value, then the object type refers to a specific simulation object. If some components contain a wildcard, then the object type refers to a class of simulation objects. A larger number of wildcards indicates a broader, more general class. For complete details about object type enumerations, please see *Enumeration and Bit Encoded Values for Use with Protocols for DIS Applications* (DIS enumerations document). It is available at the IEEE World Wide Web site: http://shop.ieee.org/store/ and at the SISO web site: http://www.sisostds.org/.

When a VR-Vantage application discovers a simulation object, it reads the enumeration and then displays the simulation object using the element definition that is mapped to the enumeration.

28.2. Creating and Editing Schemas

The elements that make up a scene have parameters that help define them, for example a model filename. The set of parameters for a particular scene element is a schema. VR-Vantage uses schemas to validate element definitions. You can create, copy, and delete schemas. For any schema, you can add and delete parameters and edit parameter values.



- Changes to schemas are saved automatically. For more information, please see "Managing VR-Vantage Settings," on page 3-13.
- If you are connected to an exercise, changes to element definitions do not take effect until you disconnect and reconnect.

Model definition schemas define the elements that can be displayed in a scene. The model definition schemas provided with VR-Vantage are:

- 3DText
- Animation
- Channel Compass
- Cockpit Display
- ControlLine
- ControlPoint
- ControlPrism
- Cuboid
- Cylinder
- Decal
- DiGuyCharacter
- EllipsoidArc
- Entity
- GreatCircleArc
- GridLines
- Line
- ParticleSystem
- Ribbon
- SpeedTree
- TacticalSmoke
- Terrain
- Tree
- WidgetTheme.

28.2.1. Creating Schemas

To create a schema:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Schema Editor page (Figure 28-2).

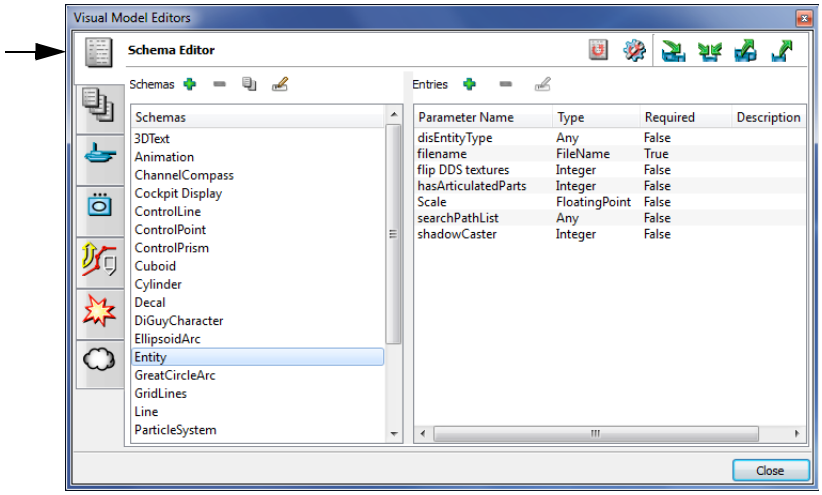


Figure 28-2. Schema Editor page

3. Click the Add button (+) next to the Schemas label. The Create Instance dialog box opens (Figure 28-3).

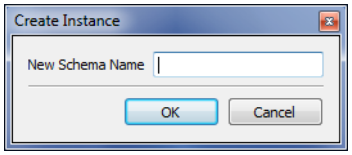


Figure 28-3. Create Instance dialog box

4. Type a name for the new schema.
5. Click OK.
6. Add parameters as described in "Adding a Parameter to a Schema," on page 28-10.

28.2.2. Deleting Schemas



If a schema is used by a model definition, you cannot delete it. The Delete Schema button will be unavailable.

To delete a schema:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Schema Editor page (Figure 28-2).
3. In the Schemas list, select the schema you want to delete.
4. Click the Delete button () next to the Schemas label. You are prompted to confirm the deletion.
5. Click Yes. The schema is removed from the list.

28.2.3. Copying Schemas

If you want a new schema that is a variant of an existing one, it can be easier to copy the existing schema and edit it than it is to create a new schema and add all of the parameters.

To copy a schema:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Schema Editor page (Figure 28-2).
3. Select the schema that you want to copy.
4. Click the Duplicate button (). The Duplicate Schema dialog box opens.
5. Type a name for the copied version of the schema.
6. Click OK.
7. The new schema is added to the list.
8. Edit the parameters as described in "Editing a Schema Parameter," on page 28-11.

28.2.4. Adding a Parameter to a Schema

To add a parameter to a schema:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Schema Editor page (Figure 28-2).
3. In the Schemas list, select the schema to which you want to add a parameter.
4. Click the Add button (+) next to the Entries label. A parameter called "key" is added to the parameter list (Figure 28-4).

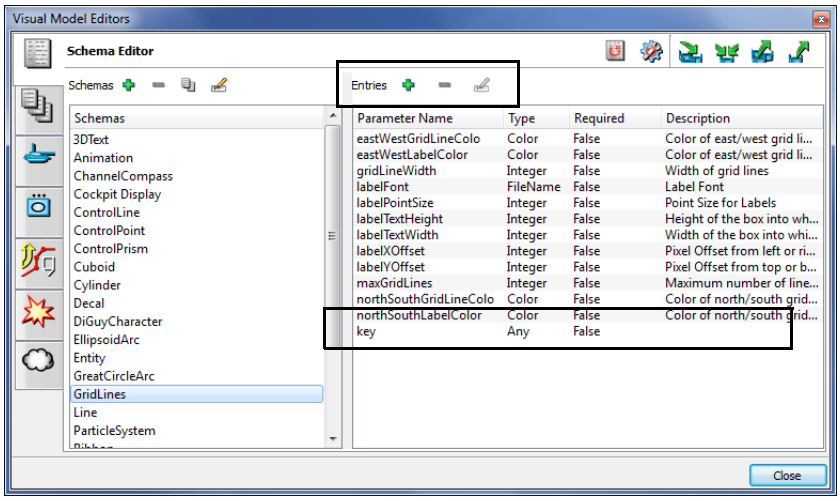


Figure 28-4. New schema parameter

5. Double-click "key". The Rename Parameter dialog box opens.
6. Type a name for the parameter.
7. If the parameter has a specific type, click the value in the Type column and edit it.
8. If the parameter is required, click the value in the Required column and change it to True.
9. Optionally, add a description. The description provides context sensitive help on the element definition pages. To add a description:
   a. Click the empty field in the Description column. The Edit Text dialog box opens.
   b. Type the descriptive text.
   c. Click OK.

28.2.5. Deleting a Parameter from a Schema

If you delete a parameter from a schema, any element definitions that use the schema may become invalid. Invalid element definitions are shown in red in the list of definitions.

To delete a parameter from a schema:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Schema Editor page (Figure 28-2).
3. In the Schemas list, select the schema from which you want to delete a parameter.
4. Select the parameter that you want to delete.
5. Click the Delete button (−) next to the Entries label.

28.2.6. Editing a Schema Parameter

To edit a parameter for a schema:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Schema Editor page (Figure 28-2).
3. In the Schemas list, select the schema for which you want to edit a parameter.
4. Click the parameter attribute that you want to edit. The attribute becomes editable.
5. Type the new attribute value.

28.3. Creating and Editing Model Definitions

Many of the visual definitions in an element definition have a model definition parameter. A model definition specifies a set of parameters that are appropriate to the object type. (The parameters are determined by the model definition's schema. For information about model schemas, please see "Creating and Editing Schemas," on page 28-7.) For most VR-Vantage users, the most important thing to know about model definitions is that for 3D models, the model definition specifies the 3D model, such as an OpenFlight file, that is used to display an entity. If you want to add new models to VR-Vantage, you will probably have to create a new model definition for each one.

VR-Vantage comes with an extensive set of model definitions that are mapped to the included models. You can edit or delete these model definitions and you can create new ones.

Model definitions are created and edited on the Model Definition Editor page of the Visual Model Editors dialog box (Figure 28-5).

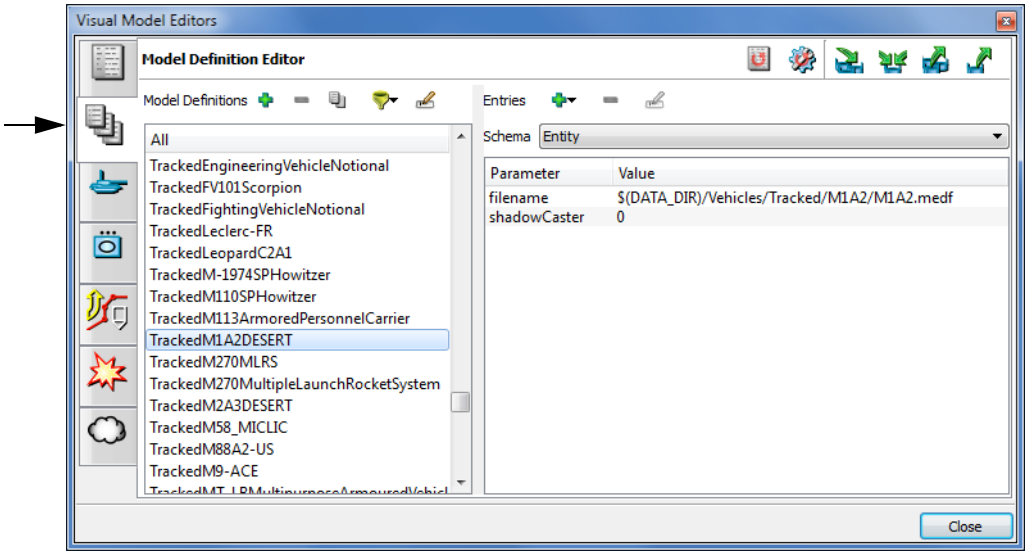


Figure 28-5. Model Definition Editor page

28.3.1. Creating a Model Definition

To create a model definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 28-5).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
4. Click the Add button (+) next to the Model Definitions label. The Add Model Definition dialog box opens (Figure 28-6).

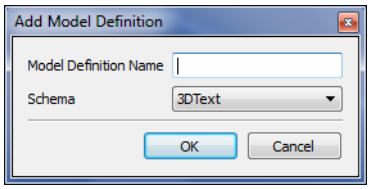


Figure 28-6. Add Model Definition dialog box

5. Type a name for the new model definition.

! Model definitions for DI-Guy characters must end with the letters DIG. Model definitions for SpeedTrees must end in ST.

---

6. In the Schema list, select a schema for the model. (This list matches the list of schemas on the Schemas page.)
7. Add parameters to the model, as described in "Adding Parameters to a Model Definition," on page 28-15.

28.3.2. Deleting a Model Definition



If a model definition is being used, you cannot delete it.

To delete a model definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 28-5).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
4. Select the model that you want to delete.
5. Click the Delete button () next to the Model Definitions label. You are prompted to confirm the deletion.
6. Click Yes. The model definition is removed from the list.

28.3.3. Copying a Model Definition

If you want a new model that is a variant of an existing one, it can be easier to copy the existing model and edit it, than to create a new model and add all of the parameters.

To copy a model definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 28-5).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
4. Select the model that you want to copy.
5. Click the Duplicate button (). The Duplicate Model Definition dialog box opens (Figure 28-7).

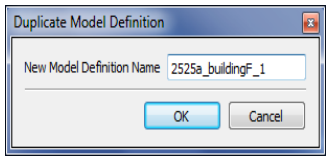


Figure 28-7. Copy model definition

6. Type a name for the copied version of the model.
7. Click OK.

8. The new model definition is added to the list.
9. Edit the parameters as described in "Editing a Model Definition," on page 28-15.

28.3.4. Filtering the List of Model Definitions

By default, the Model Definition Editor page lists all models that VR-Vantage knows about. You can filter the list to more easily work with a specific type of model.

➤ To filter the list of model definitions, click the Filter button ( ) and select a schema type from the list.

28.3.5. Editing a Model Definition

You can add parameters to a model definition, you can delete parameters, and you can change their values. You can only add parameters that are appropriate to the schema type for a model.



If you change the model definition for a simulation object that is already in the scene, the updated definition is not applied to the entity. To apply an edited model definition to all simulation objects, disconnect from the exercise and then reconnect.

Adding Parameters to a Model Definition

When you create a new model definition, you must specify the parameters required by its schema. You can only add parameters that are permitted by the schema.

To add a parameter to a model:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 28-5).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
4. Select the model for which you want to add a parameter.
5. Click the Add Parameter button ( ). A list of parameters is displayed (Figure 28-8).

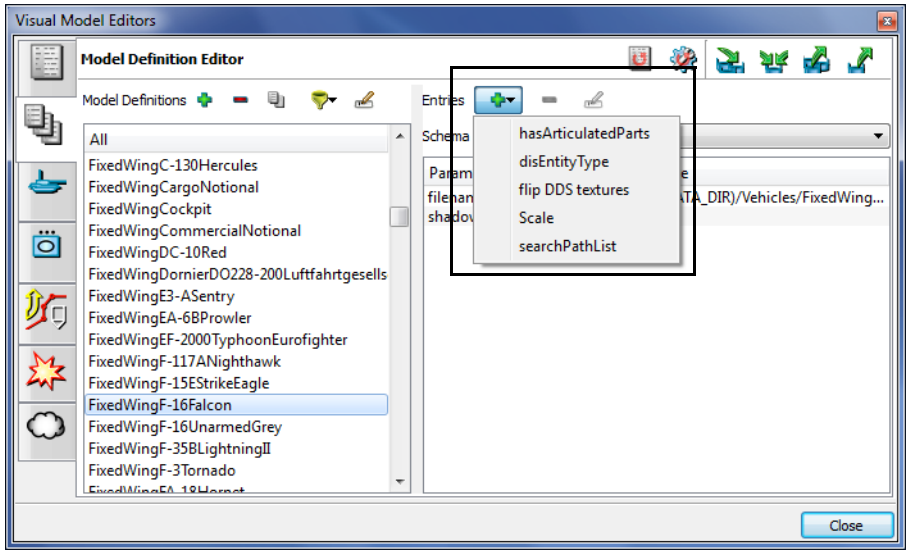


Figure 28-8. Add parameter list

6. Select the parameter you want to add. It is added to the parameter list.
7. Click the value for the parameter. The field becomes editable (Figure 28-9).

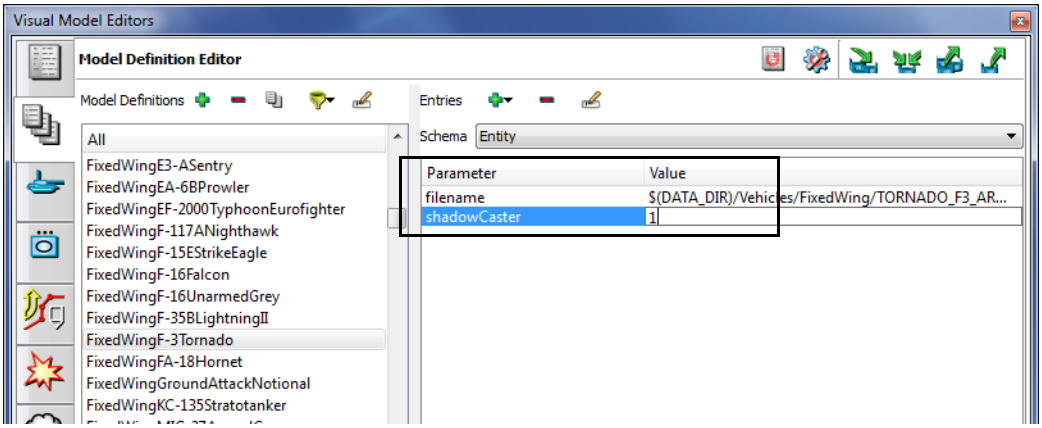


Figure 28-9. Editable parameter

8. Type or select a value for the parameter.
9. Click away from the field.

Editing a Model Definition Parameter

To edit a parameter:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 28-5).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
4. Select the model for which you want to edit a parameter.
5. Click the value for the parameter you want to edit. The field becomes editable (Figure 28-9).
6. Change the value for the parameter.
7. Click away from the field.

Deleting Parameters from a Model Definition

! If you delete a parameter from a model definition, the definition may become invalid. Invalid model definitions are shown in red.

To delete a parameter from a model:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 28-5).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
4. Select the model from which you want to delete a parameter.
5. Select the parameter that you want to delete.
6. Click the Delete button (−) next to the Entries label. The parameter is removed.

28.3.6. Saving Model Definitions

Like all VR-Vantage settings, when you change a model definition, the change is automatically saved. You can also use the common settings management controls for exporting, loading, and merging settings. For details about the common settings, please see "Managing VR-Vantage Settings," on page 3-13.

28.4. Creating and Editing Element Definitions

Element definitions define how VR-Vantage renders scene elements (simulation objects, tactical graphics, interactions, and so on).

Element definitions use a tree-style hierarchy to assign visual definitions. At any level of the hierarchy an element definition inherits the visual definitions of its parents. This makes it possible to assign a visual definition to many elements at one time. You can change the inherited parameter values for a specific element at any level of the hierarchy. However, in most cases, you cannot delete an inherited visual definition.

You can create and edit element definitions. The procedures are the same for each element type.



If you are connected to an exercise, changes to element definitions do not take effect until you disconnect and reconnect.

28.4.1. Creating an Element Definition

To create an element definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the page for the type of element definition that you want to create.
3. Expand the element definition hierarchy to the level at which you want to add an element definition and select the parent element (Figure 28-10).

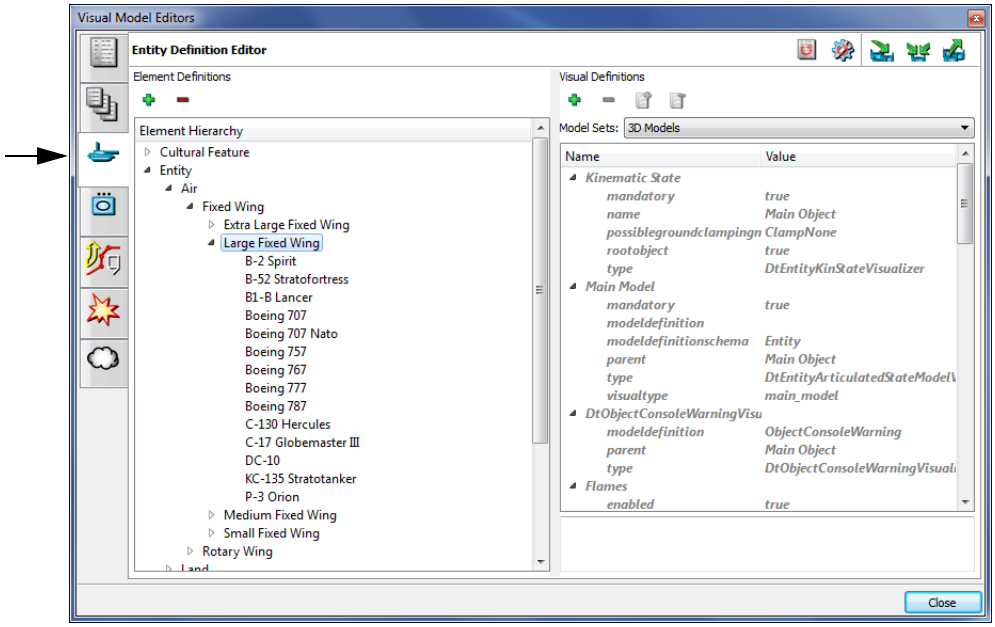


Figure 28-10. Entity Definition Editor page

4. Click the Add button (✚). The Create Element Definition dialog box opens.
5. Type a name for the element definition. (You cannot edit the name after you create it, so try to avoid typing errors.)
6. Click OK. The new element is added to the list.
7. Optionally, edit the visual definitions assigned to the element. For details, please see "Editing a Visual Definition," on page 28-21.
8. Optionally, add a visual definition to the element. For details, please see "Adding a Visual Definition," on page 28-20.
9. Optionally, save the element to a file. For details, please see "Saving Element Definitions," on page 28-24.

28.4.2. Editing an Element Definition

An element definition consists of a list of visual definitions for that element. You can add visual definitions and you can edit their parameters. In most cases, you cannot delete an inherited visual definition.

Adding a Visual Definition

To add a visual definition to an element definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the page for the type of element definition that you want to edit (Figure 28-10).
3. Select the element definition that you want to edit.
4. Optionally, on the Model Sets list, select the model set you want to use. (VR-Vantage Stealth only.)
5. Click the Add button (+) next to the Visual Definitions label. The Create Visualizer Definition dialog box displays a list of available visual definitions.

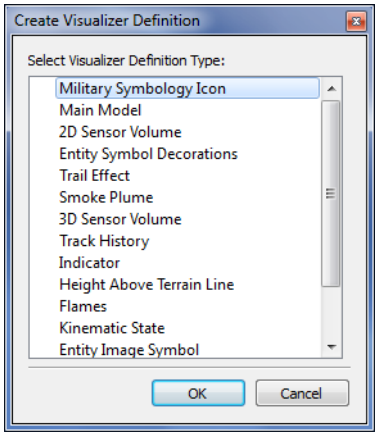


Figure 28-11. Create Visualizer Definition dialog box

6. Select the visual definition that you want to add.
7. Click OK. The visual definition is added to the element.
8. Optionally, edit the parameters for the visual definition. For details, please see "Editing a Visual Definition," on page 28-21.

Editing a Visual Definition

Visual definitions and their attributes are displayed either as gray italicized text or as black text (Figure 28-12). Italicized text indicates that the visual definition or attribute is inherited from a parent element. Visual definitions and attributes that are not italicized are particular to that element. (These entries could be inherited by child elements.)

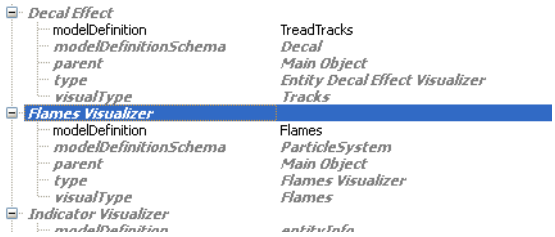


Figure 28-12. Visual definition entry

To edit a visual definition parameter:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the page for the type of element definition that you want to edit (Figure 28-10).
3. Select the element definition that you want to edit.
4. In the Visual Definitions pane, click the value of the attribute that you want to edit. Depending on the attribute, a list of available values is displayed, a dialog box is displayed (Figure 28-13), or the field becomes editable.

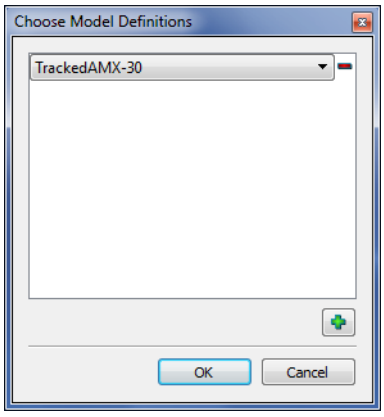


Figure 28-13. Choose Model Definitions dialog box

5. For a list, select the new value. For an editable field, type a new value. For a dialog box:
   a. If the dialog box window does not have a list, click the Add button (+). A list of values is added to the dialog box window.
   b. Select the value that you want.
   c. Click OK.

Mapping to Multiple Model Definitions or Schema

There may be cases where you want to map a visual definition to multiple model definitions or multiple schema. If you do this, VR-Vantage randomly assigns the model definition or schema to instances of the object.

To map a visual definition attribute to multiple values:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the page for the type of element definition that you want to edit (Figure 28-10).
3. Select the element definition that you want to edit.
4. In the Visual Definitions pane, click the value of the **modeldefinition** or **modeldefinitionschema** parameter that you want to edit. A dialog box opens. If the attribute already has values, they are listed in the dialog box window as a series of lists (Figure 28-14).

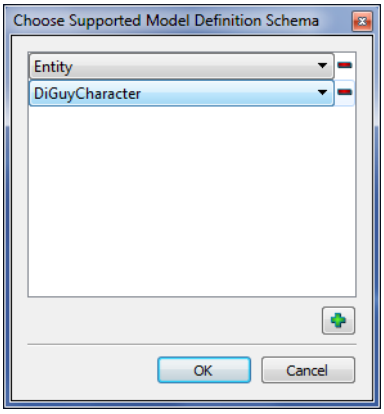


Figure 28-14. Parameter with multiple values

5. To add a value, click the Add button (+). A new list is added to the window.
6. Select a value from the new list.
7. To remove a value, click the Delete button (−) next to the list for that value.
8. Click OK. The visual definitions list does not show all of the values, but clicking it opens the dialog box again and shows the selected values.

Adding an Attribute to a Visual Definition

Each visual definition has a set of attributes. Some of them may be optional, so they are not specified as part of the factory definitions. You can add optional attributes to a visual definition.

To add an attribute to a visual definition:

1. Select the visual definition that you want to edit.
2. Click the Add Attribute button ( ). The Add Visualizer Definition Attribute window opens. It lists the attributes that are available for the visual definition (Figure 28-15).

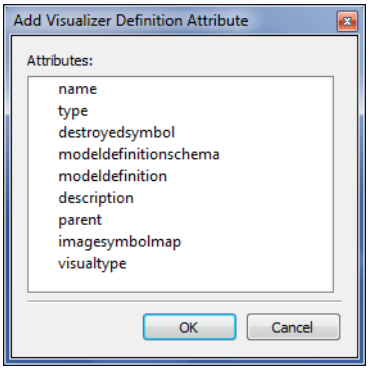


Figure 28-15. Add Visualizer Definition Attribute window

3. Select the attribute that you want to add.
4. Click OK. The attribute is added to the visual definition.
5. Specify a value for the attribute. This might require typing a value, selecting a value from a list, or selecting a value in another window.

Deleting an Attribute from a Visual Definition

You can delete individual attributes from a visual definition.

! The Delete button above the list of visual definitions deletes entire visual definitions. Do not click it thinking it will delete just the selected attribute.

To delete an attribute:

1. Select the visual definition that you want to edit.
2. Select the attribute that you want to delete.
3. Click the Delete Attribute button ( ).

28.4.3. Deleting an Element Definition



You cannot delete an element definition if it is being used.

To delete an element definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the page for the type of element definition that you want to delete (Figure 28-10).
3. Select the element definition that you want to delete.
4. Click the Delete button (−) next to the Entity Definitions label.
5. Confirm the deletion.

28.4.4. Saving Element Definitions

Changes to element definitions get saved automatically. You can also save element definitions using the standard VR-Vantage options for saving settings. For details, please see "Managing VR-Vantage Settings," on page 3-13.



29. Mapping Object Types to Element Definitions

This chapter explains how to map element definitions to DIS and HLA entity types. For information about how to create element definitions, please see Chapter 28, *Model and Element Definitions*. For information about mapping CIGI models and components, please see Chapter 36, *Mapping CIGI Models and Components*. Chapter 33, *Model Tutorials* walks you through the process of adding a model.

Introduction to Object Type Mapping 29-2
Adding an Object Type Mapping 29-2
Editing an Object Type Mapping 29-4
Filtering the Element Definition List 29-5
Deleting an Object Type Mapping 29-6
How VR-Vantage Maps DI-Guy Models 29-6
Clearing the Model Instancing Cache 29-6

29.1. Introduction to Object Type Mapping

In order to visualize a scene element (entity, unit, detonation, and so on), VR-Vantage must map its object type enumeration to an element definition. This section explains how to do that.

You map object types to element definitions in the Simulation Object Type Mappings dialog box. It has pages for mapping:

- Cockpit displays.
- Detonation effects.
- Entities.
- Firing effects.
- Tactical graphics.
- Tactical smoke.
- Units.

The mapping process is the same for all object types. You can add new object type mappings, edit existing mappings, and delete mappings.



- You can map more than one element definition to an object type. If you do this, when entities of this type appear in a simulation, VR-Vantage randomly assigns one of the element definitions to the entity.
- You can map an element definition to more than one object type.

29.1.1. Adding an Object Type Mapping

This procedure describes how to map an element definition to an object type enumeration. The element definition must already exist. The procedure is the same for any page on the Simulation Object Type Mappings dialog box.

To add an object type mapping:

1. Choose **Settings** → **Simulation Object Type Mappings**. The Simulation Object Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure 29-1). The page shows a list of object type enumerations in the Entity Type column. The entity definition mapped to the object type is listed in the Entity Definition column.

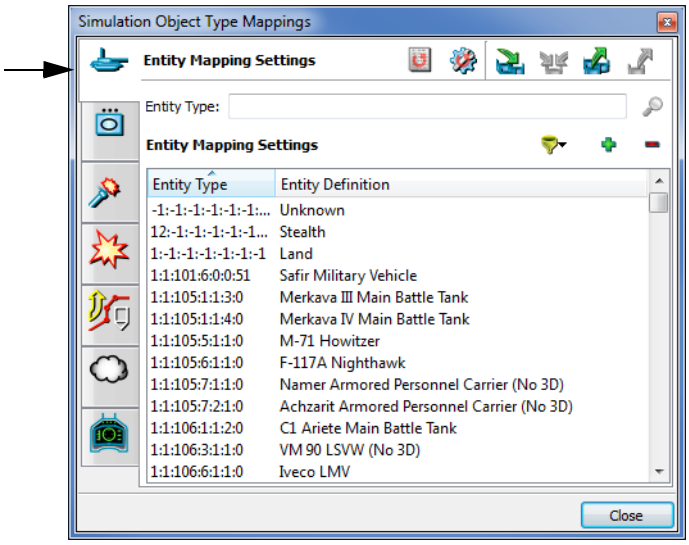


Figure 29-1. Entity Mapping Settings page

3. Click the Add button (+). The Create New Entity Type Model Mapping dialog box opens (Figure 29-2). It lists a default object type enumeration.

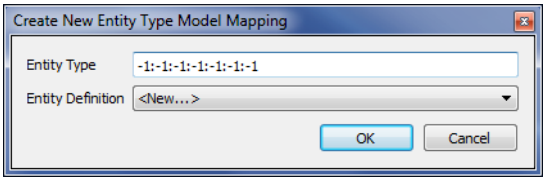


Figure 29-2. Create New Entity Type Model Mapping dialog box

4. In the Entity Type text box, type the enumeration you want to map to a model. (Separate each value with a colon(:).)
5. In the Entity Definition list, select the entity definition that you want to map to this object type.
6. Click OK.
7. The new model mapping is added to the list.

29.1.2. Editing an Object Type Mapping

This procedure describes how to edit an object type mapping for a simulation object. The procedure is the same for any page on the Simulation Object Type Mappings dialog box.

To edit an object type mapping:

1. Choose **Settings** → **Simulation Object Type Mappings**. The Simulation Object Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure 29-1).
3. Select the model mapping that you want to edit. If you know the entity enumeration that you want to edit, you can type the enumeration in the Entity Type text box and click the Search button (🔎). VR-Vantage highlights the entry for that enumeration, if it is present.
4. To change the enumeration associated with an element definition:
   a. In the Entity Type column, click the enumeration to make it editable.
   b. Change the values of the enumeration.
   c. Click someplace else in the window.
5. To change the element definition associated with an enumeration:
   a. Optionally, filter the list of available element definitions. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
   b. In the Entity Definition column, click the element definition to make it an editable list (Figure 29-3).
   c. Select the new element definition from the list.
   d. Click someplace else in the window.

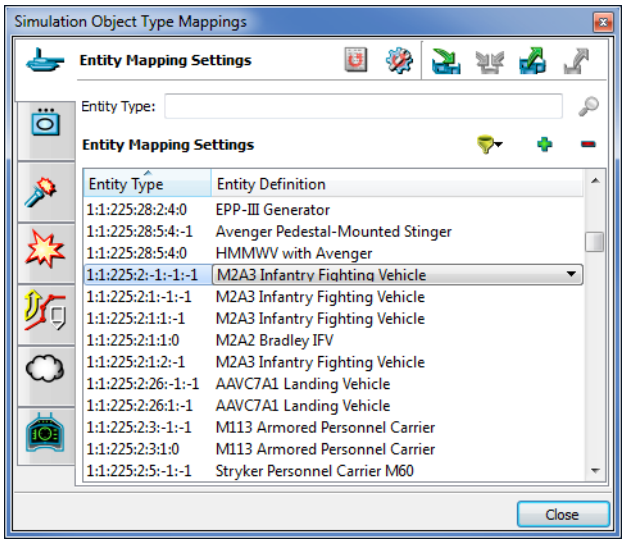


Figure 29-3. Editable entity definition

29.1.3. Filtering the Element Definition List

You can filter the list of element definitions that are available in the Entity Definition (Figure 29-3) list for mapping to entity types.



Filtering does not change the list of simulation objects in the Entity Mapping Settings window. It just changes the list of simulation objects in the Entity Definition list when you change a specific mapping.

To filter the list of element definitions:

1. On any page of the Simulation Object Type Mappings dialog box, click the Filter button (▼). A menu is displayed. A check mark indicates the type of element definition that will be displayed when you make a element definition entry editable. (You may have to expand the hierarchy to see which elements are checked.)
2. Select the element definition type that you want to see in the list or select All to see all element definitions.

29.1.4. Deleting an Object Type Mapping

The procedure for deleting an object type mapping is the same for any page on the Simulation Object Type Mappings dialog box.

To delete an object type mapping:

1. Choose **Settings** → **Simulation Object Type Mappings**. The Simulation Object Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure 29-1).
3. Select the model mapping that you want to delete. If you know the entity enumeration that you want to edit, you can type the enumeration in the Entity Type text box and click the Search button (🔎). VR-Vantage highlights the entry for that enumeration if it is present.
4. Click the Delete button (➖).

29.1.5. How VR-Vantage Maps DI-Guy Models

When VR-Vantage discovers a lifeform entity on the DIS or HLA networks, it chooses the animations to play for a DI-Guy based on the lifeform's speed, position, and similar attributes. However, if VR-Vantage receives a special DI-Guy state message (PDU) that dictates the lifeform's character, appearance, or animation, VR-Vantage will no longer try to guess and will expect to be told how to render that lifeform for the remainder of the simulation.

29.2. Clearing the Model Instancing Cache

VR-Vantage has a feature called model instancing that lets models share resources, such as geometry and textures. These shared resources are stored in a cache. Use of model instance caching decreases memory use and improves performance.

You can clear the model instancing ache if you need the disk space. You can clear it automatically whenever you create a new scene, or you can clear it manually.

To clear the model instancing cache after each scene change:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the File Caching Settings page (Figure 29-4).

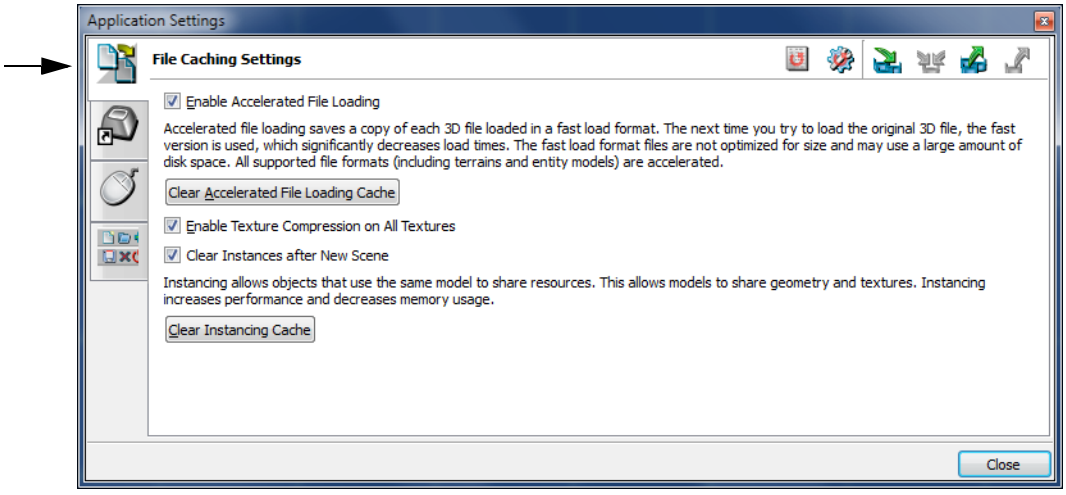


Figure 29-4. File Caching Settings page

3. Select the Clear Instances After New Scene check box.

To clear the model instancing cache manually:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the File Caching Settings page (Figure 29-4).
3. Click Clear Instancing Cache.



30. Configuring Specific Visual Models

Chapter 28, *Model and Element Definitions* provides a general introduction to model schemas, model definitions, and element definitions. This chapter describes how to configure several specific types of visual models.

Configuring 2D Icons 30-2
Editing Font-Based 2D Icons 30-2
Using Images for 2D Icons 30-4
Adding Images for Simulation Object Icons 30-9
Adding New Cockpit Display Models 30-10
Installing a Cockpit DLL 30-11
Creating a Model Definition for a Cockpit 30-11
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Compressing Model Files 30-24

30.1. Configuring 2D Icons

The 2D icons in VR-Vantage PVD and the Plan View mode of VR-Vantage Stealth are configured in visual definitions. Font-based icons are configured in the Military Symbol Icon visual definition. Image-based icons use the Entity Image Symbol visual definition.

30.1.1. Editing Font-Based 2D Icons

By default, 2D icons are configured in the Military Symbol Icon visual definition, which is part of a simulation object's entity definition. This visual definition uses font-based icons. You can change a simulation object's icon by changing the fillGlyph and outlineGlyph attributes.

To change a simulation object's icon:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Entity Definition Editor page (Figure 30-1).
3. Select the simulation object whose icon you want to edit.
4. In the Model Sets list, select 2D Icons.
5. To change the fill glyph:
   a. Under the Military Symbology Icon visual definition, select the fillGlyph attribute (Figure 30-1).

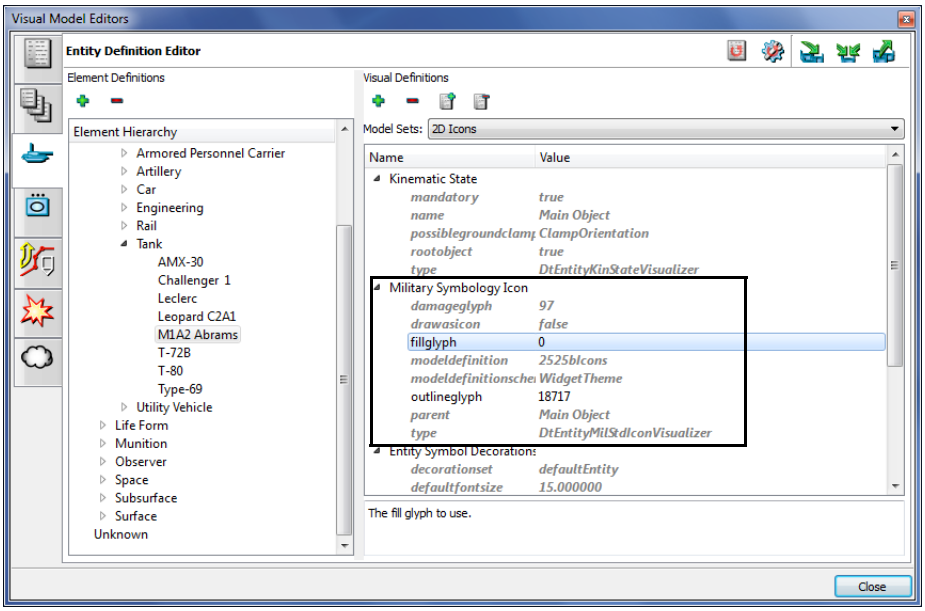


Figure 30-1. Military Symbol Icon visual definition

b. Click the value in the Value column. The Choose Font Glyph dialog box opens (Figure 30-2).

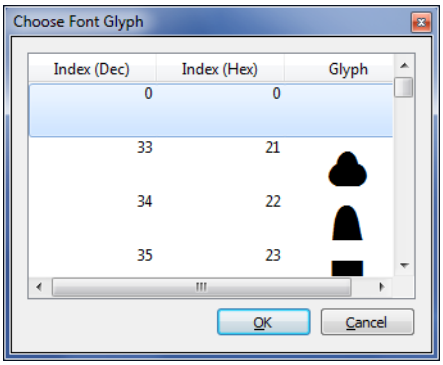


Figure 30-2. Choose Font Glyph dialog box

c. Select the glyph with the fill pattern you want to use. Click OK.

6. To change the outline glyph, follow the same procedure as changing the fill glyph.

30.1.2. Using Images for 2D Icons

By default, VR-Vantage uses TrueType fonts for 2D icons. You can replace the font-based icons with images using the Entity Image Symbol visual definition.



If you configure images for icons, be sure to save the entity definitions to a file other than the default settings. If you revert to factory defaults or otherwise switch back to font-based icons and you have not saved the image mappings, you will not be able to recover them without repeating the entire mapping process again.

To use images for entity icons:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Entity Definition Editor page (Figure 30-3). (If you want to change the icon for a unit, select the Unit Definition Editor page. To change the icon for a waypoint, select the Tactical Graphics page.)
3. In the Model Sets list, select 2D Icons.
4. In the Element Definitions list, select Entity. (If you are editing unit images, in the Element Definitions list select Aggregate. If you are editing tactical graphics images, in the Element Definitions list select Waypoint. For all other tactical graphics, skip to step 8.)
5. In the Visual Definitions list, select Military Symbology Icon (Figure 30-3).

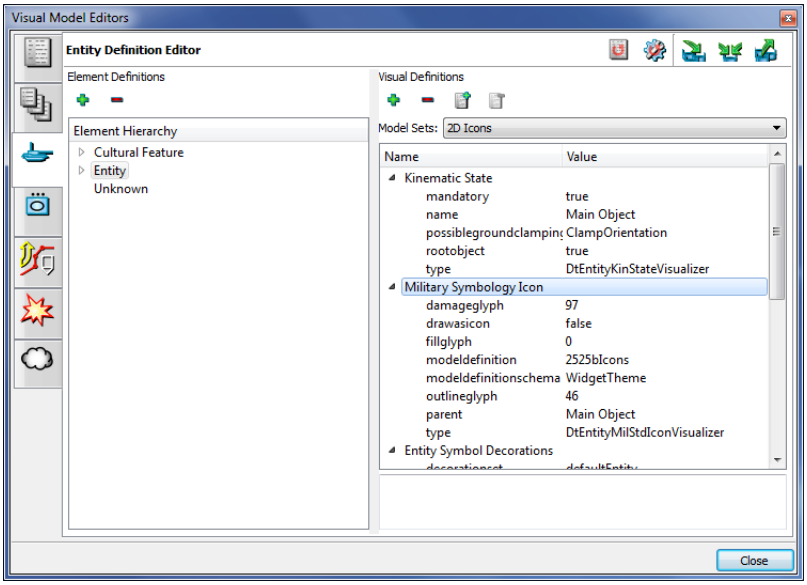


Figure 30-3. Entity element definition with Military Symbology Icon visual definition

6. Click the Delete button (−). The visual definition gets deleted.
7. Click the Add button (+). The Create Visualizer Definition window opens. It displays a list of visual definitions (Figure 30-4).

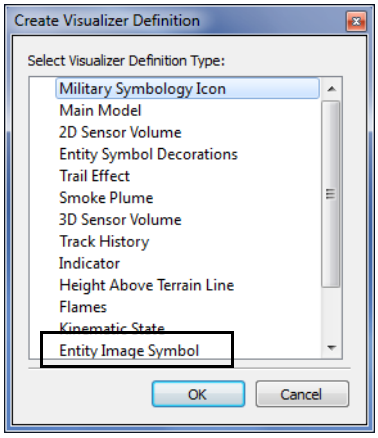


Figure 30-4. Create Visualizer Definition window

8. Select Entity Image Symbol. (If you are configuring images for units, select Aggregate Image Symbol; for tactical graphics, select Tactical Graphic Image Symbol.)
9. Click OK.
10. In the Visual Definitions list, select Entity Image Symbol (Figure 30-5).

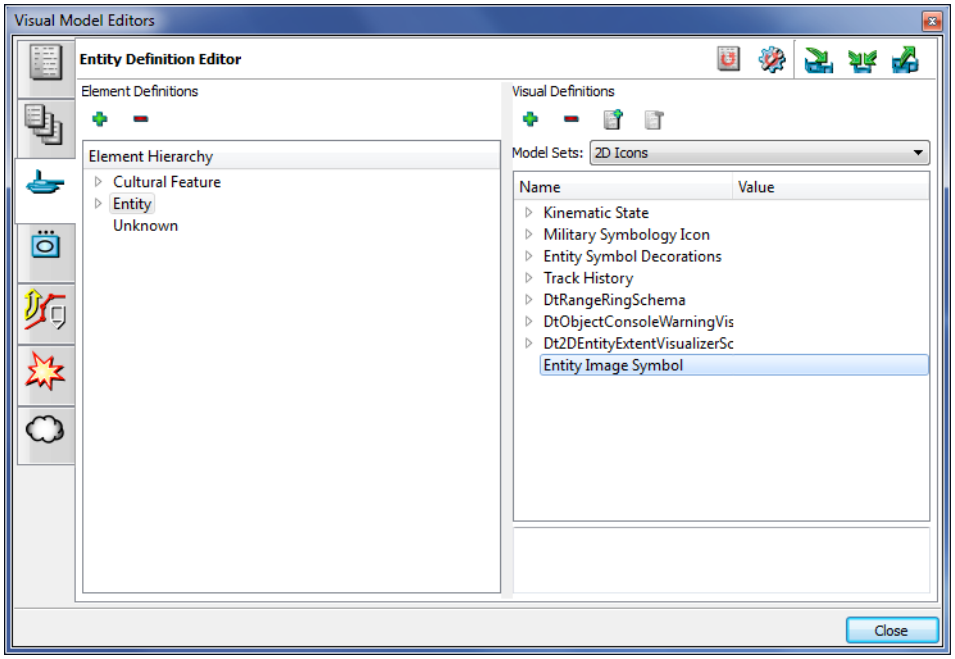


Figure 30-5. Entity element definition with Entity Image Symbol visual definition

11. Click the Add Attribute button (). The Add Visualizer Definition Attribute window is displayed (Figure 30-6).

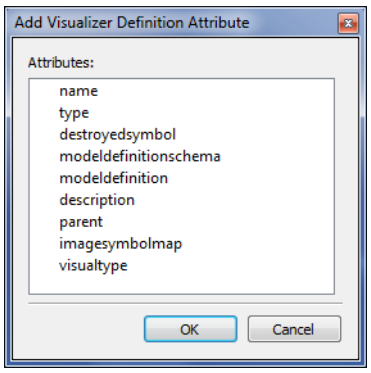


Figure 30-6. Add Visualizer Definition Attribute window

12. In the attribute list, select **parent**.
13. Click OK. The **parent** attribute is added to the visual definition.
14. Click the value field to make it editable.
15. Type Main Model and press **Enter**.
16. Click the Add Attribute button.
17. In the attribute list, select **type**. The value is filled in automatically.
18. Click the Add Attribute button.
19. In the attribute list, select **modeldefinitionschema**. The Choose Supported Model Definition Schema dialog box opens (Figure 30-7).

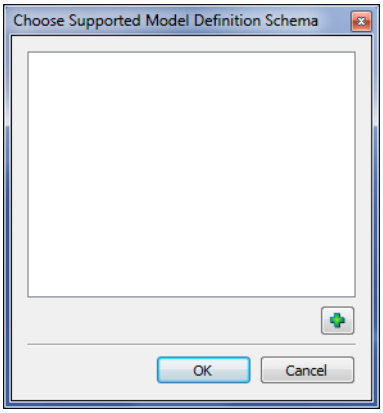


Figure 30-7. Choose Supported Model Definition Schema dialog box

20. Click the Add button. A list is added to the dialog box.
21. In the list, select **WidgetTheme** (Figure 30-8).

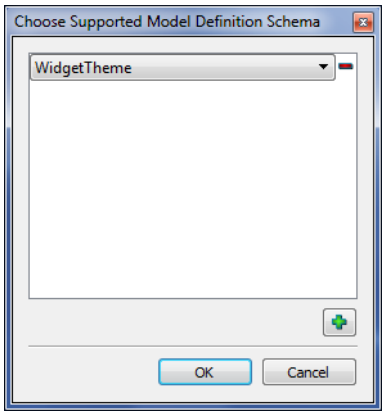


Figure 30-8. Completed Choose Supported Model Definition Schema dialog box

22. Click OK.
23. Click the Add Attribute button.
24. In the attribute list, select **imagesymbolmap**. The 2D Symbol Image Mapper dialog box opens (Figure 30-9).

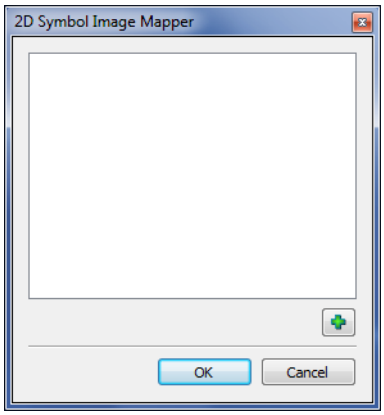


Figure 30-9. 2D Symbol Image Mapper dialog box

25. Click the Add button. A list is added to the dialog box. It lists the forces for which you can map images. and the images that you can apply to a particular force
26. Select a force and an image from the lists (Figure 30-10).

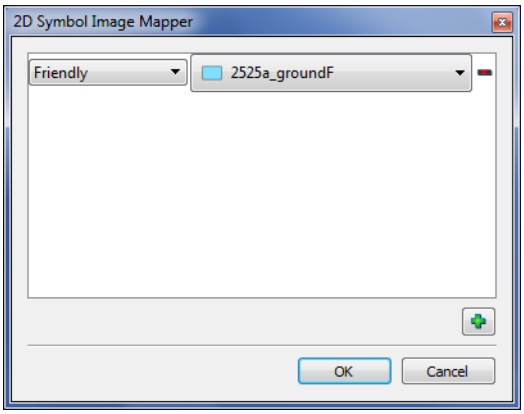


Figure 30-10. 2D Symbol Image Mapper dialog box with force chosen

27. Add an entry for each force that you want to represent with an image.
28. Click OK.
29. Click the Add Attribute button.
30. In the attribute list, select **destroyedsymbol**. The **destroyedsymbol** attribute is added to the visual definition.
31. In the **destroyedsymbol** list, select Destroyed. The completed visual definition should look similar to Figure 30-11.

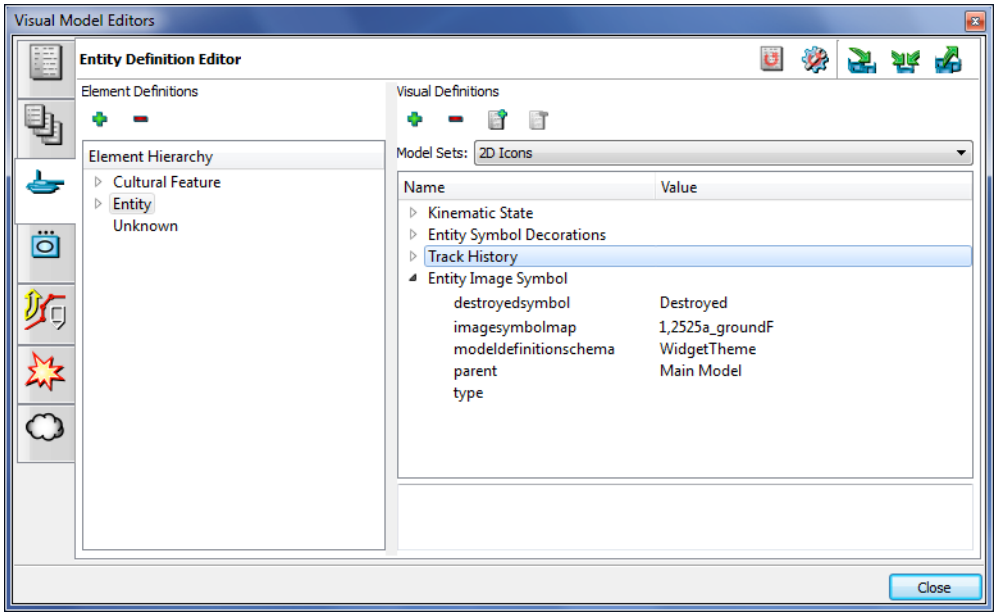


Figure 30-11. Entity Image Symbol visual definition

The settings for the Entity Image Symbol visual definition are inherited by each entity in the hierarchy from the base Entity definition. Unless you configure the various entity categories, all entities use the images you configured for the Entity category. Therefore, at a minimum, change the **imagesymbolmap** values for each force at each generic object type, such as Fixed Wing and Life Form, to use the proper image for that object type. Optionally, you can specify an image for each entity definition at the leaf level.



When you edit the Entity Image Symbol visual definition attributes, be sure that you select the 2D Icons model set.

30.1.3. Adding Images for Simulation Object Icons

VR-Vantage includes a representative set of MIL-STD 2525a images. They are in *./data/images*. If you want to add your own images, you can do so by adding a new model definition or changing the image mapping for an existing model definition. The new images are automatically added to the list of images for the **imagesymbolmap** in the Entity Image Symbol visual definition.

To add images for entities:

1. Copy the new images to *./data/images*.
2. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
3. Select the Model Definition Editor page (Figure 28-5).
4. In the Schema list, select WidgetTheme.
5. If you want to change the image used for an existing model definition:
   a. Select the model definition that you want to change, for example, 2525a_groundF.
   b. Change the file specified for the **backgroundImage** attribute.

   If you want to specify an image for a new model definition:
   a. Create a new model definition, as described in "Creating and Editing Model Definitions," on page 28-12. It is recommended that you copy an existing model definition for a 2525a symbol.
   b. Specify the image that you want to use for the new model definition.

30.2. Adding New Cockpit Display Models

VR-Vantage supports cockpit displays created with GL Studio. A cockpit is implemented through a Reusable Software Object (RSO) DLL. A cockpit's values are changed through updaters. An updater is associated with a cockpit attribute through the cockpit model definition. Figure 30-12 shows the model definition for a cockpit.

Cockpit updaters are associated with an attribute name that is known to the RSO. The value you provide for a cockpit-specific attribute is the name of an updater for dynamically changing values or a constant value. Constant values are commonly used to configure a cockpit when it is loaded. VR-Vantage provides a set of commonly used updaters. You can add additional updaters or override existing updaters through a plug-in.



The GL Studio license included with VR-Vantage only covers the cockpits delivered with the product. If you add your own cockpits, you will need GL Studio run-time licenses.

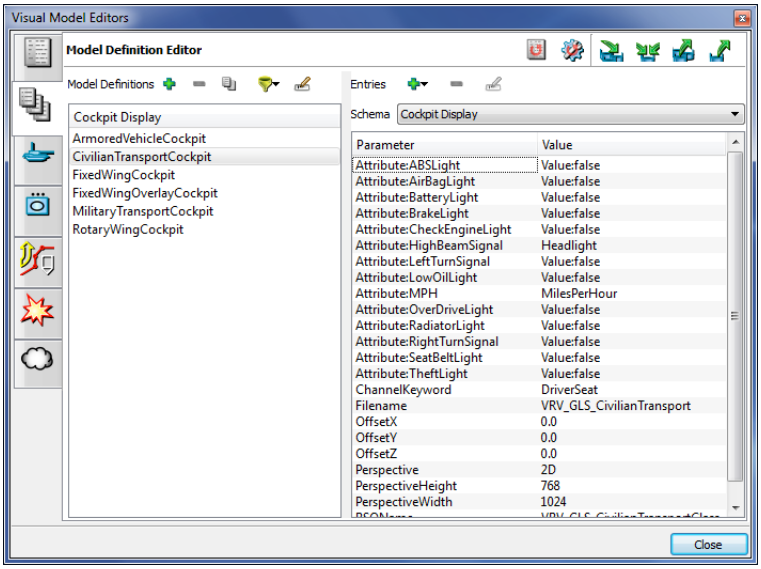


Figure 30-12. Cockpit model definition

The general procedure for adding a new cockpit model is:

1. Install the cockpit's DLL.
2. Create a model definition for the cockpit.
3. Map object types to the model definition, as described in "Adding an Object Type Mapping," on page 29-2.

30.2.1. Installing a Cockpit DLL

If you create your own cockpit, it is implemented as an RSO DLL that you must add to the VR-Vantage file structure.

➤ To install a new cockpit, place the DLL for the cockpit in *./data/Huds* and create a model definition for it.

30.2.2. Creating a Model Definition for a Cockpit

Cockpit models are configured using schemas and model definitions, just like any other model in VR-Vantage. This section provides additional details specific to cockpits.

To create a model definition for a cockpit:

1. Add a new model definition, as described in "Creating a Model Definition," on page 28-13. Be sure to select Cockpit Display as the schema. A new model definition is added to the display (Figure 30-13). The message window lists the parameters that you must add. These are the parameters defined by the schema.

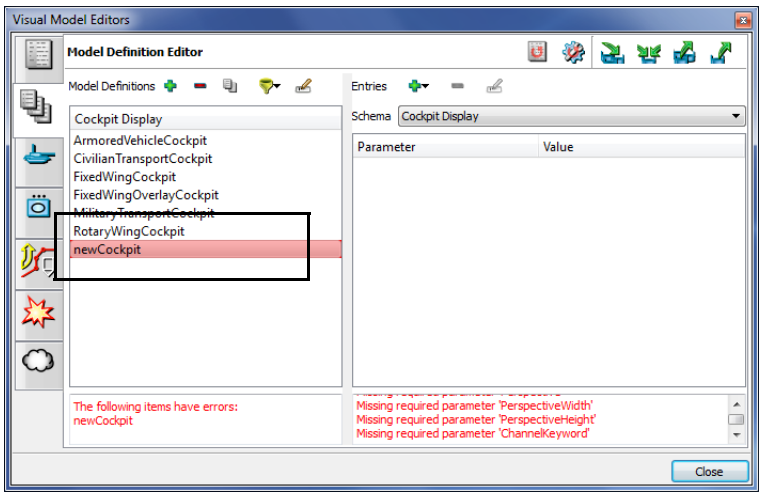


Figure 30-13. New cockpit model definition

2. Add the required parameters, as described in "Adding Parameters to a Model Definition," on page 28-15. Table 30-1 describes the required parameters.

Table 30-1: Required parameters for cockpit models

Parameter	Description
Filename	The name of the DLL without the file extension.
RSOName	The name of the class to be loaded from the DLL. Default: *filename*Class.
Perspective	2D or 3D. This parameter refers to the perspective of the cockpit display, not the terrain.

Table 30-1: Required parameters for cockpit models

Parameter	Description
PerspectiveWidth PerspectiveHeight	Adjusts the orthogonal projection for a 2D cockpit. Adjusts the perspective projection for a true 3D cockpit.
ChannelKeyword	A keyword that tells a channel to display any object that has the keyword in its definition. Default: showCockpits. (This keyword means that any channel that has the showCockpits keyword will show cockpits.)
Offset-X Offset-Y Offset-Z	Moves the cockpit offset around the screen. The OffsetX value shifts the cockpit left or right. The OffsetY value shifts it up or down. OffsetZ shifts a 3D cockpit forward and back. It has no effect on 2D cockpits.

3. Add the parameters required by the cockpit RSO. To do this, add an Attribute parameter, as follows:
   a. Add an Attribute parameter, as described in "Adding Parameters to a Model Definition," on page 28-15.
   b. Double-click the parameter to make its name editable.
   c. Add a colon and the name of an RSO attribute that you need to map. For example, Attribute:Heading.
   d. In the Value column, click the value to make it editable. Type the name of an updater or specify a constant value in the format Value:*value*. You can specify an updater that you have added through a plug-in or one of the updaters provided with VR-Vantage, as described in Table 30-2.
4. Map an object type to your definition, as described in "Adding an Object Type Mapping," on page 29-2.

Table 30-2: Updaters provided

Updater	Description
AOA	Angle of Attack. Returns the pitch of the entity clamped (5 to 30 degrees).
FeetAGL	Feet Above Ground Level. Returns the feet above the terrain (or buildings below).
FeetMSL	Feet Above Mean Sea Level. Returns the altitude above the sea level.
FeetPerMinute	Feet Per Minute. Returns the climb rate.
KilometersPerHour	Speed of the entity in kilometers per hour.
MilesPerHour	Speed of the entity in miles per hour.
KnotsPerHour	Speed of the entity in nautical miles per hour.
Pitch	Returns the pitch of the entity clamped (-180 to 180 degrees).

Table 30-2: Updaters provided

Updater	Description
Roll	Returns the roll of the entity clamped (-180 to 180 degrees).
Yaw	Returns the yaw of the entity clamped (0 to 360 degrees).
Headlight	Returns the headlight state of the entity as true or false.
Value	This updater sends any value to the cockpit once and then never again. It is used to configure initial setup and to turn display components on or off.

30.3. Configuring Wakes

When dynamic ocean is enabled, VR-Vantage simulates wakes on surface entities. Wakes are configured in the Ship Wake visual definition of an entity's element definition. If you add your own model, you may want to change the default configuration values for its wake so that it more closely matches the dimensions and velocity of the object type being modeled.

To configure a ship wake:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Entity Definition Editor page (Figure 30-14).

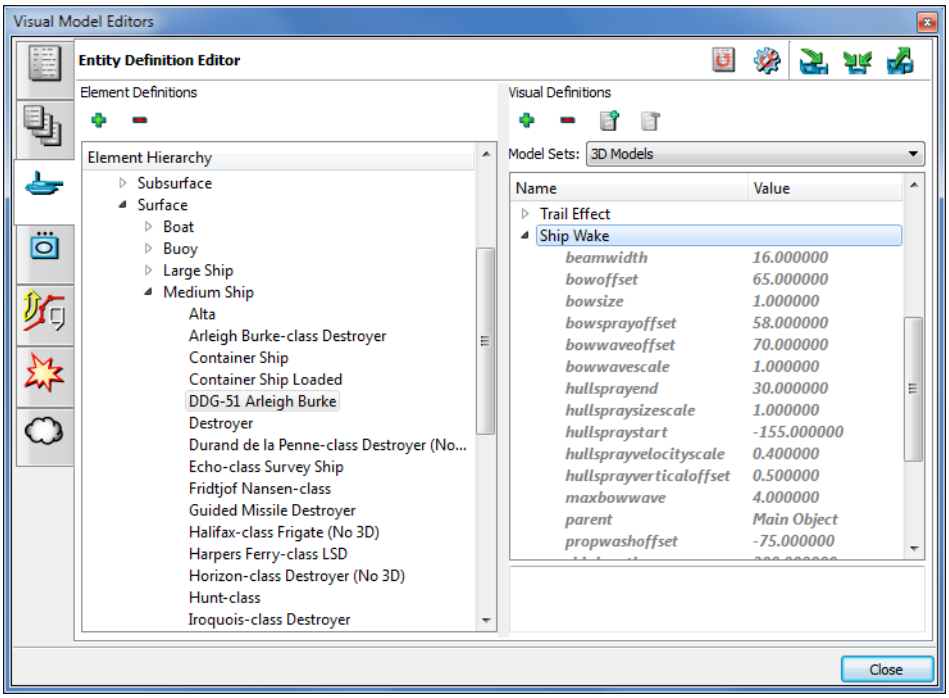


Figure 30-14. Ship Wake visual definition

3. In the Element Hierarchy, expand the Entity list to the Surface level and select the entity that you want to configure.
4. In the Visual Definitions list, select and expand the Ship Wake visual definition.

5. Edit the parameters. Table 30-3 describes each parameter.

Table 30-3: Ship Wake visual definition attributes

Parameter	Description
beamwidth	The width of the ship at its widest point.
bowsize	The size of the bow in world units. This affects the wavelength of the bow wave and the initial spread of spray particles at the bow. Use 0 for a pointy bow.
bowsprayoffset	An offset from the ship position from which to emit spray particles.
bowwaveoffset	An offset from the ship position, along the direction of travel, at which bow waves will originate.
bowwavescale	A scaling factor for the bow wave's amplitude at the bow of the ship.
draft	The depth of the hull underwater.
hullsprayend	The offset from the ship at which hull spray effects end.
hullspraysizescale	A scaling factor applied to the hull spray particles.
hullspraystart	The offset from the ship at which hull spray effects begin.
hullsprayvelocityscale	The initial velocity of hull spray particles as a percent of the ship velocity (0-1).
hullsprayverticaloffset	A vertical offset to the starting point of new hull spray particles.
maxbowwave	The maximum amplitude of the bow wave, or -1.0 for unbounded.
numhullsprays	The number of spray particles emitted periodically along the hull of the ship.
parent	The visualizer's parent.
propwashenabled	Enable or disable propeller backwash effects.
propwashoffset	An offset from the ship position from which to generate propeller backwash effects.
shiplength	The length of the object generating the wake.
sprayenabled	If enabled, the wake emits spray particles.
spraysizescale	A scaling factor applied to the size of the bow spray particles and their random spread.
sprayvelocityscale	A scaling factor for spray effects at the bow of the ship. This is applied to the initial velocity of the spray particles.
sternwaveoffset	An offset for the stern wakes.
type	The type of visualizer.
wakeoffset	An offset to the model's origin that all other offsets are relative to. Changing this offset lets you move all of the wake effects in tandem if the entity model changes.

30.3.1. Configuring Tidal Stream Wakes

Tidal stream wakes are supported as stand-alone models and are automatically attached to streamed buoys and beacons. Model definitions for wakes to be used with each of the supported buoy and beacon models are included (BuoysPillarWake, BeaconsLattice-Wake, and so on). You may want to edit them. We recommend wake lengths of at least 20m for best results. (Some of the model definitions specify values less than that.)

By default, VR-Vantage starts with a tidal stream current speed of 0. To see tidal stream wakes, change the speed on the Scene Settings dialog box, Environment Conditions Settings page. For more information, please see "Configuring Marine Conditions," on page 10-13.

You can also change the speed and direction of the tidal stream current using a CIGI Component Control or Short Component Control message. The message uses a component class of Regional Sea Surface(4), a component ID of 1, and two float component data fields - the first is the tidal stream current speed (m/s), and the second is the current direction (0-2PI radians, clockwise from North). The Region ID is ignored.

30.4. Adding Wind-based Controls to Models

VR-Vantage can simulate the movement of flags and windsocks based on the current simulated wind speed and direction on terrains. It can also simulate movement of flags and windsocks on models added through connections or programmatically (this is not supported for props or external references). These features require models with appropriate switches and articulations, as well as model-specific or terrain-specific meta files.

A meta file is associated with a terrain or model in one of the following ways:

- Place it in the same directory as the terrain or model's MEDF file. The meta file must have the same name as the MEDF file, but with a *.meta* extension.
- Specify it in the **metaFileName** parameter of the model definition used to import the model.

Meta files are user-editable, but require understanding of the annotations and naming conventions in the model file itself.

The meta files are JSON configuration files. They have sections that configure wind control of nodes, as follows:

- Control switch nodes based on wind speed.
- Control the heading (Z-Axis) of articulating (degree of freedom) nodes based on wind direction.

Each section has a `Linkage` entry and a `FeatureData` entry. The `Linkage` entry specifies an OSG node that should have the feature specified in the `FeatureData` entry.

Linkages can be specified by node name or WRM Specification comment (for example, @dis articulated_part 7872). When a model or terrain file is loaded and a meta file is associated with that file, the model or terrain file is searched for any node or nodes specified in any `Linkage` entries in that meta file and the necessary instances to implement the `FeatureData` indicated in that `Linkage`/`FeatureData` pair are created.

`FeatureData` sections indicate a **FeatureName** (which is mapped to a creator that will instantiate the appropriate object to manage that feature) and any additional parameters needed to manage the feature. The meta file used for wind features supports two features - WindSwitchPart and WindDirPart.

- WindSwitchPart. The WindSwitchPart feature is used to change the state of a switch node based on the current wind speed. The flag models used by MÄK include a switch with three states. This feature has the following parameters:
  - **WindSpeed**. A list of wind speeds (in km/h).
  - **WindState**. A list of the switch state values that correspond to the values in the **WindSpeed** parameter.

  The number of items in each list should be the same (and only contain switch states supported by the node specified in the `Linkage` entry.
- WindDirPart. The WindDirPart feature is used to modify the heading value (Z-Axis) of an articulation (degree of freedom) node based on wind direction. It has the following parameters:
  - **RotOffsetDeg**. Allows a rotation offset to be applied.
  - **RotDir**. Indicates if the node should be rotated in a clockwise or counterclockwise direction.

For information about adding new meta files or new meta file features, please see section 8.6, Transforming Nodes Programmatically, in VR-Vantage *Developers Guide*.

30.5. Flipping DDS Textures for a Model

If a model is displayed upside down because its DDS textures are not what VR-Vantage expects, you can specify that the model be flipped. (For more information about DDS textures, please see "Displaying DDS Textures Correctly," on page 24-38.)

To flip DDS textures for a model:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 28-5).
3. Optionally, filter the model definitions in the list.
4. Select the model for which you want to change the DDS parameter.
5. If the model has the **flip DDS textures** parameter in its parameters list, set it to 1.

   If the model does not have the **flip DDS textures** parameter in its parameters list, click the Add Parameter button () to see if this is a valid parameter for this model. If it is, you can add the parameter and set it to 1.

30.6. Configuring SpeedTree Trees

SpeedTree trees are high resolution models of trees. To improve performance, you can set clipping plane and level-of-detail (LOD) values to vary the resolution of the trees placed in the scene based on their distance from the observer. For details about clipping planes, please see "Setting the Clipping Planes," on page 6-13. Table 30-4 describes the settings you can change.

Table 30-4: SpeedTree settings

Parameter	Description
Clipping distance	The distance at which trees are clipped out of the scene.
Fade from High LOD to Low LOD	The range (near to far) in which high LOD trees are gradually replaced with low LOD trees.
Fade from Low LOD to Billboard	The range (near to far) in which low LOD trees are gradually replaced with billboard trees. This range is usually greater than the range for high LOD to low LOD.
Ambient Scalar	Multiplies the built-in ambient lighting value in each SpeedTree by the specified amount.
Diffuse Scalar	Multiplies the built-in diffuse lighting value in each SpeedTree by the specified amount.
Specular Scalar	Multiplies the built-in specular lighting value in each SpeedTree by the specified amount.
Transmission Scalar	Multiplies the built-in transmission lighting value in each SpeedTree by the specified amount.
Alpha Scalar	Multiplies the built-in alpha value in each SpeedTree by the specified amount.

To configure SpeedTree trees:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the SpeedTree Settings page (Figure 30-15).

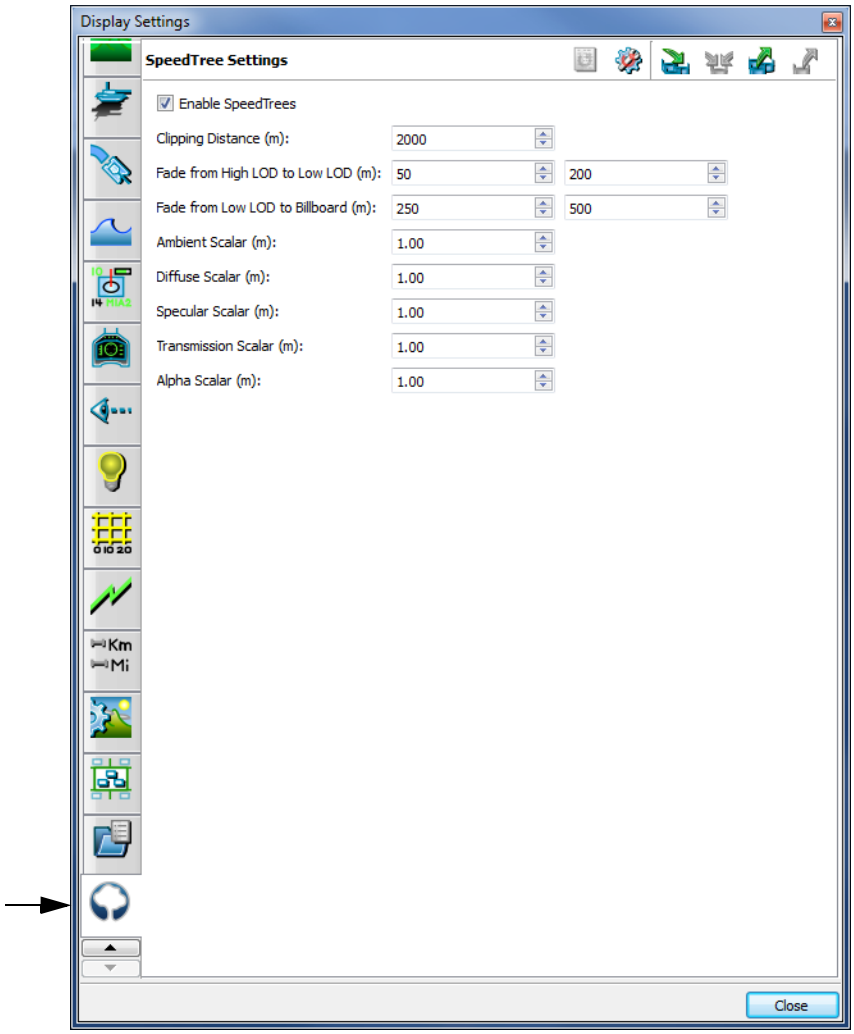


Figure 30-15. SpeedTree Settings page

3. Update parameters as desired.
4. Click Close.

30.6.1. Randomizing the Size of SpeedTrees

SpeedTrees can be created as props or streamed into the scene using an earth file. They have a default size. You can configure VR-Vantage to scale the size of SpeedTrees by a fixed amount or you can scale them randomly within a specified range. The scale applied to a SpeedTree is the product of several factors.

If a SpeedTree is a prop, it is scaled as the product of the following settings:

- The **scale** attribute in its model definition. If the **scale** attribute is not part of the model definition, the value defaults to 1.0.
- A random scale factor as specified on the SpeedTree Randomization page on the Terrain Settings dialog box, if enabled.
- A feet-to-meters conversion factor of 0.3048.

If a SpeedTree is a streamed in using an earth file, it is scaled as the product of the following settings:

- The scale attribute in its model definition. If the scale attribute is not part of the model definition, the value defaults to 1.0.
- The **marker-scale** attribute in the `model` element that configures the trees.
- A random scale factor as specified on the SpeedTree Randomization page on the Terrain Settings dialog box, if enabled.
- A feet-to-meters conversion factor of 0.3048.

You can also randomize the orientation of SpeedTrees.

To specify randomization of SpeedTree scaling:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the SpeedTree Randomization page (Figure 30-16).

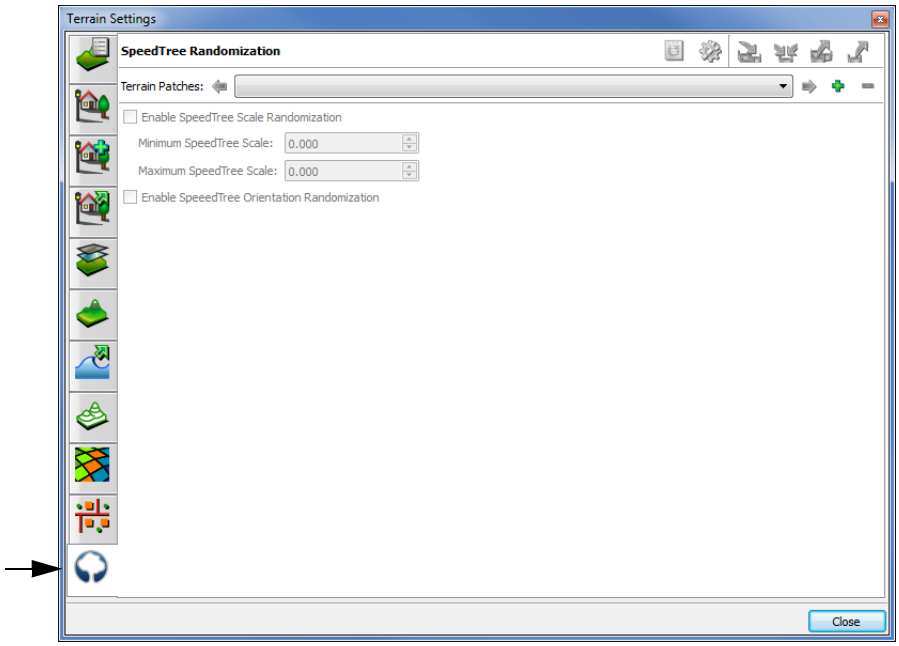


Figure 30-16. SpeedTree Randomization page

3. To enable randomization of the SpeedTree scale, select the Enable SpeedTree Scale Randomization check box.
4. If you enabled Enable SpeedTree Scale Randomization, specify values for the Minimum Tree Scale and Maximum Tree Scale.
5. To enable randomization of tree orientation, select the Enable SpeedTree Orientation check box.

30.7. Best Practices for Creating Models for VR-Vantage

If you build your own models for use in VR-Vantage, following these guidelines will result in models that work efficiently:

- Keep all textures to powers of two, for example 256x256, 128x512, or 2048x2048:
  - Make sure textures use as many of the pixels as possible and that there are no large black areas in the texture.
  - Keep alpha (transparency) to a minimum.
- Minimize the number of textures:
  - Create a texture atlas that uses multiple textures combined into one.
  - Group polygons together that use the same texture.
  - Use the same textures for all LOD nodes.
- Minimize the number of nodes:
  - Keep the hierarchy as flat as possible.
  - Move all LOD nodes to the top of the hierarchy.
  - Minimize unnecessary transforms.
  - When you reuse geometry in the model, use instancing.
- Minimize the number of polygons that have different attributes:
  - Use the same material on polygons whenever possible.
  - Use two polygons with flipped normals instead of using the double sided attribute.
  - Use the same color on polygons whenever possible.
  - Group polygons with similar attributes.
- Consider using a more aggressive LOD structure:
  - Reduce the switchout distance to be smaller so that the LODs switch sooner.
  - Minimize the number of LODs.
  - Make sure that models switch out completely at a reasonable distance.
- Reduce the number of external references:
  - Merge external reference files.
  - Create instances from external merged reference files.

30.8. Compressing Model Files

The models and image files provided with VR-Vantage are shipped in compressed formats (MÄK Encrypted Data Format (MEDF) and MÄK Encrypted Image Format (MEIF)). You may want to compress your models to save space or protect intellectual property. You can convert supported formats to MEDF and MEIF with *./bin64/medfTool.exe*. The compression tool supports the 3D modeling formats supported by VR-Vantage, such as OpenFlight, 3DS, and OBJ, and raster formats such as RGB and PNG.



When VR-Vantage processes a request to load a a file, such as an external reference in a terrain, it checks the cache and the directory of the requested file for an MEDF version of the file. If it does not exist, it loads the file in the original format.

The syntax for medfTool is as follows:

```
medfTool [-q simple_filename ... -p <integer> -s directory
   ... -z optimization -i -o -m extensions ...
   -x extensions ... --norecurse --directory directory
   -f filename -- -v -h]
```

Table 30-5 describes the arguments.

Table 30-5: medfTool arguments

Argument	Description
`(-- | --ignore_rest)`	Ignore all arguments after this one.
`--directory` *directory*	Specifies the directory to search for image and geometry files to convert into MEDF and MEIF. All subdirectories will be visited unless the `--norecurse` command line option is used.
`(-f | --file)` *filename*	Convert just this file. The extension of the file must be specified using `-x` or `-m` to indicate it is an image or a geometry file.
`(-h | --help)`	Displays usage information.
`(-i | --ignore_errors)`	Ignore errors in the encryption process and continue without exiting.
`(-m | --image_extensions)` *extension*	Specifies the extensions of image formats which will be converted into MEIF format. Use this argument to encrypt a directory. Can be used multiple times.
`--norecurse`	Do not recurse through subdirectories. Default: recurse through subdirectories.
`(-o | --onlyIfNew)`	Only generates an encrypted file if the expected output file does not exist.

Table 30-5: medfTool arguments

Argument	Description
(-p | --threads) *threads*	Specifies the number of threads to run. Specifying zero results in the number of threads equaling the number of logical processors the host machine has.
(-q | --forceOpaque) *simple_filename*	Specifies a filename and extension, but no path, to force polygons with these filenames to be opaque. Accepted multiple times.
(-s | --search) *directory*	Adds a directory to the search path when resolving external references. During processing, any external references not found are removed from the generated files. Files in the search path are not converted.
(-v | --version)	Display version information and exit.
(-x | --extensions) *extension*	Specifies the extensions of geometry file formats that will be converted into MEDF format. Use this argument to encrypt a directory. Can be used multiple times.
(-z | --optimize) *optimization*	Specifies the optimization level. Maximum optimization may provide better optimization than the default setting, but it is significantly slower. Possible values are: ◆ 0 = None. ◆ 1 = Default. ◆ 2 = Maximum optimization.

The following example recursively compresses all FLT, RGB, RGBA, PNG, and DDS files in *%MAK_DATADIR%/Terrain*:

```
%MAK_IGDIR%/bin64/medfTool.exe
  --directory %MAK_DATADIR%/Terrain --extensions flt
  --image_extensions rgb --image_extensions rgba
  --image_extensions png --image_extensions dds
```

The following example compresses all FLT, RGB, RGBA, PNG, and DDS files in *%MAK_DATADIR%/Lifeforms*. It does not compress files in subdirectories.

```
%MAK_IGDIR%/bin64/medfTool.exe
  --directory %MAK_DATADIR%/Lifeforms --norecurse
  --extensions flt --image_extensions rgb
  --image_extensions rgba --image_extensions png
  --image_extensions dds
```



31. Configuring Emitter Volumes

This chapter explains how to configure display of emitter volumes.

Configuring Emitter Volumes 31-2
Configuring Emitter Volume Color 31-2
Controlling Emitter Volume Radius 31-3
Configuring Emitter Volume Segments 31-4

31.1. Configuring Emitter Volumes

You can configure how VR-Vantage colors emitter volumes, how they are drawn, and how they are scaled for visibility. You can configure emitter volumes by editing the DefaultEllipsoidArc model definition or by creating customized ellipsoid arc model definitions and applying them to different entity models.



In order for an entity to display emitter volumes in 2D observer modes and 3D observer modes, it must have a 2D Emitter Volume visualizer in its 2D model set and 3D Emitter Volume visualizer in its 3D model sets. The DefaultEllipsoidArc model definition is an attribute of the visualizer.

31.1.1. Configuring Emitter Volume Color

By default, emitter volumes are displayed using fixed colors for high frequency and low frequency. You can configure emitter volumes to be colored based on the emission frequency or pulse rate. When emitter volume color represents frequency, color is determined by the frequency field of the EM Emission update message. In both cases, you specify a low frequency or pulse rate value and a high value.

If the emitter frequency or pulse rate is lower than your specified low value, the emitter volume is red. As frequency rises above the specified low value, emitter volume color changes, progressing through the colors of the visible spectrum until the specified high value is reached. At the high value and above, the emitter volume is violet.

To change coloring from the default, you must add the appropriate attributes to the emitter volume visualizer for the entities whose model definitions you want to change. Table 31-1 describes the emitter volume visualizer attributes that affect emitter volume color.

Table 31-1: Emitter volume visualizer attributes

Attribute	Description
colorByFrequency	If True, color by frequency instead of using static colors.
lowFrequency	The low frequency threshold for coloring by frequency. Default: 800 MHz.
highFrequency	The high frequency threshold for coloring by frequency. Default: 1 GHz.
usePulseFrequency	If colorByFrequency is True and usePulseFrequency is True, color emitter volumes by pulse frequency.
lowPulseFrequency	The low pulse rate threshold for coloring by frequency. Default: 100 Hz.
highPulseFrequency	The high pulse rate threshold for coloring by frequency. Default: 3 KHz.

31.1.2. Controlling Emitter Volume Radius

A emitter volume's radius (that is, the distance it extends from the emitter) is based in part on emitter power and in part on elevation and azimuth sweep data obtained from EM-Emission state messages. A higher emitter power value results in a longer radius, while a wider field of view results in a shorter radius (because the radiated power is distributed over a wider area).

If VR-Vantage relied exclusively on these values, the range of sizes among different emitter types could become too wide to be practical, with some emissions being barely visible, and other emissions covering the entire virtual world. Therefore, a configurable exponent weight and scale factor have been added to help fine tune the emitter beam radii. The radius exponent weight (a value between 0 and 1) slows the growth of the radius when power or area is greater than 1 and increases the growth of the radius when power or area is less than 0. The scale factor increases the radii of all beams by the given value.

To change the scale factor and exponent from the default, you must add one or both of the following attributes to the emitter volume visualizer for the entities whose model definitions you want to change:

- linearScale. The amount of linear scaling applied to all emitter volumes. Default: 100.
- exponentialScale. The amount of exponential scaling applied to emitter volumes. Default: 0.1.

How VR-Vantage Calculates the Radius

VR-Vantage calculates emitter volume radius by approximating the spread of the emissions based on the elevation and azimuth sweeps. If the approximate coverage is zero, it sets the value to 1. Then it applies the linear and exponential scaling values. The code for implementing this is as follows:

```
double tempVar = 8*elevationSweep*sin(2*azimuthSweep);
if (tempVar <=0) tempVar=1.0;
scale = linearScale * pow(sqrt(power/tempVar), exponentialScale );
```

31.1.3. Configuring Emitter Volume Segments

VR-Vantage displays a emitter volume as a group of spherical sections projecting from the sensing device. By default, for each 10 degrees (or portion thereof) in the emitter's field of view, VR-Vantage draws one segment. Figure 31-1 shows segments set to 10° (the default) and 30°.

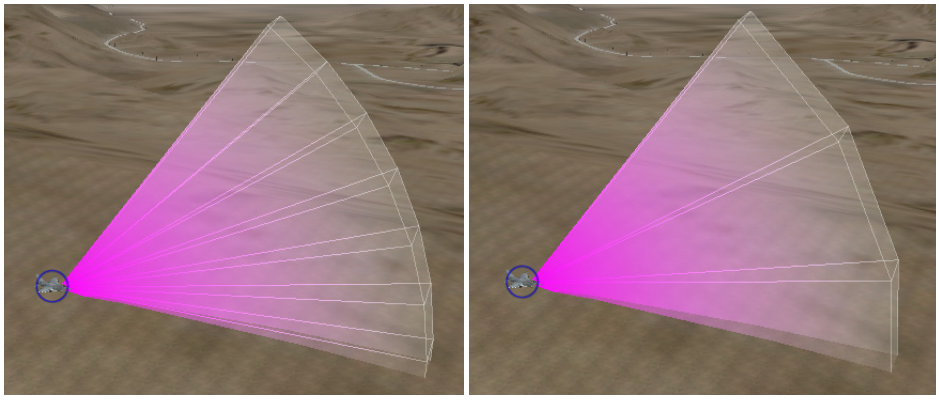


Figure 31-1. Emitter volume segments

Emitter volume segments are managed by the EllipsoidArc schema and model definitions based on it. VR-Vantage ships with one ellipsoid arc model definition – Default-EllipsoidArc. You can edit this model definition or create copies of it and customize them. If you want to have different emitter volumes for different entities, assign a different ellipsoid arc model definition to each one.

Specifying the Segment Angle

To specify the segment angle:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page.
3. Click the Filter button (▾) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
4. Select DefaultEllipsoidArc (Figure 31-2).

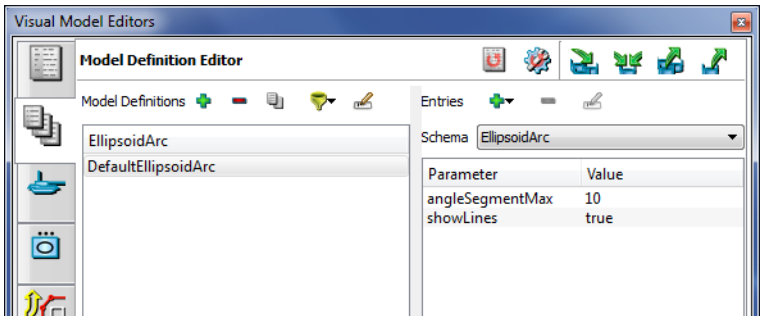


Figure 31-2. EllipsoidArc model definition

5. Change the value of the **angleSegmentMax** parameter. The minimum value is 10 (degrees); the maximum is 45.

Displaying Segment Outlines

By default, VR-Vantage displays opaque outlines showing the segment edges along the surface of the emitter volume.

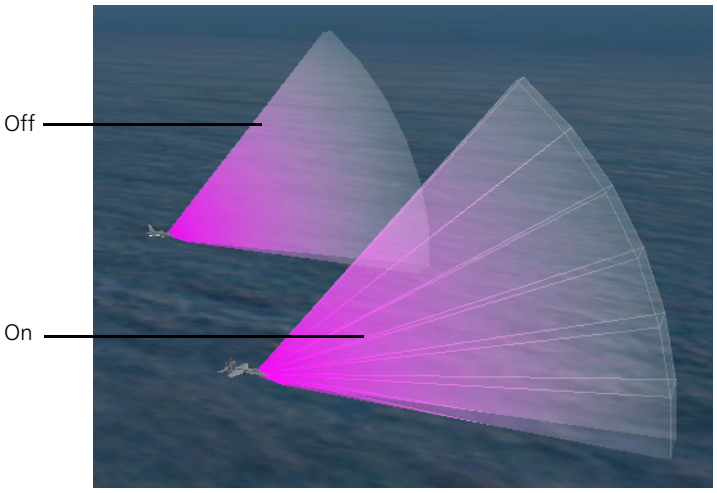


Figure 31-3. Segment outlines

To display or hide segment outlines:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page.
3. Click the Filter button (▾) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
4. Select DefaultEllipsoidArc.
5. Change the value of the **showLines** parameter.

Adding a Custom EllipsoidArc Model Definition

If you want to customize the segment angle and segment outlines for a particular entity without changing the values for other entities, you must create a separate ellipsoid arc model definition and add it to the entity's model definition.

To create a custom ellipsoid arc model definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page.
3. Click the Filter button (▾) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
4. Select DefaultEllipsoidArc.
5. Click the Duplicate Model Definition button (). The Duplicate Model Definition dialog box opens with a default definition name.
6. Accept the generated name or type a new name for the model definition.
7. Click OK. The model definition is added to the list.
8. Change the parameter values for the new model definition as desired.
9. Select the Entity Definition Editor page.
10. Select the entity whose emitter volume you want to change.
11. Select the 3D Sensor Volume visualizer for the entity.
12. Click the Value column for the **modeldefinition** attribute. The Choose Model Definition dialog box opens. It has a list of model definitions.
13. Select the model definition that you just created.
14. Click OK.
15. If you are connected to an exercise, disconnect and then reconnect to enable the new model definition.



32. Adding DI-Guy Models to VR-Vantage

This chapter explains how to take DI-Guy models created with the DI-Guy SDK and integrate them into VR-Vantage.

Adding New DI-Guy Models to VR-Vantage 32-2
Copy DI-Guy Files to the Data Directory 32-2
Add Model Definitions and Element Definitions 32-2

32.1. Adding New DI-Guy Models to VR-Vantage

VR-Vantage supports DI-Guy characters and includes many lifeform characters. However, MÄK customers sometimes want to add their own DI-Guy characters. The general process for adding a new character is as follows:

1. Create the new character using DI-Guy software and copy the required files to the *./data* directory.
2. Add a model definition and element definition for the new character.

32.1.1. Copy DI-Guy Files to the Data Directory

VR-Vantage stores files for DI-Guy characters in *./data/Lifeforms/DIGuy* and its subdirectories. After you create a new character using DI-Guy software, you must copy the files for this character to these directories.

DI-Guy documentation recommends that all customer content be placed in *$(DIGUY)/custom*. To follow this convention, create a directory called *./data/Lifeforms/DIGuy/custom* and put your files in the appropriate subdirectories under it.

VR-Vantage can visualize custom DI-Guy characters based on DIS enumerations mapped to element definitions or by recognizing custom DI-Guy PDUs.

- If you want to map your custom characters to element definitions, follow the procedures in this chapter.
- If you want to visualize characters based on custom DI-Guy PDUs without creating element definitions or object type mappings, place the DI-Guy files in the *./data/Lifeforms/DIGuy/custom* directory as described in the previous paragraph. No further configuration is needed.

32.1.2. Add Model Definitions and Element Definitions

To visualize a DI-Guy character in VR-Vantage, you must add a model definition and element definition for each character.

Create a DI-Guy Model Definition

To create a model definition for a DI-Guy:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page.
3. Click the Add button (✚) next to the Model Definitions label. The Add Model Definition dialog box opens.
4. Type a name for the new model definition. It must end with the letters DIG.
5. In the Schema list, select DiGuyCharacter (Figure 32-1).

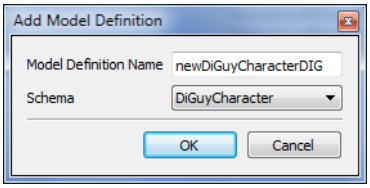


Figure 32-1. Add Model Definition dialog box

6. Click OK. The new model definition is added. It is highlighted in red because it is missing parameters (Figure 32-2).

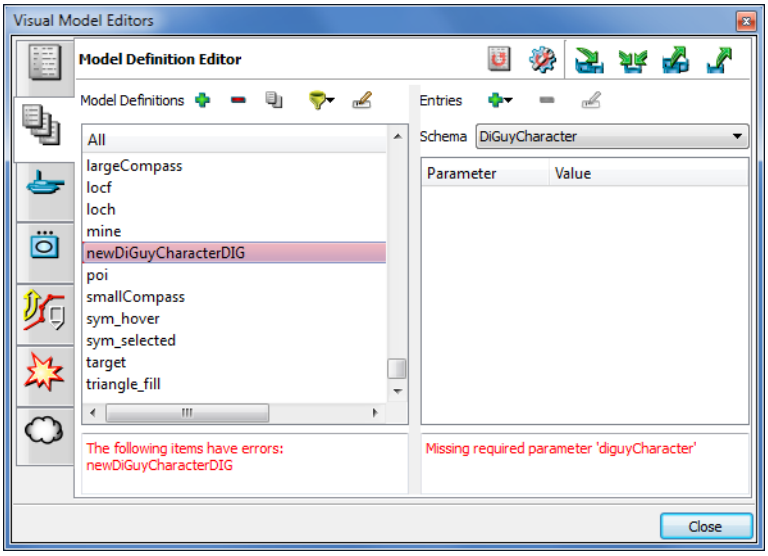


Figure 32-2. New model definition

7. Click the Add Parameter button (). A list of parameters is displayed (Figure 32-3).

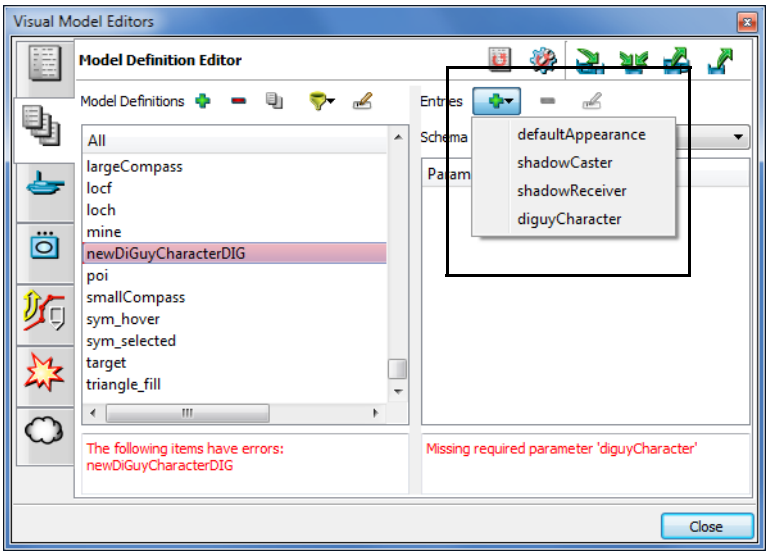


Figure 32-3. Add parameter list

8. Select defaultAppearance. It is added to the parameter list.
9. Click the value for the parameter. The field becomes editable.
10. Type the default appearance name for this character (Figure 32-4).
11. Add a diguyCharacter parameter.
12. Click the value for the parameter. The field becomes editable.
13. Type the character name for this character.
14. Add the shadowCaster and shadowReceiver parameters (Figure 32-4).

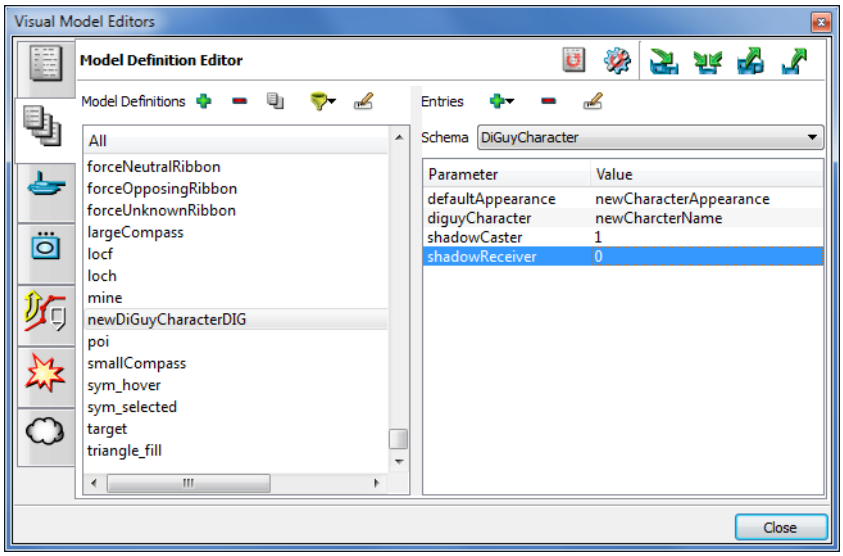


Figure 32-4. DI-Guy character parameters

Add an Element Definition

To create an element definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Entity Definition Editor page.
3. Expand the element definition hierarchy to the Life Form level and select the type of life form you are adding (Figure 32-5).

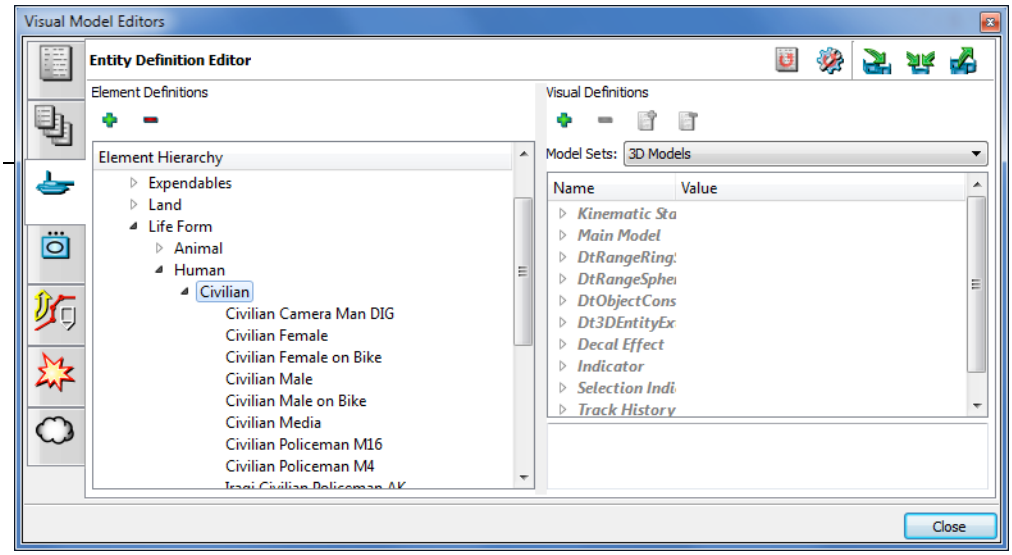


Figure 32-5. Entity Definition Editor page

4. Click the Add button (✚). The Create Element Definition dialog box opens.
5. Type a name for the element definition. (You cannot edit the name after you create it, so try to avoid typing errors.)
6. Click OK. The new element is added to the list (Figure 32-6).

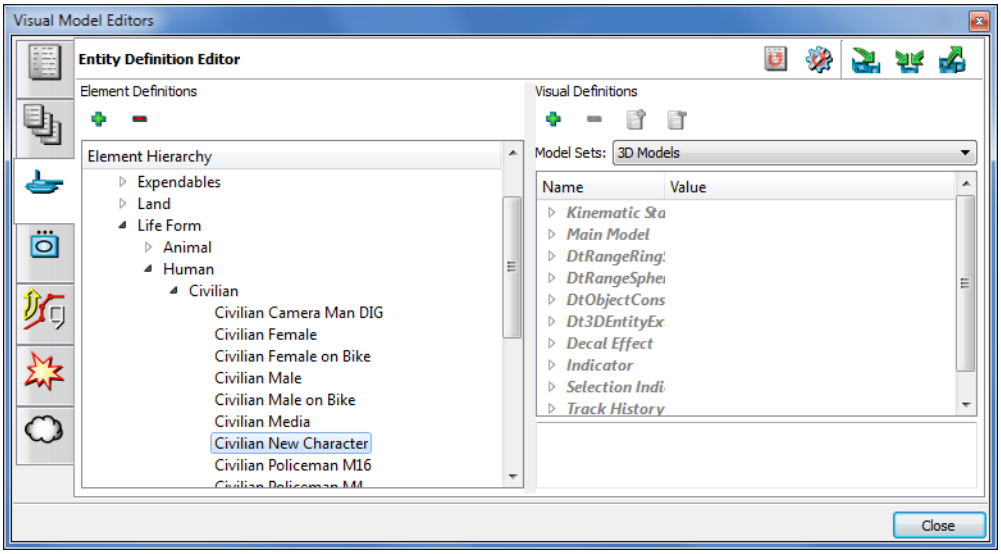


Figure 32-6. New entity definition added

7. In the Visual Definitions list, select Main Model (Figure 32-7).

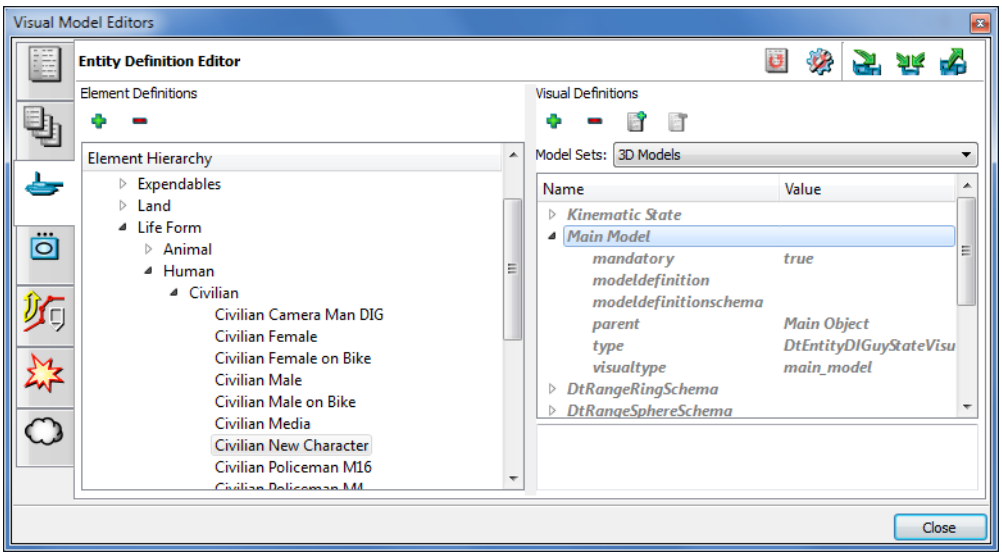


Figure 32-7. Main Model visual definition

8. Click the Value for the **modeldefinition** attribute. The Choose Model Definition dialog box opens.
9. Click the Add button (+). A list is added to the window (Figure 32-8).

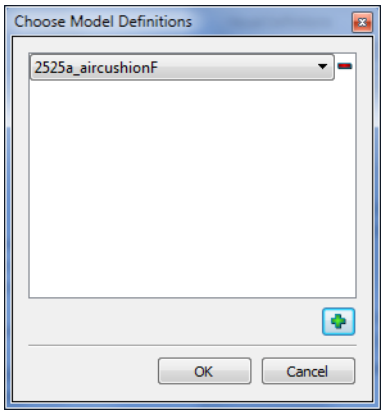


Figure 32-8. Choose Model Definition dialog box

10. Select the model definition that you created for this character (Figure 32-9).

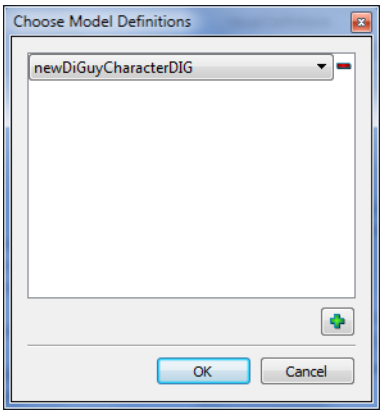


Figure 32-9. New model definition selected

11. Click OK. The model definition is updated (Figure 32-10).

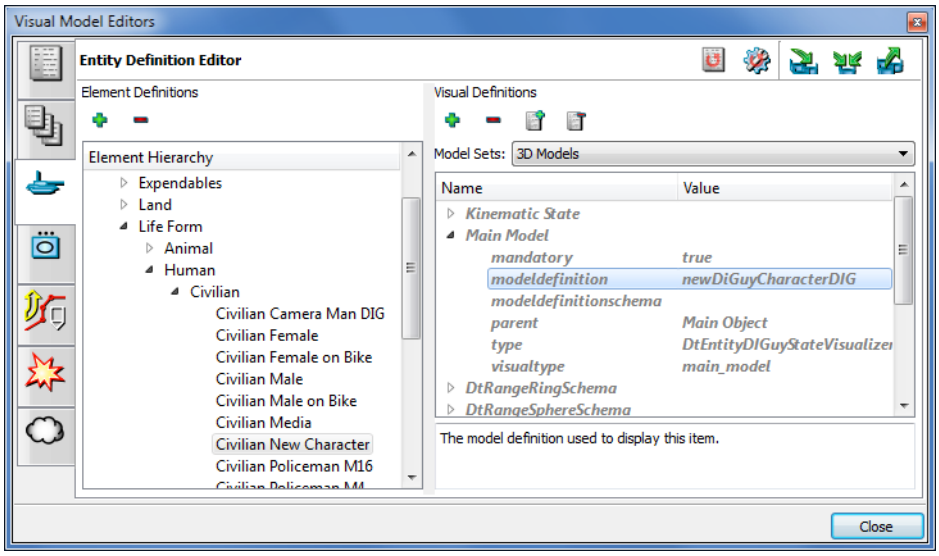


Figure 32-10. Completed entity definition

12. Select the value column for the **modeldefinitionschema** attribute. The Choose Supported Model definition Schema dialog box opens.
13. Click the Add button (+). A list is added to the window.
14. Select DiGuyCharacter.
15. Click OK.
16. Close the dialog box.



33. Model Tutorials

Although the individual procedures for managing model definitions and model mappings are fairly straightforward, understanding how they fit together to help you achieve your visualization goals is not always obvious. The tutorial in this chapter demonstrates how to combine various procedures to add models.

Adding a Model to VR-Vantage 33-2
- Create a Model Definition 33-2
- Add an Element Definition 33-5
- Add a Model Mapping 33-9
- Test the Model Mapping 33-11

33.1. Adding a Model to VR-Vantage

This tutorial shows how to add a new model to a VR-Vantage application. To help you with the tutorial, VR-Vantage includes a model of an F/A-18 Hornet that is not mapped to any entities.

To see a set of brief videos that demonstrate this tutorial, choose **All Programs** → **MÄK Technologies** → **VR-Vantage 2.1** → **Documentation** → **VR-Vantage Video Tutorials**, run *./doc/vrvantage_tutorialvideos.htm*, or click the camera icon next to the procedure whose video you want to view.

The basic steps are:

1. Create a model definition ("Create a Model Definition," on page 33-2).
2. Add an element definition ("Add an Element Definition," on page 33-5).
3. Map the new model to a simulation object or object type enumeration ("Add a Model Mapping," on page 33-9).
4. Test the new model ("Test the Model Mapping," on page 33-11).

33.1.1. Create a Model Definition

A model definition is an instance of a schema. It specifies values for the parameters required by the schema.

To create the model definition:



1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Model Definition Editor page (Figure 33-1).

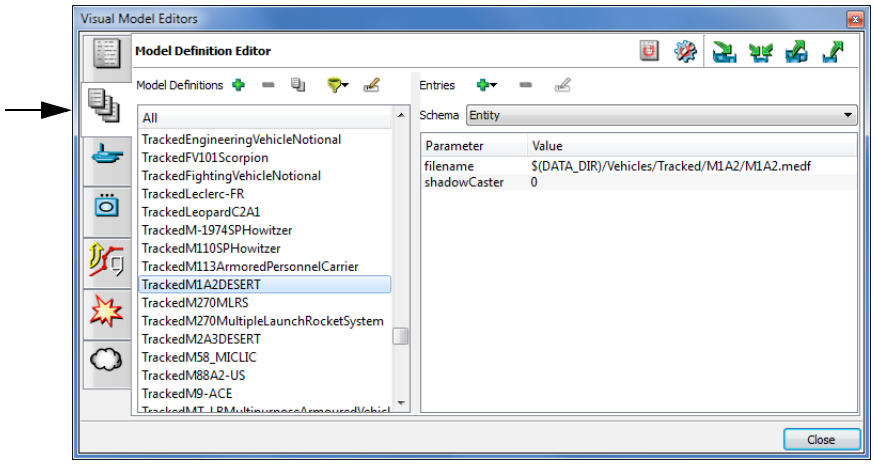


Figure 33-1. Model Definition Editor page

3. Optionally, filter the model definitions in the list to just show entity model definitions. (For details, please see "Filtering the List of Model Definitions," on page 28-15.)
4. Click the Add button (+) next to the Model Definitions label. The Add Model Definition dialog box opens (Figure 33-2).

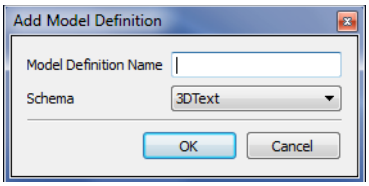


Figure 33-2. Add Model Definition dialog box

5. Type a name for the new model definition, for example, myF18.
6. If you filtered the model definition list, the Schema box says Entity. If not, in the Schema list, select Entity. The dialog box now looks like Figure 33-3.

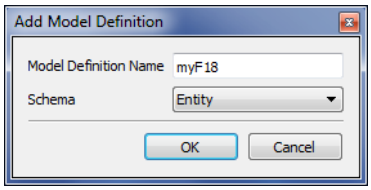


Figure 33-3. New model definition

7. Click OK. The new definition is added to the list (Figure 33-4). It does not have any parameters specified yet, so VR-Vantage prints an error message. Now you must specify the model file for this model definition.

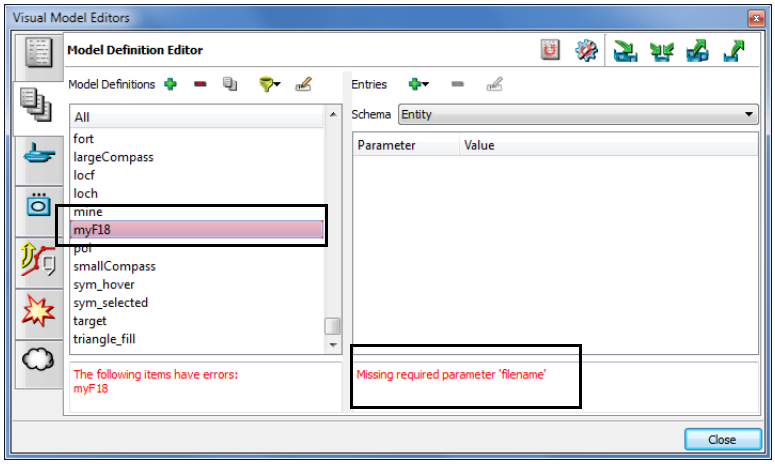


Figure 33-4. New model definition in list

8. Select the new model definition.
9. Click the Add Parameter button (). A list of parameters is displayed (Figure 33-5).

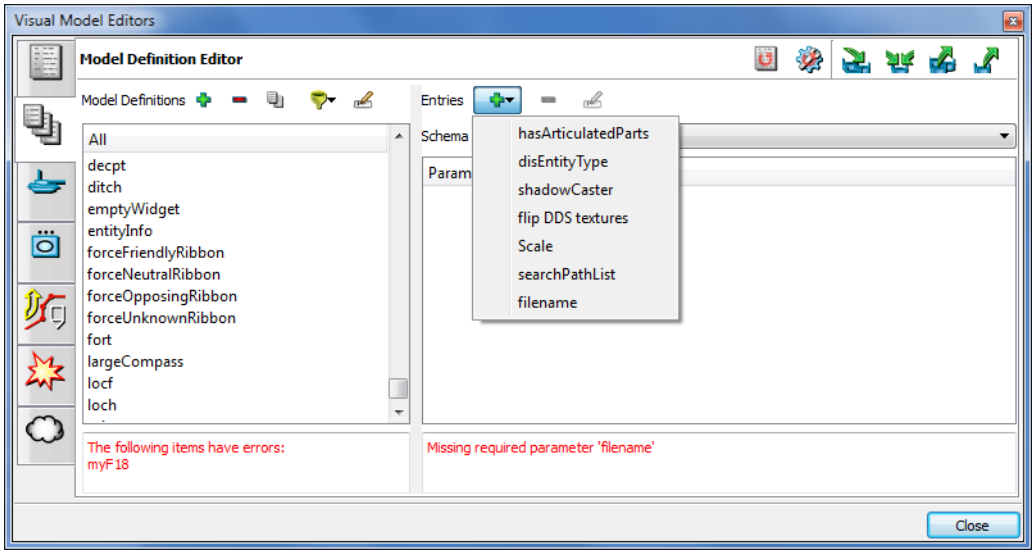


Figure 33-5. List of parameters

10. Select **filename**. It is added to the parameter list.
11. Click the value for the parameter. A file selection dialog box opens.
12. Navigate to *./data/Vehicles/FixedWing/FA-18_Hornet* and select *FA-18_Hornet.flt*.
13. Click OK. The value is updated (Figure 33-6).

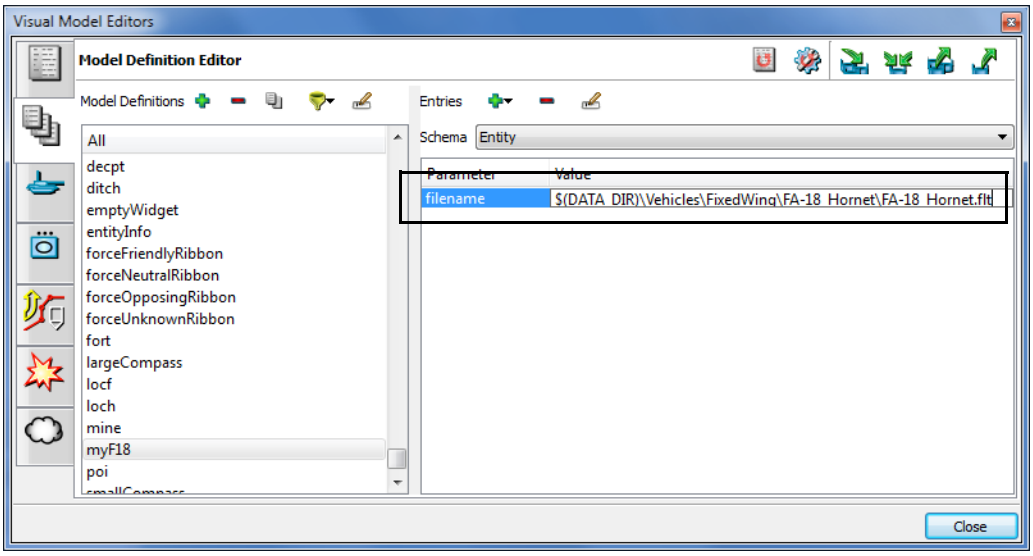


Figure 33-6. Model definition parameter

33.1.2. Add an Element Definition

An element definition configures the visualizers used to display an element and its effects. You must specify the model definition to use for the Model Visualizer.

To add an element definition:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Entity Definition Editor page (Figure 33-7).

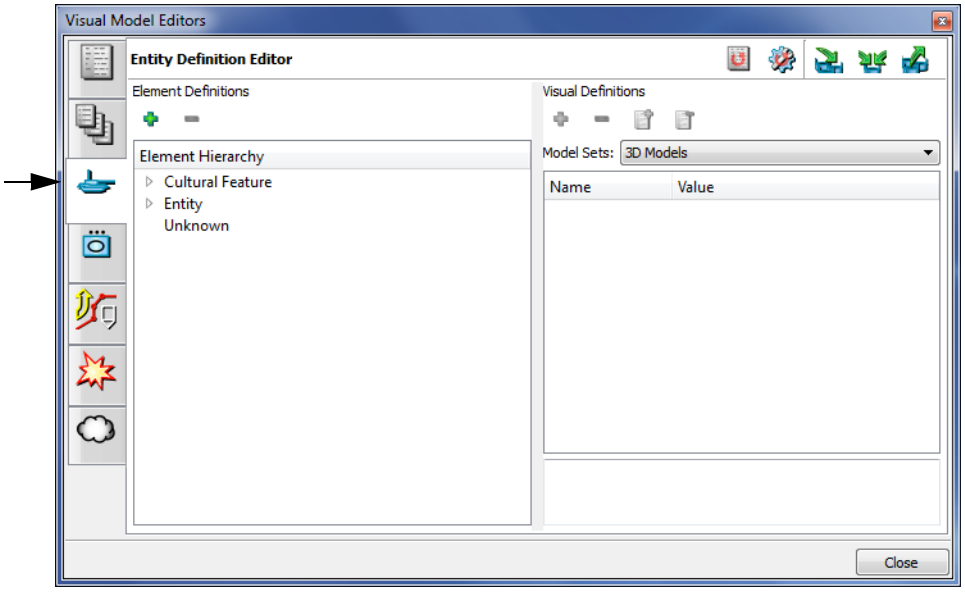


Figure 33-7. Entity Definition Editor page

3. Expand the Entity section of the hierarchy and then expand the Air section.
4. Select Fixed Wing.
5. Select Medium Fixed Wing.
6. Click the Add button (+) next to the Entity Definitions label. The Create Element Definition dialog box opens.
7. Type a name for the new entity, for example, myF18.
8. Click OK. An entry called myF18 is added to the list of fixed wing entities (Figure 33-8). It has the same list of visualizers as the fixed wing parent level.

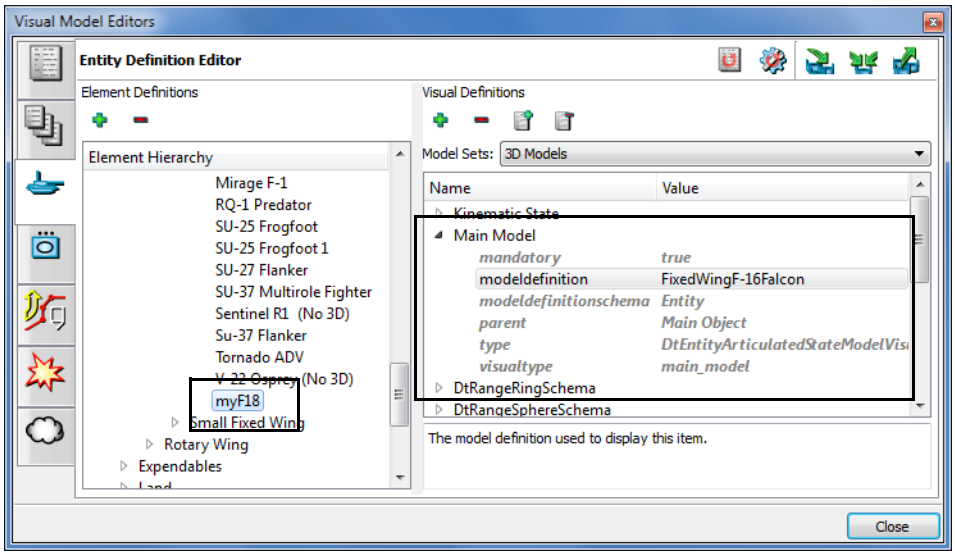


Figure 33-8. New entity definition

9. Scroll through the Visual Definitions list until you find the Main Model visualizer. This visualizer specifies the model definition that this element should use. It has the model definition of the parent element. We need to change it to use the myF18 model definition.

10. Click the Value column for the **modelDefinition** attribute to make it editable. The Choose Model Definitions dialog box opens (Figure 33-9). It shows the current model definition as a selection in a list.

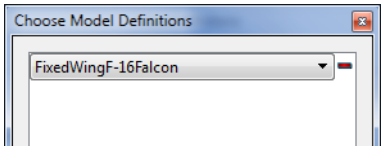


Figure 33-9. Choose Model Definitions dialog box with list of definitions

11. Click the Down Arrow to expand the model definition list and select the new model definition (myF18).

12. Click OK. The model definition is now specified (Figure 33-10).

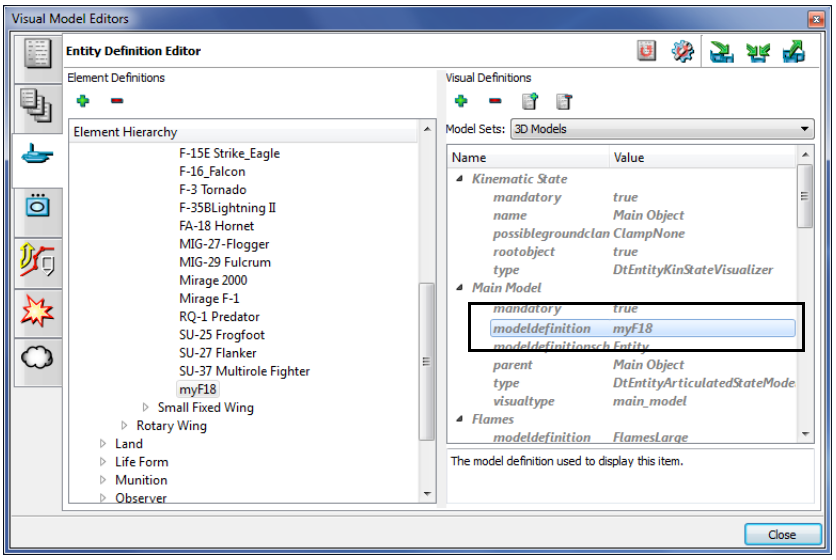


Figure 33-10. Model Definition for Model Visualizer

13. Close the Visual Model Editors dialog box.

33.1.3. Add a Model Mapping

Now, you have to map the new model definition to an object type enumeration.

To add a model mapping:

1. Choose **Settings** → **Simulation Object Type Mappings**. The Simulation Object Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure 33-11).

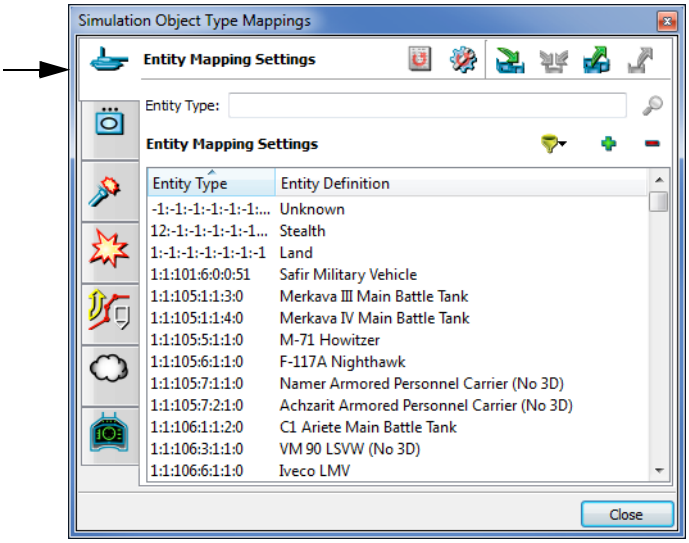


Figure 33-11. Entity Mapping Settings page

3. Click the Filter button ( ).
4. In the list, select **Entity** → **Air** → **Fixed Wing** → **Medium Fixed Wing**. (This does not change the Entity Mapping Settings list; it filters the list in the Create New Entity Type Model Mapping dialog box.)
5. Click the Add button ( ). The Create New Entity Type Model Mapping dialog box opens (Figure 33-12). It lists a default entity type enumeration.

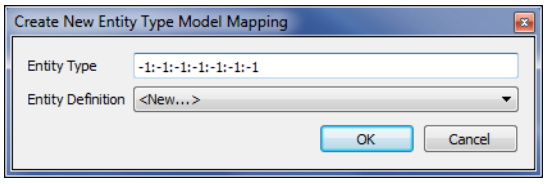


Figure 33-12. Create New Entity Type Model Mapping dialog box

6. In the Entity Type text box, type the enumeration you want to map to the new model mapping. (The enumeration for an F/A18 is 1:2:225:1:9:1:-1.)



VR-Vantage already has an F/A18 mapped to this enumeration. However you can map multiple model definitions to an enumeration. When an object type that has multiple model definitions mapped to it is discovered in a simulation, VR-Vantage randomly assigns a model definition from among those mapped to the object type.

7. In the Entity Definition list, select the model definition that you added in the previous procedure (myF18) (Figure 33-13).

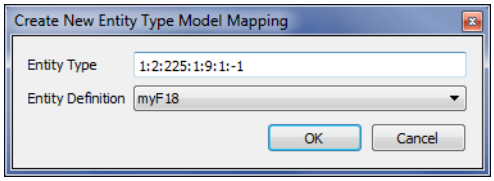


Figure 33-13. Create new model mapping

8. Click OK.
9. The new model mapping is added to the list.

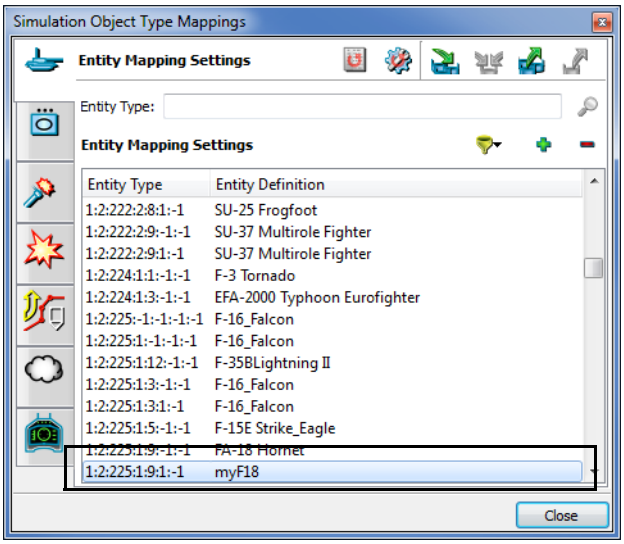


Figure 33-14. New model mapping

10. If you are connected to an exercise, disconnect and reconnect. Changes to model definitions and mappings do not take effect until you reconnect.

33.1.4. Test the Model Mapping

It is a good idea to test the new model mapping to see if the correct model is being displayed. You can test a model by running a simulation that has the entity or object type, or you can perform the simple test described here.

To test a model:



1. Open a terrain database that has easily identifiable props. For the purposes of this tutorial, open the Makland terrain.
2. In the VR-Vantage window, move the observer so that you are viewing the palace on top of the hill near the town in Makland.
3. Click the palace to select it (Figure 33-15).

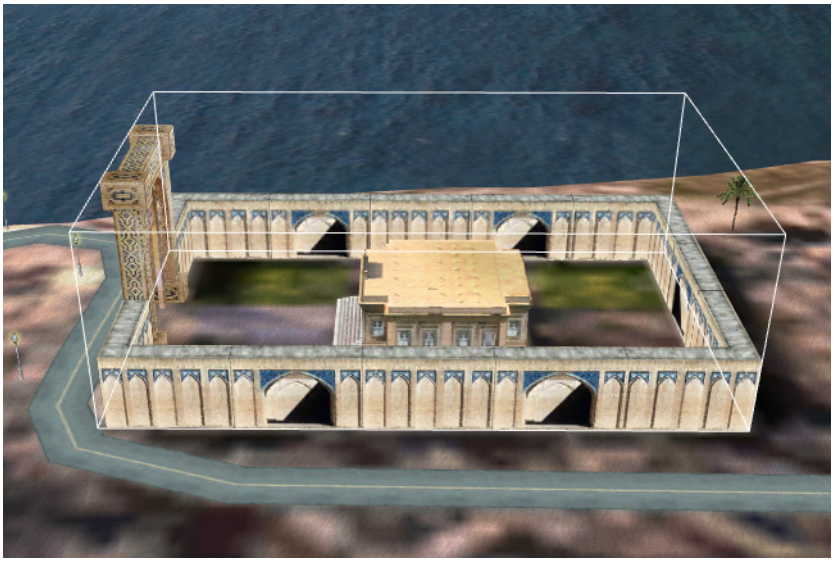


Figure 33-15. Palace

4. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
5. Select the Edit Existing Props page. The list of props shows that Building26, the palace, is selected (Figure 33-16).

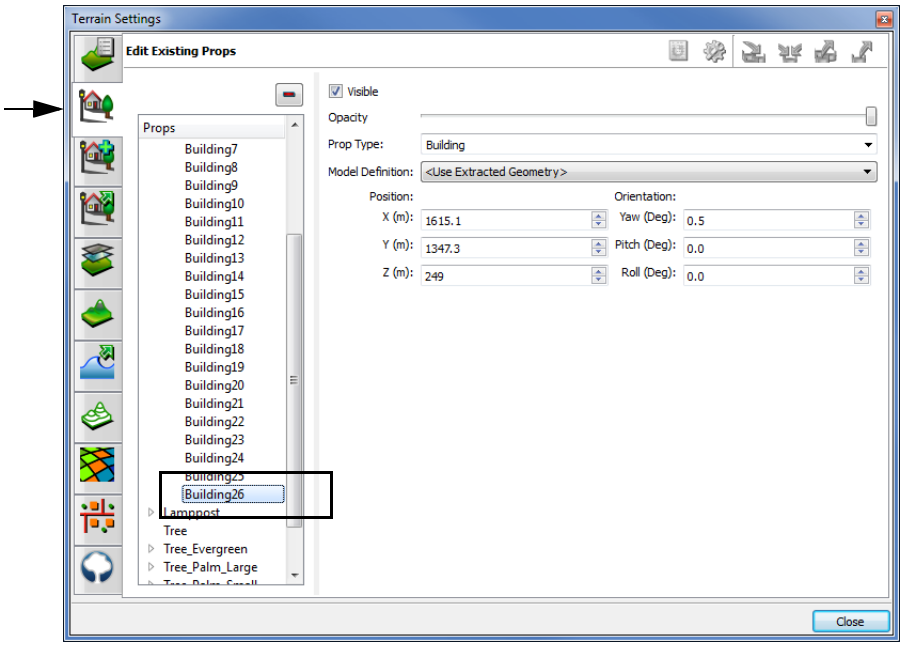


Figure 33-16. Edit Existing Props page

6. In the Model Definition list, select the model definition that you added earlier in this tutorial (Figure 33-17). The model of the palace is replaced with the model for the F/A-18 (Figure 33-18). If this is the model that you wanted to add, then you know that you completed the procedure correctly. If this is not the model, you expected, check the filename you specified for the model definition.

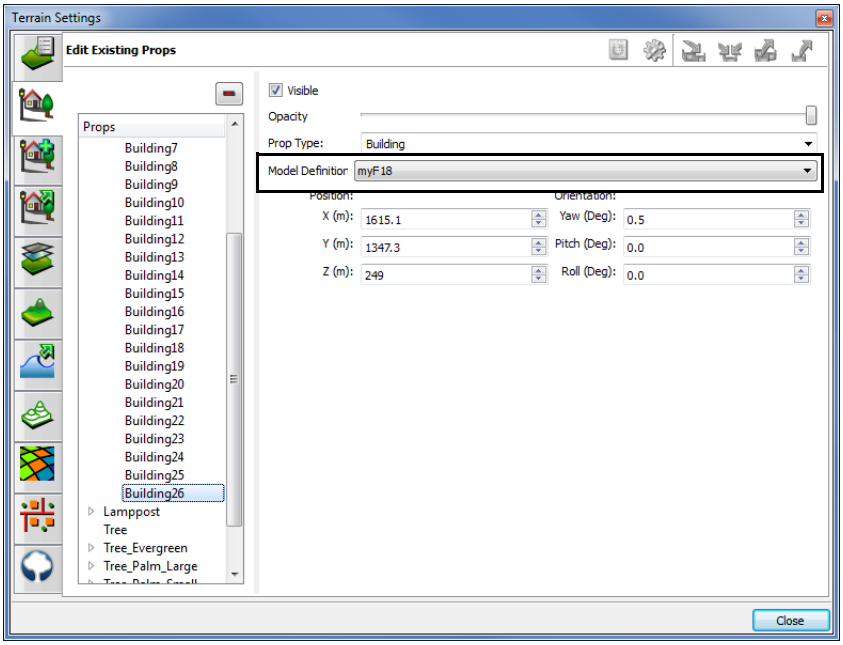


Figure 33-17. Changed model definition

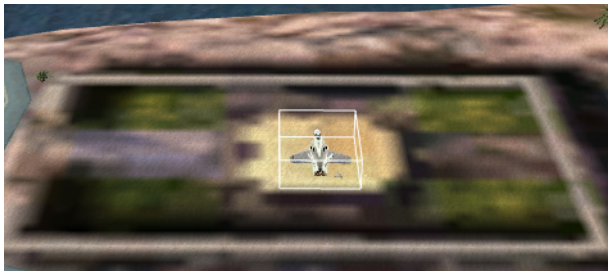


Figure 33-18. F/A-18 replaces the palace

7. If you are going to use this terrain for simulations, change the model definition back to Use Extended Geometry.



34. The WRM Specification (DIS Notes)

Some OpenFlight files contain information specified by the *WRM Entity Model Specification for DIS Interoperability*. This information makes it possible for VR-Vantage to depict the state of an entity's articulated and attached parts correctly and to switch among different entity appearances.

This chapter contains information that can help you build entity models that comply with the WRM specification, or add that compliance to existing models.

The WRM specification was developed by MÄK Technologies (now VT MÄK), Paradigm Simulation Inc., MultiGen Inc., and SAIC, for the ARPA War Breaker project. (Paradigm Simulation and MultiGen merged and were later acquired by Presagis.)



Although the WRM specification was developed for DIS, it is used in the HLA RPR FOM.

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34.1. Introduction

In order for visualization applications such as VR-Vantage to change the state of a model in response to network messages, they must have certain information about the model. For example, which piece of the model's geometry is associated with which articulated part, and which piece of a model is associated with a particular entity appearance attribute.

This chapter describes a method of encoding information in an OpenFlight format model so that applications can make these associations. For the most part, information is associated with a MultiGen node by including it as a comment associated with the node. Comments that contain this information begin with the token, `@dis`.

VR-Vantage depicts the movement of articulated parts and changes in entity appearances only when using models constructed to this specification.

This chapter represents a subset of the Model Specification for DIS Interoperability (version 001). For more details, please refer to that document. You can obtain the Model Specification at http://www.presagis.com/files/standards/wrm.pdf.

Although VR-Vantage implements only a subset of the functionality enabled by the WRM Model Specification, we recommend that models conform to as much of the specification as is appropriate for the model, to promote compatibility with future versions of VR-Vantage, and with visualization applications from other vendors.

34.2. The OpenFlight File Format

The OpenFlight file format organizes geometry into the following types of nodes:

- Face nodes represent individual polygons.
- Object nodes represent face nodes that are logically or geographically related. Object nodes can have only face nodes (polygons) as children.
- Level of detail (LOD) nodes provide a means to select alternate geometries based on a user-definable range. Using lower resolution geometry for objects that are far from the observer saves memory and improves performance.
- Degree of Freedom (DOF) nodes specify translational or rotational freedom, or both, for portions of a model. They can be used for DIS articulated parts or animated special effects. They specify a type of transformation and its limits, such as "rotate about the x axis between 45 and 135 degrees". The OpenFlight approach to degrees of freedom is hierarchical.
- Group nodes represent logically-related or geographically-related object nodes. Group nodes are the most general, and may have any type of nodes, except face nodes, as children.

34.2.1. Node Name and Comment Fields

Each node contains a comment field for user-definable data. The WRM Specification defines keywords that, when placed in a comment field, provide the information that DIS applications need to properly render a model.

34.2.2. External References and Instancing

The following OpenFlight constructs provide a means to avoid duplicating massive amounts of geometry:

- An external reference (or xref) is a pointer to another OpenFlight file that contains additional geometry.
- A transformation matrix is usually attached to an xref to locate the position and orientation of the referenced object's coordinate system geometry. Each instance may have a transformation matrix controlling the position and orientation of the child's coordinate system.

34.3. Modeling for DIS Interoperability

The WRM Specification provides uniform standards for locating and orienting the model coordinate system and a way to map DIS codes to associated models and parts. By conforming to these standards, applications that support the WRM Specification do not need customized software to interpret the multiple potential model formats that might otherwise exist.

34.3.1. The DIS Attribute Lexicon (DAL)

DIS attributes are specified using the following syntax:

```
@dis keyword values # comment
```

where:

- `@dis` must precede the keyword.
- *`keyword`* is one of the DAL keywords.
- values can be a number or string. Depending on the requirements of the keyword, the values specified can be an individual value, a comma separated list, or a range.
- `#` indicates the start of a comment. Comments are case sensitive. A comment continues until the next `@dis` entry.

Remember that all comments will be parsed by VR-Vantage, so spelling counts.

34.3.2. DAL Keywords

The WRM Spec supports the following keywords:

- `articulated_part` *`part`*. Identifies the movable parts of a model with a unique DIS Articulated Part code. This keyword is placed in a Group node that is a child to the DOF node that identifies an articulated part, and above the geometry that is going to be articulated. This keyword is always followed by the motion keyword. The articulated part codes are specified in DIS Standard SISO-REF-010-2006 Enumerations and Bit Encoded Values Articulated Parts. They are listed in Table 34-3.

  This keyword is always followed by the switch keyword.

- `switch` *`appearance`*. Identifies a model appearance attribute with a DIS keyword. This keyword is placed in a Switch node in the model above the geometry that is going to be switched.

  The switch keyword takes the name value in DIS Standard SISO-REF-010-2006 Enumerations and Bit Encoded Values Entity Appearance (General and Specific), joined by the underscore character (_) if the name is multiple words, as its value. Note that frozen_status, power_plant_status, and state are preceded by an abbreviation for their domain, as follows: gm_ for guided munitions and lf_ for life forms. For a list of supported values, please see Table 34-2.

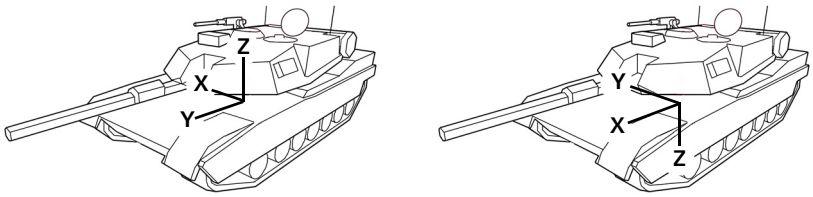
- `state` *`state`*,*`state`*... . Specifies the state of the appearance attribute with a DIS appearance state code. This keyword is placed in a Group node just below the switch node. For a list of supported values, please see Table 34-2.

34.3.3. Model Coordinate Systems

OpenSceneGraph (OSG) and the DIS Standard use different right-hand coordinate systems. Table 34-1 describes the two systems. Figure 34-1 illustrates them.

Table 34-1: Model coordinate systems

Coordinate	OpenSceneGraph	DIS
X	Right	Forward
Y	Forward	Right
Z	Up	Down



OSG coordinate system DIS coordinate system

Figure 34-1. Model coordinate systems

When you create models, it is recommended that you use the OpenSceneGraph coordinate system. The simulation application will convert the coordinates, as follows:

- xmodel = yDIS.
- ymodel = xDIS.
- zmodel = -zDIS.

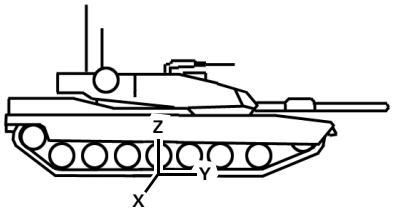
Location of the Origin for Models

The origin of the model's coordinate system should be located as follows, depending on the domain of the entity:

- Land: on the base of the vehicle, on the axis of yaw rotation.
- Surface: On the axis of the center of buoyancy, in the plane of the waterline for unloaded ship.
- Subsurface: On the axis of the center of buoyancy, in the plane of the waterline for surfaced submarine.
- Air and Space: At the center of gravity.

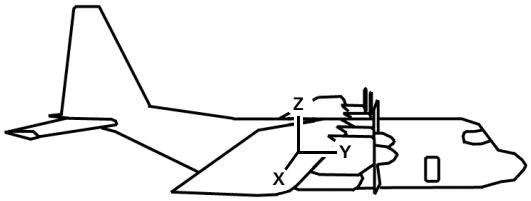
Figure 34-2 illustrates the location of a model's origin for each platform domain.

Land



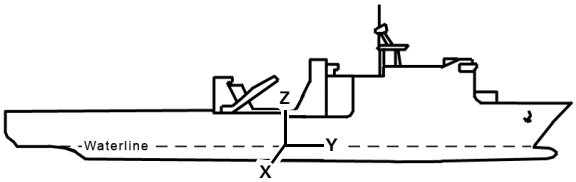
On the plane of ground contact, at the axis of yaw rotation.

Air



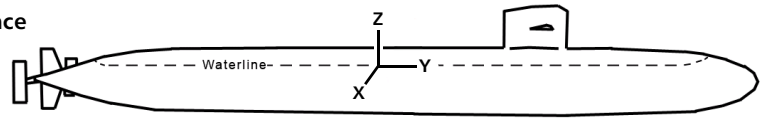
At the center of gravity.

Surface



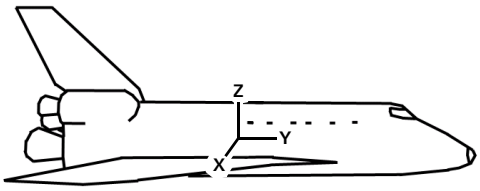
On the axis of the center of buoyancy, in the plane of the waterline for an unloaded ship.

Subsurface



On the axis of the center of buoyancy, in the plane of the waterline of a surfaced submarine.

Space



At the center of gravity.

Figure 34-2. Location of origin by domain

34.4. Articulated Parts

In order for VR-Vantage to properly depict the state of articulated parts, models must conform to the following specifications:

- There must be one DOF node for each articulated part. (This means that if there are several LODs, they should be children of the DOF.) Each articulation DOF should be a descendant of the DOF for the part to which it is attached (unless the parent part is just the base model itself). For example, the DOF for a gun should be a descendant of the DOF for a turret.
- Each articulated part DOF node must have all of the geometry and other nodes associated with the part underneath it. This DOF node must have a comment associated with it. The comment must be of the form:

  `@dis articulated_part` *`part-number`*

  where *`part-number`* is the enumeration for the particular type of part that this part of the model represents. For example, the part number of a turret is 4096, and the part number of a gun is 4416.

  Therefore, the child group of a turret's DOF must be commented with:

  ```
  @dis articulated_part 4096
  ```

  The child group of a gun's DOF must be commented with:

  ```
  @dis articulated_part 4416
  ```
- The WRM Model Specification specifies that information about the legal motions of each articulated part be encoded in the comment field. Currently, VR-Vantage does not use this information.
- Do not include static offsets in the DOF attributes. That is, when you set all of the DOF parameters (X, Y, Z, heading, pitch, roll) to 0, the model should appear in its neutral position.

34.5. Entity Appearances

VR-Vantage supports switching between different pieces of a model's geometry based on appearance attributes. For instance, a tank's turret should look different if the hatch is open or closed. An entire tank should look different if it is damaged or destroyed.

Switch nodes are used to represent a choice between several different children, based on a particular appearance attribute.

We define a switch node as a group node with a comment of the form:

```
@dis switch attribute
```

where `attribute` is the name of the attribute that should be used to select a child. (For example, damage, smoke, hatch, and so on.)

The children of the switch node represent the different portions of a model among which VR-Vantage will select, based on the appearance attribute. If a switch node is commented with:

```
@dis switch hatch
```

it may, for example, have three children containing geometry for a closed hatch, popped hatch, and open hatch.

These children of the switch node must be commented so that VR-Vantage knows which child matches which values of the appearance attribute. The comment is of the form:

```
@dis state value-list
```

`value-list` is of the form `m[,m]+` where `m` is one of the following:

- An integer representing the enumeration of a value that an appearance attribute may take on, for example, 1 for hatch closed.
- Two integers, a and b, separated by a hyphen, representing all enumerations from a through b, for example, 2-5 for all states whose enumerations are 2, 3, 4, or 5.
- The integer -1, which indicates that this child is the default child, to be used when the attribute state matches no values in any children.

For instance, the child of the hatch switch node that represents a closed hatch might be used when the hatch attribute value is either 0 (not-applicable), 1 (closed), or any value other than those enumerated in other children. This child would be commented:

```
@dis state 0,1,-1
```

The child with the popped hatch geometry should be used when the value is 2 (popped) or 3 (popped with person visible) and is commented:

```
@dis state 2,3
```

The child that contains the open hatch geometry should be used when the value is 4 (open) or 5 (open with person visible) and is commented:

```
@dis state 4,5
```

There may be many switch nodes for the same attribute. For example, there may be several pieces of a tank's geometry that are affected by the destroyed attribute.

The WRM Model Specification also discusses the inheritance of appearance attributes from ancestor nodes. VR-Vantage does not support this functionality. To tell VR-Vantage to, for example, display a camouflaged tank when the paint scheme attribute is set to camouflage, and a normal tank otherwise, you must use the switch node method described previously.

In Figure 34-3, the turret DOF node is attached to the body Group node. The barrel, gun, and hatch DOF nodes are attached to the turret. This allows the turret to be positioned in the coordinate system of the body, and the barrel, gun, and hatch to be positioned in the coordinate system of the turret.

This model also contains a switch node that is flagged with animation. The comment on this node is `@dis switch moving`. This switches between two Group nodes – Stop and Go. Under the Stop node there is a single mesh of the treads of the tank. Under the Go node there is a Group node, with the animation flag set on. This creates a flipbook animation of all nodes below this Group node. There are three meshes in different states of moving: Frame 1, Frame 2 and Frame 3. At runtime OpenSceneGraph will animate these meshes when the velocity is not 0.

If multiple color schemes are needed to represent camouflage, winter, and desert versions, another switch is needed.

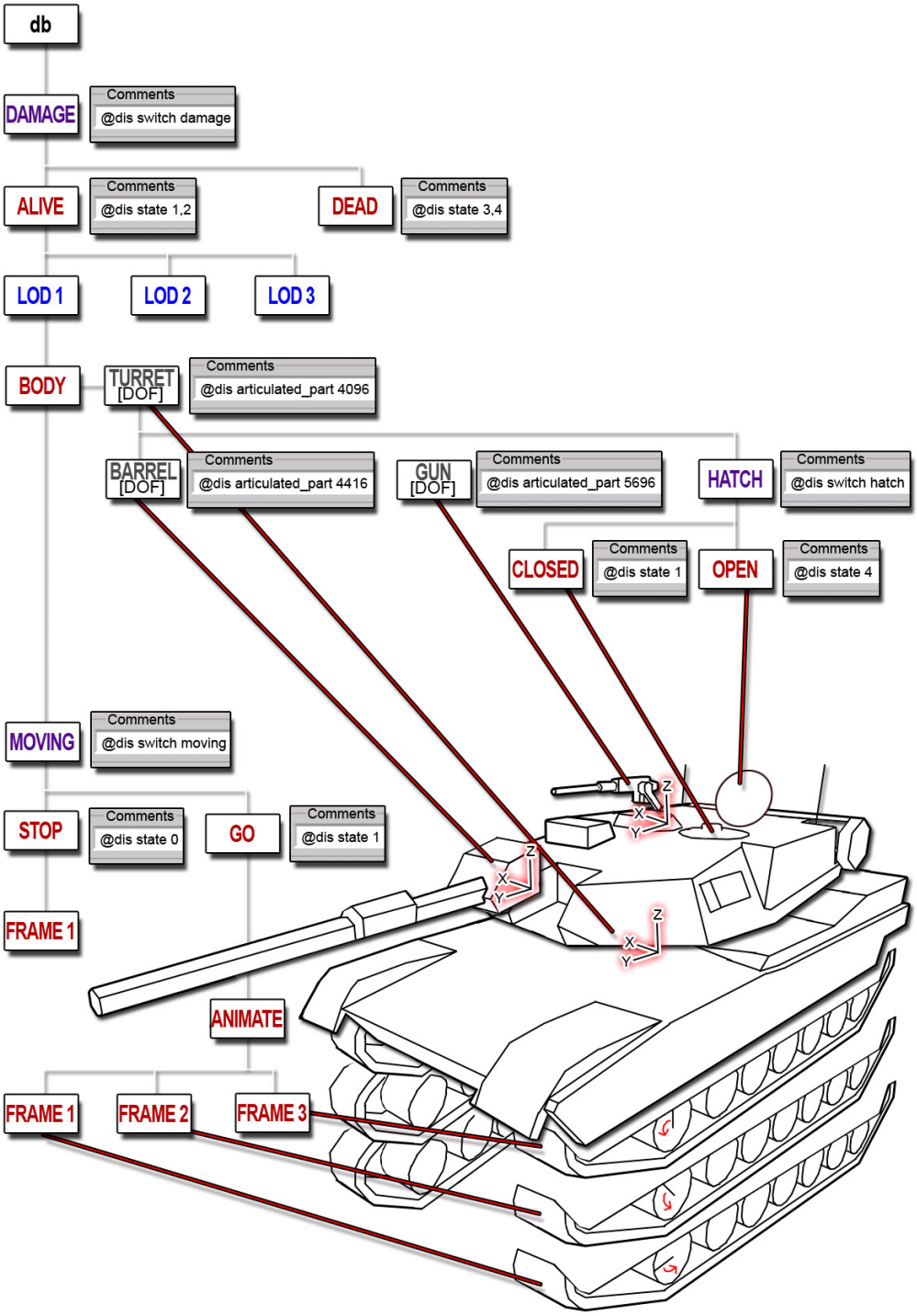


Figure 34-3. 3D model structure

34.6. Animation

By default, animation sequences are displayed as quickly as possible. However, you can configure the animation sequence rate using a WRM animation comment in the animation node's comment field.

The comment syntax is as follows:

```
@dis animation num_frames_per_second [ skip | noskip ]
```

where:

- `animation` tells VR-Vantage that animation instructions follow.
- *`num_frames_per_second`* is the rate at which VR-Vantage should display the frames.
- `skip` and `noskip` indicate whether the elapsed time should be used to choose the next frame, or whether at most one frame should be advanced each frame.

34.7. DIS Keyword Values

Table 34-2 lists the values that you can use for the `@dis switch` keyword. For any switch keyword, the supported state values (`@dis state [value 1],[value 1]...`) are listed in the State column. The Bit column lists the appearance bit for setting DIS appearances. (Some bit number are repeated because they are valid only for a particular platform.)

Table 34-2: DIS Appearance and States (Sheet 1 of 4)

Values	Description	State/ Description	Bit
afterburner	State of an air platform's afterburner.	0 = Off 1 = On	16
anticollision_lights	State of anti-collision lights.	0 = Off 1 = On	14
blackout_brake_lights	State of blackout brake lights.	0 = Off 1 = On	27
blackout_lights	State of blackout lights.	0 = Off 1 = On	26
brake_lights	State of brake lights.	0 = Off 1 = On	14
camouflage_type	Type of camouflage.	0 = Desert 1 = Winter 2 = Forest 3 = Unused	17-18
compliance	Compliance of lifeform.	0 = Lifeform None 1 = Detained 2 = Surrender 3 = Using Fists 4 = Verbal Abuse 1 5 = Verbal Abuse 2 6 = Verbal Abuse 3 7 = Passive Resistance 1 8 = Passive Resistance 2 9 = Passive Resistance 3 10 = Non-Lethal Weapon 1 11 = Non-Lethal Weapon 2 12 = Non-Lethal Weapon 3 13 = Non-Lethal Weapon 4 14 = Non-Lethal Weapon 5 15 = Non-Lethal Weapon 6	

Table 34-2: DIS Appearance and States (Sheet 2 of 4)

Values	Description	State/ Description	Bit
concealed	Type of concealment.	0 = Not Concealed 1 = In Concealed Position	19
damage	Damaged appearance of an entity.	0 = None 1 = Slight 2 = Moderate 3 = Destroyed	3-4
density	Density of environmental.	0 = Clear 1 = Hazy 2 = Dense 3 = Very Dense 4 = Opaque 5 = Unused	
fire_power	Characteristics of fire-power kill.	0 = No 1 = Yes	2
flaming	State of flames rising from an entity.	0 = No 1 = Yes	15
flashlight	State of lights.	0 = Off 1 = On	
formation_lights	State of formation lights.	0 = Off 1 = On	24
frozen_status	Frozen status of an entity.	0 = Not Frozen 1 = Frozen	21
hatch	State of the primary hatch.	0 = Not Applicable 1 = Closed 2 = Popped 3 = Popped and Person Visible 4 = Open 5 = Open and Person Visible 6 = Custom1 7 = Custom2	9-11
head_lights	State of headlights.	0 = No 1 = Yes	12
health	State of injury.	0 = None 1 = Slight 2 = Moderate 3 = Fatal	

Table 34-2: DIS Appearance and States (Sheet 3 of 4)

Values	Description	State/ Description	Bit
interior_lights	State of interior lights.	0 = Off 1 = On	29
landing_lights	State of landing lights.	0 = Off 1 = On	12
launch_flash	Describes the presence of a guided munitions launch flash.	0 = No 1 = Yes	
launcher	State of the platform's primary launcher.	0 = Not Raised 1 = Raised	16
life_form_state	Lifeform action.	0 = None 1 = Upright Still 2 = Upright Walking 3 = Upright Running 4 = Kneeling 5 = Prone 6 = Crawling 7 = Swimming 8 = Parachuting 9 = Jumping 10 = Sitting 11 = Squatting 12 = Crouching 13 = Wading 14 = Surrender 15 = Detained	
lights	State of lights.	0 = Off 1 = On	
mobility	Characteristics of mobility kill.	0 = No 1 = Yes	1
navigation_lights	State of navigation lights.	0 = Off 1 = On	13
paint_scheme	Paint scheme of an entity.	0 = Uniform 1 = Camouflage	0
power_plant_status	State of the entity’s power-plant.	0 = Off 1 = On	22
ramp	State of a ramp.	0 = Down 1 = Up	25

Table 34-2: DIS Appearance and States (Sheet 4 of 4)

Values	Description	State/ Description	Bit
running_lights	State of running lights.	0 = Off 1 = On	12
smoke	State or location of smoke and vapor.	0 = None 1 = Plume 2 = Engine 3 = Engine and Plume	5-6
spot_lights	Describes whether spot-lights are on or off.	0 = Off 1 = On	28
state	State of an entity.	0 = Active 1 = Deactivated	23
tail_lights	State of tail lights.	0 = Off 1 = On	13
tent	State of a tent extension.	0 = Not Extended 1 = Extended	24
trailing_effects	Size of the trailing effect for the entity.	0 = None 1 = Small 2 = Medium 3 = Large	7-8
weapon_1	State of primary weapon.	0 = None 1 = Stowed 2 = Deployed 3 = Firing Position	
weapon_2	State of secondary weapon.	0 = None 1 = Stowed 2 = Deployed 3 = Firing Position	

Table 34-3 lists the supported values for the `@dis articulated_part` keyword. String values are part of the WRM specification, but are not currently supported.

Table 34-3: DIS Articulations (Sheet 1 of 5)

Value	String	Description
3296	bridge_launcher	Position of the bridge launcher.
3328	bridge_section_1	Position of bridge section 1.
3360	bridge_section_2	Position of bridge section 2.
3392	bridge_section_3	Position of bridge section 3.

Table 34-3: DIS Articulations (Sheet 2 of 5)

Value	String	Description
7616	fuselage_fold	Fold on plane's body.
1184	helicopter_main_rotor	Describes main rotor rotation.
1216	helicopter_tail_rotor	Describes tail rotor rotation.
3072	landing_gear	Landing gear on a plane.
3520	launcher_arm_primary	Position of the primary launcher arm.
1120	left_aileron	Position of the left aileron.
1056	left_flap	Position of the left flap.
3168	left_weapon_bay_door	Left door to weapon bay.
3552	other	Position of other articulated parts.
3424	primary_blade_1	Position of the primary blade 1.
3456	primary_blade_2	Position of the primary blade 2.
3488	primary_boom	Position of the primary boom.
5056	primary_defense_systems_1	Position of the primary defense systems 1.
5088	primary_defense_systems_2	Position of the primary defense systems 2.
5120	primary_defense_systems_3	Position of the primary defense systems 3.
5152	primary_defense_systems_4	Position of the primary defense systems 4.
5184	primary_defense_systems_5	Position of the primary defense systems 5.
5216	primary_defense_systems_6	Position of the primary defense systems 6.
5248	primary_defense_systems_7	Position of the primary defense systems 7.
5280	primary_defense_systems_8	Position of the primary defense systems 8.
5312	primary_defense_systems_9	Position of the primary defense systems 9.
5344	primary_defense_systems_10	Position of the primary defense systems 10.
4416	primary_gun_number_1	Position of the primary gun number 1.
4448	primary_gun_number_2	Position of the primary gun number 2.
4480	primary_gun_number_3	Position of the primary gun number 3.
4512	primary_gun_number_4	Position of the primary gun number 4.
4544	primary_gun_number_5	Position of the primary gun number 5.
4576	primary_gun_number_6	Position of the primary gun number 6.
4608	primary_gun_number_7	Position of the primary gun number 7.
4640	primary_gun_number_8	Position of the primary gun number 8.
4672	primary_gun_number_9	Position of the primary gun number 9.
4704	primary_gun_number_10	Position of the primary gun number 10.

Table 34-3: DIS Articulations (Sheet 3 of 5)

Value	String	Description
4736	primary_launcher_1	Position of primary launcher 1.
4768	primary_launcher_2	Position of primary launcher 2.
4800	primary_launcher_3	Position of primary launcher 3.
4832	primary_launcher_4	Position of primary launcher 4.
4864	primary_launcher_5	Position of primary launcher 5.
4896	primary_launcher_6	Position of primary launcher 6.
4928	primary_launcher_7	Position of primary launcher 7.
4960	primary_launcher_8	Position of primary launcher 8.
4992	primary_launcher_9	Position of primary launcher 9.
5024	primary_launcher_10	Position of primary launcher 10.
5376	primary_radar_1	Position of the primary radar 1.
5408	primary_radar_2	Position of the primary radar 2.
5440	primary_radar_3	Position of the primary radar 3.
5472	primary_radar_4	Position of the primary radar 4.
5504	primary_radar_5	Position of the primary radar 5.
5536	primary_radar_6	Position of the primary radar 6.
5568	primary_radar_7	Position of the primary radar 7.
5600	primary_radar_8	Position of the primary radar 8.
5632	primary_radar_9	Position of the primary radar 9.
5664	primary_radar_10	Position of the primary radar 10.
4096	primary_turret_number_1	Position of the primary turret number 1.
4128	primary_turret_number_2	Position of the primary turret number 2.
4160	primary_turret_number_3	Position of the primary turret number 3.
4192	primary_turret_number_4	Position of the primary turret number 4.
4224	primary_turret_number_5	Position of the primary turret number 5.
4256	primary_turret_number_6	Position of the primary turret number 6.
4288	primary_turret_number_7	Position of the primary turret number 7.
4320	primary_turret_number_8	Position of the primary turret number 8.
4352	primary_turret_number_9	Position of the primary turret number 9.
4384	primary_turret_number_10	Position of the primary turret number 10.
1152	right_aileron	Position of the right aileron.
1088	right_flap	Position of the right flap.
3200	right_weapon_bay_doors	Right door to the weapon bay.

Table 34-3: DIS Articulations (Sheet 4 of 5)

Value	String	Description
7584	rotor_fold	Fold on helicopters rotors.
1024	rudder	Position of the rudder.
6656	secondary_defense_systems_1	Position of the secondary defense systems 1.
6688	secondary_defense_systems_2	Position of the secondary defense systems 2.
6720	secondary_defense_systems_3	Position of the secondary defense systems 3.
6752	secondary_defense_systems_4	Position of the secondary defense systems 4.
6784	secondary_defense_systems_5	Position of the secondary defense systems 5.
6816	secondary_defense_systems_6	Position of the secondary defense systems 6.
6848	secondary_defense_systems_7	Position of the secondary defense systems 7.
6880	secondary_defense_systems_8	Position of the secondary defense systems 8.
6912	secondary_defense_systems_9	Position of the secondary defense systems 9.
6944	secondary_defense_systems_10	Position of the secondary defense systems 10.
6016	secondary_gun_number_1	Position of the secondary gun number 1.
6048	secondary_gun_number_2	Position of the secondary gun number 2.
6080	secondary_gun_number_3	Position of the secondary gun number 3.
6112	secondary_gun_number_4	Position of the secondary gun number 4.
6144	secondary_gun_number_5	Position of the secondary gun number 5.
6176	secondary_gun_number_6	Position of the secondary gun number 6.
6208	secondary_gun_number_7	Position of the secondary gun number 7.
6240	secondary_gun_number_8	Position of the secondary gun number 8.
6272	secondary_gun_number_9	Position of the secondary gun number 9.
6304	secondary_gun_number_10	Position of the secondary gun number 10.
6336	secondary_launcher_1	Position of the secondary launcher 1.
6400	secondary_launcher_3	Position of the secondary launcher 3.
6432	secondary_launcher_4	Position of the secondary launcher 4.
6464	secondary_launcher_5	Position of the secondary launcher 5.

Table 34-3: DIS Articulations (Sheet 5 of 5)

Value	String	Description
6496	secondary_launcher_6	Position of the secondary launcher 6.
6528	secondary_launcher_7	Position of the secondary launcher 7.
6560	secondary_launcher_8	Position of the secondary launcher 8.
6592	secondary_launcher_9	Position of the secondary launcher 9.
6624	secondary_launcher_10	Position of the secondary launcher 10.
6368	secondary_launcher_2	Position of the secondary launcher 2.
6976	secondary_radar_1	Position of secondary radar 1.
7008	secondary_radar_2	Position of secondary radar 2.
7040	secondary_radar_3	Position of secondary radar 3.
7072	secondary_radar_4	Position of secondary radar 4.
7104	secondary_radar_5	Position of secondary radar 5.
7136	secondary_radar_6	Position of secondary radar 6.
7168	secondary_radar_7	Position of secondary radar 7.
7200	secondary_radar_8	Position of secondary radar 8.
7232	secondary_radar_9	Position of secondary radar 9.
7264	secondary_radar_10	Position of secondary radar 10.
5696	secondary_turret_number_1	Position of the secondary turret number 1.
5728	secondary_turret_number_2	Position of the secondary turret number 2.
5760	secondary_turret_number_3	Position of the secondary turret number 3.
5792	secondary_turret_number_4	Position of the secondary turret number 4.
5824	secondary_turret_number_5	Position of the secondary turret number 5.
5856	secondary_turret_number_6	Position of the secondary turret number 6.
5888	secondary_turret_number_7	Position of the secondary turret number 7.
5920	secondary_turret_number_8	Position of the secondary turret number 8.
5952	secondary_turret_number_9	Position of the secondary turret number 9.
5984	secondary_turret_number_10	Position of the secondary turret number 10.
3104	tail_hook	Tail hook on a plane for aircraft carrier landings.
7584	wing_fold	Fold on plane's wings.



IX. Graphics

This section discusses overlays, tactical graphics, and remote graphics.



35. Tactical Graphics and Remote Graphics

Tactical graphics are graphical objects that represent points, lines, and areal objects used for various purposes in simulations. Remote graphics are graphics that are drawn onto the scene by remote programs that use the VR-Vantage Remote Draw API. This chapter explains how to display them in VR-Vantage.

Displaying Tactical Graphics 35-2
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Showing and Hiding Tactical Graphics 35-5
Showing and Hiding Tactical Graphics Labels 35-6
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35.1. Displaying Tactical Graphics

Tactical graphics are graphical objects that represent points, lines, areal objects, text, and symbols used for various purposes in simulations (Figure 35-1 and Figure 35-2). They could represent routes that simulation objects are following, a destination point, or a way to show some sort of relationship, such as height-above-terrain (HAT) lines. VR-Vantage can display tactical graphics published by VR-Forces.

You can configure the display of tactical graphics as follows:

- Enable and disable the display of tactical graphics.
- Show or hide vertex indicators for point, linear, and areal objects.
- Show or hide height-above-terrain lines.
- Display height-above-terrain lines only for selected graphics.

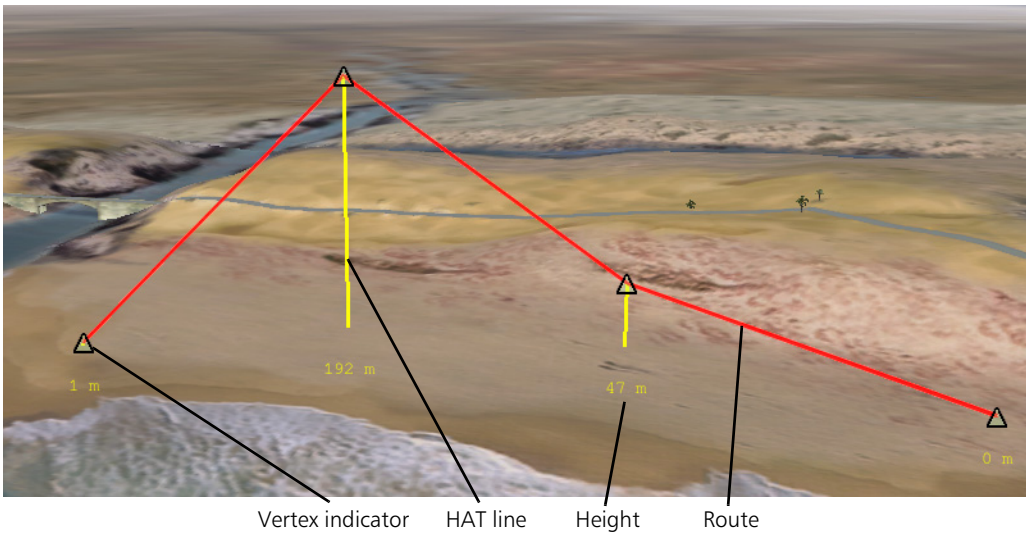


Figure 35-1. Tactical graphics with height-above-terrain lines (3D)

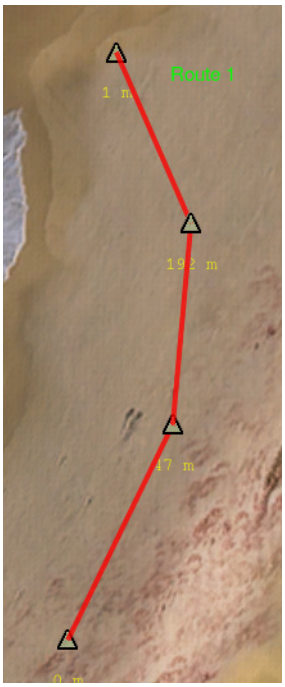


Figure 35-2. Tactical graphic (2D)

35.1.1. Overlays

All tactical graphics are assigned to overlays. Overlays are conceptually similar to clear plastic sheets that you might layer over a map so that you easily add and remove supplementary information.

There is always at least one overlay – the Default overlay. However, VR-Forces users can create multiple overlays. When VR-Vantage receives information about tactical graphics over the network, it lists the overlays and their respective graphics on the Overlays tab of the Objects List Panel (Figure 35-3).

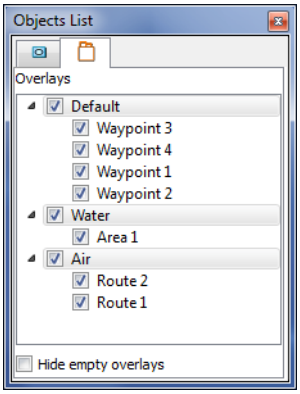


Figure 35-3. Overlays tab

35.1.2. Showing and Hiding Tactical Graphics

You can control the display of tactical graphics from the Display Settings dialog box, Tactical Graphics Display Settings page, from menu and toolbar options, and from the Objects List Panel Overlays tab.

To show or hide tactical graphics:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Tactical Graphics Display Settings page (Figure 35-4).

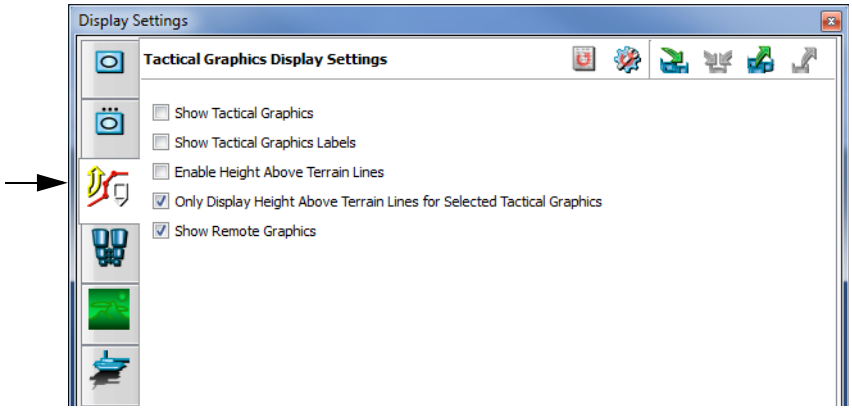


Figure 35-4. Tactical Graphics Display Settings page

3. Select or clear the Show Tactical Graphics check box.

> In VR-Vantage Stealth and PVD, you can also enable and disable tactical graphics by choosing **Settings** → **Tactical Graphics** or clicking the Tactical Graphics button ( ) on the Display Settings Toolbar.

Showing and Hiding Tactical Graphics on the Overlays Tab

On the Overlays tab, you can show and hide tactical graphics individually and by overlay.

To control the display of tactical graphics from the Overlays tab:

1. On the Objects List Panel, select the Overlays tab (Figure 35-3).
2. To hide all graphics on a particular overlay, clear the check box for that overlay.
3. To hide a specific tactical graphic, clear its check box.
4. To redisplay a hidden tactical graphic or overlay, select its check box.

35.1.3. Showing and Hiding Tactical Graphics Labels

In addition to displaying the outlines of tactical graphics, you can display graphics (labels) for the vertices of these objects. Vertex labels are enabled in Figure 35-1 and Figure 35-2. In Plan View mode, VR-Vantage also displays a tactical graphic's name. For details about displaying labels for 2D icons, please see "Displaying Labels for 2D Icons," on page 18-7.



Displaying vertex labels can affect performance.

To show or hide vertex labels:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Tactical Graphics Display Settings page (Figure 35-4).
3. Select or clear the Show Tactical Graphics Labels check box.



In VR-Vantage Stealth and PVD, you can also enable and disable tactical graphics labels by choosing **Settings** → **Tactical Graphics Labels** or clicking the Tactical Graphics Labels button () on the Display Settings Toolbar.

35.1.4. Displaying Height-Above-Terrain Lines for Vertices

In 3D observer modes, you can display height-above-terrain (HAT) lines for the vertices of tactical graphics. These vertical lines between an object's vertices and the ground help you understand the relationship of the object to the terrain. The height for each vertex is displayed (using whatever units are configured on the Display Units Settings page) (Figure 35-1).

HAT lines are shown only for tactical graphics that could be above or below the ground, such as routes, and waypoints. You can show and hide these lines and you can specify that they be shown for all objects or only for the selected objects.

! Use of height above terrain lines can reduce the frame rate.

To show or hide height-above-terrain lines:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Tactical Graphics Display Settings page (Figure 35-4).
3. To display HAT lines, select the Enable Height Above Terrain Lines check box.
4. To only display lines for selected objects, select the Only Display Height Above Terrain Lines For Selected Tactical Graphics check box.

35.2. Displaying Remote Graphics

VR-Vantage can display graphics sent from other applications using the VR-Vantage Remote Draw API (Figure 35-5).

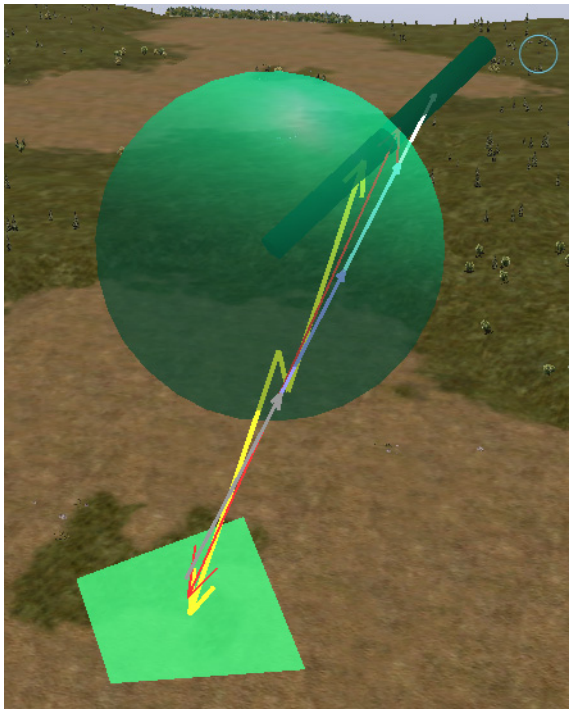


Figure 35-5. Remote graphics

To enable or disable the display of remote graphics:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Tactical Graphics Display Settings page (Figure 35-6).

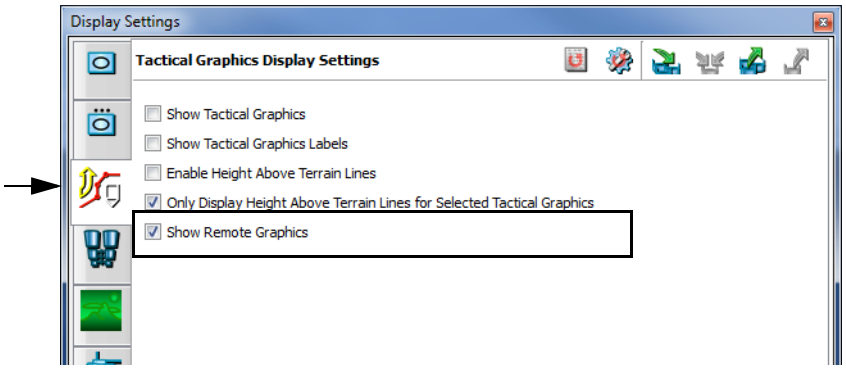


Figure 35-6. Tactical Graphics Display Settings page

3. Select or clear the Show Remote Graphics check box.



In VR-Vantage Stealth and PVD, you can also enable and disable remote graphics by choosing **Settings** → **Remote Graphics** or by clicking the Remote Graphics button ( ) on the Display Settings Toolbar.

35.2.1. Viewing a List of Remote Graphics

Remote graphics can be organized into sets. There is no fixed organization. Labeling of sets is entirely at the discretion of the programmer who develops the application that generates the graphics. The Remote Graphics Panel displays remote graphics in a hierarchy by set.

The VR-Vantage Remote Draw API lets developers send data about objects as attribute:value pairs, for example Speed:30 KM. The attributes are organized by type using attribute group templates. You can enable and disable the display of attribute information by group and by individual attribute. Figure 35-7 illustrates the attributes for the Entity and Packet attribute group templates displayed in Figure 35-8.

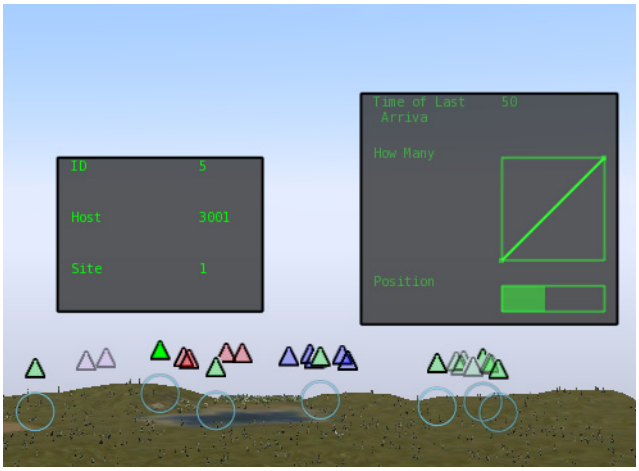


Figure 35-7. Remote graphics attribute group display

To view a list of remote graphics:

1. Choose **View** → **Remote Graphics Panel**. The Remote Graphics Panel is displayed (Figure 35-8). The Remote Graphics Sets tab lists remote graphics by set.

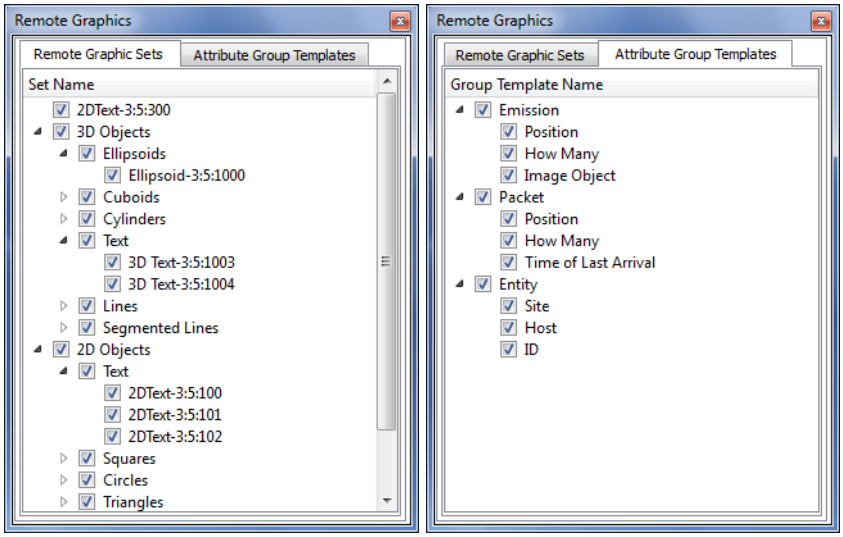


Figure 35-8. Remote Graphics Panel

2. To hide or display a remote graphic set or individual graphic, check or clear its check box in the Remote Graphics Sets list.
3. To view Attribute Group Templates, select the Attribute Group Templates tab. To see the attribute display, mouse over an object for which display data is available.



X. VR-Vantage Support for CIGI

VR-Vantage supports the Common Image Generator Interface (CIGI). The chapters in this section describe the extent of CIGI support. This includes a tutorial for using the included CIGI host application.



36. Mapping CIGI Models and Components

Unlike DIS or HLA, CIGI does not have a standard set of entity type mappings. Therefore, a CIGI connection cannot use the entity type mappings described elsewhere in this manual. VR-Vantage provides a set of mappings (MAK CIGI Mappings) for the entity models it includes. These mappings work with the CIGI host emulator provided with VR-Vantage. You can add new mappings, and you can edit the default mappings to work with other hosts. This chapter provides a minimal introduction to CIGI and the VR-Vantage CIGI driver and explains how to map CIGI components.

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- The VR-Vantage CIGI Driver 36-2
- CIGI Packet Support 36-3
- Mapping CIGI Input to VR-Vantage 36-4

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36.1. Introduction to CIGI

CIGI (Common Image Generator Interface) is an interface that allows an image generator (IG) to receive messages from a host to control what is drawn by the IG. CIGI defines packets that are sent between the host and the IG. CIGI is an open source project. It provides an interface control document and an open source library to send and receive CIGI messages: the CIGI Class Library (CCL). The VR-Vantage CIGI driver uses the CCL. VR-Vantage ships with the open-source CIGI Host Emulator. The host emulator and CCL are available at http://cigi.sourceforge.net. Chapter 37, *CIGI Host Emulator Tutorial* describes how to use the host emulator to control VR-Vantage.

36.1.1. The VR-Vantage CIGI Driver

The VR-Vantage CIGI driver supports best-effort (UDP) and reliable (TCP) communication between the CIGI driver and the host. When VR-Vantage uses a best-effort connection, it opens a UDP socket to the host port and tries to exchange data with the host. When it uses a reliable connection, the CIGI driver can act as a TCP client or TCP server. If it runs as a client, on connection the CIGI Driver tries to connect to a TCP server port on the host. If the connection fails, the driver returns to the disconnected state. If it runs as a server, it opens a TCP server socket on the listen port, and it accepts any connections made to that port. Data is then sent on that connection.

CIGI supports two modes of operation: synchronous and asynchronous. In synchronous mode, the IG sends a CIGI Start of Frame packet to the host, which prompts the host to send it data. The data is processed by the IG and is rendered; then the next frame starts. In asynchronous mode, the host sends data at any point and the IG renders the data. Since data may not be received every frame, the IG usually uses dead-reckoning and smoothing to update the positions of the entities until it receives an update.

The VR-Vantage CIGI driver supports synchronous and asynchronous modes. Synchronous mode can be run in single-threaded or multi-threaded mode, as follows:

- In single-threaded mode, the driver runs in the same thread as VR-Vantage, so its rate is bound by the VR-Vantage frame-rate. For example, if the driver is set to run at 60 Hz, but VR-Vantage has a frame rate of 20, the driver will only be able to run at 20 Hz. However, if the driver rate is set to 30 Hz, and VR-Vantage is running at 60, the CIGI Driver will only process CIGI messages at 30 Hz.
- In multi-threaded mode, the driver and VR-Vantage run in separate threads. The driver tries to maintain the desired rate. It sends start of frame messages, processes received messages, and sends messages to the main application to be rendered. Although this is not a true synchronous mode, it is the recommended synchronous mode for performance reasons.

36.1.2. CIGI Packet Support

VR-Vantage can receive the following CIGI packets:

- IG Control.
- Entity Control. Collision Detection is not supported.
- Component Control.
- Short Component Control.
- Articulated Part Control.
- Short Articulated Part Control.
- Rate Control.
- Celestial Sphere Control. Only date/time is supported.
- Weather Control. Only rain and snow are supported.
- View Control.
- View Definition. Mirror, Pixel Replication, and Orthographic projection are not supported.
- HAT/HOT Request.
- Line of Sight Segment Request.
- Line of Sight Vector Request.
- User-defined packet. VR-Vantage supports a user-defined packet for CIGI. For details, please see *DtCigiDiGuyCtrl.h*.

VR-Vantage can send the following packets:

- Start of Frame.
- HAT/HOT Response.
- Line of Sight Response.

For a complete list of supported and unsupported fields for each packet type, please see Chapter 39, *CIGI Packets Supported*.

36.1.3. Mapping CIGI Input to VR-Vantage

You map CIGI input to VR-Vantage models and other data files in the CIGI Mappings dialog box. You can map the following objects and components:

- CIGI entity models.
- CIGI entity components.
- CIGI system components.
- CIGI view components.
- CIGI model states.
- CIGI model animations.
- CIGI database mappings.
- CIGI regional sea surface components.
- CIGI observer mode mappings.
- CIGI active sensor regions.

36.2. Mapping Entity Models for CIGI

To view entity models using CIGI, you must map the visual models to the entity types known to the CIGI host. You can also map articulated parts for entities.

To map an entity model to a CIGI entity type:

1. Choose **Settings** → **CIGI Mappings**. The CIGI Mappings dialog box opens.
2. Select the CIGI Entity Models page (Figure 36-1).

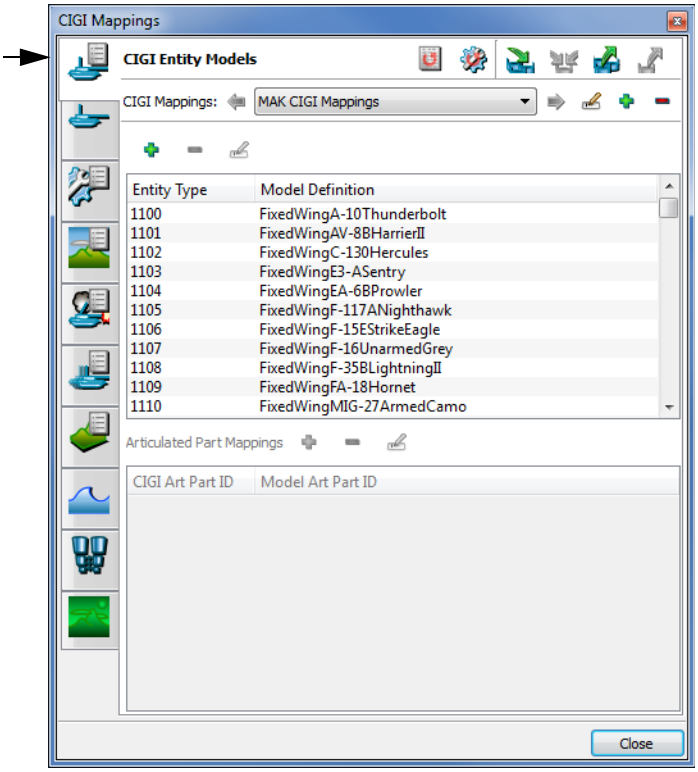


Figure 36-1. CIGI Entity Models page

3. Click the Add button (+) above the list of entity types. The Create New Entity Type Model Mapping dialog box opens (Figure 36-2).

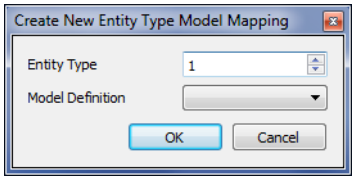


Figure 36-2. Create New Entity Type Model Mapping dialog box

4. Type an integer in the Entity Type box.

5. Select a model definition in the Model Definition list.
6. Click OK. The mapping is added to the list.

36.2.1. Adding an Articulated Part Mapping to an Entity Model

You can map articulated parts to an entity.

To add an articulated part mapping to an entity:

1. Choose **Settings** → **CIGI Mappings**. The CIGI Mappings dialog box opens.
2. Select the CIGI Entity Models page (Figure 36-1).
3. In the list of entity types, select the entity to which you want to add an articulated part. The Articulated Part Mappings window becomes active.
4. Click the Add button (+) next to the Articulated Part Mappings label. The Create New Art Part Mapping dialog box opens (Figure 36-3).

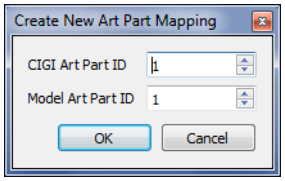


Figure 36-3. Create New Art Part Mapping dialog box

5. In the CIGI Art Part ID box, type an integer. This is an arbitrary number that must match whatever value the CIGI host uses.
6. In the Model Art Part ID box, type an integer. This value is the DIS comment node in the model.
7. Click OK.
8. The mapping is added to the Articulated Part Mappings window.

36.3. Mapping CIGI Components

VR-Vantage can process the following CIGI control messages:

- Entity component control message. Lets you specify model state, animation frame, animation range, and animation speed.
- View component control message. Lets you specify wireframe and whether or not to display the performance statistics overlay.
- System component control message. Lets you specify display of shadows.

The various component pages in the CIGI Mapping Settings dialog box let you specify the component IDs for these messages. The model state mappings specify the data for entity component controls.

For each type of component, if there are two or fewer data fields being used, you can use a component control or short component control message to set the component data. If there are more than two data fields in use, you cannot use a short component control.

The process for mapping components is similar for each component type.

To map a component ID:

1. Choose **Settings** → **CIGI Mappings**. The CIGI Mappings dialog box opens (Figure 36-1).
2. Select the page for the type of component you want to map.
3. Click the Add button (+) above the mapping window. The Create New Component Mapping dialog box opens (Figure 36-4).

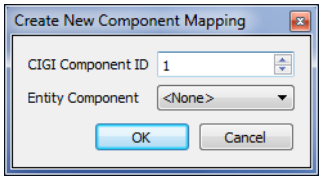


Figure 36-4. Create New Component Mapping dialog box

4. Type an integer value for the component ID. This is the value that will be used in the Component ID field of a component control message.
5. Complete the dialog box as follows:
   - For entity, view, or system components, select the component type from the list. The options vary for the different component types.
   - For animation controls, type the name of an animation.
   - For model state, select an appearance from the list.
6. Click OK. The mapping is added to the window.

36.3.1. Component Control Message Formats

This section describes the fields of the component control messages that VR-Vantage supports.

Entity Component Controls

You can use entity component controls to set the state in entity models and manipulate animations that are built into the model.

Model State

Model states are the equivalent of DIS appearance states. A model state component control message takes a component ID for a model state as configured on the Entity Components page and a model state mapping as configured on the CIGI Model State mappings page.

Table 36-1: Model state component control

Component Class	Entity (0).
Instance ID	Entity ID.
Component ID	ID for Model State, as set on the Entity Components Mappings page.
Component State	The value of the state.
Data 1	Model State, as set in CIGI Model State mappings page (int).
Data 2	Model State, as set in CIGI Model State mappings page (int).



Multiple nodes can be set to the same state through multiple data fields. You can set up to two states with a Short Component Control message or up to six with a Component Control Message.

Animation Control

Entity models can contain named animation nodes. You can set the speed, range, and current frame. The animation node in the model is designated by a string. A mapping from an integer to this string must be specified on the CIGI Model Animations page.

Table 36-2: Animation speed component control

Component Class	Entity (0).
Instance ID	Entity ID.
Component ID	ID for animation speed, as set on the Entity Components Mappings page.
Component State	Animation ID, as set on the Model Animations mappings page.
Data 1	Speed (float).
Data 2	Not applicable.

Table 36-3: Animation range component control

Component Class	Entity (0).
Instance ID	Entity ID.
Component ID	ID for animation range, as set on the Entity Components Mappings page.
Component State	Animation ID, as set on the Model Animations mappings page.
Data 1	First frame index (unsigned int).
Data 2	Last frame index (unsigned int).

Table 36-4: Animation frame component control

Component Class	Entity (0).
Instance ID	Entity ID.
Component ID	ID for animation frame, as set on the Entity Components Mappings page.
Component State	Animation ID, as set on the Model Animations mappings page.
Data 1	Frame index (unsigned int).
Data 2	Not applicable.

System Component Controls

You can enable and disable shadows using the Component State field of a System Component Control message. You can change shadow quality by passing an integer value in the Data 1 field of the component control. Table 36-5 describes the fields and values for the shadow component control.

Table 36-5: Shadows component control

Component Class	System (13).
Instance ID	Not applicable.
Component ID	Set in the System Components mappings page.
Component State	0 — Disable shadows. 1 — Enable shadows.
Data 1	Shadow Quality. Valid values are 1 through 4, with 1 being the worst quality and 4 the best.
Data 2	Not applicable.

View Component Controls

You can enable or disable the performance statistics overlay and wireframe mode using View Component Control messages. The component ID of either component can be set through the CIGI View Components page in the CIGI Mappings dialog box.

Table 36-6: Performance overlay component control

Component Class	View (1).
Instance ID	Not applicable.
Component ID	Set in the View Components mappings page.
Component State	0 — Disable performance statistics overlay. 1 — Enable overlay.
Data 1	Not applicable.
Data 2	Not applicable.

Table 36-7: Wireframe mode component control

Component Class	View (1).
Instance ID	Not applicable.
Component ID	Set in the View Components mappings.
Component State	0 — Disable wireframe mode. 1 — Enable wireframe mode.
Data 1	Not applicable.
Data 2	Not applicable.

36.4. Mapping a Database

Similar to mapping components to IDs, in a simulation using CIGI you can map databases to database numbers. If the host sends a control message that specifies a database, VR-Vantage loads it. If a database is not mapped or the host does not send a control message to load a database, you must load the database in VR-Vantage as you normally would for other connection types.

To map a database:

1. Choose **Settings** → **CIGI Mappings**. The CIGI Mappings dialog box opens (Figure 36-1).
2. Select the CIGI Database Mapping page (Figure 36-5).

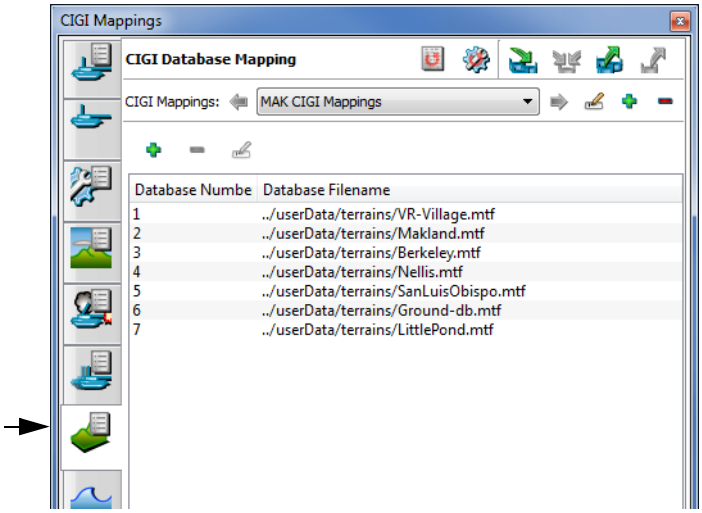


Figure 36-5. CIGI Database Mappings page

3. Click the Add button (+) above the list of databases. A file chooser dialog box opens.
4. Select the database that you want to map to.
5. Click Open. The Create Database Mapping dialog box opens (Figure 36-6).

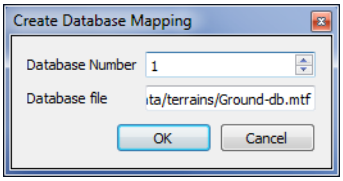


Figure 36-6. Create Database Mapping dialog box

6. Type a number for the database. If you choose a number that is in use, this database replaces the currently mapped database.

7. Click OK.

36.5. Mapping CIGI Views

VR-Vantage associates CIGI views with VR-Vantage channels using channel keywords. (For details about channel keywords, please see "Changing a Channel's Attributes," on page 6-11.) Any channel with keyword cigiView*X* is associated with CIGI view *X*. For example, keyword cigiView2 would map to CIGI view 2.

CIGI view control packets affect the observer that is controlling the specified view. VR-Vantage looks up the channel that has the keyword that matches the view ID specified in the view control packet. Then it finds the observer controlling that channel and applies the view control commands to that observer. If multiple channels have the same keyword, then the first channel found with a matching keyword is used.

Multiple channels with the same keyword are fine, as long as they are all controlled by the same observer. This removes the need for CIGI view groups, although VR-Vantage supports them.

36.5.1. Mapping a CIGI View to an Observer Mode

You can map an observer mode to the ViewType parameter in a CIGI view control message.

To map an observer mode to a CIGI view:

1. Choose **Settings** → **CIGI Mappings**. The CIGI Mappings dialog box opens (Figure 36-1).
2. Select the CIGI Observer Mode Mapping page (Figure 36-7).

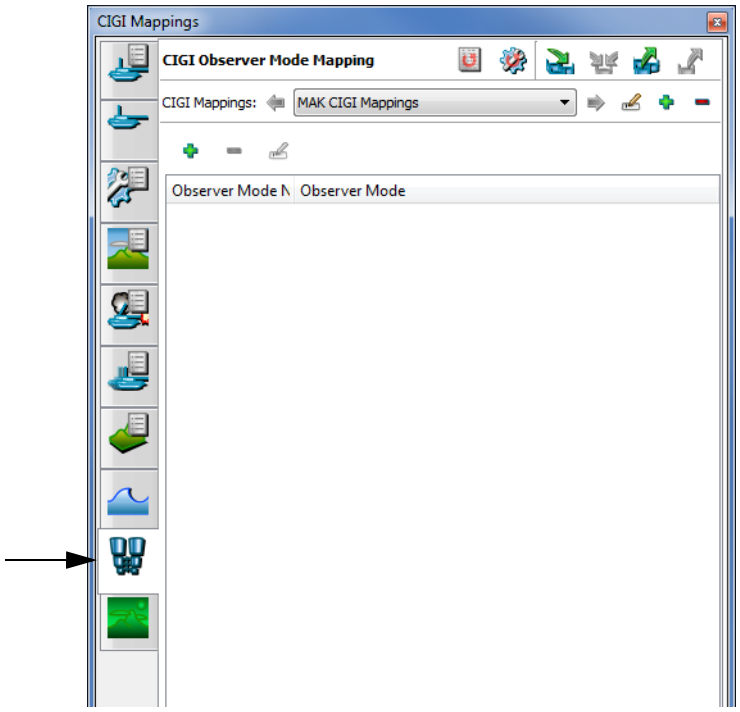


Figure 36-7. CIGI Observer Mode Mapping page

3. Click the Add button (+) above the list of observer mode mappings. The Create New Observer Mode Mapping dialog box opens.
4. Type the CIGI ID or select an ID from the list.
5. Select an observer mode from the Observer Mode list.
6. Click OK.

36.6. Prototypical Host – IG Configurations

This section describes several prototypes for host simulation and image generator configurations. The VR-Vantage CIGI implementation supports the networked IG configuration.

In the classic IG configuration (Figure 36-8), the host simulation connects to the network and filters all the entities and interactions, providing only the relevant ones to the image generator (shown as the VR-Vantage Application) using a protocol like CIGI. The IG renders the scene and presents it to the user on display screens of some sort.

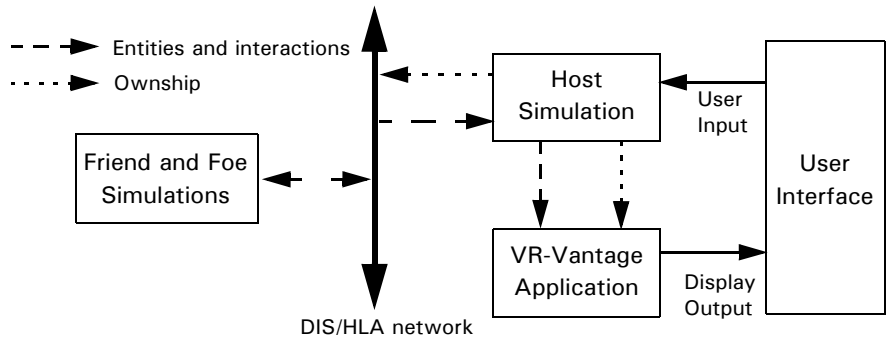


Figure 36-8. Classic IG Configuration

In the networked IG configuration (Figure 36-9), the host simulation communicates only the "ownship" (the one entity the host is simulating) to the image generator, using a protocol like CIGI. The image generator presents all the other entities and interactions in the distributed simulation.

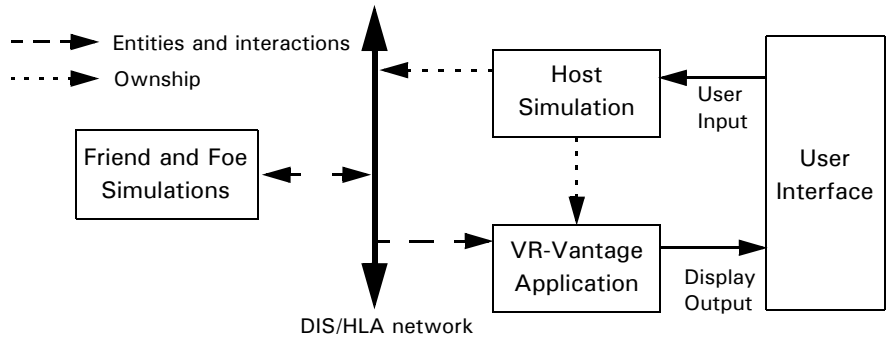


Figure 36-9. Networked IG Configuration

In the distributed visual/simulation configuration (Figure 36-10), the host simulation communicates with the visual application over the DIS/HLA network. (This is the way VR-Vantage connects to any distributed simulation entity.)

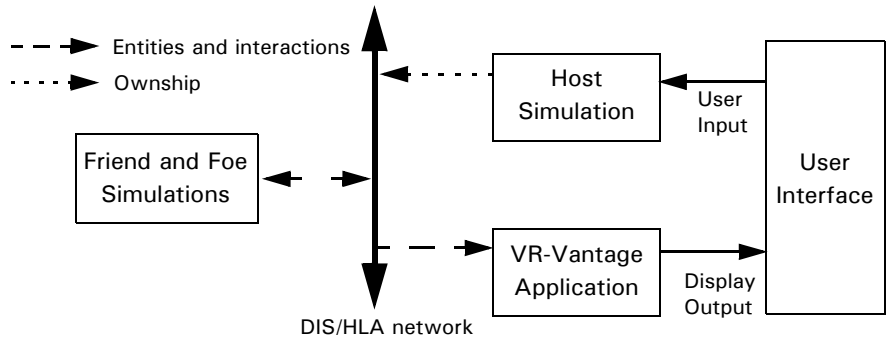


Figure 36-10. Distributed Visual/Simulation Application IG Configuration

In the integrated visual/simulation application (Figure 36-11), the simulation code is embedded in the visual application. This is the way many games are built. You can use the VR-Vantage toolkit to embed simulation code in VR-Vantage or embed VR-Vantage in a simulation application.

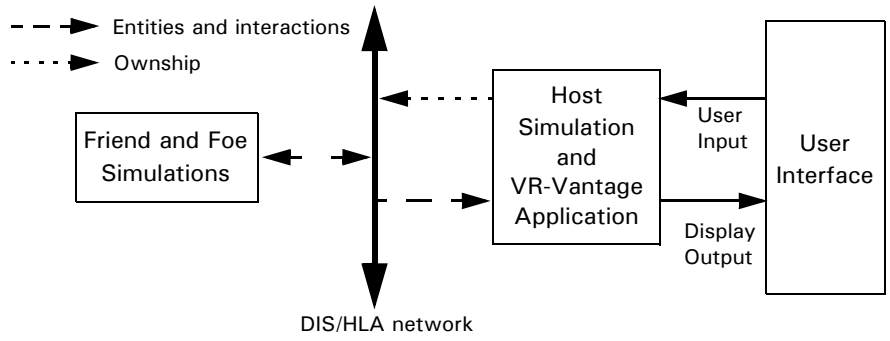


Figure 36-11. Integrated Visual/Simulation Application Configuration



37. CIGI Host Emulator Tutorial

VR-Vantage includes a CIGI host emulator (Windows only). This tutorial explains how to run it and interact with VR-Vantage.

Using the CIGI Host Emulator (Windows Only) 37-2
Start the Host Emulator 37-3
Connect VR-Vantage to the CIGI Host Emulator 37-4
Create an Ownship Entity on the Host Emulator 37-5
Create a Simulated Entity on the Host Emulator 37-7
Change an Entity's Model State 37-7
Add an Effect 37-9
Change the Weather 37-10

37.1. Using the CIGI Host Emulator (Windows Only)

The Windows version of VR-Vantage includes a CIGI host emulator and a set of mappings that you can use to test your CIGI setup. This section provides a basic introduction to starting the host emulator, connecting VR-Vantage to it, and sending basic control messages to VR-Vantage.

Figure 37-1 illustrates connection settings that must be the same on the host emulator ("Start the Host Emulator," on page 37-3) and the CIGI connection in VR-Vantage ("Connect VR-Vantage to the CIGI Host Emulator," on page 37-4).

- For best results, shut down VR-Vantage before you start this tutorial. Start it when instructed to do so.
- To see a set of brief videos that illustrate this tutorial, on the Start menu, choose **VR-Vantage 2.1** → **Documentation** → **VR-Vantage Video Tutorials**, open *./doc/vrvantage_tutorialvideos.htm*, or click the camera icon next to the procedure that you want to view.

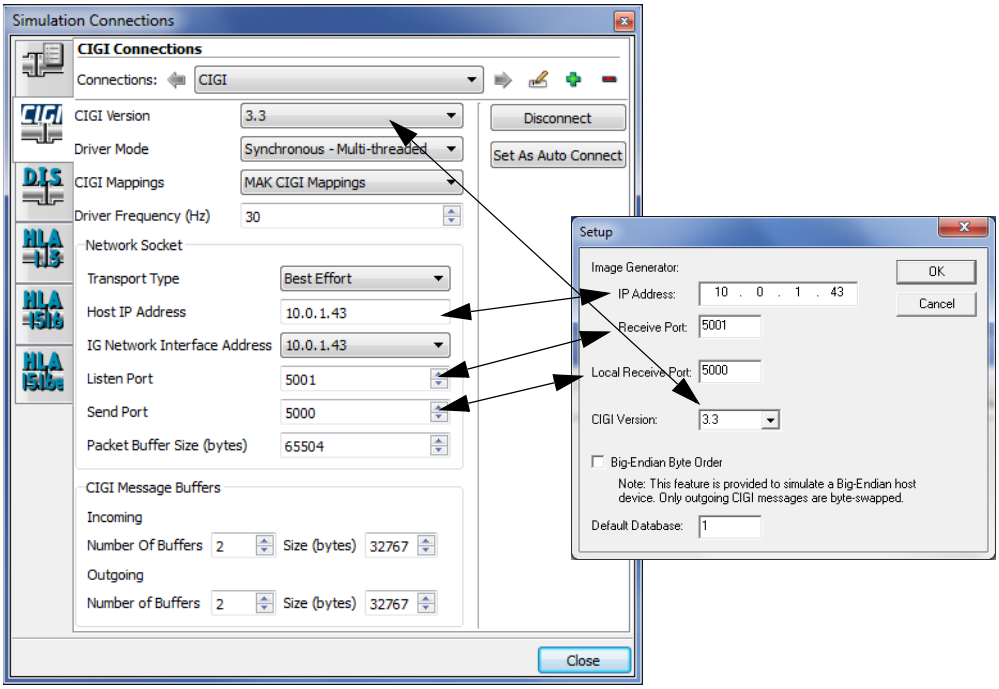


Figure 37-1. Connection settings and host emulator setup

37.1.1. Start the Host Emulator

Running the host emulator on the same computer as VR-Vantage could affect VR-Vantage's performance.

To start the host emulator:



1. On the Start menu, choose **All Programs** → **VR-Vantage 2.1** → **Tools** → **CIGI Host Emulator**. The host emulator starts up (Figure 37-2). The first time you run it, the Setup dialog box opens automatically (Figure 37-3). (Thereafter, to change the setup, in the host emulator, choose **File** → **Setup**.)

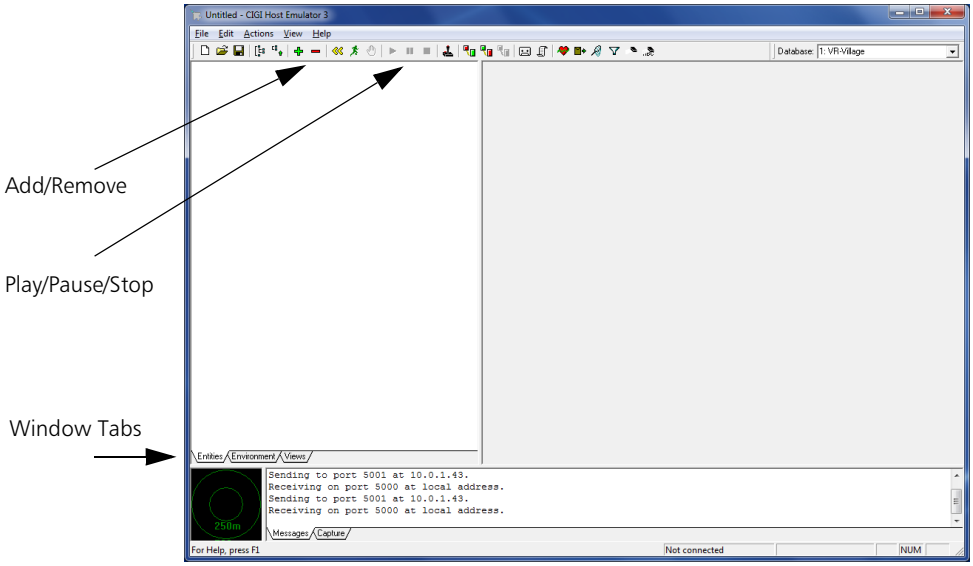


Figure 37-2. CIGI host emulator

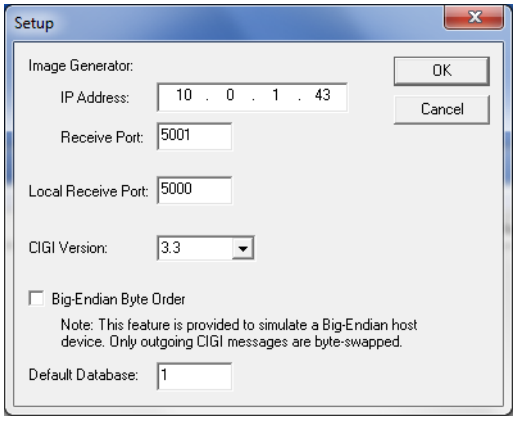


Figure 37-3. Setup dialog box

2. In the IP Address box, type the IP address for the computer on which you are running VR-Vantage.

3. In the Receive Port box, type the port that is configured as the Listen Port in the CIGI Connection that you are using in VR-Vantage. (In other words, this is the port to which the host emulator should send its messages.)
4. In the Local Receive Port, type the port on which the host emulator should receive messages. This must match the Send Port value on the CIGI Connection that you are using in VR-Vantage.
5. Specify the CIGI version that you want to use.
6. Specify the default database that you want to use. This value should match a database mapping in the CIGI Database Mapping page of the CIGI Mapping Settings in VR-Vantage. (Database 1 is VR-Village.)
7. Click OK.

37.1.2. Connect VR-Vantage to the CIGI Host Emulator

To connect VR-Vantage to the CIGI Host Emulator:

1. Start VR-Vantage IG.
2. Choose **Settings** → **Connections**. The Simulation Connections dialog box opens.
3. Select the CIGI Connections page (Figure 37-1).
4. Select a connection or create a new one.
5. Set the CIGI Version to the same CIGI version you specified in the host emulator setup.
6. Set CIGI Mappings to MAK CIGI Mappings.
7. Set the Host IP Address to the IP address of the computer on which the host emulator is running.
8. Set the Network Device Address to the IP address of the computer running VR-Vantage IG. The Image Generator IP Address in the host emulator setup must match this value.
9. Set the Listen Port to the same value as the Image Generator Receive Port value in the host emulator setup.
10. Set the Send Port to the same value as the Local Receive Port value in the host emulator setup.
11. Change any other connection parameters as desired.
12. Click Connect. After a few seconds, VR-Vantage displays the database configured in the host emulator.

37.1.3. Create an Ownship Entity on the Host Emulator

The ownship entity controls the observer in VR-Vantage.

To create the ownship entity:

1. In the CIGI host emulator, select the Entities tab (Figure 37-2). The window is empty because there are no entities.
2. On the toolbar (Figure 37-2), click the Add button (). The New Entity dialog box opens (Figure 37-4).

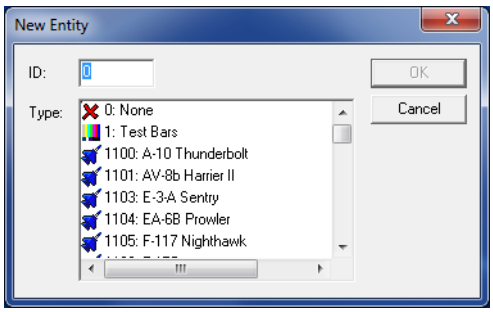


Figure 37-4. New Entity dialog box

3. Select 0: None.
4. Click OK. The Ownship entity is added to the entity list. Its properties are listed in the panel to the right of the entity list (Figure 37-5).

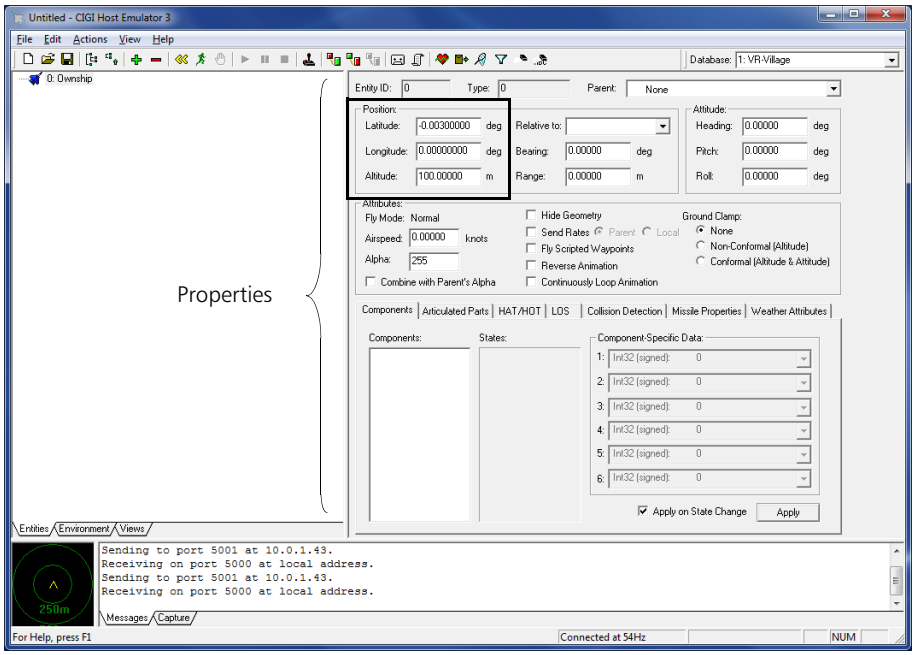


Figure 37-5. Entity properties for ownship entity

5. In VR-Vantage, an entity called CIGI Ownship is added to the entity list.
6. Attach to the entity by sending a view control message from the host emulator:
   a. Choose **Actions** → **Send Packet** → **View Control**. The Send View Control Packet dialog box opens.
   b. Edit the view control attributes as desired.
   c. Click Send. The CIGI host emulator sends a view control with the Position data in the main window. (If you are using database 1 (VR-Village), the view changes to a view of the village.
7. In the Position group box on the host emulator, change the Altitude attribute (Figure 37-5). The view in VR-Vantage changes.

37.1.4. Create a Simulated Entity on the Host Emulator

Creating a simulated entity will let you apply effects and experiment with setting model states and other attributes.

To create a simulated entity:



1. In the CIGI host emulator, select the Entities tab (Figure 37-2).
2. On the toolbar (Figure 37-2), click the Add button (+). The New Entity dialog box opens (Figure 37-4).
3. Select M1A2.
4. Click OK. The entity is added to the entity list.
5. In VR-Vantage, an entity called CIGI Entity 1 is added to the entity list.

37.1.5. Change an Entity's Model State

To change an entity's model state:

1. In VR-Vantage, attach to the M1A2.
2. Rotate the view so that you can see the rear of the tank.
3. In the host emulator, select the Entities tab.
4. Select the M1A2 entity (Figure 37-6).

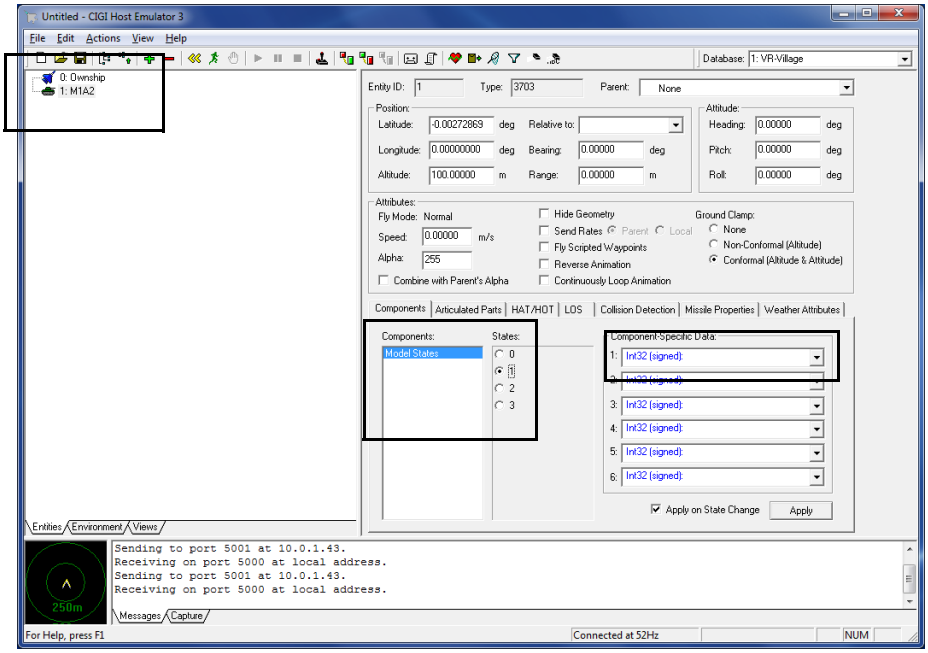


Figure 37-6. Entity attributes

5. In the properties panel, select the Components tab (Figure 37-6).
6. In the States list, select option 1.
7. In the Component Specific Data list, put the cursor in the first box.
8. Type 16.
9. Click Apply. The brake lights on the tank turn on (Figure 37-7).



Figure 37-7. Brake lights

37.1.6. Add an Effect

To add an effect in the MÄK implementation of CIGI, you add the effect and attach it to an entity.

To add an effect:



1. In the CIGI host emulator, select the Entities tab (Figure 37-2).
2. On the toolbar (Figure 37-2), click the Add button (✚). The New Entity dialog box opens (Figure 37-4).
3. Select Detonation.
4. Click OK. The effect is added to the entity list.
5. On the properties panel, in the Parent list, select M1A2. In the entity list, the Detonation is now subordinate to the M1A2 entity (Figure 37-6).

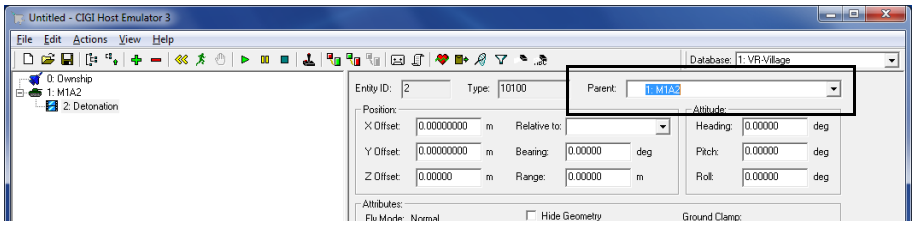


Figure 37-8. Entity attributes

6. To display the detonation, click Play (Figure 37-2).

37.1.7. Change the Weather

You can send control messages to enable and disable precipitation. VR-Vantage supports layer 4 (rain) and 5 (snow).

To change the weather:



1. In the host emulator, choose **Actions** → **Send Packet** → **Weather Control**. The Send Weather Control Packet dialog box opens (Figure 37-9).

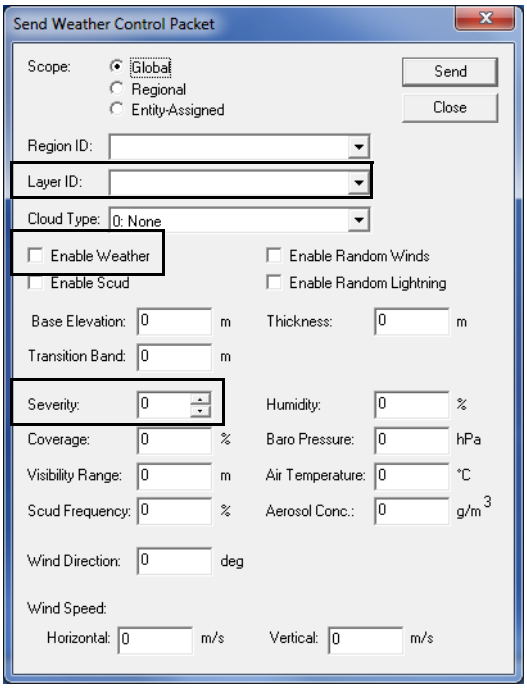


Figure 37-9. Send Weather Control Packet dialog box

2. In the Layer ID box, type 4 (for rain) or 5 (for snow).
3. Select the Enable Weather check box.
4. In the Severity box, select an option greater than zero.
5. Click Send. VR-Vantage displays the selected form of precipitation.



38. CIGI Utilities

This chapter describes the utilities provided for testing CIGI connections.

Using asynchHostTest.py 38-2
Using logger.py 38-3
Using snooper.py 38-4
The pyCigi Module 38-5

38.1. Using asynchHostTest.py

The *./tools/CigiUtilities/asynchHostTest.py* script has two functions. It acts as a simple CIGI host that sends test packets to a socket for test purposes. It also serves as an example of how you can write a script to test your CIGI network.

This script opens a socket and repeatedly sends IGControl and EntityControl messages to the socket until you press **`Ctrl`**+**`c`**. The script instructs the IG to load the Ground-DB terrain database and 700 FixedWingA-10Thunderbolt entities from VR-Vantage. It then cycles the roll of the entities at a given frame rate.

To run *asyncHostTest.py* with default values (port 5001, IP 127:0:0:1), use:

```
asyncHostTest.py
```

The script creates 700 entities and changes their roll value. To see the entities in VR-Vantage:

1. Start VR-Vantage.
2. Choose **Settings** → **Connection**. The Simulation Connections dialog box opens.
3. Select the CIGI Connections page. The Listen Port (5001) and Host IP Address match the default values for the host created by the script.
4. Change the IG Network Interface Address to 127.0.0.1.
5. Click Connect. VR-Vantage loads the ground-db terrain and displays the entities (Figure 38-1).

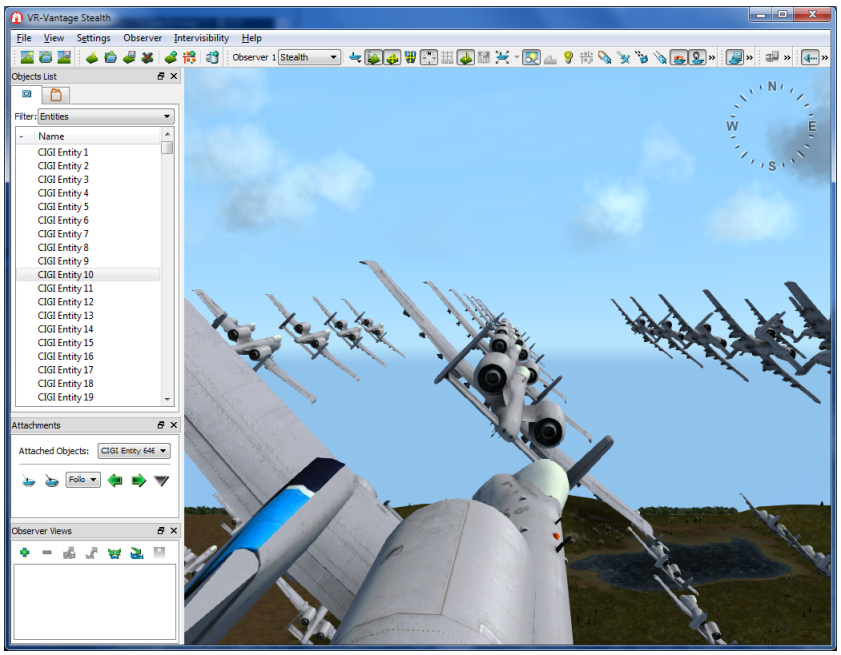


Figure 38-1. Entities generated by *asyncHostTest.py*

38.2. Using logger.py

The *./tools/CigiUtilities/logger.py* script listens to a UDP socket (unicast or multicast) and records the packets it receives. It can then play the packets back.

To record:

```
logger.py -r
```

The default log file is *cigiSession.log*.

To play:

```
logger.py
```

The logger records data in a binary format. However, you can convert it to a readable format. To convert the data, run:

```
logger.py -c
```

The default output file is *cigiSession.txt*. The following is an example of converted log entries:

```
<Time(0.000000)>
<IGControl({'lastFrame': 0, 'timeStamp': 0, 'dbNum': 6, 'frameNum': 1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -122.988,
  'pitch': 0.0, 'entType': 1100, 'roll': 1.0, 'alpha': 255, 'yaw': 0.0,
  'lat': 36.00827037, 'entID': 1, 'bits1': 1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
  122.9883, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0, 'alpha': 255,
  'yaw': 0.0, 'lat': 36.00827037, 'entID': 2, 'bits1': 1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
  122.98859999999999, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0,
  'alpha': 255, 'yaw': 0.0, 'lat': 36.00827037, 'entID': 3, 'bits1': 1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
  122.98889999999999, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0,
  'alpha': 255, 'yaw': 0.0, 'lat': 36.00827037, 'entID': 4, 'bits1': 1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
  122.98919999999998, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0,
  'alpha': 255, 'yaw': 0.0, 'lat': 36.00827037, 'entID': 5, 'bits1': 1})>
```



When the logger records packets, it does not compress them. The log file can quickly grow quite large.

38.3. Using snooper.py

The *./tools/CigiUtilities/snooper.py* script can connect to the host and the IG at the same time and can record traffic and then play it back. Figure 38-2 illustrates the snooper as follows:

- Host/IG interaction without the snooper.
- Host/IG interaction with the snooper mediating. The snooper receives the packets from the host and IG and passes them on. It also records them to a file.
- Snooper playback. The snooper sends the logged packets to the proper destination.



When the snooper records packets, it does not compress them. The log file can quickly grow quite large.

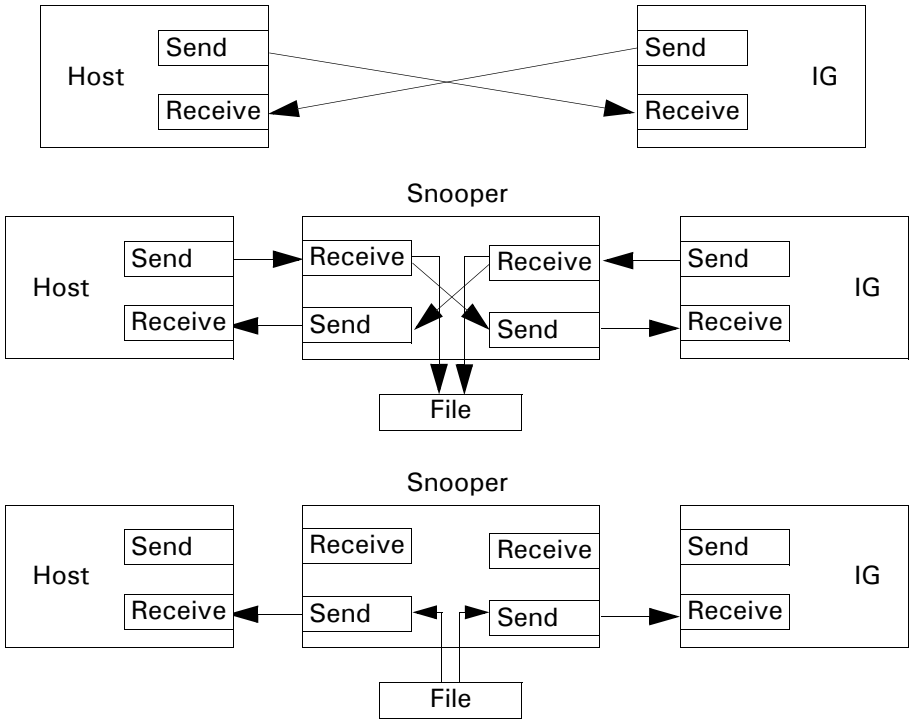


Figure 38-2. Using the snooper

To run the snooper you must specify send and receive ports for both the host and IG, for example:

```
snooper.py --host_send_port 5000 --host_recv_port 5001
  --ig_recv_port 5002 --ig_send_port 5003
```

Since this is a long command line, you can save the command line to a configuration file, as follows:

```
snooper.py --host_send_port 5000 --host_recv_port 5001
  --ig_recv_port 5002 --ig_send_port 5003 --save [-f
  myfile]
```

If you do not specify a file with `-f`, the command is saved to *snooper.cfg*.

To load the saved configuration, run:

```
snooper.py --load [-f myfile]
```

38.4. The pyCigi Module

The pyCigi module (*./tools/CigiUtilities/byCigi*) is a package of modules to handle the reading, writing, packing and unpacking of CIGI messages. pyCigi has modules to handle each of the CIGI message types that are supported by VR-Vantage. For a list of supported packets, please see Chapter 39, *CIGI Packets Supported*.

Each module within pyCigi is self documented and contains a unit test. The documentation for a module can be seen from inside a Python shell:

```
python
>>> import pyCigiStartOfFrame
>>> help(pyCigiStartOfFrame.StartOfFrame)
```

To run the unit test for a module, run the module as a script from a shell window:

```
pyCigiStartOfFrame.py
```

The script *pyCigiMappings.py* gets information about mappings from *./appData/settings/stealth/MAK CIGI Mappings.mcsx*. Do not move this file or the script will not work.

For complete documentation of the pyCigi module, please see *Readme.txt*.



39. CIGI Packets Supported

This Simulation Object Type MappingsSimulation Object Type Mappings lists the various CIGI packets and the fields that VR-Vantage supports.

CIGI Packet Support 39-2
Support for CIGI Weather Control Packet 39-9
User Defined CIGI Packet 39-9

39.1. CIGI Packet Support

The tables in this section describe VR-Vantage support for the following CIGI packet types:

- IG Control (Table 39-1).
- Entity Control (Table 39-2).
- Component Control (Table 39-3).
- Short Component Control (Table 39-4).
- Articulated Part Control (Table 39-5).
- Short Articulated Part Control (Table 39-6).
- Rate Control (Table 39-7).
- Celestial Sphere Control (Table 39-8).
- Atmosphere Control (Table 39-9).
- Weather Control (Table 39-10).
- View Control (Table 39-11).
- View Definition (Table 39-12).
- HAT/HOT Request (Table 39-13).
- Line-of-sight Segment Request (Table 39-14).
- Line-of-sight Vector Request (Table 39-15).

Table 39-1: IG control packets

Field	Supported	Unsupported
Database Number	X	
IG Mode	X	
Timestamp Valid	X	
Extrapolation/Interpolation Enable	X	
Host Frame Number	X	
Timestamp	X	
Last IG Frame Number	X	

Table 39-2: Entity control packets

Field	Supported	Unsupported
Entity ID	X	
Entity State	X	
Attach State	X	
Collision Detection Enable		X
Inherit Alpha	X	
Ground/Ocean Clamp	X (Conformal Only)	
Animation Direction	X	
Animation Loop Mode	X	
Animation State	X	
Linear Extrapolation/Interpolation Enable	X	
Alpha	X	
Entity Type	X	
Parent ID	X	
Roll/Pitch/Yaw	X	
Latitude/Longitude/Altitude or X/Y/Z offset	X	

Table 39-3: Component control packets

Field	Supported	Unsupported
Component ID	X	
Instance ID	X	
Component Class	X	
Component State	X	
Component Data	X	

Table 39-4: Short component control packets

Field	Supported	Unsupported
Component ID	X	
Instance ID	X	
Component Class	X	
Component State	X	
Component Data	X	

Table 39-5: Articulated part control packets

Field	Supported	Unsupported
Entity ID	X	
Articulated Part ID	X	
Articulated Part Enable	X	
X/Y/Z Offset Enable	X	
Roll/Pitch/Yaw Enable	X	
X/Y/Z Offset	X	
Roll/Pitch/Yaw	X	

Table 39-6: Short articulated part control packets

Field	Supported	Unsupported
Entity ID	X	
Articulated Part ID 1	X	
Articulated Part ID 2	X	
DOF Select 1	X	
DOF Select 2	X	
Articulated Part Enable 1	X	
Articulated Part Enable 2	X	
DOF 1	X	
DOF 2	X	

Table 39-7: Rate control packets

Field	Supported	Unsupported
Entity ID	X	
Articulated Part ID	X	
Apply To Articulated Part	X	
Coordinate System	X	
X/Y/Z Linear Rate	X	
Roll/Pitch/Yaw Angular Rate	X	

Table 39-8: Celestial sphere control packets

Field	Supported	Unsupported
Hour	X	
Minute	X	
Ephemeris Model Enable	X	
Sun Enable		X
Moon Enable		X
Star Field Enable		X
Date/Time Valid	X	
Date	X	
Star Field Intensity		X

Table 39-9: Atmosphere control packets

Field	Supported	Unsupported
Global Air Temperature		X
Global Visibility Range	X	
Global Horizontal Wind Speed	X	
Global Vertical Wind Speed		X
Global Wind Direction	X	
Global Barometric Pressure		X

Table 39-10: Weather control packets

Field	Supported	Unsupported
Entity/Region ID		X
Layer ID	X (Only Rain/Snow)	
Humidity		X
Weather Enable	X	
Random Winds Enable		X
Random Lightning Enable		X
Cloud Type		X
Scope		X
Severity	X	
Air Temperature		X
Visibility Range*	X	
Scud Frequency		X
Coverage		X
Base Elevation		X
Thickness		X
Transition Band		X
Horizontal Wind Speed*	X	
Wind Direction*	X	
Barometric Pressure		X
Aerosol Concentration		X
For more information, please see "Support for CIGI Weather Control Packet," on page 39-9		

Table 39-11: View control packets

Field	Supported	Unsupported
View ID	X	
Group ID	X	
X/Y/Z Offset Enable	X	
Roll/Pitch/Yaw Offset Enable	X	
Entity ID	X	
X/Y/Z Offset	X	
Roll/Pitch/Yaw	X	

Table 39-12: View definition packets

Field	Supported	Unsupported
View ID	X	
Group ID	X	
Near/Far/Left/Right/Top/Bottom Enable	X	
Mirror Mode		X
Pixel Replication Mode		X
Projection Type		X
Reorder		X
View Type		X
Near/Far/Left/Right/Top/Bottom	X	

Table 39-13: HAT/HOT request packets

Field	Supported	Unsupported
HAT/HOT ID	X	
Request Type	X (Extended not supported)	
Coordinate System	X	
Update Period	X	
Entity ID	X	
Latitude/Longitude/Altitude or X/Y/Z offset	X	

Table 39-14: Line-of-sight segment request packets

Field	Supported	Unsupported
LOS ID	X	
Request Type		X (Extended not supported)
Source Point Coordinate System	X	
Destination Point Coordinate System	X	
Response Coordinate System		X
Destination Entity ID Valid	X	
Alpha Threshold		X
Source Entity ID	X	
Source Latitude/Longitude/Altitude or X/Y/Z Offset	X	
Destination Latitude/Longitude/Altitude or X/Y/Z Offset	X	
Material Mask		X
Update Period	X	
Destination Entity ID	X	

Table 39-15: Line-of-sight vector request packets

Field	Supported	Unsupported
LOS ID	X	
Request Type		X (Extended Not Supported)
Source Point Coordinate System	X	
Response Coordinate System		X
Alpha Threshold		X
Entity ID	X	
Azimuth	X	
Elevation	X	
Minimum Range	X	
Maximum Range	X	
Source Latitude/Longitude/Altitude or X/Y/Z Offset	X	
Material Mask		X
Update Period	X	

39.1.1. Support for CIGI Weather Control Packet

VR-Vantage supports the CigiWeatherCtrlV3 packet's wind direction, horizontal wind direction, and visibility range fields (WindDir, HorizWindSp, and VisibilityRng respectively).

Prior to VR-Vantage 2.1, this packet was used just for precipitation. To provide backward compatibility, the RegionID field (which we normally do not support) is used as a flag set to indicate which weather control items are supported and which are ignored.

The flags are

```
enum WeatherControlState
{
  WindDirSet = 0           // bit 0
  , WindSpeedSet = 1         // bit 1
  , VisibilitySet = 2        // bit 2
  , PrecipitationIgnore = 3  // bit 3
};
```

As before, WeatherEn enables or disables precipitation, with LayerID indicating precipitation type (4 == rain, 5 == snow). Therefore, existing CIGI Weather Control packets used with VR-Vantage work as they did before.

If you want to specify wind direction, horizontal wind speed, visibility, or some combination of them, the appropriate flags must be set into the RegionID field. Precipitation values can be ignored by setting bit 3 of the RegionID field.

39.2. User Defined CIGI Packet

VR-Vantage supports a user-defined packet for CIGI. For details, please see *DtCigiDiGuyCtrl.h*.



XI. Configuring the Graphical User Interface

The chapters in this section describe the graphical user interface (GUI) and how to configure it.



40. The VR-Vantage User Interface

The VR-Vantage graphical user interface has features typical for modern windowing systems and follows standard conventions for using menus and selecting objects. This chapter describes some features that might not be immediately obvious.

Dockable Panels and Toolbars 40-2
- Docking and Undocking a Panel 40-2
- Docking and Undocking a Toolbar 40-3
- Displaying and Hiding Panels and Toolbars 40-3
- Restoring the Layout of Toolbars and Panels 40-4

Viewing the Window in Full Screen Mode 40-4

Using Context-Sensitive Menus 40-5

Common VR-Vantage Buttons 40-5

File Extensions 40-5

Specifying Display Units 40-7

40.1. Dockable Panels and Toolbars

VR-Vantage has floating, dockable panels for many of its important functions (Figure 40-1). It also has toolbars that let you quickly access the commands available on the menus.

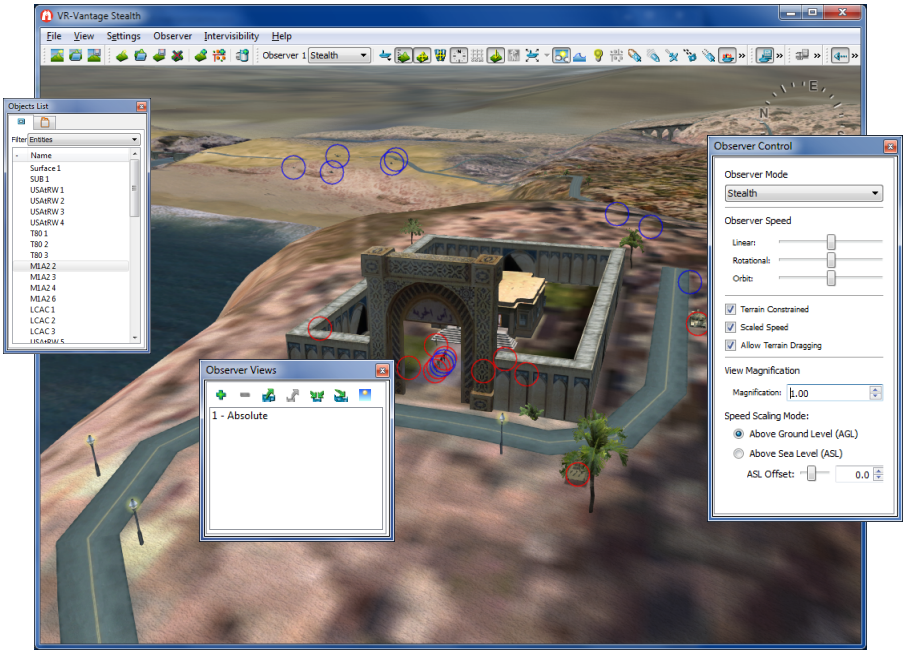


Figure 40-1. VR-Vantage window and undocked panels

40.1.1. Docking and Undocking a Panel

To undock a panel:

1. Place the cursor over the panel's title.
2. Press and hold the left mouse button.
3. Drag the panel away from the window.

➤ To dock a floating panel, double-click its title bar.

40.1.2. Docking and Undocking a Toolbar

To undock a toolbar:

1. Place the cursor over the handle.



Figure 40-2. Toolbar handle

2. Press and hold the left mouse button.
3. Drag the toolbar away from the window.

➤ To dock a toolbar, drag it back to the toolbar strip. The other toolbars will move to create a space to drop in the toolbar (Figure 40-3).

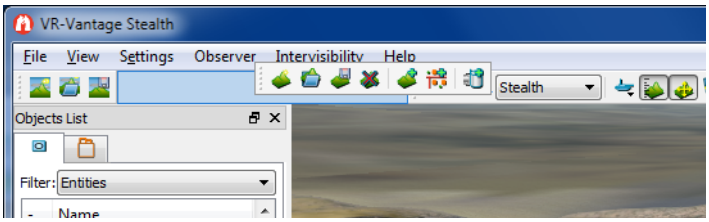


Figure 40-3. Docking a toolbar

40.1.3. Displaying and Hiding Panels and Toolbars

You can hide any of the panels or toolbars.

➤ To hide or view a panel or toolbar, select it on the View menu.

40.1.4. Restoring the Layout of Toolbars and Panels

VR-Vantage saves the layout of toolbars and panels when you shut down. (It does not save the size and location of the main window.) You can restore the factory layout or the last saved layout.

To restore the layout of toolbars and panels:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the GUI Layout page (Figure 40-4).

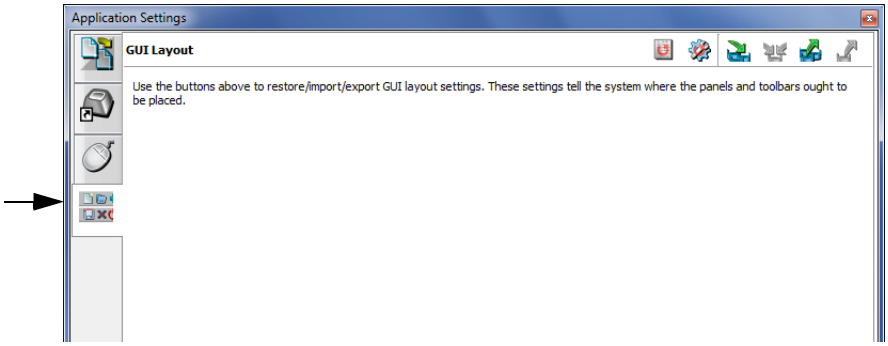


Figure 40-4. GUI Layout page

3. Click the settings button for the operation you want to perform. (For a summary of common settings buttons, please see "Managing VR-Vantage Settings," on page 3-13.)

40.2. Viewing the Window in Full Screen Mode

You can display VR-Vantage so that it covers the entire screen and does not show the title bar or border. This mode is intended for use in demonstrations. When menus and panels are hidden, you can still use all keyboard controls, and you can still click simulation objects in the window to attach the observer to them.

You can configure VR-Vantage to start in full screen mode with the `--fullScreen` command-line option. If you are viewing a simulation that takes place primarily over the ocean, you may get better performance using the `--pseudoFullScreen` command-line option.

➤ To view VR-Vantage in full screen mode, choose **View** → **Show Full Screen**, or press **`Ctrl+Enter`**.

➤ To exit full screen mode, press **`Ctrl+Enter`**.

40.3. Using Context-Sensitive Menus

VR-Vantage has context sensitive menus (also called popup menus or right-click menus) that you can display by clicking the right mouse button.

If you right-click a simulation object, tactical graphic, or other scene object, the menu displays the actions that you can take.

If you right-click the menu bar, you can select the commands available on the View menu.

40.4. Common VR-Vantage Buttons

VR-Vantage dialog boxes have a common set of buttons, as follows:

- Add an item (definition, model, and so on).
- Remove the selected item.
- Copy the selected item and add the copied version to the list.
- Select a filter of some type.
- Rename the selected item.
- Add from a list.
- Move up in the list.
- Move down in the list.
- Select the previous item.
- Select the next item.
- Add an attribute.
- Remove local attribute definition and use the parent's definition.
- Search.

40.5. File Extensions

Table 40-1 lists the file extensions for VR-Vantage file types:

Table 40-1: VR-Vantage file extensions

File type	Extension
Terrain	mtf
Scene	msf
View	osrx
Display configuration	dcx
Schema	smtx
Model definition	ommx

Table 40-1: VR-Vantage file extensions

File type	Extension
Element definitions (Entity definitions, Aggregate definitions, Tactical graphics definitions, Interaction definitions)	elem
Cockpit mapping	mhtx
Object type mapping	metx
Aggregate mapping	magx
Weapon fire mapping	mwfx
Detonation mapping	mdtx
Tactical graphics mapping	mtgx
CIGI mappings	mcsx
Environment	envx
Key mapping	kmpx
GUI layout	uisx
Entity display settings	edsx
Unit display settings	adsx
Tactical graphics display settings	tdsx
Observer settings	omcx
Cockpit display settings	mhsx
Intervisibility settings	invx
Render settings	mrsx
File cache settings	usdx
Interest management settings	misx
Loader settings	mlsx
Speedtree settings	forx

40.6. Specifying Display Units

You can specify the units used to display coordinate system, distance, altitude, and other measurements. Display units are configured by measurement type. This means that you can use different measurement units for different types of data. You can also specify the number of decimal places for measurement values. When you change a measurement display unit, the changes take effect immediately. They are saved and applied the next time you run VR-Vantage.



The following coordinate system and unit display information is independent of (and therefore not affected by) the settings described in this section:

- The coordinate system information for the observer location in the Observer Information Panel.
- Grid line coordinates, units, and precision.

The types of data and the display objects that they affect are as follows:

- Coordinate system
- Distance
- Altitude
- Velocity (speed)
- Acceleration
- Rotational velocity
- Orientation (heading).

Table 40-2 describes the coordinate systems that you can specify.

Table 40-2: Coordinate systems supported

Coordinate system	Description
Latitude/Longitude (degrees:minutes:seconds)	Location is displayed as two position fields and one altitude field. Displays coordinates in the latitude and longitude using the geodetic WGS84 coordinate system. Each angle is displayed in degrees:minutes:seconds with seconds displaying base 10 fractional seconds.
Latitude/Longitude (decimal radians	Location is displayed as two position fields and one altitude field. Position coordinates in the latitude and longitude using the geodetic WGS84 coordinate system. Each angle is displayed in decimal radians.
Geocentric	Location is displayed as three position fields. Position coordinates are displayed in the geocentric coordinate system. The position fields are always in meters.

Table 40-2: Coordinate systems supported

Coordinate system	Description
UTM	Location is displayed as two position fields and one altitude field. Position coordinates are displayed in the Universal Transverse Mercator system. The first position field displays the zone and the x location in meters. The second position field displays the y position in meters.
MGRS	Location is displayed as two position fields and one altitude field. Position coordinates are displayed in the Military Grid Reference System. The first position field displays the zone. The second position field displays the grid location. The precision controls the number of digits used in the grid display.
Database	Location is displayed as three position fields. Location is displayed using VR-Vantage's current internal cartesian database system. The position fields are displayed using the current distance units.

To specify measurement units:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Display Units Settings page (Figure 40-5).

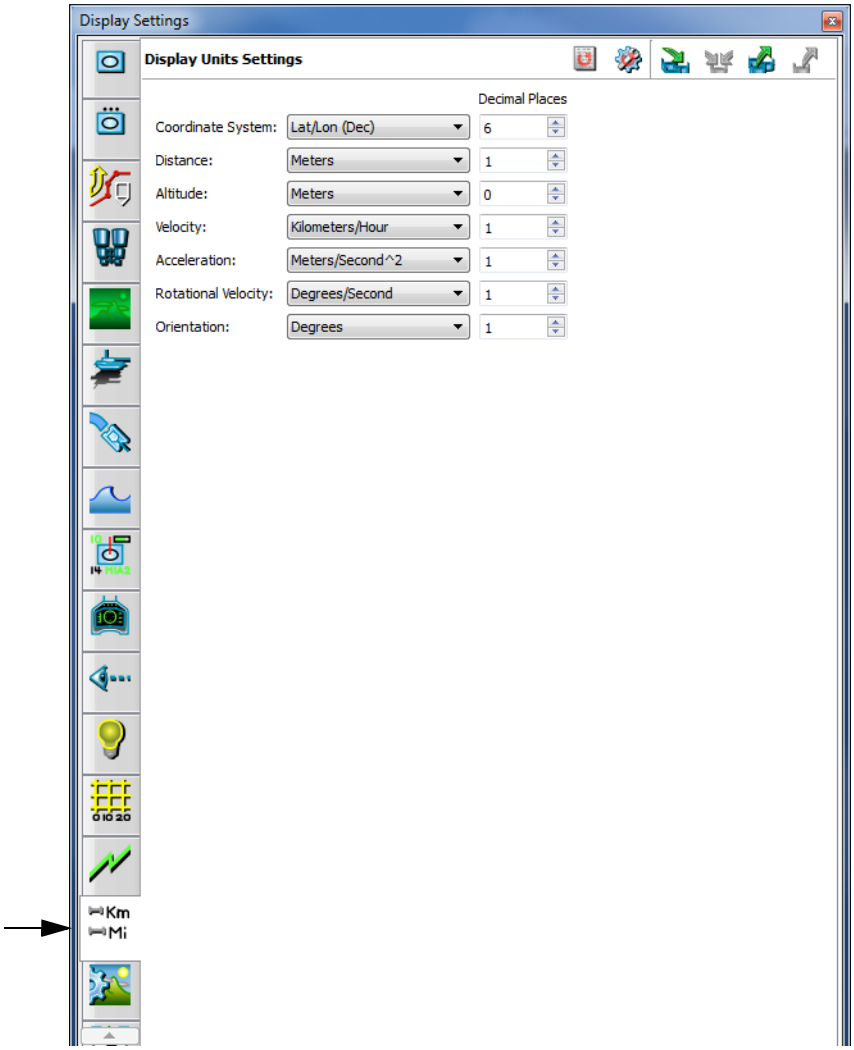


Figure 40-5. Display Units Settings page

3. Select the measurement unit you want for each option from its list.
4. Type a precision for each measurement unit in the corresponding box in the Decimal Places column.



41. Creating and Editing Key Mappings

This chapter explains how to edit key mappings and create new key mappings.

Introduction 41-2
The Key Mapping Editor 41-2
Binary Key Mappings 41-3
Editing a Key Map 41-3
Adding a Key Mapping 41-4
Changing a Key Mapping 41-5
Deleting a Key Mapping 41-6
Using Combined Key Mappings 41-7
Filtering the Function List 41-8
Creating a Key Map 41-8
Deleting a Key Map 41-8

41.1. Introduction

When you move the observer, you are actually executing functions that control the observer's movement. For example, the Move Observer Forward function moves the observer forward in observer coordinates. The Move Level Observer Forward function moves the observer forward in level observer coordinates.

The various movement functions are mapped to the keys on the keyboard and to mouse buttons and the mouse wheel.

VR-Vantage comes with key mappings that we think will meet the needs of most VR-Vantage users. However, you can edit the default keyboard mappings and create new mappings of your own with the Key Mapping Editor.

41.2. The Key Mapping Editor

The Key Mapping Editor (Figure 41-1) lists all of the functions that you can control from the keyboard and the keys to which they are mapped. Some functions are mapped to more than one key or key combination. A key can be mapped to more than one function (combined mappings). You can:

- Edit a function's key mappings.
- Add new mappings.
- Delete mappings.

Changes are saved automatically.

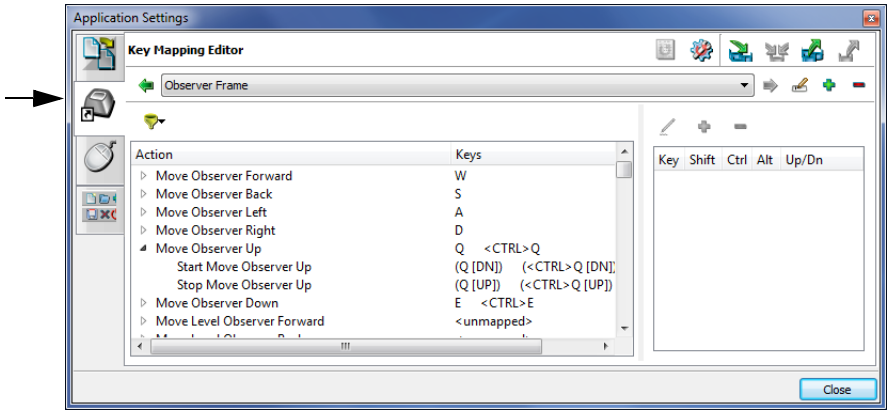


Figure 41-1. Key Mapping Editor

41.2.1. Binary Key Mappings

Many navigation functions require you to press and hold a key. For example, you press and hold **`W`** to move the observer forward. (By contrast some keyboard actions are toggles or unary functions, such as pressing period to attach to the next simulation object.) For these actions, VR-Vantage needs to keep track of when the key is pressed down (start the action) and when it is released (stop the action). To a human user, a function like Move Observer Forward is experienced as one action. But the computer experiences it as two actions. Therefore, key mappings must take this into account. The Key Mapping Editor shows the key mappings for these functions as paired functions that are subordinate (children) to the primary function (the parent), as shown in the Move Observer Up entry in Figure 41-1.

41.3. Editing a Key Map

The Key Mapping Editor lists all of the VR-Vantage functions that you can control from the keyboard.

To edit a key map:

1. Choose **Settings** → **Application**. The Application Settings dialog box opens.
2. Select the Key Mapping Editor page (Figure 41-1).
3. Select the function whose key mappings you want to edit.
4. Edit the key mappings as described in:
   - "Adding a Key Mapping," on page 41-4.
   - "Changing a Key Mapping," on page 41-5.
   - "Deleting a Key Mapping," on page 41-6.
5. Optionally, export the key map to a file.
6. Click OK.

41.3.1. Adding a Key Mapping

If a function is not mapped to a key, it is marked <unmapped>. You can add a mapping to unmapped functions and you can add additional key mappings to functions that are already mapped. If you add a key mapping to a binary function, the Key Mapping Editor automatically applies it to the child (UP and DN) functions. You can add key mappings to the child functions of binary mappings. When you add a key mapping to a child function, it is not applied to its paired function or the parent function.

In most cases, an unmapped function is unmapped because it is not meaningful in the observer frame for the key mapping. For example, the level observer movement functions are not meaningful in the observer frame key mappings.

To add a key mapping:

1. Optionally, filter the function list. For details, please see "Filtering the Function List," on page 41-8.
2. Select the function to which you want to add a key mapping.
3. Click the Add button (+) above the Key Map window (Figure 41-2). The Key Entry dialog box opens (Figure 41-3).

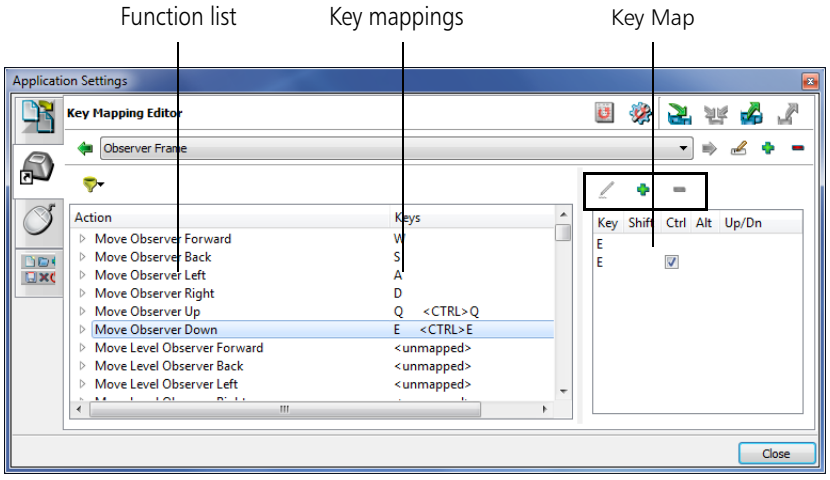


Figure 41-2. Key Mapping Editor

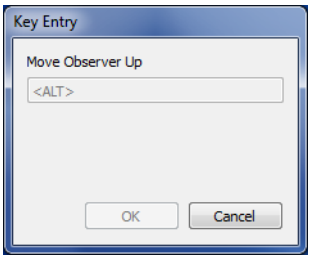


Figure 41-3. Key Entry dialog box

4. On the keyboard, press the key or key combination (such as **Ctrl**+key or **Shift**+key) that you want to map to this function.
5. Click OK. (If you choose a key combination that is already in use, VR-Vantage notifies you and asks how to proceed. For details about duplicate key mappings, please see "Using Combined Key Mappings," on page 41-7.) The mapping is added to the function and is listed in the Keys column of the function list and in the Key Map window.

41.3.2. Changing a Key Mapping

If a key mapping is assigned to a binary function, the key is automatically assigned to the child functions. You cannot edit the key mappings for the child functions. You can only change the parent's key mapping. However, if you add a key mapping to a child function, you can edit it.

To change a key mapping:

1. Select the function whose key mapping you want to change. Its key mappings get listed in the Key Map window (Figure 41-2).
2. In the Key Map window, select the key mapping that you want to change.
3. Click the Edit Key Mapping button (). The Key Entry dialog box opens (Figure 41-4). It shows the current key mapping.

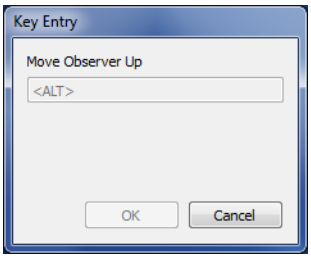


Figure 41-4. Key Entry dialog box

4. On the keyboard, press the key or key combination (such as **Ctrl**+key or **Shift**+key) that you want to map to this function.

5. Click OK. The mapping is changed.

41.3.3. Deleting a Key Mapping

To delete a key mapping:

1. Select the function whose key mapping you want to delete. Its key mappings get listed in the Key Map window (Figure 41-2).
2. In the Key Map window, select the key mapping that you want to delete.
3. Click the Delete button (−) above the Key Map window. The mapping is deleted. The function list is updated.

41.4. Using Combined Key Mappings

You can assign a key combination to more than one function. This allows you to combine the behaviors of two or more functions into one key combination. For example, the **Z** key detaches the observer from the attached simulation object. The **Space Bar** resets the observer view to the default view. Suppose that whenever you detach from a simulation object, you want the observer to return to the default view. You could map the Reset function to **Z**. **Z** is now mapped to two functions. When you press **Z**, VR-Vantage detaches from the attached simulation object and moves the observer to the default view.

To manage combined key mappings:

1. Add the appropriate key mapping to a function.
2. Click OK. The Key Already Mapped dialog box opens (Figure 41-5). It lists the functions that already use this key mapping.

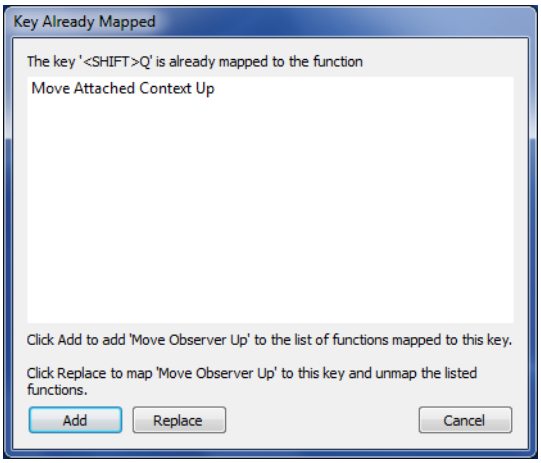


Figure 41-5. Key Already Mapped dialog box

3. If the functions listed are the ones with which you want to share this key mapping, click Add. The key mapping is added to the function.
4. If you do not want to share this key mapping with other functions and want to use it for the function that you are editing, click Replace. The key mapping is applied to the function you are editing and removed from the functions listed in the dialog box.
5. If you do not want to remove the key mapping from existing functions and do not want to share it with the other functions, click Cancel. Presumably you wanted a unique key mapping for the function you are editing and did not realize you chose one that was already in use. Choose a different key mapping for this function.

41.5. Filtering the Function List

You can filter the function list in the Key Mapping Editor. Functions are grouped thematically.

➤ To filter the function list, click the Filter button ( ) and select an option on the list.

41.6. Creating a Key Map

To create a key map:

1. Choose **Settings** → **Application**.The Application Settings dialog box opens.
2. Select the Key Mapping Editor page (Figure 41-1).
3. Click the Add button ( ). The Create New Key Map dialog box opens.
4. Type a name for the new key map.
5. Click OK.
6. Add key mappings for the movement actions as described in "Adding a Key Mapping," on page 41-4.

41.7. Deleting a Key Map

To delete a key map:

1. Choose **Settings** → **Application**.The Application Settings dialog box opens.
2. Select the Key Mapping Editor page (Figure 41-1).
3. In the key mapping list, select the key mapping that you want to delete.
4. Click the Delete button ( ).
5. Confirm that you want to delete the selected key map.



MÄK Products Glossary

This glossary defines terms used in MÄK product documentation.

absolute dead reckoning

A method of dead-reckoning in which an application uses the time stamps contained within state updates if the sender is using absolute time stamping. Contrast with relative dead reckoning.

aggregate

The combination of individual entities, aggregates, or both into a single object. For example, an organizational group such as a platoon.

API

Application Programming Interface.

articulated part

A part of an entity that is capable of movement relative to the entity, such as a turret or gun.

attached part

An object that is attached to another object, such as a rocket attached to a jet.

body coordinate frame

A coordinate framework centered on an entity. To represent the orientation of an entity, an application uses Euler angles or a rotation matrix that rotates from a reference frame to the body coordinate frame.

channel

A channel renders the view of an observer in a 3D visualization application.

clipping

A feature that prevents the display of terrain and objects or parts of objects, that are closer than or farther than specific distances from the observer.

clipping planes

The range of distances from the observer (near clipping and far clipping) in which an application clips objects.

culling

The process of discarding database objects which are not within view, and therefore need not be rendered and displayed.

Cartesian coordinates

A system for indicating location by means of three planes intersecting at right angles to one another at the origin.

Data Distribution Management

The set of HLA services used to specify the routing of data between publishers and subscribers. DDM adds greater control over the Declaration Management (DM) services that only specify filtering based on the class of the data (e.g., ground vehicle versus aircraft). DDM uses the data content to express regions of interest and regions of affect whose overlap establish a communication channel. An example is geographic filtering where a publisher indicates a region around the entity or effect and a subscriber indicates a region expressing its sensor range.

dead-reckoning

A process by which an application calculates the expected location of an entity during periods between state updates, based on velocity, acceleration, and rotational velocity.

DDM

Data Distribution Management.

Defense Modeling and Simulation Office

The former name of the executive secretariat for the Executive Council on Modeling and Simulation (EXCIMS), which provided a full-time focal point for information concerning Department of Defense modeling and simulation (M&S) activities. Renamed Modeling and Simulation Coordination Office. Currently the MSCO promulgates M&S policy, initiatives, and guidance to promote cooperation among DoD components to maximize efficiency and effectiveness.

DIS

Distributed Interactive Simulation.

DIS data packets

See Protocol Data Unit.

display engine

An object in an application that can render 3D data.

Distributed Interactive Simulation

The DIS protocol is a set of standards that govern how participating applications share information about the virtual world. The protocol specifies a set of packets, called protocol data units (PDUs), that communicate this information. Each PDU identifies the sender and contains other information depending on the PDU type. The DIS protocol also specifies when and how frequently PDUs are sent.

The DIS protocol has been superseded by the High-Level Architecture for use by the Department of Defense.

DMSO

See Defense Modeling and Simulation Office.

element definition

In VR-Forces and VR-Vantage, an element definition specifies all of the visualizers that control the various aspects of visualizing a scene element. For example, an element definition includes the main model or military symbology, trailing effects, cockpit displays, and so on.

emitter

A simulated device on an entity that emits electromagnetic radiation, for example, radar.

entity

An element in a simulation, such as a vehicle or a person, that is represented in the simulation through the issuance of state messages.

entity maintenance

A process by which the MÄK Data Logger compensates for discontinuities following a time jump. The Logger sends out interim state messages for entities that were present before the time jump so that they do not time out before the next update message arrives.

entity-type

A list of seven components as specified by the DIS protocol and the HLA RPR FOM. If none of the seven components contains a wildcard (-1) value, then the entity type refers to a specific, narrowly-defined entity. If some components contain a wildcard, then the entity type refers to a class of entities. A larger number of wildcards indicates a broader, more general class.

The components of an entity-type are:

- Entity kind
- Domain
- Country
- Category
- Subcategory
- Specific
- Extra.

environmental process

According to the IEEE 1278.1a specification (DIS), environmental process PDUs communicate simple environment variables, small scale environmental updates, and embedded processes.

Euler angles

A set of three angles used to describe the orientation of an entity as a set of three successive rotations about three different orthogonal axes (x, y, and z). These angles specify successive rotations needed to transform from a reference coordinate system to the entity's body coordinate system.

event

An interaction between objects or between an object and the terrain, such as firing of a munition, or a collision of entities.

exercise

The DIS term for a one or more interacting simulation applications. Compare to federation execution in HLA.

exercise connection

The object (*DtExerciseConn*) through which a VR-Link application connects to the network. State messages are sent through the exercise connection and information about remote entities is received through the exercise connection. (All MÄK products are VR-Link applications.)

exercise ID

A numeric identification for a DIS simulation exercise.

FED file

Federation Execution Data file. The Federation Execution Data is the subset of FOM data needed and read by the RTI. VR-Link applications also read the FED file.

federate

A connection to the RTI. Typically a single simulation application can be thought of as a federate.

federation

A group of HLA federates capable of playing in the same federation execution.

Federation Object Model

Defines the data content of a federation execution.

federation execution

The federation execution represents the actual operation, over time, of a subset of the federates and the RTI initialization data taken from a particular federation. A federation execution is the logical equivalent of a DIS simulation exercise.

field of view

Controls the perspective of the observer.

A wide field of view creates an effect like that of a wide-angle camera lens. Objects appear smaller and farther away from the observer, since the observer coverage spans a wider area. Depth become exaggerated.

A narrow field of view creates an effect like that of a telephoto lens. Objects appear larger and closer to the observer, and the overall scene depth appears flattened. The distances between objects appears compressed.

filter range

A setting that prevents distant entities from being processed while allowing distant terrain to appear normally.

FOM

See Federation Object Model.

FOM Module

In HLA Evolved, defines additional modular data content for a federation execution, usually extensions to an existing FOM. (Also supported by the HLA 1.3 and HLA 1516 versions of the MÄK RTI. Per the HLA Evolved interface specification:

"A partial FOM (containing some or all OMT tables) that specifies a modular component of a FOM. A FOM module may contain classes not inherent to it but upon which the FOM module depends, i.e., superclasses to the modular components. These superclasses will be included in the FOM module either as complete or scaffolding definitions."

frame rate

The rate at which the application displays updated images.

ground clamping

A process by which the a 3D visualization application keeps an entity anchored to the surface of its terrain database, regardless of the altitude data contained in its entity state message.

geocentric coordinates

A coordinate system calculated with respect to the earth's center. The origin of the geocentric coordinate system is the center of the earth. The positive X-axis passes through the prime meridian at the equator; the positive Y-axis passes through 90 degrees east longitude at the equator; and the positive Z-axis passes though the north pole.

geodetic coordinates

A coordinate system in which position is determined relative to a reference ellipsoid, such as the surface of the earth at sea level. In MÄK applications, geodetic coordinates consist of latitude and longitude in radians, and altitude in meters above the reference ellipsoid.

gridded data

Data that has been processed in a rectangular array of points, in X, Y or latitude/longitude, at which single data values define a two dimensional function. According to the IEEE 1278.1a specification, gridded data transmits information about large-scale or high-fidelity spatially and temporally varying ambient fields and about environmental processes and features.

guise

An alternative entity type used to display an object depending on the force ID. For example, a tank could look like an M1A1 to friendly forces and a T72 to hostile forces.

head-up display

A set of indicators and readouts superimposed onto a graphics display. Also called an overlay.

heartbeat

In DIS, the frequency with which current PDUs are sent to the network regardless of whether or not the entity's state has changed.

High-Level Architecture

The High Level Architecture (HLA) for simulations is a U. S. Department of Defense (DOD)-wide initiative to provide an architecture to support interoperability and reuse of simulations. The HLA supersedes DIS for the DOD.

HLA

See High-Level Architecture.

interaction

A message describing a simulation event. An interaction describes an event, it does not update an object's state.

Logger control PDUs

A set of DIS PDUs or HLA interactions that let you control the MÄK Logger remotely.

logical range

A suite of TENA Resources, sharing a common object model, that work together for a given range event. Similar in concept to the HLA Federation.

Local RTI Component

The libraries on a computer that implement an RTI. A federate communicates with the HLA network through the LRC.

LRC

See Local RTI Component.

MÄK Technologies Lisp

An adaptation of the Lisp language used in configuration files for MÄK products.

message

A general term used to refer to DIS PDUs and HLA interactions and state updates. In TENA, a message is similar to an HLA interaction.

MIM

The MOM & Initialization Module (MIM) allows for extensions to be made to the HLA standard MOM. It is a subset of the FOM that contains OMT tables that describe the HLA MOM. The MIM also contains additional predefined HLA constructs such as object and interaction roots, data types, transportation types and dimensions. HLA specifies a standard MIM that is incorporated into all FDDs automatically by the RTI. The standard MIM can be replaced with a user-supplied MIM containing the standard MIM plus extensions.

model definition

In VR-Forces and VR-Vantage, a model definition specifies the 3D model and other basic attributes of a model. It is referenced by an element definition.

Modeling and Simulation Coordination Office

The executive secretariat for the Executive Council on Modeling and Simulation (EXCIMS), which provided a full-time focal point for information concerning Department of Defense modeling and simulation (M&S) activities. The MSCO promulgates M&S policy, initiatives, and guidance to promote cooperation among DoD components to maximize efficiency and effectiveness. (Formerly DMSO)

MSCO

Modeling and Simulation Coordination Office. (Formerly DMSO.)

MTL

See MÄK Technologies Lisp.

orientation clamping

Adjusts the pitch and roll of an entity so that it appears properly seated when the terrain is inclined. For example, if a tank is moving horizontally across the face of a hill, orientation clamping prevents the tank from appearing level, and therefore, partially embedded into the hillside. Used with ground clamping.

object

An element in a simulation that has persistence, as opposed to an interaction, which is a transient element.

object handle

An integer that an application uses to identify a particular object in RTI service calls. An object handle is meaningful only to a particular federate. The same object can be known to different federates by different object handles.

object name

A character string that can be used to identify an object. In HLA, the object name is known to the RTI, and the RTI provides functions to find out an object's name, given its handle, and vice versa. Object names can be chosen by applications that register the objects with the RTI, however if you do not want to choose names for objects, the RTI will assign names for you.

observer

In MÄK 3D applications, the point of view into the scene. (Called the eyepoint in MÄK Stealth 6.x and earlier.)

PDU

See Protocol Data Unit.

Protocol Data Unit

A unit of data message (packet) that is passed on a network between DIS simulation applications.

radio transmitter

A simulated device on an entity, capable of transmitting radio communications.

radio receiver

A simulated device on an entity, capable of receiving radio communications.

Realtime Platform Reference FOM

An HLA reference FOM based on the DIS protocol.

recording

A Data Logger file that stores a history of the interactions in a simulation for playback.

reflected entity list

A list of entities simulated by remote applications (federates in HLA) and about which the local simulation has received information over the network.

reference FOM

A FOM designed to be used as a whole, or with modification, by a wide variety of similar federation executions.

relative dead reckoning

A method of dead reckoning in which an application approximates the location of an object based on the local time of receipt of the last state update message.

remote display engine

A display engine running in an application that is separate from the master application, and which is controlled by the master application.

RID file

See RTI Initialization Data.

RTI Initialization Data

The initialization data required by the RTI for operation.

Data required by an RTI during initialization, independent of the FOM being used. RID data is usually dependent on a specific implementation of the RTI.

RPR FOM

See Realtime Platform Reference FOM.

RTI

See Run-Time Infrastructure.

Run-Time Infrastructure

A library and other supporting software that implements the HLA interface specification. All federates communicate with one another in an HLA environment through RTI functions.

scene element

In VR-Vantage and VR-Forces, any object that is rendered in the scene, such as an entity model, interaction, or tactical graphic.

Simulation Interoperability Standards Organization

A group that seeks to promote modeling and simulation interoperability and reuse for the benefit of diverse M&S communities, including developers, procurers, and users, world-wide.

simulation time

In VR-Forces, simulation time is used in dead-reckoning of remote entities and thresholding of local entities. Typically, simulation time is set once during each iteration of the application's main simulation loop so that all entities are dead-reckoned based on the same value of current time.

SISO

See Simulation Interoperability Standards Organization.

smooth period

The period of time over which trajectory smoothing takes place.

smoothing

A method of ensuring that transitions from an entity's dead-reckoned position to its actual position are not so abrupt as to be visually disconcerting.

state

The current status of an object, including location, direction of movement, extent of damage, and so on.

tape

An alternative term for a Logger recording. Not a physical magnetic tape.

terrain following

In a 3D visualization application, causes the observer (eyepoint) to maintain a constant distance above the terrain surface. The observer's height changes in tandem with the peaks and valleys as it passes over the geography.

timeout

The period of time in which an application continues to display an entity after that entity's update messages have stopped appearing on the network. Time-outs are usually not used in HLA because there is no set frequency (no heartbeat) for transmitting messages.

timescale

A factor by which time is accelerated or slowed during playback of a Data Logger recording.

topographic coordinates

A right-handed Cartesian coordinate system whose X-Y plane is tangent to the earth's surface at the origin, with the positive X axis pointing north, the positive Y axis pointing east, and the positive Z axis pointing down. There are an infinite number of topographic coordinate systems – one for each point on the earth's surface.

topographic coordinate frame

A coordinate frame in the context of the terrain.

trajectory smoothing

A method used by to smooth positional discontinuities that could occur when new state updates arrive.

UDP port

A network channel through which an application sends and receives data for DIS exercises.

Universal Transverse Mercator

In general, a non-cartesian coordinate system in which the X, Y, and Z correspond to easting (nearly east), northing (nearly north), and height above an ellipsoid that approximates the surface of the earth.

UTM

See Universal Transverse Mercator.

view control messages

A set of programmatic messages that let you control the view in VR-Vantage applications remotely.



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VR-Vantage Quick Reference Card

Table QR-1: Command-Line Options

Option	Description
(-- | --ignore_rest)	Ignore all command-line options after this one.
--alphaBits *bits*	Sets the number of alpha bits (0, 8).
--antiAliasing *level*	Set the anti-aliasing level (0, 2, 4, 8, or 16). Default: 4.
--appDataDir *directory*	Specifies the location of application data.
-B | --bindObservers *"observer1, observern,saved_views_file"*	Assigns the views in the specified saved view file to the observers in the order that the observers are listed in the command. Must also specify terrain file. For multiple observers, must specify display engine configuration with --dispSetting.
(-c | --showConsole)	Display a console window.
(-C | --autoConnect) {*filename* | *connector_name*}	Automatically connect to the network using the specified connector.
--dataDir *directory*	Specifies the location of the data directory .
--depthBits *bits*	Sets the depth of graphics to 24 bits or 32 bits. Default: 24.
--displayEnginePort *port*	Specifies the display engine port used by a remote display engine. Used only if --slave is specified.
--dispSetting *filename*	Specifies the display engine configuration to load.
--enableOculus	Enable support for the Oculus Rift HMD. Implies --noVSync.
--entDispSetting *filename*	Specifies the entity display setting to load.
--envSetting *filename*	Specifies the environment configuration file to load.
(-E | --entTypeMap) *filename*	Load the specified entity type mapping file. The file extension determines the type of mapping.
--factoryRootDir	Set the root directory used to restore settings to factory defaults.
--fullScreen	Start in full screen mode.
(-F | --frameRate) *rate*	Specifies a fixed frame rate for rendering. If 0, it is variable.
(-G | --locale) *language*	Specifies the locale (for localization).
--gui *filename*	Specify GUI configuration file to load.
(-h | --help)	Displays command-line usage information.
--highestPriority	Changes application and the main render thread to the highest available priority.
(-I | --unbatchedRendering)	Disables instance rendering.
(-K | --disableKDTrees)	Disable creation of KD trees for intersections.
(-l | --logFileName) *filename*	Specifies the log file name.
(-L | --loadObservers) *filename*	Loads the saved observers in the specified file. Can be used multiple times.
(-n | --notifyLevel) *notify_level*	Specifies the notification level for application messages. Range: 0-4.
--noGui	Start without the graphical user interface.
--noVSync	Disables vsynched windows.
(-O | --hasNTPSync)	Enables synchronized ocean between different display engines. System clocks must be synchronized.
--plugin *filename*	Load the specified plug-in. Can be used multiple times.

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Table QR-1: Command-Line Options

Option	Description
`--pseudoFullScreen`	Use pseudo full screen for full screen mode.
`(-s | --slave)`	Run as a remote display engine.
`(-S | --suppressHatIntersectOnAttach)`	Suppress the periodic HAT intersection when attached.
`--stencilBits` *bits*	Sets the number of stencil bits (0 or 8). Default: 0.
`--tcpSendTimeout`	Sets the timeout (in seconds) for the master display engine to wait for a remote display engine before giving up on a send. Default: 30 seconds.
`(`*terrain_MTF_file* `|` *scene_MSF_file*`)`	Specifies a terrain (MTF) or scene (MSF) file to load.
`--unplug` *filename*	Do not load the specified plug-in. Can be used multiple times.
`--userDataDir` *directory*	Specifies the user data directory.
`(-v | --version)`	Display version information and exit.
`-W | --withDisplayEngine` *port@netAddress;displayConfigFile name1 .... n* `-W | --withDisplayEngine` *port@netAddress:displayConfigFile name1 .... n*	Connect to a display engine running in subordinate mode on another computer. On Windows, use a semi-colon (;). On Linux, use a colon (:).
`(-Z | --ignoreZoomForSpeedtreeLod`	Disable zoom for SpeedTree LOD.

Table QR-2: Mouse Button Mappings

Navigation Action	Mouse Action	Context
Attach to entity.	**Shift** + left-click	Entity.
Attach to prop.	**Ctrl** + **Shift** + left-click	Prop.
Deselect all.	Left-click	Terrain or sky.
Drag terrain.	Left-click + drag	Terrain or prop.
Object selected, others unselected.	Left-click	Selected entity or prop.
Select entity or prop.	**Ctrl** + left-click	Unselected entity or prop.
Select object and unselect all others.	Left-click	Unselected entity or prop.
Teleport to location.	**Shift** + left-click	Terrain.
Teleport to prop.	**Shift** + left-click	Prop.
Teleport to entity.	**Ctrl** + **Shift** + left-click	Entity.
Unselect.	**Ctrl** + left-click	Selected entity or prop.
Display context-sensitive menu.	Right-click	Entity or prop.
3D Only		
Drag the view.	Middle mouse button drag	All.
Drag heading and pitch (mouse look).	Right Drag	All.
Orbit drag.	**Ctrl** + left-click + drag	Terrain or prop.
Zoom in (magnification).	**Ctrl** + mouse wheel forward	All.
Zoom out (magnification).	**Ctrl** + mouse wheel backward	All.
Reset magnification.	Middle mouse button	All.
Move observer forward.	Mouse wheel forward	All.
Move observer back.	Mouse wheel back	All.

Table QR-2: Mouse Button Mappings

Navigation Action	Mouse Action	Context
Move observer level observer forward.	**Shift** + mouse wheel forward.	All.
Move observer level observer backward.	**Shift** + mouse wheel backward.	All.
Move flashlight beam.	Right mouse button drag	All.
Expand flashlight beam.	**Alt** + mouse wheel forward.	All.
Contract flashlight beam.	**Alt** + mouse wheel backward.	All.
2D Only		
Rotate terrain.	Right-click + drag	All. Orient North disabled.
2D Zoom in.	Mouse wheel forward; Middle button + drag	All.
2D Zoom out.	Mouse wheel backward; Middle button + drag	All.

K = numeric keypad (K8 means press Keypad 8). To use the numeric keypad for navigation, NumLock must be on.

Table QR-3: Observer Keyboard Mappings

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Move forward.	**w**	unmapped	**w**	unmapped
Move back.	**s**	unmapped	**s**	unmapped
Move left.	**a**	unmapped	**a**	unmapped
Move right.	**d**	unmapped	**d**	unmapped
Move up.	**q**, **Ctrl** + **q**	unmapped	**q**, **Ctrl** + **q**	unmapped
Move down.	**e**, **Ctrl** + **e**	unmapped	**e**, **Ctrl** + **e**	unmapped
Move forward level observer.	unmapped	**w**	unmapped	**w**
Move back level observer.	unmapped	**s**	unmapped	**s**
Move left level observer.	unmapped	**a**	unmapped	**a**
Move right level observer.	unmapped	**d**	unmapped	**d**
Move up level observer.	unmapped	**q**, **Ctrl** + **q**	unmapped	unmapped
Move down level observer.	unmapped	**e**, **Ctrl** + **e**	unmapped	unmapped
Move attached context forward.	**Shift** + **w**	**Shift** + **w**	**Shift** + **w**	**Shift** + **w**
Move attached context back.	**Shift** + **s**	**Shift** + **s**	**Shift** + **s**	**Shift** + **s**
Move attached context left.	**Shift** + **a**	**Shift** + **a**	**Shift** + **a**	**Shift** + **a**
Move attached context right.	**Shift** + **d**	**Shift** + **d**	**Shift** + **d**	**Shift** + **d**
Move attached context up.	**Shift** + **q**	**Shift** + **q**	**Shift** + **q**	unmapped
Move attached context down.	**Shift** + **e**	**Shift** + **e**	**Shift** + **e**	unmapped
Level yaw left.	K **4**	K **4**	Left arrow	Left arrow
Level yaw right.	K **6**	K **6**	Right arrow	Right arrow
Level pitch up.	**Shift** + **j**	**Shift** + **j**	**Shift** + **j**	unmapped

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Table QR-3: Observer Keyboard Mappings

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Level pitch down.	**Shift** + **k**	**Shift** + **k**	**Shift** + **k**	unmapped
Level roll right.	**Shift** + **i**	**Shift** + **i**	**Shift** + **i**	unmapped
Level roll left.	**Shift** + **m**	**Shift** + **m**	**Shift** + **m**	unmapped
Yaw left.	**Shift** + **h**	**Shift** + **h**	**Shift** + **h**	**Shift** + **h**
Yaw right.	**Shift** + **l**	**Shift** + **l**	**Shift** + **l**	**Shift** + **l**
Pitch up.	K **8**	K **8**	↑	unmapped
Pitch down.	K **2**	K **2**	↓	unmapped
Roll right.	K **9**	K **9**	K **9**	unmapped
Roll left.	K **3**	K **3**	K **3**	unmapped
Orbit right.	**Ctrl** + **d**, →	**Ctrl** + **d**, →	**Ctrl** + **d**	unmapped
Orbit left.	**Ctrl** + **a**, ←	**Ctrl** + **a**, ←	**Ctrl** + **a**	unmapped
Orbit up.	**Ctrl** + **w**, ↑	**Ctrl** + **w**, ↑	**Ctrl** + **w**	unmapped
Orbit down.	**Ctrl** + **s**, ↓	**Ctrl** + **s**, ↓	**Ctrl** + **s**	unmapped
Look up.	**Ctrl** + K **8**	**Ctrl** + K **8**	**Ctrl** + K **8**	**Ctrl** + K **8**
Look down.	**Ctrl** + K **2**	**Ctrl** + K **2**	**Ctrl** + K **2**	**Ctrl** + K **2**
Look left.	**Ctrl** + K **4**	**Ctrl** + K **4**	**Ctrl** + K **4**	**Ctrl** + K **4**
Look right.	**Ctrl** + K **6**	**Ctrl** + K **6**	**Ctrl** + K **6**	**Ctrl** + K **6**
Look tilt left.	**Ctrl** + K **3**	**Ctrl** + K **3**	**Ctrl** + K **3**	**Ctrl** + K **3**
Look tilt right.	**Ctrl** + K **9**	**Ctrl** + K **9**	**Ctrl** + K **9**	**Ctrl** + K **9**
Zoom In	unmapped	unmapped	unmapped	**Ctrl** + **e**
Zoom Out	unmapped	unmapped	unmapped	**Ctrl** + **q**
Suppress constrain to terrain.	**x**	**x**	**x**	**x**
Water Impact	unmapped	unmapped	unmapped	unmapped
Reset observer:	**Space**	**Space**	**Space**	**Space**
In absolute mode, go to the center of the scene. If attached, reset the attach position and orientation.				
Toggle Speed Scaling Mode (MSL or AGL)	unmapped	unmapped	unmapped	unmapped
Level observer.	K **5**	K **5**	**Shift** + **Space** + ↓	K **5**
Toggle Force North Orientation	unmapped	unmapped	unmapped	unmapped
Toggle Orient To Target Constraint	unmapped	unmapped	unmapped	unmapped
Toggle Flashlight	**F**	**F**	**F**	**F**
Reset the camera.	K **0**	K **0**		K **0**
Increase View Magnification	**=**	**=**	**=**	unmapped
Decrease View Magnification	**–**	**–**	**–**	unmapped
Reset View Magnification	**0**	**0**	**0**	unmapped
Increase View Resolution	unmapped	unmapped	unmapped	**=**
Decrease View Resolution	unmapped	unmapped	unmapped	**–**
Detach.	**z**	**z**	**z**	**z**
Toggle Hide Model On Attach	unmapped	unmapped	unmapped	unmapped

Table QR-3: Observer Keyboard Mappings

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Attach to the next entity allowed by the attachment filter.	Period (**.**)	Period (**.**)	Period (**.**)	Period (**.**)
Attach to next entity or prop.	**>**	**>**	**>**	**>**
Attach to the previous entity allowed by the attachment filter.	Comma (**,**)	Comma (**,**)	Comma (**,**)	Comma (**,**)
Attach to previous entity or prop.	**<**	**<**	**<**	**<**
Set Mimic Attach Type	unmapped	unmapped	unmapped	unmapped
Set Tether Attach Type	unmapped	unmapped	unmapped	unmapped
Next attach mode.	**Shift**+**z**	**Shift**+**z**	**Shift**+**z**	**Shift**+**z**
Increase linear speed.	K **7**	K **7**	K **7**	K **7**
Decrease linear speed.	K **1**	K **1**	K **1**	K **1**
Increase orbit speed.	K **+**	K **+**	K **+**	K **+**
Decrease orbit speed.	K **–**	K **–**	K **–**	K **–**
Increment Rotation Speed Gain	unmapped	unmapped	unmapped	unmapped
Decrement Rotation Speed Gain	unmapped	unmapped	unmapped	unmapped
Toggle speed scaling on or off.	K *****	K *****	K *****	K *****
Toggle Prop Transparency	**T**	**T**	**T**	**T**
Toggle Terrain Scaling	unmapped	unmapped	unmapped	unmapped
Increment Terrain Scale	unmapped	unmapped	unmapped	unmapped
Decrement Terrain Scale	unmapped	unmapped	unmapped	unmapped
Toggle Track Histories	unmapped	unmapped	unmapped	unmapped
Toggle Entity Labels	**L**	**L**	**L**	**L**
Toggle Rotate Entity Symbols	unmapped	unmapped	unmapped	unmapped
Toggle Tactical Graphics	**Shift**+**G**	**Shift**+**G**	**Shift**+**G**	**Shift**+**G**
Toggle Entity Height Above Terrain Lines	unmapped	unmapped	unmapped	unmapped
Toggle Tactical Graphics HAT Lines	unmapped	unmapped	unmapped	unmapped
Toggle Entity Height Above Terrain Mode	unmapped	unmapped	unmapped	unmapped
Toggle Tactical Graphics Height Above Terrain Mode	unmapped	unmapped	unmapped	unmapped
Toggle constrain to terrain on or off.	**/**	**/**	**/**	**/**
Toggle Constrain To Center	**U**	unmapped	unmapped	unmapped
Clear the current movement mode. This key is an escape mechanism if keys are not behaving as you expect. This is typically due to a loss of the window context.	**c**	**c**	**c**	**c**
Next Observer Mode	**]**	**]**	**]**	**]**
Previous Observer Mode	**[**	**[**	**[**	**[**
Toggle view controls on or off.	**Shift**+**c**	**Shift**+**c**		**Shift**+**c**

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Table QR-3: Observer Keyboard Mappings

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Clear All Trajectory Histories.	unmapped	unmapped	unmapped	unmapped
Toggle OSG Framerate statistics	**F2**	**F2**	**F2**	**F2**
Print OSG statistics	**Shift** + **[**	**Shift** + **[**	**Shift** + **[**	**Shift** + **[**



Link - Simulate - Visualize

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