

VR-Vantage

Users Guide

VR-Vantage Stealth
VR-Vantage IG
VR-Vantage XR
VR-Vantage PVD

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 and configure VR-Vantage and persons who will 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 as follows:

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.

Chapter 4, *VR-Vantage Concepts* explains VR-Vantage concepts that you should understand before you read other chapters in this manual.

Chapter 5, *Composing Terrains*, explains how load terrains and how to build composable terrains and scenes.

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, *Scenes and Environmental Effects*, explains how to configure the environment, including date and time, clouds, and precipitation.

Chapter 8, *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 9, *Moving the Observer*, explains how to navigate the observer through the 2D and 3D scenes.

Chapter 10, *Attaching the Observer*, explains attach modes and how to attach the observer to entities and props.

Chapter 11, *Viewing Entities and Entity Effects*, explains how to select entities. It also describes inset views, ground clamping, smoothing and entity related graphics, such as trailing effects and decal effects.

Chapter 12, *Aggregate Entities* explains how to manage the display of aggregate entities.

Chapter 13, *Intervisibility Objects* explains how to create and configure intervisibility objects.

Chapter 14, *Tactical Graphics and Remote Graphics* explains how to manage tactical graphics and remote graphics.

Chapter 15, *Using VR-Vantage XR* describes features that only apply to VR-Vantage XR.

Chapter 16, *Mapping Models and Effects*, explains how to map 3D models to objects and effects.

Chapter 17, *Model and Element Definitions*, explains how to create and edit schemas, model definitions, and element definitions.

Chapter 18, *Mapping CIGI Models and Components*, explains how to map CIGI models and components, which are different from the mappings used for DIS and HLA.

Appendix A, *Terrain Tutorials*, has tutorials that show how to create a terrain and how to configure a terrain server using local data.

Appendix B, *Model Tutorials*, has tutorials that show how to add an entity model and how to add a SpeedTree.

Appendix C, *Display Engine Tutorials*, shows how to create display engine configurations, save them, and load them.

Appendix D, *CIGI Host Emulator Tutorial*, shows how to use the CIGI host emulator with VR-Vantage.

Appendix E, *Creating and Editing Key Mappings*, explains how to use the Key Map Editor to create and edit key maps for keyboard navigation.

Appendix F, *The VR-Vantage User Interface* describes some of the basic features of the VR-Vantage graphical user interface (GUI).

Appendix G, *Managing Network Connections*, explains how to configure network connections.

Appendix H, *CIGI Packets Supported*, lists CIGI packets and the extent to which they are supported by VR-Vantage.

Appendix I, *The WRM Specification (DIS Notes)*, explains the model specification for articulated parts.

Appendix J, *Processing MetaFlight Files*, explains how to process MetaFlight files so that you can open them in VR-Vantage.

MÄK Products Glossary defines DIS, HLA, and TENA 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 Developers Guide* explains how to use the VR-Vantage Toolkit API.
- *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*.
- Class reference documentation in HTML format. You can open the class documentation from the Windows Start menu on the VR-Vantage Documentation submenu or by opening *./vrvantage1.3/doc/reference/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 local entities, aggregate them into hierarchical units, assign tasks, set state parameters, and create plans that have tasks, set statements, and conditional statements. VR-Forces also functions as a plan view display for viewing remote entities 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 four end-user applications (VR-Vantage Stealth, VR-Vantage XR, VR-Vantage PVD, and VR-Vantage IG), the VR-Vantage Toolkit, and VR-Vantage FreeView.
  - VR-Vantage Stealth displays a realistic, 3D view of your virtual world. You can view this world from the inside of a simulated moving vehicle, or place the eyepoint at another moving or stationary location. The Stealth lets you switch rapidly among several predefined viewpoints while the simulation is underway.
  - 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 XR provides a common operational picture using the same 3D views as VR-Vantage Stealth, 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.
  - VR-Vantage PVD provides a 2D plan view display. It gives you the big picture of the simulated world.
  - 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.
  - VR-Vantage Free View is a terrain and 3D model viewer that introduces some of the features of VR-Vantage applications in a useful, free utility.
- 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.

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:	vrv-support@mak.com

Internet

MÄK web site home page:	www.mak.com
License key requests:	www.mak.com/support/licenses.php
Product version and platform information:	www.mak.com/support/productversions.php
For the free, unlicensed MÄK RTI:	www.mak.com/products/rti.php
Support FAQ:	www.mak.com/support/faq.php

Post

Send postal correspondence to:	VT MÄK 68 Moulton St. Cambridge, MA, USA 02138

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.
`{ }`	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 UNIX 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**.
	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.x/doc* appears in the text as *./doc.*

Hardware and Operating System Naming Conventions

Unless otherwise specified, references to UNIX include Linux, regardless of the type of computer it is running on. References to PCs refer to Intel processor-compatible computers running a version of Microsoft Windows.

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 popup 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 which 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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The copyright notices in the Software and this entire statement, including the above license grant, this restriction and the following disclaimer, must be included in all copies of the Software, in whole or in part, and all derivative works of the Software, unless such copies or derivative works are solely in the form of machine-executable object code generated by a source language processor.

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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/

pThreads Library

VR-Exchange links with the pThreads win32 library. The library is distributed under the GNU Lesser General Public License (LGPL). MÄK has made no modification to this library. For information about the pThreads win32 library please see: http://sourceware.org/pthreads-win32/

EHS, PCRE, and PME

The MÄK RTI links with the EHS, PCRE, and PME libraries. These libraries are distributed under the GNU Lesser General Public License (LGPL). MÄK has made modification to these libraries only to allow them to compile on the supported platforms. For more information about these libraries please see the following web sites:

- EHS: http://xaxxon.slackworks.com/ehs/
- PCRE: http://www.pcre.org/
- PME: http://xaxxon.slackworks.com/pme/index.html

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

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 1-9 for details.



1 Introduction to VR-Vantage

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

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1.1. The VR-Vantage Product Line

VR-Vantage is VT MÄK's line of visualization products. It is designed to meet your needs for visualizing the simulated battlefield. 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 3D information station. It is optimized for customers who need a 3D environment for situational awareness, simulation debugging, or after action review. 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.
- VR-Vantage XR. VR-Vantage XR (for eXaggerated Reality) combines the 3D capabilities of VR-Vantage Stealth with the 2D plan view display of VR-Vantage PVD. Then it adds 3D colorized models to provide both an immersive 3D experience and a common operational picture of the simulated world.
- VR-Vantage FreeView. VR-Vantage FreeView is a free terrain and 3D model viewer that introduces customers to some of the features of VR-Vantage while providing some useful functionality. VR-Vantage FreeView is not documented in this manual. For more information, please see the VR-Vantage FreeView First Experience Guide and VR-Vantage FreeView online help.



- The VR-Vantage applications share many features in common. Therefore, for simplicity, in his manual we use the term VR-Vantage to refer generically to the VR-Vantage applications when we describe common features.
- Screen captures of dialog boxes are usually taken from VR-Vantage XR, and they 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 *VR-Vantage Developers Guide*.

Table 1-1 lists VR-Vantage features supported by different VR-Vantage applications.

Table 1-1: VR-Vantage features by application

Feature	Stealth	IG	XR	PVD
3D projection	X	X	X	
2D projection			X	X
Model sets				
3D models	X	X	X	
3D colorized models			X	
2D icons			X	X

Table 1-2 lists VR-Vantage features supported in the 3D and 2D projections.

Table 1-2: VR-Vantage features by projection (Sheet 1 of 2)

Feature	3D	2D
Terrain agility and composability	X	X
Attach modes	X	X
Observer movement modes		
Observer frame	X	X
Level observer frame	X	
Laptop	X	X
2D level observer frame		X
Model sets		
3D models	X	X (XR only, top view)

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)

Table 1-2: VR-Vantage features by projection (Sheet 2 of 2)

Feature	3D	2D
3D colorized models	X	X (XR only, top view)
2D icons	X (XR only)	X
SpeedTrees	X	
Cockpit displays	X	
DI-Guy characters	X	
Environment effects	X	
Track histories	X	X
View controls	X	X
Remote draw API	X	X (2D graphics only)
Trailing effects	X	
Sensor volumes	X	X
Intervisibility	X	X
Entity labels	Text panels	Configurable symbol decorations
Detonation and muzzle flashes	X	
Fire and detonation lines	X	X
Wireframe view	X	X
Paged terrain	X	X
Streaming terrain	X	X

1.1.1. VR-Vantage Product Licensing

Each VR-Vantage product is sold separately; however, the VR-Vantage Stealth and VR-Vantage XR products include a license to run VR-Vantage IG. Please contact your MÄK salesperson for details.

1.2. VR-Vantage Features

VR-Vantage XR, Stealth, and IG deliver a realistic, three-dimensional view of terrain, vehicles, and other objects. 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.

VR-Vantage XR and PVD provide a two-dimensional plan view-style display.

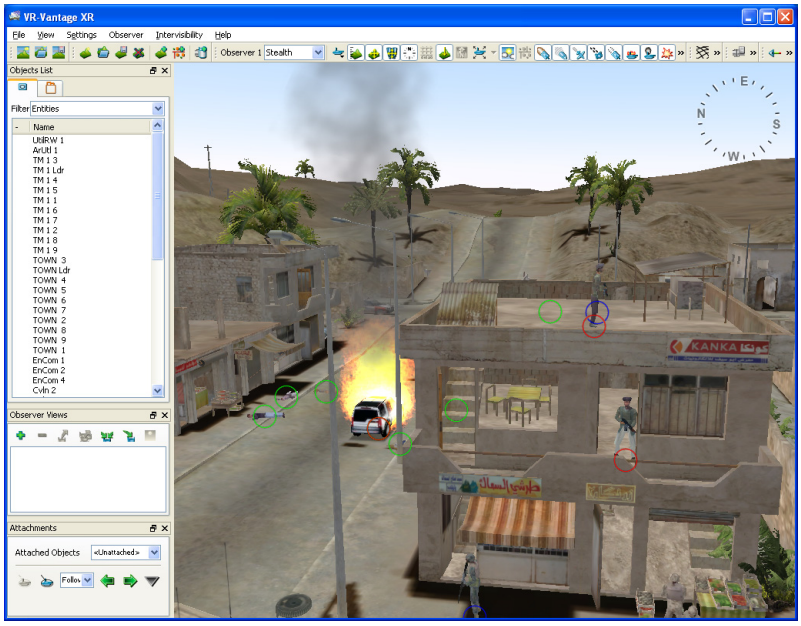


Figure 1-1. VR-Vantage XR 3D

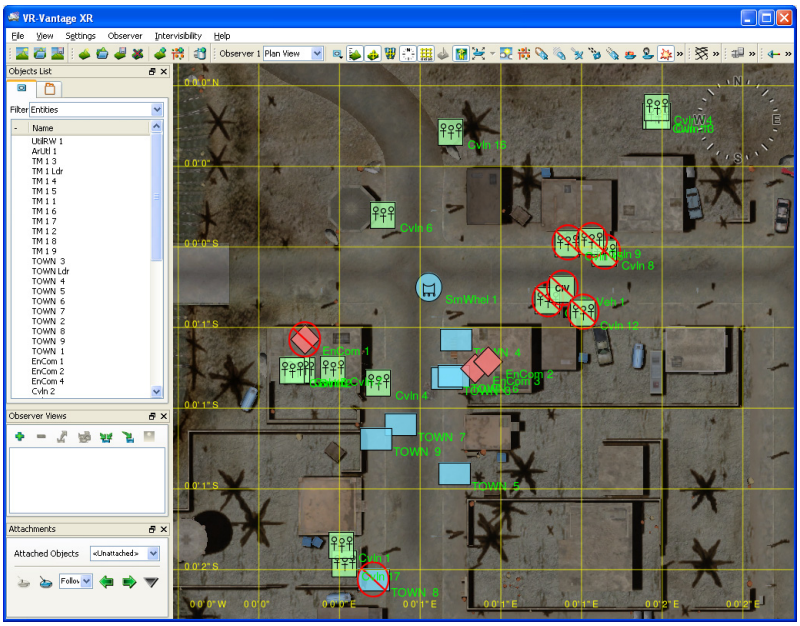


Figure 1-2. VR-Vantage XR 2D

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.

1.2.1. 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 and the current draft of the IEEE 1516 C++ API maintained by the SISO Dynamic Link Compatible RTI API Product Development Group. 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, and 6.
- 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.

1.2.2. 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 Chapter 5, *Composing Terrains*. For details about models, please see Chapter 16, *Mapping Models and Effects*.

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 7, *Scenes and Environmental Effects*.

1.2.3. 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 9, *Moving the Observer*.

1.2.4. 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 11-14 and "Using Ground Clamping," on page 11-11.

1.2.5. eXaggerated Reality (XR)

VR-Vantage XR supports all of the 3D features of VR-Vantage Stealth and all of the 2D features of VR-Vantage PVD. Then it adds the XR model set to enhance your ability to understand the layout of forces in the 3D projection. The 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 15, *Using VR-Vantage XR*.

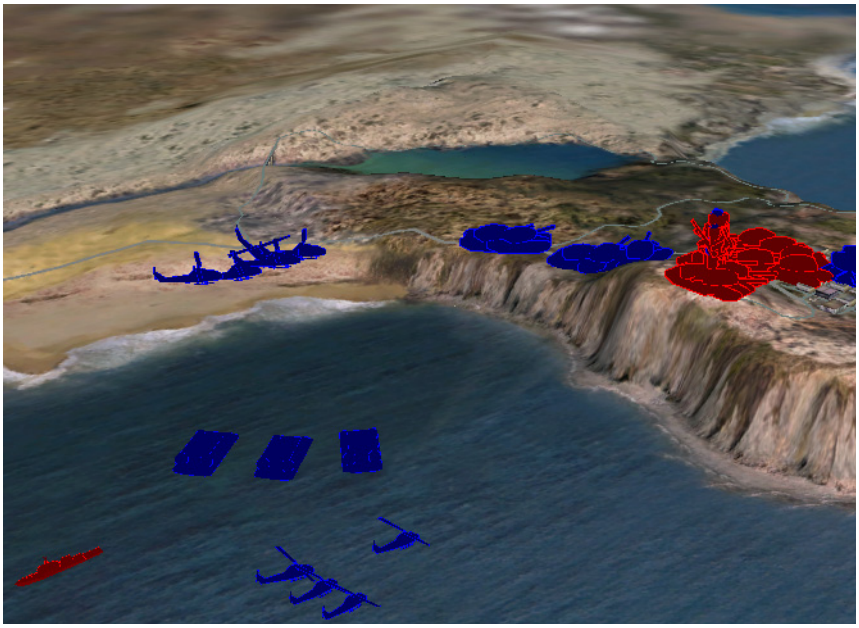


Figure 1-3. Model scaling and colorized models

1.2.6. Plan View Display

VR-Vantage PVD and the Plan View observer mode in VR-Vantage XR 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.

1.2.7. 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, 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 5, *Composing Terrains*.

1.2.8. Remote Control

You can control VR-Vantage remotely through view control messages, which can be generated by MÄK applications such as the Logger and VR-Forces, and by programs that use the Stealth Control Toolkit or the VR-Vantage Control Toolkit. For details, please see "Controlling the Observer from Other Applications," on page 9-24.

1.2.9. 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 screen, 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 Appendix F, *The VR-Vantage User Interface*. For descriptions of individual windows and dialog boxes, please see online help.

1.3. 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
- GL Studio®: interactive cockpit instrumentation and HMI from DiSTI®
- DI-Guy™: realistic human character animation from Boston Dynamics
- 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.

1.3.1. 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.

1.3.2. 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.

1.3.3. DI-Guy

VR-Vantage uses DI-Guy software and content for human character animation. DI-Guy is developed by Boston Dynamics (http://www.bostondynamics.com).

VR-Vantage comes with DI-Guy functionality built-in, and with a large set of DI-Guy characters, appearances, and animations. 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.

1.3.4. 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.

1.3.5. 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.

1.3.6. 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).

1.3.7. 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).



Installing VR-Vantage

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

Installing VR-Vantage 2-2
Installing VR-Vantage on Windows 2-2
Installing VR-Vantage on a Linux System 2-4
Uninstalling VR-Vantage on Windows 2-4
The VR-Vantage Directory Structure 2-5
Installing and Setting Up the License Manager 2-6
Specifying the License Server 2-7
Installing an RTI 2-9
Installing the MÄK RTI 2-10
Localizing the Graphical User Interface 2-10
Translating Other Interface Files 2-13
Applying the Language Files 2-13

2.1. Installing VR-Vantage

This section explains how to install VR-Vantage on a Windows or a Linux operating system. You must also install the license manager files. (For details, please see "Installing and Setting Up the License Manager," on page 2-6.) For HLA, you must install an RTI. (For details, please see "Installing an RTI," on page 2-9.)



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 application files. When you receive your installation code you can reinstall and install the toolkit.

2.1.1. Installing VR-Vantage on Windows

VR-Vantage has two installers – one for the applications and toolkit, and one for data. The installation process is the same for both installers, but you must install the applications first.

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



- You must have administrator privileges to install MÄK products on Windows Vista.
- When you install large applications on Vista, such as VR-Vantage, 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 is due to how Vista scans setup programs before it executes them. If you experience this problem, turning off User Access Control can reduce or eliminate this delay.

Installing VR-Vantage from Optical Media

MÄK products are supplied on CDs or DVDs with a common installation interface.

To install VR-Vantage:

1. Insert the MÄK Products disc into your optical media drive. If the autorun feature on your computer is enabled, the MÄK PC Products Installation window opens. The PC Products Installation window is similar to Figure 2-1.

   If the MÄK PC Products Installation window does not open, open the Windows Explorer. In the root directory for your optical media drive, double-click *makInst.exe*. The MÄK PC Products Installation window opens.

2. In the MÄK PC Products Installation window, click VR-Vantage or VR-Vantage Data.
3. Follow the instructions of the installation program. If you are installing VR-Vantage Data, you are prompted to approve installation to the existing folder. Click Yes.

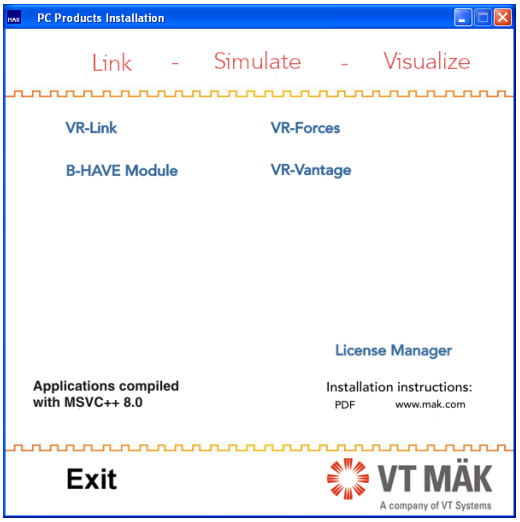


Figure 2-1. MÄK PC Products Installation window

Installing VR-Vantage from a Downloaded File

If you downloaded VR-Vantage, you received executable installation files.

➤ To install VR-Vantage from an executable file, run the executable. Follow the installation instructions in "Installing VR-Vantage from Optical Media" starting with step 3.

2.1.2. Installing VR-Vantage on a Linux System

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

Installing VR-Vantage from Optical Media

To install VR-Vantage:

1. Mount the optical drive.
2. Insert the MÄK Products disc into your optical media drive.
3. Run:

   ```
   ./install
   ```

4. Follow the on-screen instructions. You can install VR-Vantage into any directory for which you have write permission.

Installing VR-Vantage from a Downloaded File

If you downloaded VR-Vantage, you received a compressed tar file.

To install VR-Vantage from a tar file:

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 tar file:

   `gtar xzf stealth`*`xx-os`*`.tar.gz`

   where *`xx-os`* is the release, operating system, and other product release coding.

You must use gtar (from GNU) not the operating system's default tar.

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 2-2 (runtime and toolkit). Table 2-1 describe the contents of the directories.

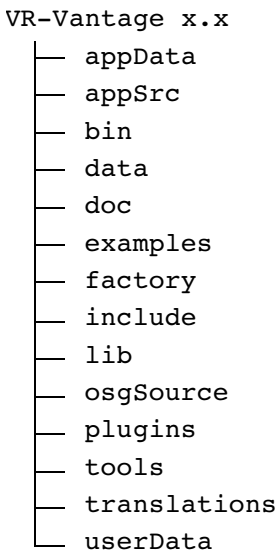


Figure 2-2. VR-Vantage directory tree

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.
./bin	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.
./lib	Libraries for building applications with the VR-Vantage Toolkit API.
./osgSource	The OSG and third party source used to build VR-Vantage.

Table 2-1: Contents of VR-Vantage directories

Directory	Directory contents
./plugins	Plug-in shared libraries.
./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 License Manager

Before you can use a MÄK product, you must obtain a valid license file, install the 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. The installers are also available for download at:

- Windows: ftp://ftp.mak.com/out/MAKLicenseManager-win-setup.exe
- Linux: ftp://ftp.mak.com/out/MAKLicenseManager-linux-setup.tar.gz

Complete installation and configuration instructions are included with the license manager installer. Instructions are also available at: http://www.mak.com/products/install_license.php

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 2-3). It prompts you to enter the hostname of the license server and optionally, a port number.

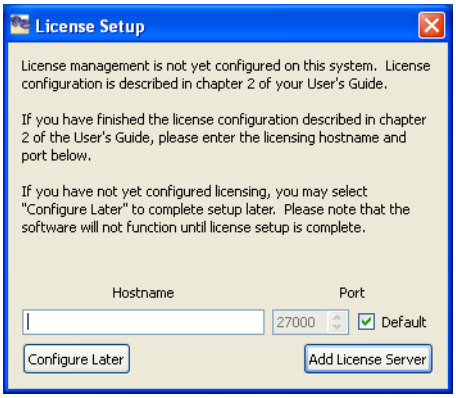


Figure 2-3. License Setup dialog box

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 Add License Server. The application will start.

- 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 it is *C:\Documents and Settings\user_name\Application Data\MAK\licenses<n>.xml*. On UNIX, it is *.mak/licenses<n>.xml*. (There may be more than one cache file, for example, *licenses1.xml* and *licenses2.xml*.)

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.



To view a video that illustrates this procedure on Windows, please go to http://www.mak.com/html/setenvvar.htm

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 System Properties dialog box.

   Windows XP:

   a. In Windows XP, on the Start menu, choose My Computer.

   b. In the My Computer window, under System Tasks, click View System Information. The System Properties dialog box opens.

   Windows Vista or Windows 7:

   a. In Windows Vista, open the Control Panel. On Vista, select System and Maintenance.

   b. Click System.

   c. Click Advanced System Settings. The System Properties dialog box opens.

2. Click the Advanced tab.
3. Click the Environment Variables button. The Environment Variables dialog box opens.
4. Click the New button. The New System Variable dialog box opens.
5. In the Variable Name field, enter MAKLMGRD_LICENSE_FILE.
6. In the Variable Value field, enter `@server_name`, where `server_name` is the name of the license server.
7. Click OK to back out of each dialog box and set the variable.

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

In many cases, you do not need an RTI server, such as the rtiexec, or a central application 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.) Be sure the license server is running, then start the applications, and they should be able to communicate. 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. To do this, you edit a resource file using the following procedure:

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 2-4).



Figure 2-4. 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 2-5).

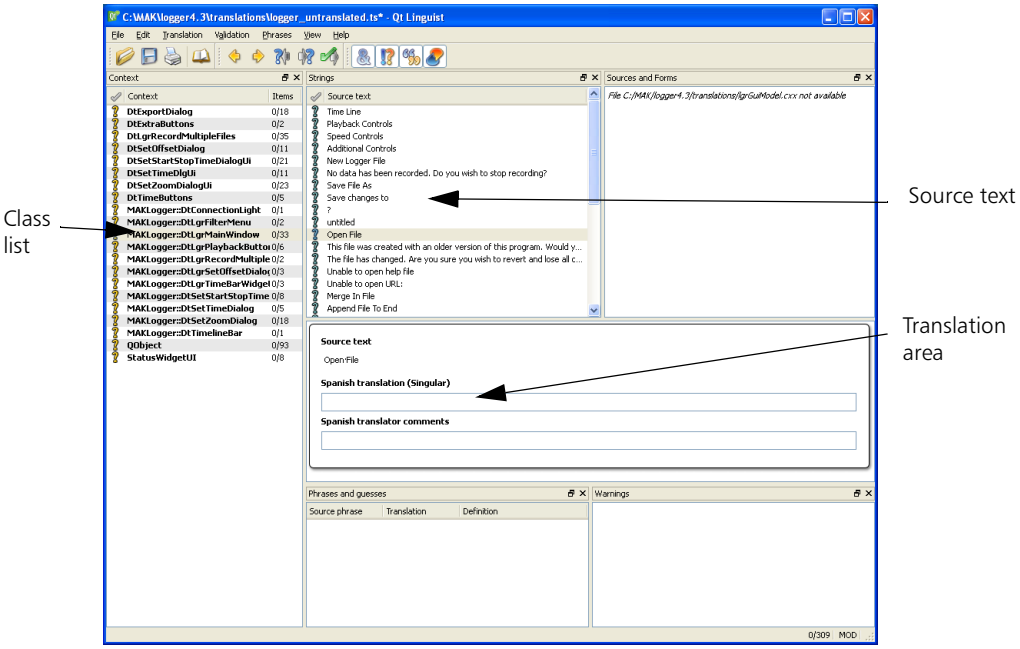


Figure 2-5. Linguist window

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 2-5, *DtLgrMainWindow* 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 2-6 shows the text Open File selected.

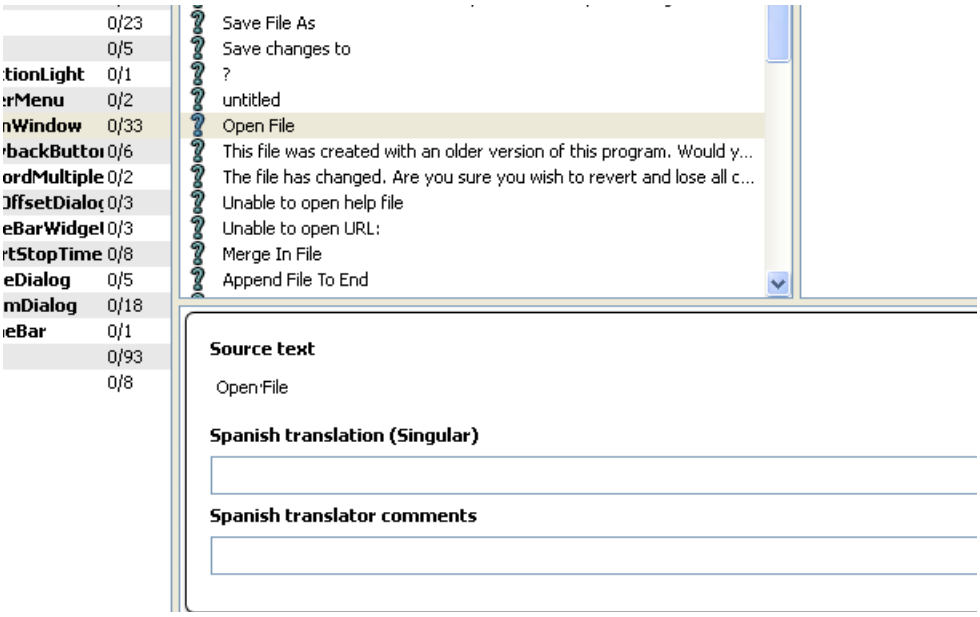


Figure 2-6. Text selected for translation

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 2-7). 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.

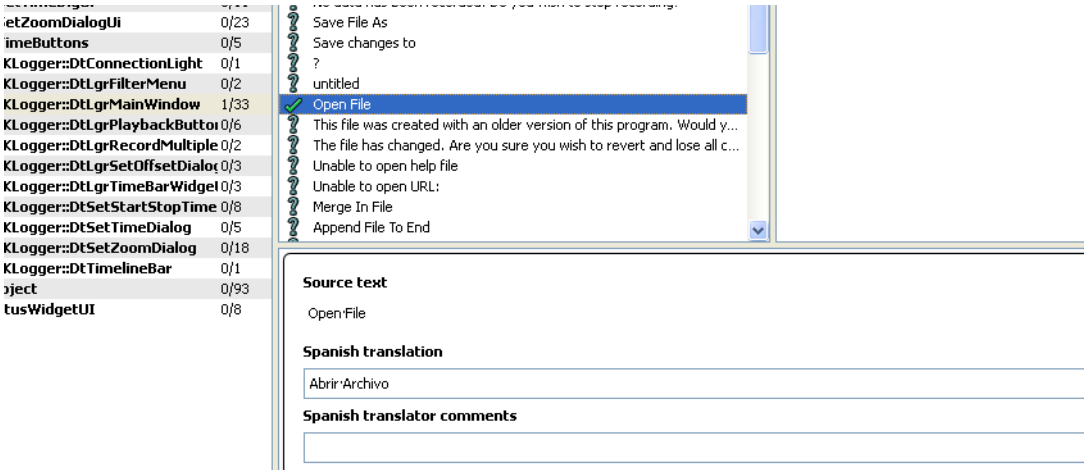


Figure 2-7. Completed translation for Open File

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 *stealth_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.



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 3-3
  - Command-Line Options 3-4
  - Shutting Down VR-Vantage 3-5
- Introduction to the VR-Vantage Graphical User Interface 3-5
- Opening a Local Terrain 3-6
  - Closing a Terrain 3-6
- Connecting to a Simulation Network 3-7
  - Setting Up Auto Connect 3-8
  - Disconnecting from the Simulation Network 3-9
  - Using the Simulation Connections Toolbar 3-10
- Managing VR-Vantage Settings 3-11
  - Synchronizing Settings Among VR-Vantage Installations 3-13
  - Global Settings and Observer-Specific Settings 3-13
- Optimizing Performance 3-14
  - Displaying Performance Statistics 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 1.3** → *application*, where *application* is one of the VR-Vantage applications, such as VR-Vantage XR 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).

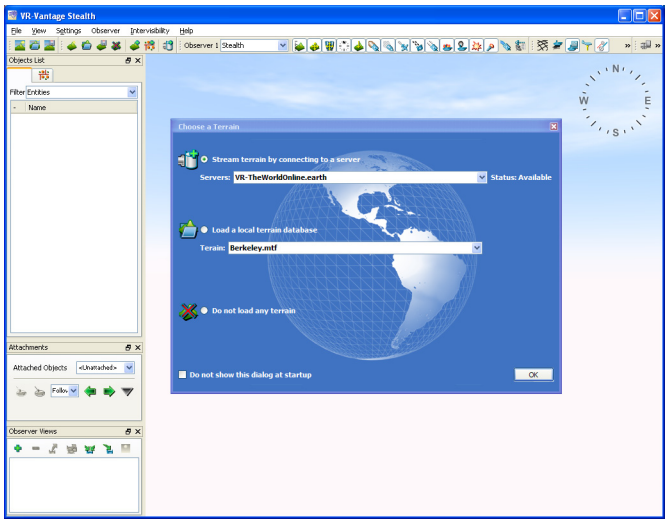


Figure 3-1. VR-Vantage window at startup

2. Select one of the terrain loading options:
   - Select a terrain server, such as VR-TheWorldOnline, from the list
   - Select a local terrain database from the list
   - Do not load a terrain database.

   If you select a terrain database, VR-Vantage loads it (Figure 3-2).

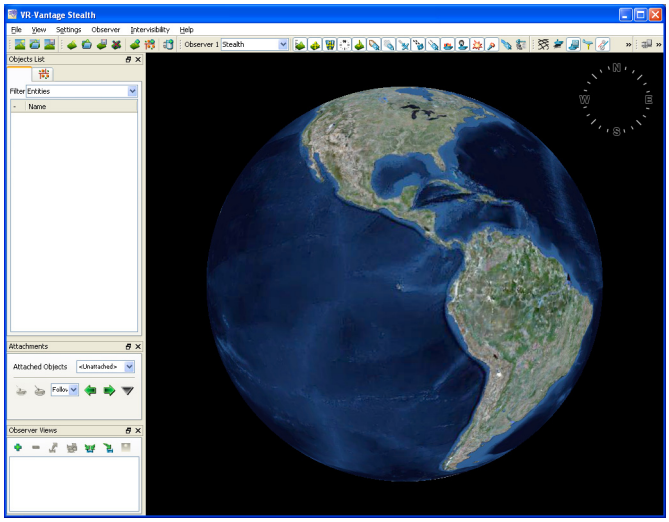


Figure 3-2. VR-Vantage window at startup

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. To start a VR-Vantage application, enter:

   application `[`***options***`]`

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

   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 2)

Option	Description
(-- | --ignore_rest)	Ignore all command-line options after this one.
--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.
(-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).
--dispSetting *filename*	Specifies the display engine configuration to load.
--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.
--fullScreen	Start with window in full screen mode.
(-G | --locale) *language*	Specifies the locale (for localization).
(-h | --help)	Display command-line usage information.
(-l | --logFileName) *filename*	Specifies the log file name.
(-L | --loadObservers *filename1 filenamen*	Loads the saved observers in the specified files.
(-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.

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

Option	Description
`--observerMode` *mode*	Specifies the observer mode for each observer in the startup configuration, for example Observer 1, Plan View. If you specify an observer that does not exist, the mode is not set. Accepted multiple times.
`--plugin` *filename*	Load the specified plug-in. Can be used multiple times.
`--showConsole`	Display a console window.
(*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.
`--vsync`	Start with vsynched windows.
Windows syntax: `-W | --withDisplayEngine` *port@netAddress;display ConfigFilename1 .... n* Linux syntax: `-W | --withDisplayEngine` *port@netAddress:display ConfigFilename1 .... n*	Connect to a display engine running on another computer.

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 Appendix F, *The VR-Vantage User Interface*.

3.3. Opening a Local Terrain

As explained in "Terrain Agility and Composability," on page 4-2, VR-Vantage lets you build local terrains from elevation data, images, and feature data, which you can save in MTF format. When you open a local terrain in VR-Vantage, you open an MTF file; you do not open a file in its native format. (If you want to open files directly from their native formats, you do so by loading terrain patches, raster maps, and feature layers.)

VR-Vantage includes several local terrains. This procedure explains how to open the MÄK-supplied terrains or a terrain that you have created and saved in the MTF format. For details about how to compose a terrain from source data, please see Chapter 5, *Composing Terrains*. For details about opening a geocentric terrain from a terrain server, please see "Connecting to Terrain Servers," on page 5-11.



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.

To open a terrain:

1. Choose **File** → **Open Terrain**, or click the Open Terrain icon ()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 icon () on the Terrain Toolbar.
- Choose **File** → **New Terrain**, or click the New Terrain icon () on the Terrain Toolbar.
- Choose **File** → **New Scene**, or click the New Scene icon () 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 (RPR FOM 1.0 and RPR FOM 2.0, draft 17), and HLA 1516 (RPR FOM 1.0 and RPR FOM 2.0, draft 17). You can change the configuration values of the default connectors and you can add connectors. For details about creating and editing connections, please see Appendix G, *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 3-10.

To connect to a simulation network:

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

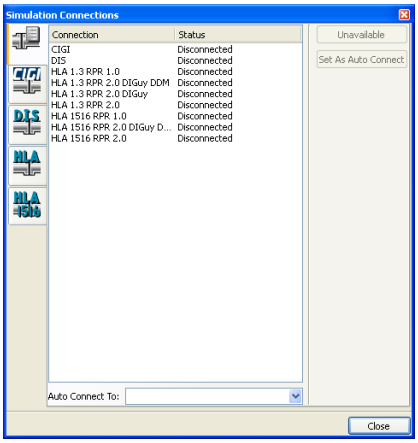


Figure 3-3. Connection Status page

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

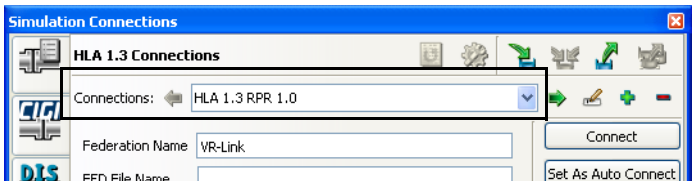


Figure 3-4. HLA 1.3 Connections page

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).

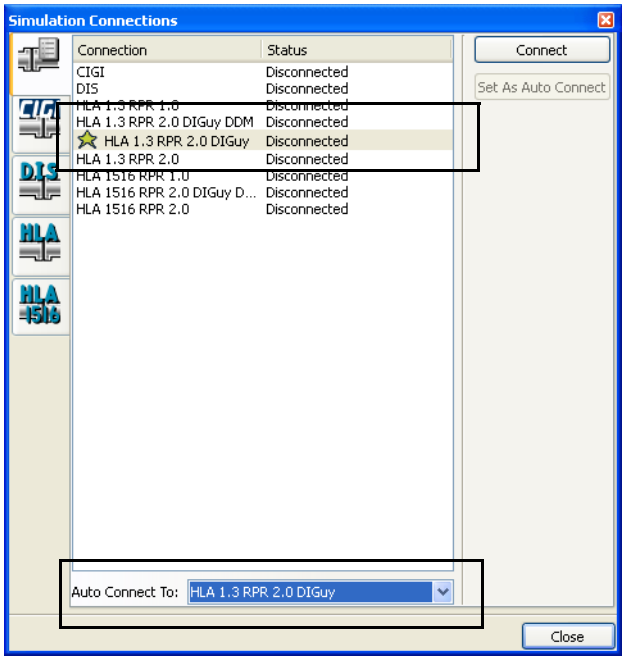


Figure 3-5. Auto connect enabled

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 drop-down 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 drop-down 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 connect to and disconnect from a selected group of connections.



Figure 3-6. Simulation Connections Toolbar

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

To quickly connect to selected simulation connections:

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

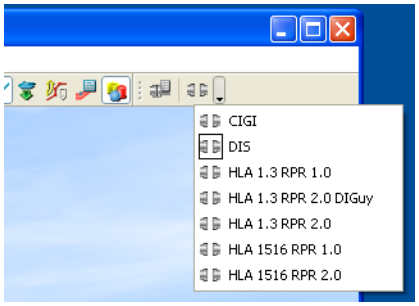


Figure 3-7. Connection list

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.

3. Click the Connect icon.

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

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 have different settings depending on the observer mode. For more information, please see "Global Settings and Observer-Specific Settings," on page 3-13.

- Dependent settings are the schemas, model definitions, element definitions, and entity type mappings that collectively determine how entities 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 the settings 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 them by clicking an icon 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 icons. They are described in the list.



Figure 3-8. Settings icons

- Revert to the default settings (1). Override any changes made to settings during this session.
- Restore the factory settings (2). 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 (3). Replace the current settings with those stored in the selected file.
- Merge in settings from a file (4). (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 works. 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.

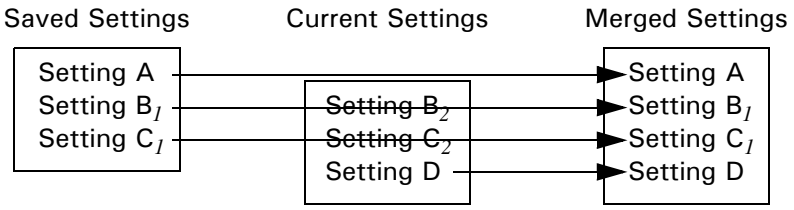


Figure 3-9. Merged settings

- Export settings to a file (5). Save the current settings to the selected file. (In most cases you must type the extension as part of the file name. For a list of file extensions, please see "File Extensions," on page F-6.)
- Save the selected setting to a file (6). (Only supported for dependent settings.)



- The icons 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 entity 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 view controls enabled and Out-the-Window mode has them disabled.

3.6. Optimizing Performance

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

- Processor speed
- 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 3-15.

The following actions can affect performance:

- Increasing the size or density of a cloud layer
- Displaying performance statistics
- Use of ground clamping
- Displaying height-above-terrain lines.

The following sections describe options for optimizing performance:

- "Configuring SpeedTree Trees," on page 17-25
- "Configuring File Caching," on page 5-23
- "Configuring Model Instancing," on page 16-7
- "Setting the Clipping Planes," on page 6-11
- "Enabling Texture Compression," on page 5-23
- "Considerations and Limitations for Building Terrains," on page 5-3
- "Filtering Entities Using Interest Management," on page 11-31.

3.6.1. Displaying Performance Statistics

VR-Vantage can display two kinds of performance statistics — OSG statistics (Figure 3-10), and VR-Vantage statistics (Figure 3-11).

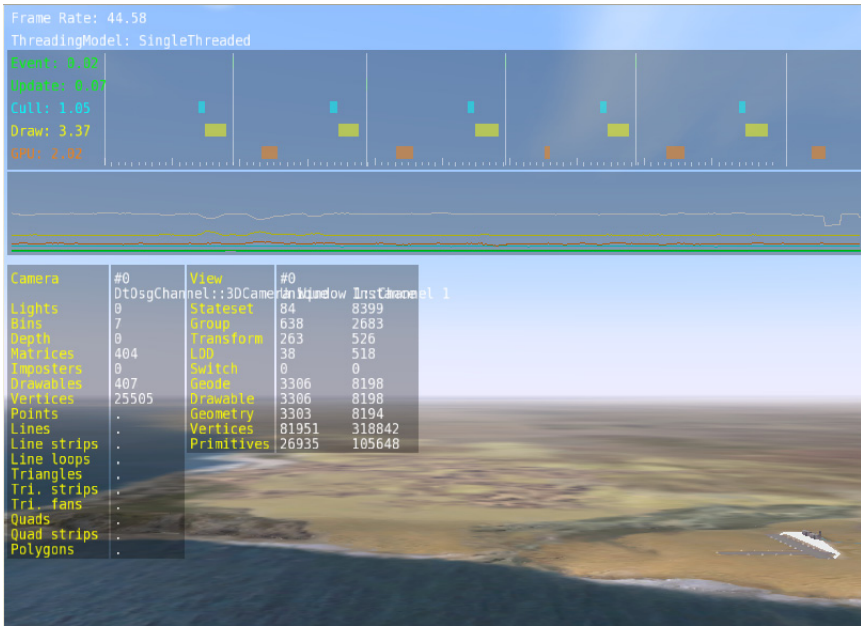


Figure 3-10. OSG performance statistics



Figure 3-11. VR-Vantage performance statistics

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 3-12).

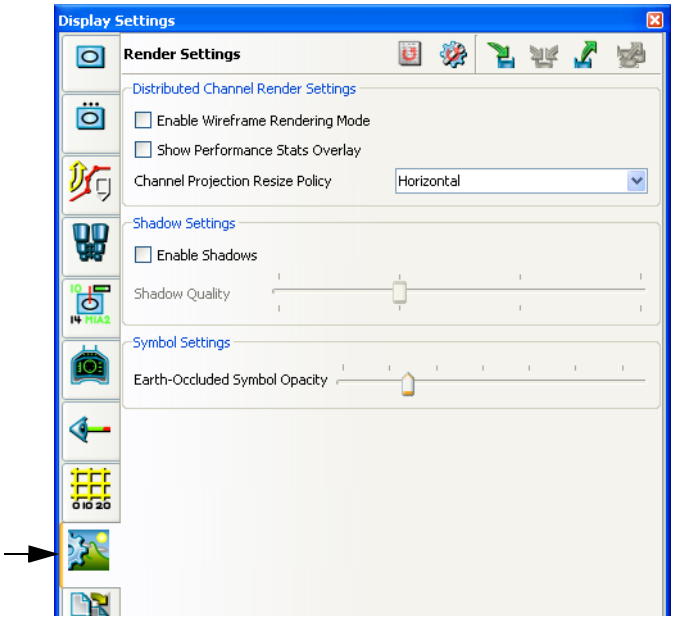


Figure 3-12. Render Settings page

3. Select the Show Performance Stats Overlay check box. A statistics display is added to the window (Figure 3-11).

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.



VR-Vantage Concepts

This chapter briefly describes the major functional and organizational concepts that underlie VR-Vantage and directs you to the sections that fully describe them.

Terrain Agility and Composability 4-2
- Elevation Data 4-3
- Images 4-3
- Feature Layers and Props 4-3

The VR-Vantage Display Engine 4-4
- How VR-Vantage Responds to Display Engine Connections 4-5
- The Display Engine's Connection States 4-5
- Windows and Channels 4-5
- Window Types 4-5

The Observer 4-6
- Observer Modes 4-6

Working with Scenes 4-8

Introduction to VR-Vantage Object Modeling 4-8
- Entity, Object, and Effects Model Formats 4-10
- Model Sets 4-11
- Mapping Models to Entities and Objects 4-12

4.1. 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. For more information, please see "Creating a Composed Terrain," on page 5-3.
- Specify a set of files to load using a *.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. SpeedTrees do not work with this terrain format. For more information, please see "Connecting to Terrain Servers," on page 5-11.

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 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.

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 5-23.

4.1.1. Elevation Data

VR-Vantage imports elevation data as terrain patches. It supports the following formats:

- MÄK terrain database (*.gdb*)
- MÄK encrypted data format (*.medf*)
- MÄK Stealth format (*.mtl*)
- MÄK terrain project or terrain descriptor file (*.mtp*, *.mtd*)
- OpenFlight (*.flt*)
- MetaFlight (*.mft*)
- DTED (*.dt0*, *.dt1*, *.dt2*, *.dted*)
- CTDB 4, 7, 7L (*.c4b*, *.c7b*, *.c7l*)
- Shape terrain data (*.shp*)
- Terrapage (*.txp*)
- 3DS
- OBJ
- OSG
- LWO.

4.1.2. Images

You can import images in the following formats:

- GEO Tiff (*.tif*, *.tiff*)
- JPEG (*.jpg*, *.jpeg*)
- PNG
- RGB
- Windows bitmap (*.bmp*)
- GIF.

4.1.3. 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 source data from which you can add props to a terrain. A feature layer can be a MÄK Terrain Format (GDB) file, a shapefile (SHP), or DFAD data (DFD).

For more information, please see "Adding Props to a Terrain," on page 5-16.

4.2. 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 4-1.

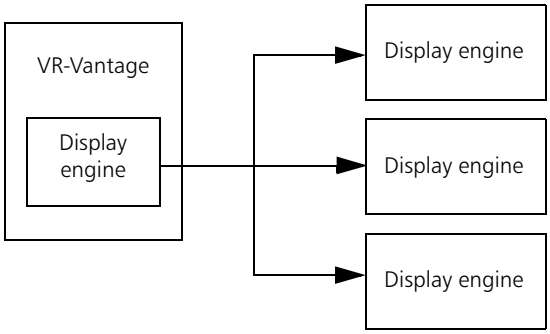


Figure 4-1. VR-Vantage and display engines



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.

For a complete discussion of display engines, please see Chapter 6, *Windows, Channels, and Display Engines*.

4.2.1. 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.

4.2.2. 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.

4.2.3. 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.

4.2.4. 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 11-10.)
- 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 VR-Vantage 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.

4.3. 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 an entity or prop. When the observer is attached to an entity, it moves automatically with that entity. 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.

The observer is such a pervasive component of VR-Vantage that it is not covered in just one section of the manual. For more information, please see:

- Chapter 8, *The Observer and Observer Modes*
- Chapter 9, *Moving the Observer*
- Chapter 10, *Attaching the Observer*
- "Displaying Models for Remote Observers," on page 11-30.

4.3.1. 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 entity graphics and observer movement.



VR-Vantage FreeView includes two observer modes. You can change the observer-specific settings. However, you cannot otherwise edit them or create new ones.

Table 4-1 lists the observer modes and default settings provided with VR-Vantage applications.

Table 4-1: Observer modes

Application	Observer Mode	Projection	Model Set	Key Map
VR-Vantage IG	Out-the-Window	3D	3D Models	Observer Frame
	Inset	3D	3D Models	Observer Frame
VR-Vantage Stealth	Stealth Out-the-Window	3D	3D Models	Observer Frame
VR-Vantage XR	Stealth Out-the-Window Inset	3D	3D Models	Observer Frame
	XR	3D	3D Colorized Models	Observer Frame
	Plan View	2D	2D Icons	2D Level Observer Frame
VR-Vantage PVD	Plan View	2D	2D Icons	2D Level Observer Frame
	Inset	2D	2D Icons	Observer Frame
VR-Vantage FreeView	Out-the-Window	3D	Not applicable	Observer Frame
	Plan View	2D	Not applicable	2D Level Observer Frame

You can edit observer modes and add new ones. For details, please see "Creating and Editing Observer Modes," on page 8-2.

4.4. Working with Scenes

A scene contains an environment, the time of day, and possibly, a terrain. If particular environment settings are important to the simulations you are viewing, use of scenes can be an important convenience feature. A scene does not have to have a terrain. For example, when you start VR-Vantage, a default scene is loaded that does not have a terrain.

4.5. Introduction to VR-Vantage Object Modeling

VR-Vantage applications can display the simulated world using different projections (2D and 3D). In each projection, it can display appropriate types of models (2D icons, 3D models, and so on). Models are organized into model sets, and at any one time only the models in a particular model set are used.



Please see Table 1-1 to see which projection your VR-Vantage application supports.

VR-Vantage can apply various types of visual effects to a model, such as trailing effects, height-above-terrain lines, track histories, and so on. Some of these effects are appropriate to a particular projection, some are available for both projections. Visual effects are implemented using visualizers.

Visual effects and model sets are managed by the integration of schemas, model definitions, element definitions, and model mapping.

- A schema is a set of parameters for a scene element (such as an entity). VR-Vantage uses schemas to validate model definitions.
- A model definition specifies values for the required and optional parameters for an instance of a schema. For example the model definition for an M1A2 tank is an instance of the Entity schema. The model definition for a lifeform is an instance of a DiGuyCharacter schema. Of particular importance, a model definition specifies the 3D model to be used to represent an element in the scene. (2D icons are specified by the Military Symbol Icon Visualizer in the entity definition.)
- Element definitions (where elements can be entities, tactical graphics, or interactions) configure visual definition schemas on scene elements. For any given element, you can create a definition for each model set in which you want the element to be visualized. For example, you might want to visualize a tank in the 3D Models, 2D icons, and 3D Colorized Models model sets. You might want a tree to be visualized only in the 3D Models model set.
- Model definitions are associated with particular entity types by mapping an element definition to an entity type enumeration.

Figure 4-2 illustrates these relationships using an M1A2 entity. The model definition called Tracked_M1A2_DESERT uses an Entity schema. One of the parameters of the schema is the filename, which for this model definition is defined as *M1A2.medf*. The entity definition called M1A2 Abrams has a Model Visualizer. The modelDefinition attribute in the visualizer is specified as Tracked_M1A2_DESERT, which means that it will use the *M1A2.medf* model. The entity type 1:-1:-1:-1:-1:-1:-1 is mapped to the M1A2 Abrams entity definition. So, when VR-Vantage discovers an entity with the enumeration 1:-1:-1:-1:-1:-1:-1, it will look up the M1A2 Abrams entity definition, which will tell it to use a Model Visualizer for this entity that uses the Tracked_M1A2_DESERT model definition, which specifies that VR-Vantage use the *M1A2.medf* model to render the entity in the scene.

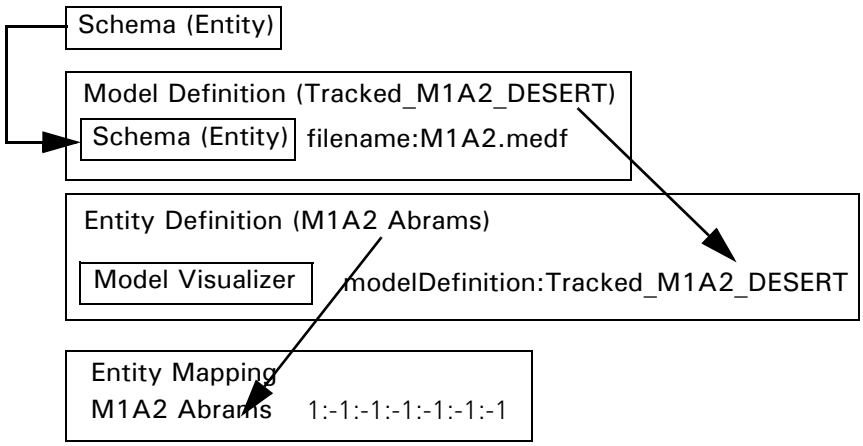


Figure 4-2. Element definitions and model mapping

To apply these abstract concepts to the concrete goals of a typical VR-Vantage user, we could say that:

- If you want to visualize a completely new class of scene elements in VR-Vantage, such as a celestial body, you would need to create a schema that specifies its parameters. If you want to change the parameters of an existing object, such as an entity, you would edit its schema. For details, please see "Creating and Editing Schemas," on page 17-3.
- If you want to add a new instance of an element, such as a star, you would create a model definition using the celestial body schema and specify its parameters. If you want to change an element definition by, for example, changing the model displayed for it, you would edit its model definition. For details, please see "Creating and Editing Model Definitions," on page 17-7.
- If you want your scene element to have visual effects, you would add appropriate visualizers in the entity definitions page or a specialized page. (If your new element requires visualizers that are not included with VR-Vantage, you would have to use the VR-Vantage toolkit to add them.) If you want to change the visualizers on an existing scene element, such as an entity, you would edit its entity definition. For details, please see "Creating and Editing Element Definitions," on page 17-13.
- Finally, if the new object will be displayed based on simulation data received over the network, you must map it to an entity enumeration. For details, please see "Mapping Models to Entities and other Scene Elements," on page 16-2.

4.5.1. Entity, Object, and Effects Model Formats

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 16-8.
- VR-Vantage FreeView cannot load models in MEDF format.

You can provide your own models if they are in one of the following supported formats:

- OpenFlight
- 3ds
- OBJ.

4.5.2. Model Sets

Each VR-Vantage application includes one or more of the following model sets:

- 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 icons. This is the default model set for the Plan View observer mode.

Table 4-2 lists the VR-Vantage model sets and the VR-Vantage applications that support them.

Table 4-2: VR-Vantage model sets

Model Set	Application
3D Models	VR-Vantage Stealth VR-Vantage IG VR-Vantage XR
3D Colorized Models	VR-Vantage XR
2D Icons	VR-Vantage XR VR-Vantage PVD



The model sets available in each VR-Vantage application are fixed. You cannot add model sets or edit the model sets provided.

For more information about observer modes, please see "Observer Modes," on page 4-6. For information about changing model sets, please see "Changing the Model Set," on page 15-3.

4.5.3. Mapping Models to Entities and Objects

Model mapping is the process of associating an entity or other scene element with an element definition.

DIS and HLA objects are specified by an entity type enumeration. An entity 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 entity type refers to a specific 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. For complete details about entity 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/.

For more information about mapping models, please see Chapter 16, *Mapping Models and Effects*, Chapter 17, *Model and Element Definitions*, and Chapter 18, *Mapping CIGI Models and Components*.



Composing Terrains

This chapter explains how to combine various types of data to build a terrain. For basic conceptual information about terrain agility, please see "Terrain Agility and Composability," on page 4-2. "Composing a Terrain," on page A-2 is a tutorial that steps you through the entire process of creating a terrain.

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5.1. Creating a Composed Terrain

The general procedure for composing a terrain is as follows:

1. Choose **File** → **New Terrain**, or click the New Terrain icon ( )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 5-4.
3. Optionally, add imagery, as described in "Adding Images to a Terrain," on page 5-5.
4. Optionally, add feature data, as described in "Adding a Feature Layer," on page 5-10.
5. Optionally, add props or extract props, as described in "Adding Props from a Feature Layer," on page 5-18 and "Extracting Props from a Terrain Patch," on page 5-16.
6. Save the terrain, as described in "Saving a Terrain," on page 5-4.

"Composing a Terrain," on page A-2 demonstrates how to create a composed terrain.

5.1.1. 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, use the MÄK Terrain Database Tool (TDB Tool), which is included with VR-Vantage, to create a GDB terrain composed of the DTED cells. Then load the GDB terrain into VR-Vantage.
- The larger a terrain database is (as measured by the number of polygons), the more it will affect performance.

5.1.2. 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. 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 5-23.) However, 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. Terrains get saved with the extension *.mtf*.

To save a terrain:

1. Choose **File** → **Save Terrain**, or click the Save Terrain icon ( )on the Terrain Toolbar. The Save Terrain dialog box opens.
2. Type a name for the terrain.
3. Click Save.

5.2. 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 5-3.

! 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.

---

i When you add a terrain patch, the settings on the Display Settings dialog box, Loader Settings page get applied to the terrain. The Flip DDS Textures setting is relevant to all terrains. The other settings only affect MetaFlight terrains. For details about these settings, please see "Displaying DDS Textures Correctly," on page 5-26 and "Loading MetaFlight Terrains," on page 5-15.

To add a terrain patch to a terrain database:

1. Choose **File** → **Add Terrain Patch**, or click the Add Terrain Patch icon ( )on the Terrain Toolbar. The Add Terrain Patch dialog box opens and an Open dialog box opens on top of it.
2. Select a file in a supported format.

3. Click Open. The Add Terrain Patch dialog box displays details about the terrain patch (Figure 5-1).

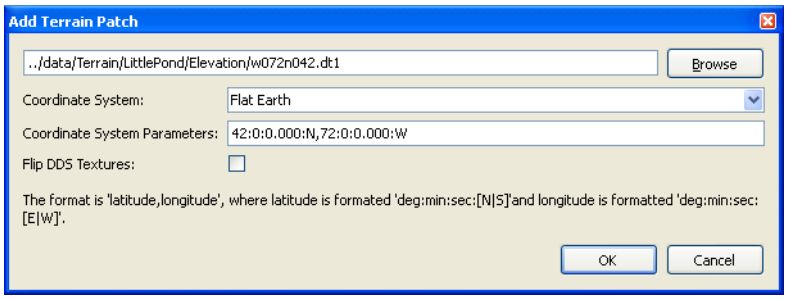


Figure 5-1. Add Terrain Patch dialog box

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.
5. Click OK. The terrain patch is added.
6. Optionally, add additional terrain patches.
7. Save the terrain.

5.3. 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.

To add raster maps to the terrain:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Raster Maps page (Figure 5-2).

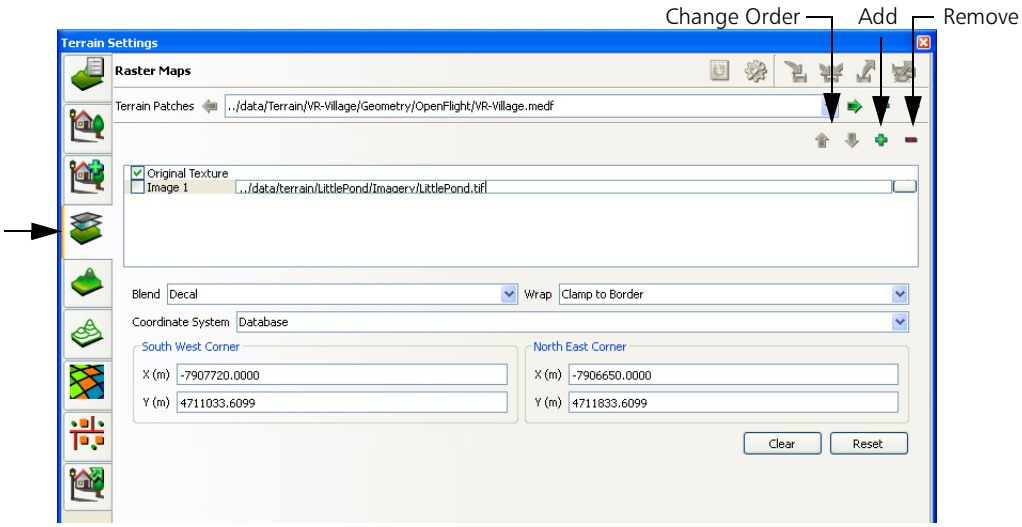


Figure 5-2. Raster Maps page

3. Click the Add icon (+) that is above the list of raster maps. A line is added to the Raster Maps list (Figure 5-2).
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 window, select the check box to the left of the entry (Figure 5-3).

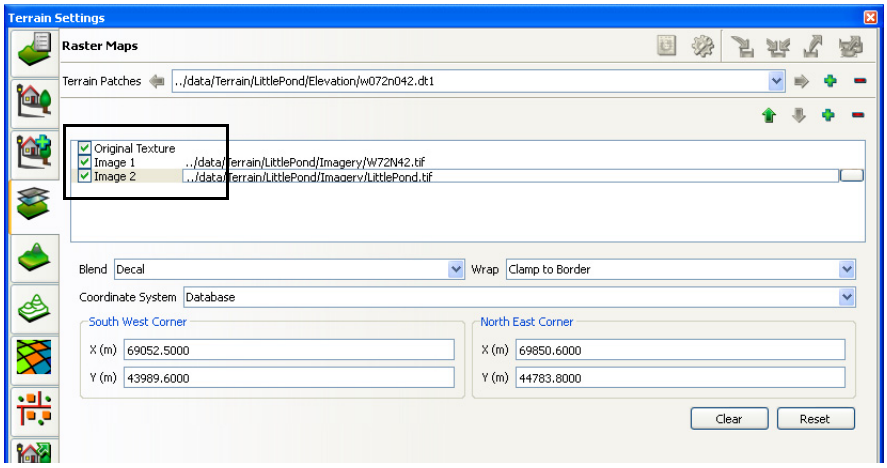
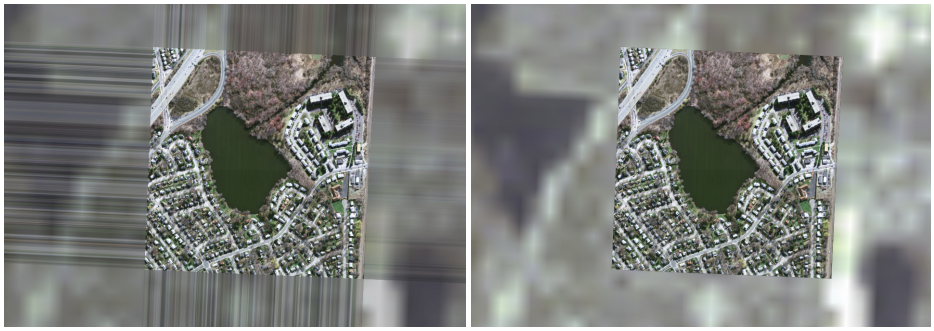


Figure 5-3. Making an image visible

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.
     - 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 5-5 and Figure 5-5):
     - 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 Geo TIFF, 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 5-4. Raster image wrap effects (Clamp and Clamp to Border)

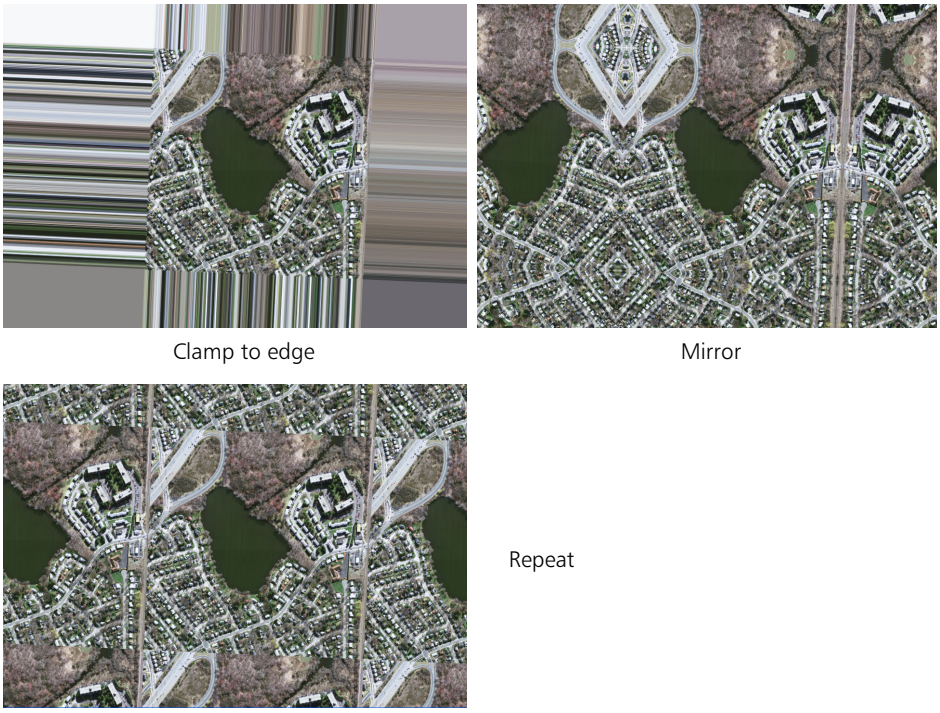


Figure 5-5. Raster image wrap effects (Clamp to Edge, Mirror, Repeat)

5.3.1. 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 5-6 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 5-6. 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 5-2).
3. Select the raster image whose order you want to change.
4. Click the Up Arrow or Down Arrow to the right of the Raster Maps label. The image moves in the list and the window changes as appropriate.

5.4. Adding a Feature Layer

A feature layer is a file that contains source data from which you can add props to a terrain. A feature layer can be a MÄK Terrain Format (GDB) file, a shapefile (SHP), or DFAD data (DFD).

- Adding a feature layer does not, by itself, make any visible difference to a terrain. To take advantage of 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 5-16.
- 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 Add Props page (Figure 5-7).

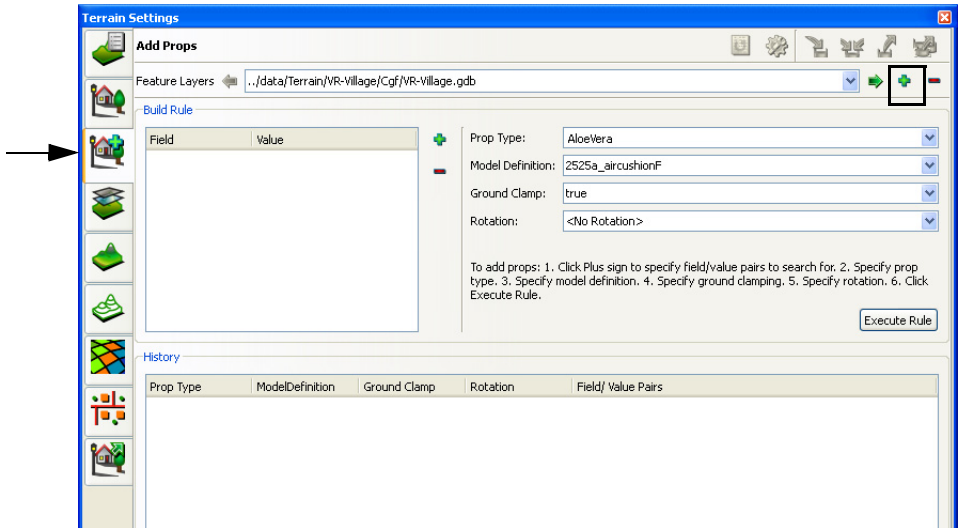


Figure 5-7. Add Props page

3. Click the Add icon (+) to the right of the Feature Layers list. 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 feature layers.

5.5. Connecting to Terrain Servers

VR-Vantage supports the osgEarth libraries for creating terrains from remote or local data sources (Figure 5-8). Terrain servers support streaming of elevation and image data and are, therefore, ideal for displaying terrains that have large amounts of data.

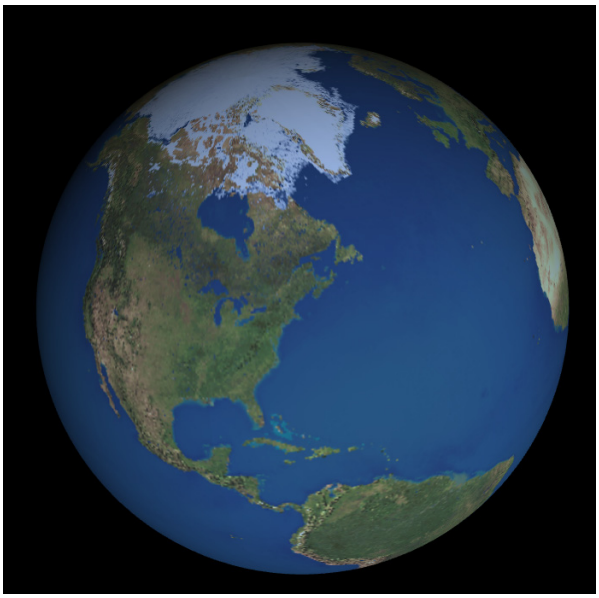


Figure 5-8. Geocentric terrain

You can manipulate the terrain from the keyboard and mouse and can save it as an MTF terrain for quick loading.

VR-Vantage includes several terrain server configurations for servers that are accessible over the internet, including a server hosted by VT MÄK (*VR-TheWorld.earth*, which connects to VR-TheWorld Online). 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.

"Adding a Terrain Server," on page A-13, is a tutorial that shows how to create a terrain server that serves local data.



When you view a geocentric terrain and zoom out more than 6 million meters or so, 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.

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.

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 5-9).

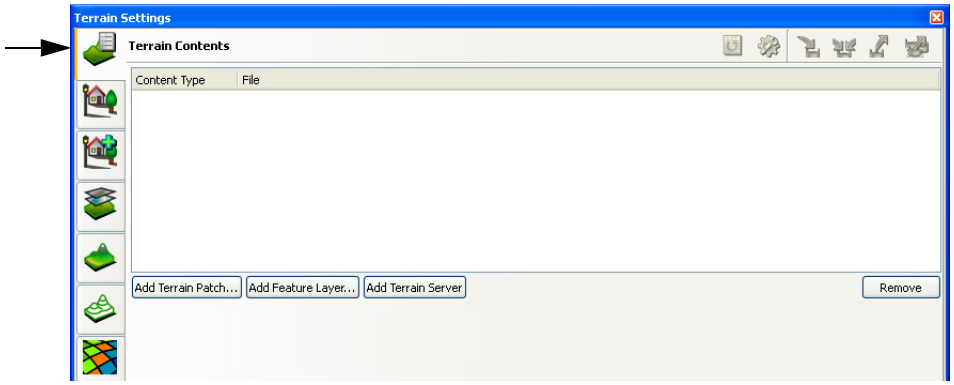


Figure 5-9. Terrain Contents

4. Click Add Terrain Server. The Add Terrain Server dialog box opens (Figure 5-10). The dialog box contains information about the selected terrain server. It is not editable. (For information about editing terrain server configurations, please see "Editing a Terrain Server Configuration," on page 5-15.)

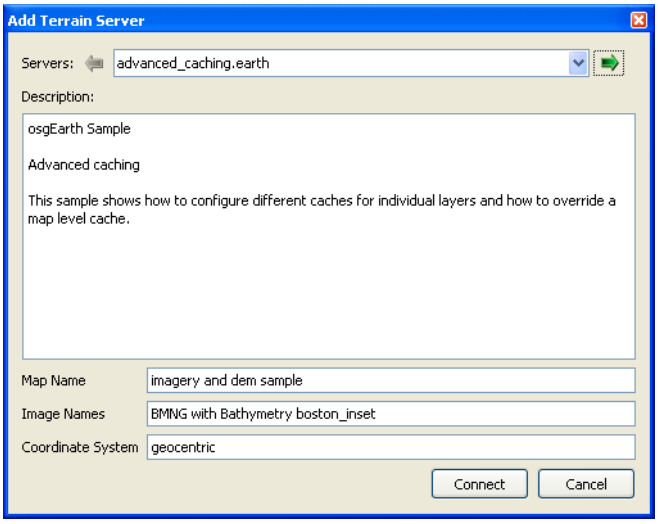


Figure 5-10. Add Terrain Server dialog box

5. Select a server from the Servers drop-down list.
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 5-4.

5.5.1. Adding Terrain Server Connections

You can add additional terrain servers to the list provided with VR-Vantage. Terrain servers 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.

"Adding a Terrain Server," on page A-13, is a tutorial that shows how to create a terrain server that serves local data.

To add a terrain server:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Server Settings page (Figure 5-11). The dialog box displays the contents of the configuration file for the selected server.

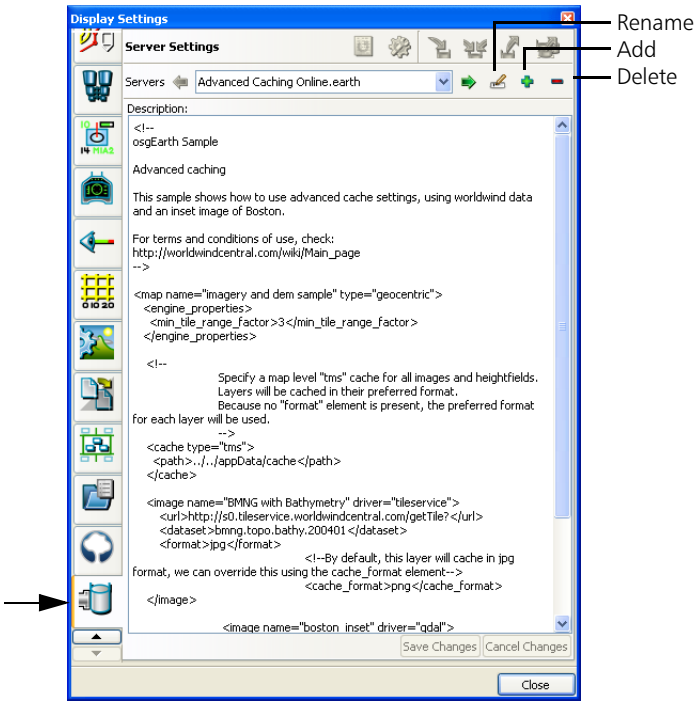


Figure 5-11. Server settings page

3. Select a terrain server configuration that is similar to the one that you want to add.
4. Click the Add icon (✚). A new configuration file is added to the list. It copies the contents of the previously selected configuration and names the server in the format *oldServerName*_1.
5. Make whatever changes are necessary to configure your new server. This would usually mean changing the URLs that point to the data. A URL can be an internet URL, a path to a directory, or a path to a specific file.
6. Optionally, click the Rename icon (✎) and rename the server.
7. Click Save Changes. New server files are saved to *./userData/servers*.

5.5.2. Editing a Terrain Server Configuration

VR-Vantage provides a text editor interface that lets you edit the osgEarth terrain server configuration files. You can also edit them in any text editor. You are responsible for ensuring proper syntax.

To edit a terrain server:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Server Settings page (Figure 5-11). The dialog box displays the contents of the configuration file for the selected server.
3. In the Servers list, select the terrain server configuration that you want to edit.
4. In the text window, edit the file.
5. Click Save Changes.

5.6. Loading MetaFlight Terrains

VR-Vantage supports MetaFlight terrain databases. To load a MetaFlight terrain, add a terrain patch, as you would for any other non-MTF terrain. However, before you can load a MetaFlight file, you must first process it using the mftTool and medfTool. For details, please see Appendix J, *Processing MetaFlight Files*.

VR-Vantage can only load MetaFlight terrains that conform to a particular specification. If you try to load a terrain that does not conform to the specification, VR-Vantage sends an error message to the console and the log file. For details about this specification, please contact support@mak.com.

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 5-23.

5.7. 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.

5.7.1. 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 *Bridge_Arch_Stone.flt* file 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 A-18.

To extract props from a terrain:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Extract Props page (Figure 5-12).

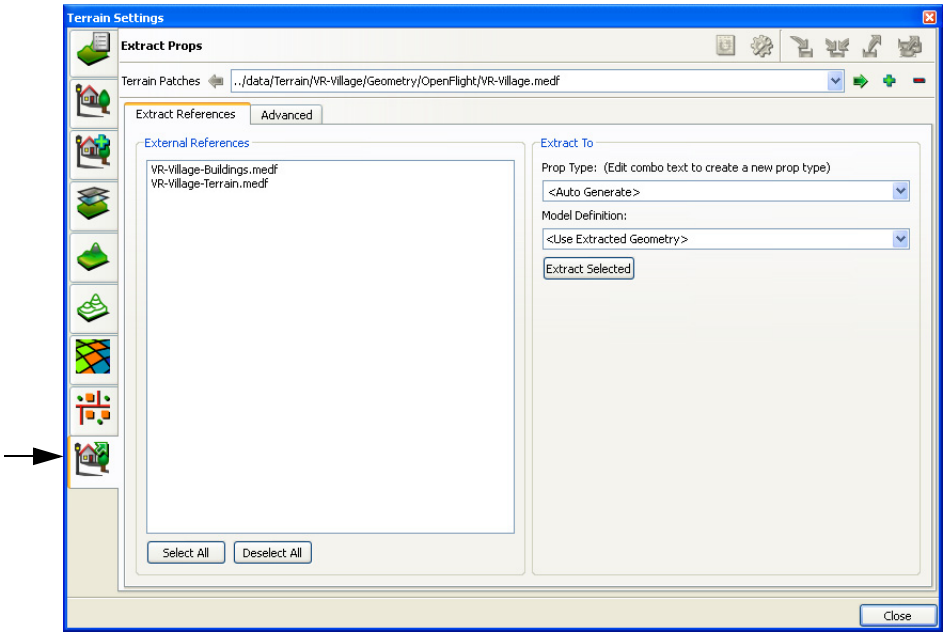


Figure 5-12. Extract Props page

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 Terrain Contents dialog box.

5.7.2. 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 "Composing a Terrain," on page A-2 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 5-13).

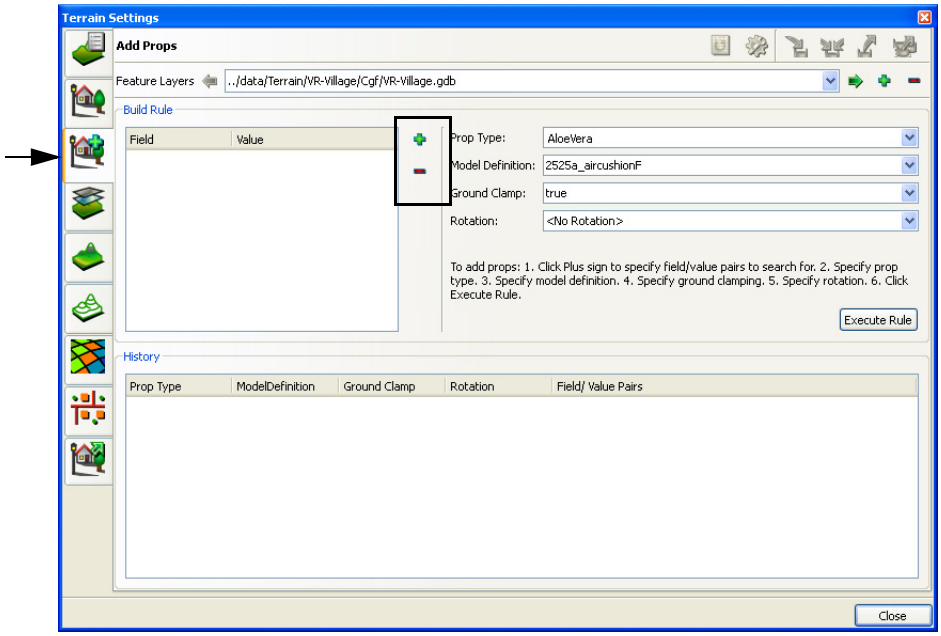


Figure 5-13. Terrain Settings, Add Props page

3. In the Feature Layers list, select the feature layer from which you want to import the props.
4. Click the Add icon (+) to the right of the Field/Value window (Figure 5-13). The Build Field/Value Pair dialog box opens (Figure 5-14).

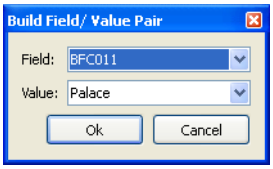


Figure 5-14. Build Field/Value Pair dialog box

5. In the Field drop-down list, select a field. Fields are the column headings in the feature definition.
6. In the Value drop-down 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 5-15).

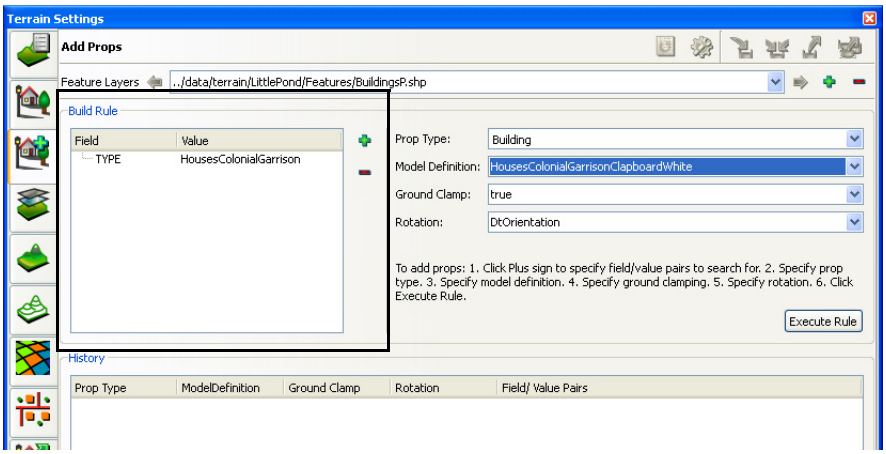


Figure 5-15. New Field/Value pair

8. Add additional Field/Value pairs as needed to define the prop that you want to add.
9. In the Prop Type drop-down list, select the prop type to assign to the prop you want to add.
10. In the Model Definition drop-down 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.

5.7.3. 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 5-16).

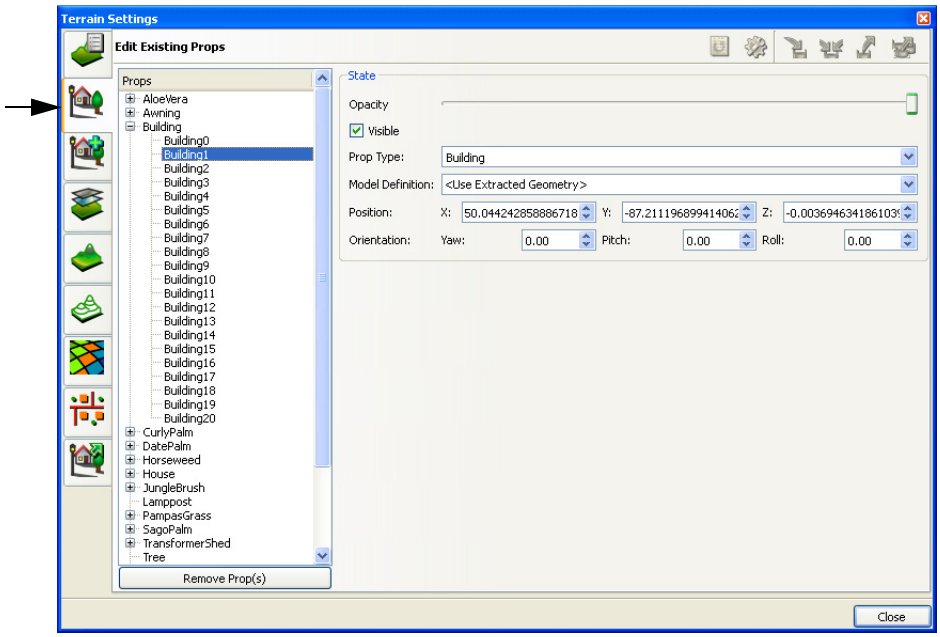


Figure 5-16. Edit Existing Props page

3. Expand the list to view the entries under a particular type of prop.

5.7.4. 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.

5.7.5. Setting the Opacity of Props

To set a prop's opacity:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Edit Existing Props page (Figure 5-16).
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**.

5.7.6. 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 5-16).
3. In the list of props, select the props whose type you want to change.
4. Select a prop type from the Prop Type drop-down list, or type a new type name. The selected props are moved to the new prop type in the Props window.

5.7.7. 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 5-16).
3. In the list of props, select the prop whose position or orientation you want to change.
4. To change position, type new values in the X, Y, or Z boxes, or use the spinner controls to change the position values.
5. To change the orientation, type new values in the Yaw, Pitch, or Roll boxes, or use the spinner controls to change the orientation values.

5.7.8. Changing a Prop's Model Definition

You can change the model definition used to render a prop in the scene. For information about model definitions, please see Chapter 17, *Model and Element Definitions*. For an example of changing a prop's model definition, please see "Test the Model Mapping," on page B-10.

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 5-16).
3. In the list of props, select the prop whose model definition you want to change.
4. In the Model Definition drop-down list, select a model definition. The selected props are rendered using the new model definition.

5.8. 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.

To enable or disable file caching:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the File Caching Settings page (Figure 5-17).

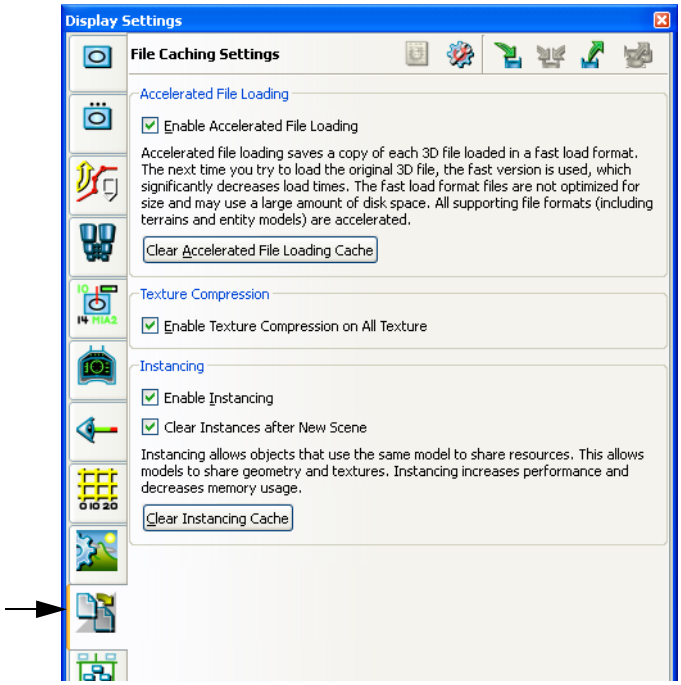


Figure 5-17. File Caching Settings page

3. Select or clear the Enable Accelerated File Loading check box.

5.8.1. 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** → **Display**. The Display Settings dialog box opens.
2. Select the File Cache Settings page (Figure 5-17).
3. Select or clear the Enable Texture Compression on all Texture check box.

5.8.2. 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** → **Display**. The Display Settings dialog box opens.
2. Select the File Cache Settings page (Figure 5-17).
3. Click the Clear Accelerated File Loading Cache button.

5.9. Displaying Feature Data

If a terrain contains feature data, you can display it in the Plan View observer mode. Figure 5-18 shows a section of the Little Pond terrain with features disabled and enabled.



Figure 5-18. Feature data

➤ To display feature data, choose **Observer** → **Features**, or click the Feature Data icon ( ) on the Observer Settings Toolbar.

5.9.1. 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 5-19, we have changed the Woodland feature in the Little Pond terrain to be pink. Compare it to the default color (Figure 5-18).



Figure 5-19. 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 5-20).
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.

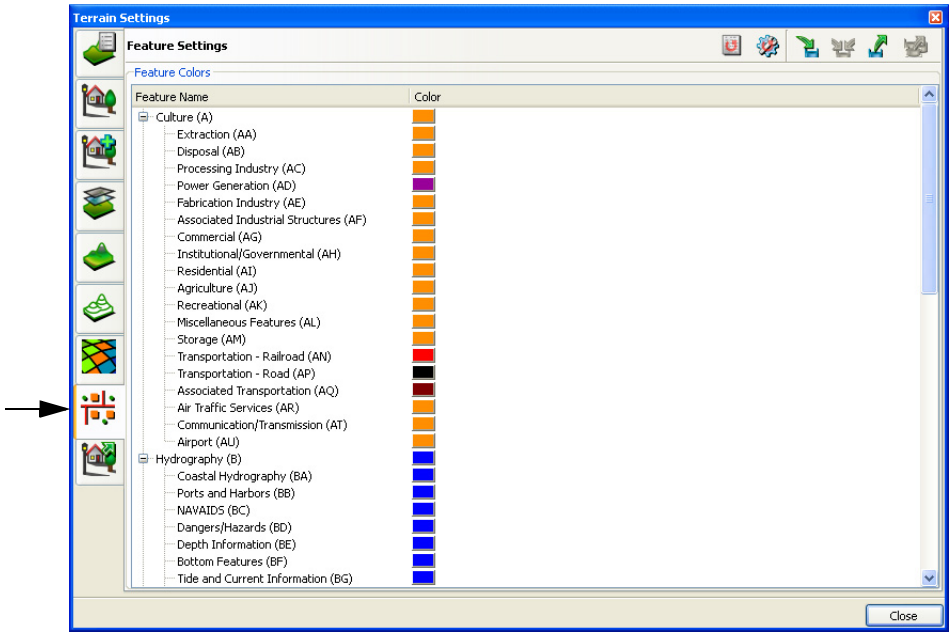


Figure 5-20. Feature Settings page

5.10. 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 cornet. 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 17-24.)
- When you add a terrain patch. (For details, please see "Adding Elevation Data (Terrain Patches) to a Terrain," on page 5-4.)
- As a global setting. (For details, please see "Flipping DDS Textures Globally," on page 5-27.)

5.10.1. Flipping DDS Textures Globally

You can specify the DDS textures setting to 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 5-21).

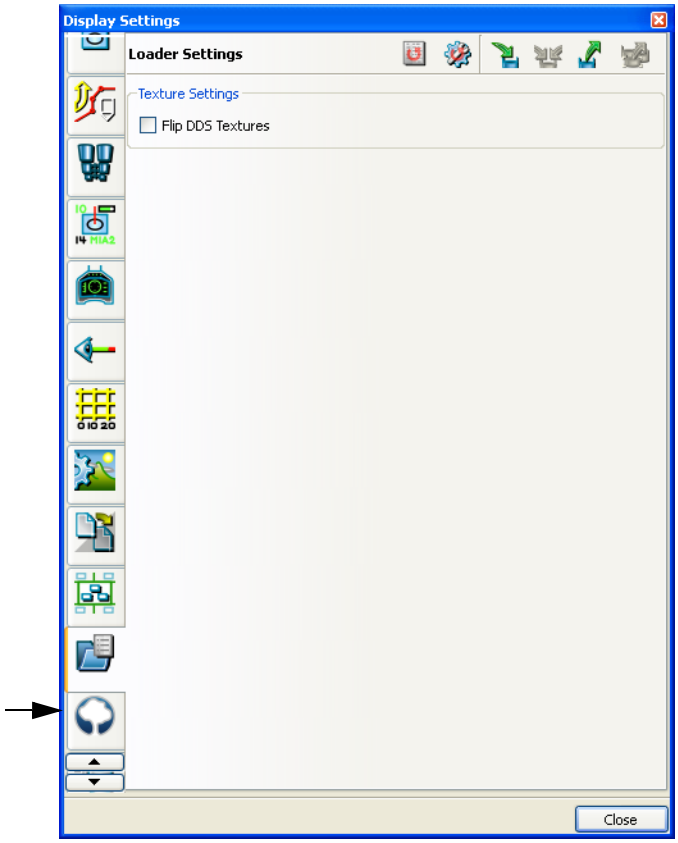


Figure 5-21. Loader Settings page

3. Select the Flip DDS Textures check box.
4. Click Close.

5.11. 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 2-2).
3. Select the observer mode for which you want to enable or disable grid lines (2D modes only).
4. Select or clear the Display Grid Lines check box.



You can also enable or disable track histories by choosing **Observer** → **Grid Lines** or clicking the Grid Lines icon () on the Observer Settings Toolbar.

5.11.1. Configuring Grid Lines

You can configure the coordinate system used for grid lines, the precision, and 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 5-22).

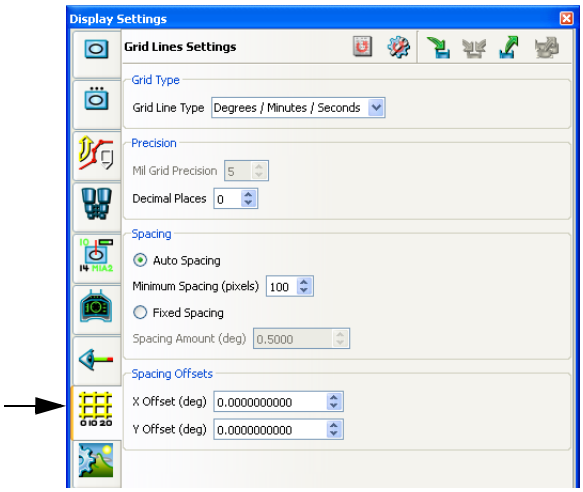


Figure 5-22. Grid Lines Settings page

3. To change the coordinate system used for grid lines, select an option in the Grid Line Type drop-down 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 precision of the grid line labels, type a value in the appropriate option in the Precision group box.
5. To change the spacing type, select an option in the Spacing group box and specify a value for the chosen spacing type.
6. To specify an offset from the origin, change the values in the Spacing Offsets group box.

5.12. 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 5-23 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.

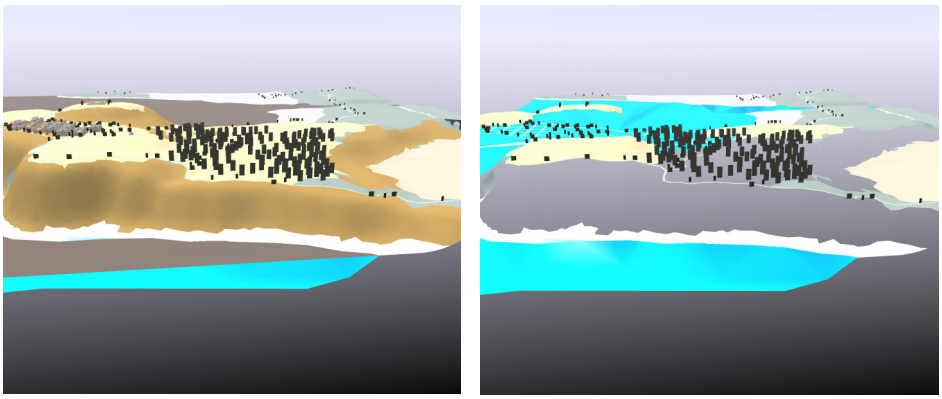


Figure 5-23. Visible surfaces toggled off

To display or hide GDB soil types:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Visible Surfaces page (Figure 5-24).

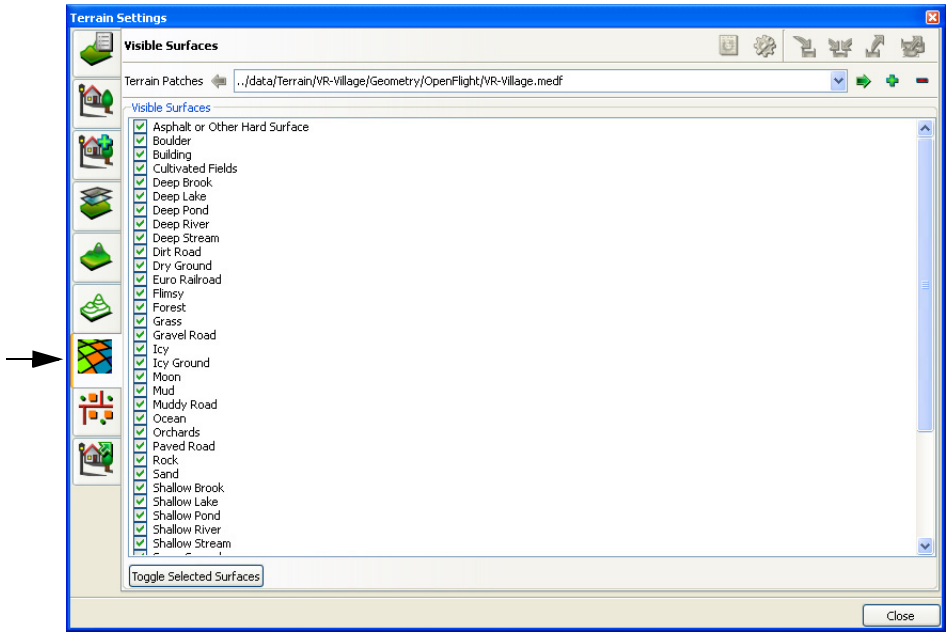


Figure 5-24. Visible Surfaces page

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 of the soil types whose state you want to change.
   b. Click Toggle Selected Surfaces.

5.13. Coloring Terrain Based on Elevation

You can color the terrain based on elevation. If you have a raster map, the color is superimposed on the image.

To enable or disable coloring of terrain by elevation:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Elevation Color Settings page (Figure 5-25).

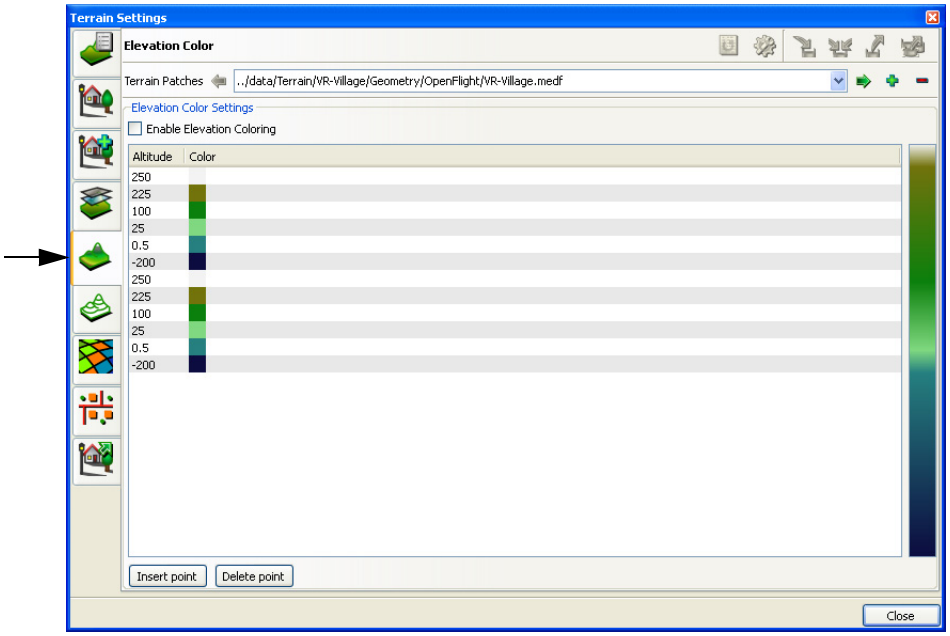


Figure 5-25. Elevation Color page

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.

5.13.1. 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 Settings page (Figure 5-25).
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 Settings page (Figure 5-25).
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 Settings page (Figure 5-25).
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.

5.14. 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 5-26). You can configure the thickness of contour lines and the interval between them.

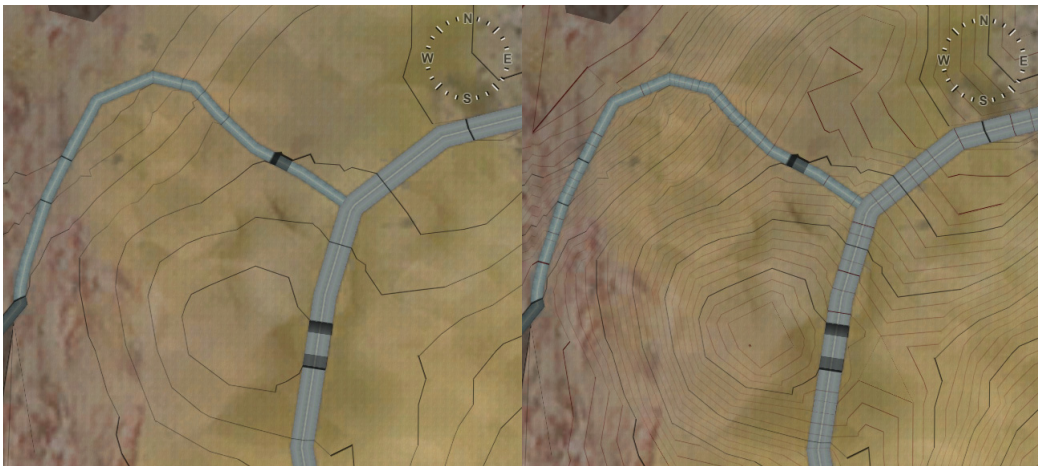


Figure 5-26. Contour lines and intermediate contour lines

To display contour lines:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Contour Line Settings page (Figure 5-27).

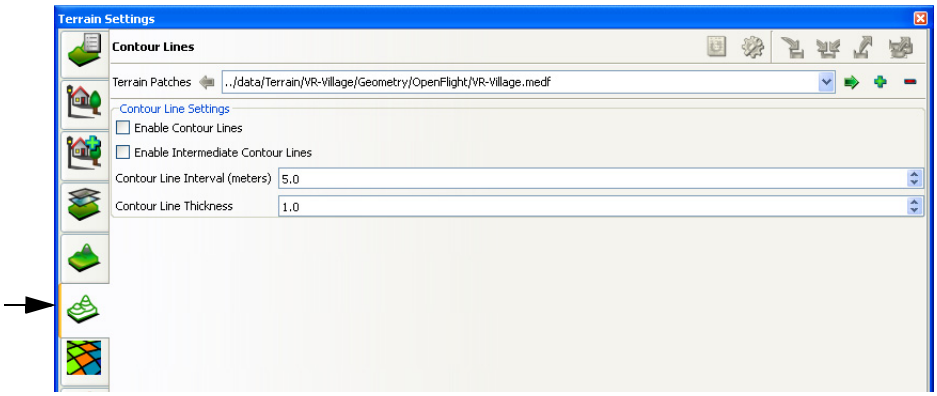


Figure 5-27. Contour Lines page

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.

5.14.1. 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 Line Settings page (Figure 5-27).
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.

5.15. Displaying Models and Terrain in Wireframe Mode

In wireframe mode, VR-Vantage displays the polygons that make up the terrain and objects (Figure 5-28).



Figure 5-28. 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 5-29).

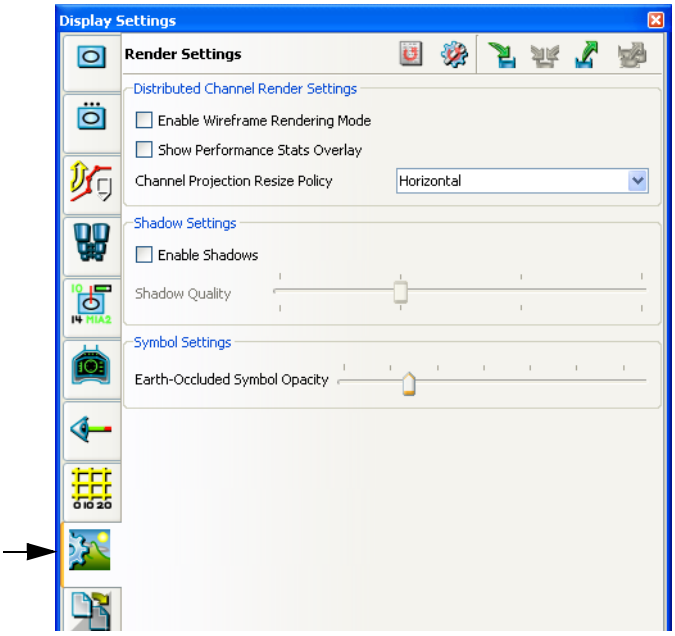


Figure 5-29. Render Settings page

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 icon ( ) on the Display Settings Toolbar.

5.16. Building Efficient MetaFlight Terrains for VR-Vantage

VR-Vantage can only load MetaFlight terrains built with certain tools. All MetaFlight files must be pre-processed by VR-Vantage tools before they can be loaded into VR-Vantage. 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.
- 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 and 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, etc).
- For optimal performance the first few sub levels (levels 1-4) should be made of FILE LOD GEOM tiles only. No children LOD GEOM tiles in the first few levels.
- For optimal performance the terrain should be balanced so 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 in order to reduce cull times. (For example, instead of having 10 individual buildings, externally reference one city block with all 10 buildings.)

5.17. Configuring LODs for Paged Terrains

The OSG_MAX_PAGEDLOD environment variable 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.

5.18. Terrain Databases Provided with VR-Vantage

Table 5-1 describes the terrain databases provided with VR-Vantage. Some have variants, which indicate the coordinate system or other variations.

Table 5-1: Terrain databases shipped with VR-Vantage

Database	Variation	Description
Berkeley	Berkeley.mtf	UTM. OpenFlight. Feature data. Shows the area around Berkeley, California, USA. It is provided courtesy of Terrex.
Ground	ground-db.mtf	UTM. OpenFlight. A generic relatively flat ground terrain.
HarrisAfghan-Village	HarrisAfghanVillage-FlatEarthMetaFlight.mtf	Paged terrain using flat earth projection. A terrain of Afghanistan with a high resolution inset of a small village. This terrain was created in VR-Vantage from source data. The terrain data is provided courtesy of Harris, Inc.
	HarrisAfghanVillage-FlatEarth.mtf	A static terrain database of Afghanistan with a high resolution inset.
	HarrisAfghanVillageGdal.mtf	A streaming version of this terrain using local data.
	HarrisAfghanVillageGeocentricMetaFlight.mtf	Paged terrain using geocentric coordinates.
Kabul	Kabul.mtf	UTM. OpenFlight. The area around Kabul, Afghanistan.
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," on page A-2
	LittlePondVR-TheWorldOnline.mtf	Little Pond features inset into VR-TheWorld Online.
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.
	MaklandCgfTopoMap.mtf	A topographic map laid on top of the Makland terrain.
	MaklandLocalWorld.mtd	Geocentric. Low resolution local terrain.

Table 5-1: Terrain databases shipped with VR-Vantage

Database	Variation	Description
	MaklandNoSpeedtrees.mtf	No SpeedTrees for improved performance.
MetaFlight examples	MetaFlightSample-FlatEarth.mtf	A MetaFlight terrain that covers the same area as HarrisAfghanVillage in Flat Earth coordinates. It demonstrates changes to LODs by changing color as you zoom in and out.
	MetaFlightSampleGeocentric.mtf	A MetaFlight terrain that covers the same area as HarrisAfghanVillage in geocentric coordinates. It demonstrates changes to LODs by changing color as you zoom in and out.
Nellis	Nellis.mtf	UTM. An example of a SAF terrain suitable for simulation, but not typically used in 3D imaging. A terrain covering the area around the Nellis Air Force Base, in Nevada, U.S.A.
OpenStreet-MapServer	OpenStreetMapServerOnline.mtf	Connects to a remote terrain server.
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 a *.earth* file.
TerraSim_SampleUrban	TerraSim_SampleUrban.mtf	UTM. An urban database based on Pittsburgh, Pennsylvania, U.S.A., with a highly detailed segment that includes feature data and buildings with multiple floors. It is provided courtesy of TerraSim.
	TerraSimSampleUrban-MetaFlight.mtf	A MetaFlight version of this terrain.
VR-TheWorld-Online	VR-TheWorldOnline.mtf	Lets you quickly connect to the publicly available VR-TheWorld Server for streaming terrain.
	VR-TheWorldOnline-high-ResolutionElevation-withBathymetry.mtf	A configuration that uses higher resolution LODs than *VR-TheWorldOnline.mtf*. This may result in reduced performance, particularly for aircraft.

Table 5-1: Terrain databases shipped with VR-Vantage

Database	Variation	Description
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.
	VR-VillageAfghanistanVR-TheWorldOnline.mtf	Geocentric. The high resolution data from *VR-Village.mtf* is inset in Afghanistan in VR-TheWorld online server.
	VR-VillageNoSpeedTrees.mtf	VR-Village with no SpeedTrees for improved performance.
World	WorldFlatEarthNoElevation.mtf	Flat earth. Low resolution projected image of the world.
	WorldGeocentric.mtf	Geocentric. Low resolution projection of the world.



Windows, Channels, and Display Engines

This chapter explains how to add and configure windows and channels and how to connect to remote display engines. For general information about display engines, please see "The VR-Vantage Display Engine," on page 4-4.

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6.1. 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. Appendix C, *Display Engine Tutorials*, shows how to edit a channel's attributes and how to save and load display engine configurations.

6.1.1. Adding a Window

You can add as many windows as you want. New windows are named Window 2, Window 3, 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:

1. 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 6-1).

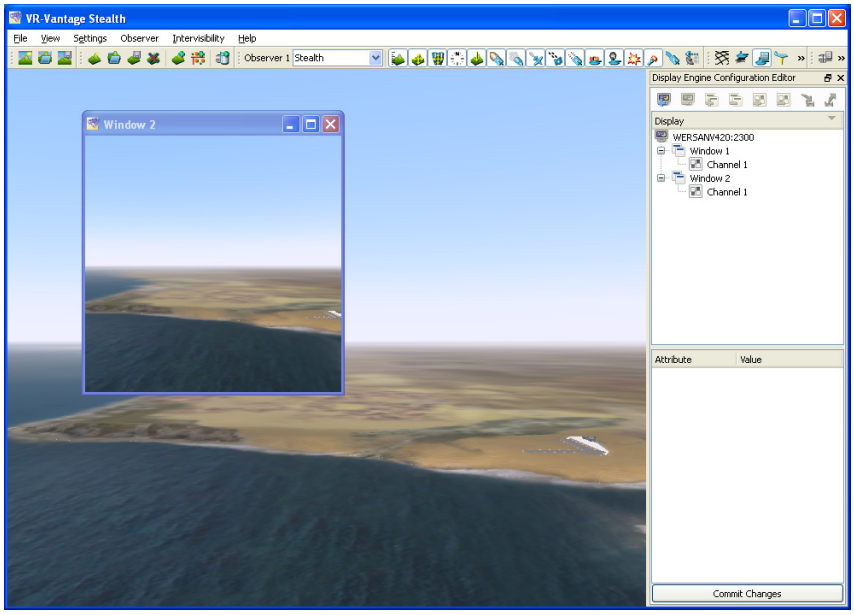


Figure 6-1. New window

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 6-2).

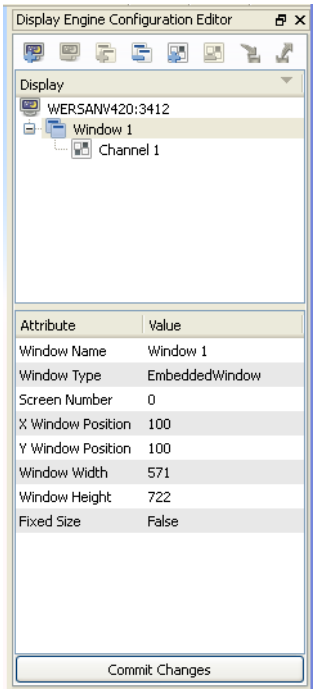


Figure 6-2. Display Engine Configuration Editor Panel



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 icon (), or right-click the display engine name and choose **Add a Window** on the menu. A new window opens and is listed in the Display Engine Configuration Editor Panel (Figure 6-3).

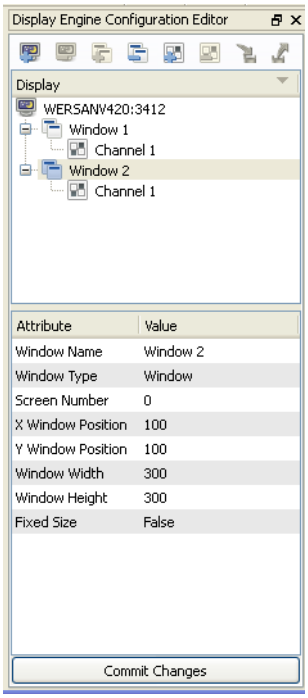


Figure 6-3. New window

6.1.2. 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 icon ( ), 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 6-10). For details about editing channel attributes, please see "Changing a Channel's Attributes," on page 6-9.

6.1.3. 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 icon ( ), or right-click the window name and choose **Remove Window** from the menu.

6.1.4. 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 icon ( ), or right-click the window name and choose **Remove Channel** from the menu.

6.1.5. 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 icon ( ), 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 configuration. Include the extension .dcx.
4. Click Save.

6.1.6. 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 6-7.

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 icon (), 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 6-19.) 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 6-6. 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* (Be sure to add the extension .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 with 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.

6.2. 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 4-5)
- 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 6-2).
2. Click the value of the attribute that you want to change.
3. To change a numeric value, type a new value or use the spin control to change the value. To change the Window Type or Fixed Size, select a value from the drop-down 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.

6.3. Changing a Channel's Attributes

You can change the following attributes of a channel:

- Channel Name
- Observer Name
- 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)
- Dynamic Near Far Planes
- Parent Channel
- Camera Position Offset (X, Y, Z)
- Camera Orientation Offset (Psi (heading), Theta (pitch), Phi (roll))
- Viewport (Left, Right, Bottom, Top)
- Keywords – user-defined 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 6-4).

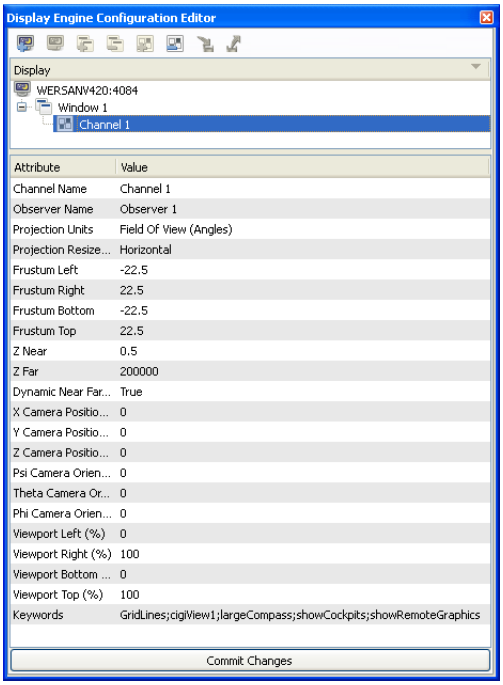


Figure 6-4. Channel attributes

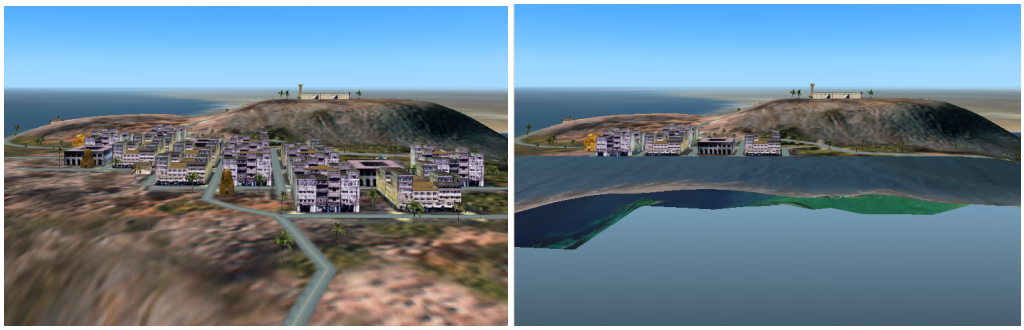
2. Click the value of the attribute that you want to change.
3. To change a numeric value, type a new value or use the spin control to change the value. To change the Observer Name, Project Units, Projections Resize Policy, or Parent Channel, select a value from the drop-down list. To change the Channel 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.

6.3.1. 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.

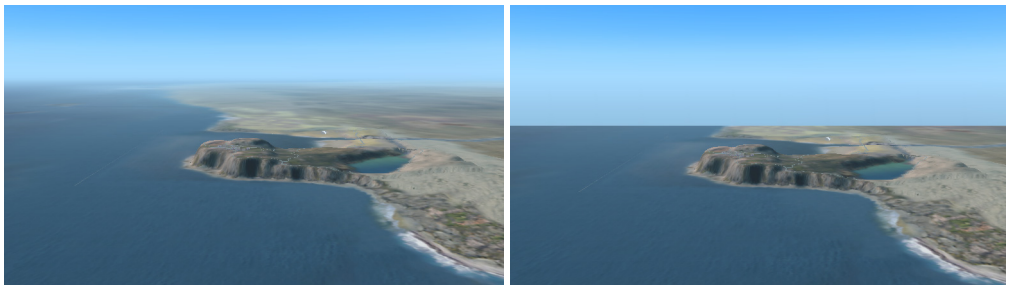
By default, VR-Vantage uses dynamic clipping planes. The near and far clipping values are determined based on the altitude of the observer. You can disable dynamic clipping planes and set the clipping planes manually with the Z Near and Z Far attributes of a channel.

Figure 6-5 illustrates the effect of changing the Z Near value. Figure 6-6 illustrates the effect of changing the Z Far value.



Z Near = 1 Z Near = 500

Figure 6-5. Near clipping



Z Far = 10000000 Z Far = 10000

Figure 6-6. Far clipping

- To enable or disable use of dynamic clipping planes, set the Dynamic Near Far Planes attribute to True or False.
- To change the near clipping plane, edit a channel's Z Near attribute. To change the far clipping plane, edit the Z Far attribute.

6.3.2. 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 6-8 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 6-7).

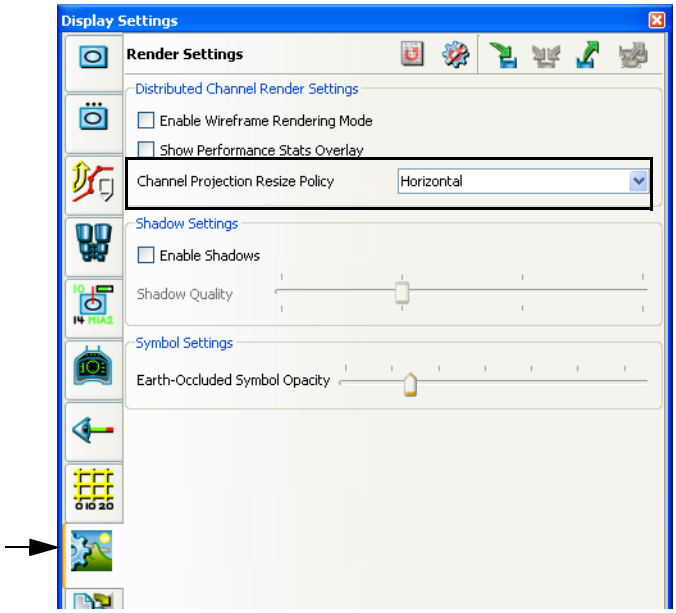
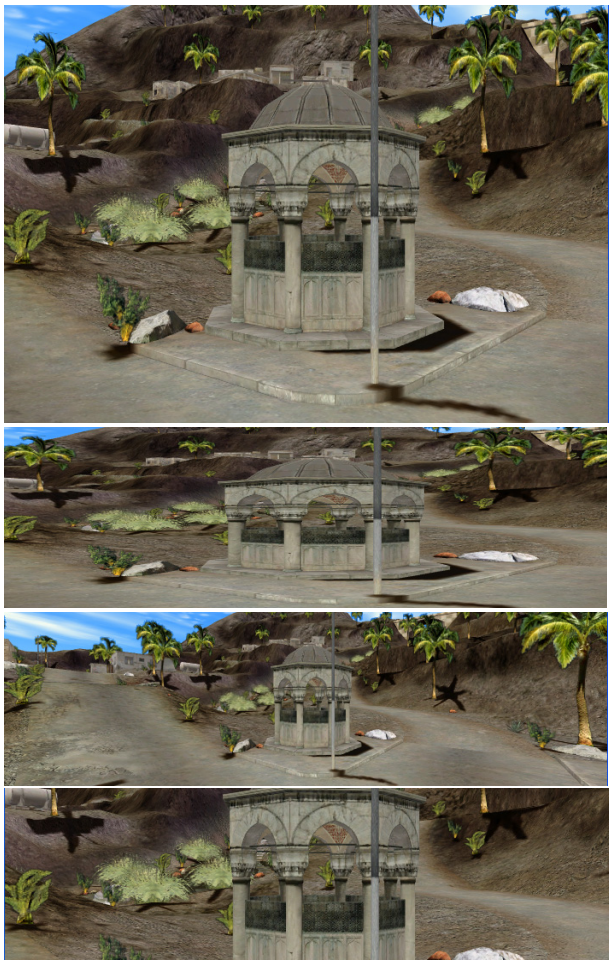


Figure 6-7. Display Settings, Render Settings page

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



Initial view

Resized with Fixed resize policy

Resized with Horizontal resize policy

Resized with Vertical resize policy

Figure 6-8. Effect of different projection resize policies

6.3.3. 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 6-9 illustrates different field-of-view settings. The view on the left has frustum values -30, 30, -30, 30. The view on the right has the frustum values -10, 10, -10, 10.

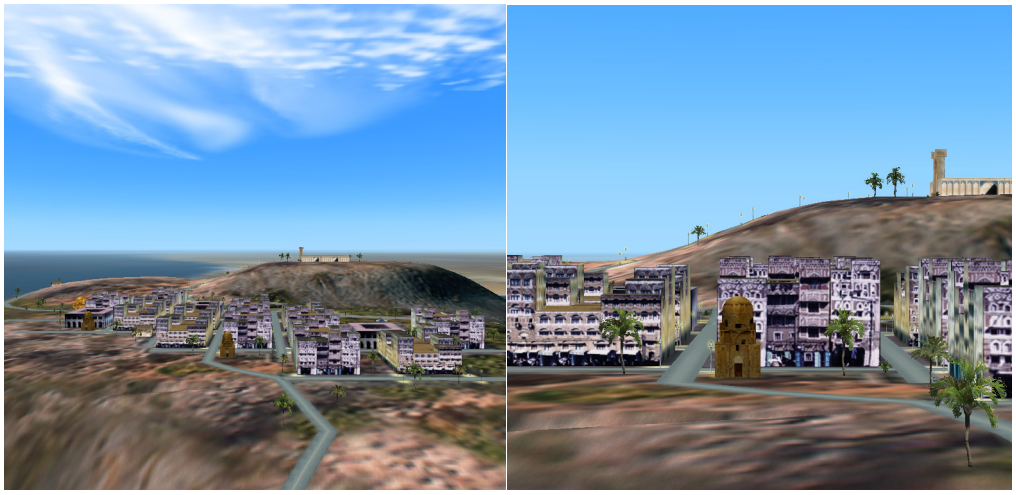


Figure 6-9. Field-of-view

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

6.3.4. 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 6-10 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.

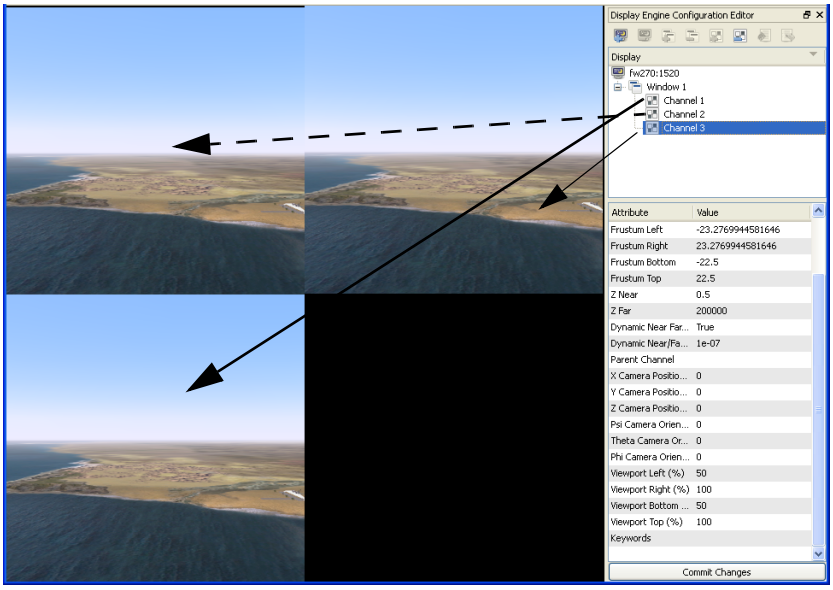


Figure 6-10. Window with three channels and three viewports

Viewports are specified as a percentage of the window from left to right and top to bottom. Figure 6-11 shows the percentage allocation for the viewports in (Figure 6-10).

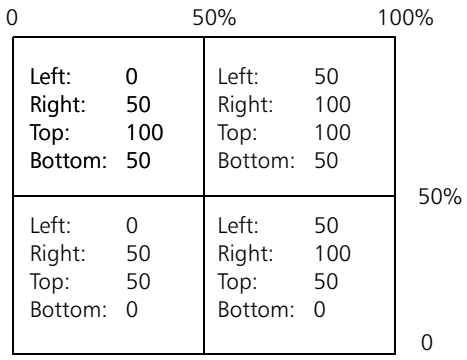


Figure 6-11. Viewport configuration



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

6.4. 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 **Programs** → **MÄK Technologies** → **VR-Vantage 1.3** → **VR-Vantage Display Engine 32-bit** (or 64-bit).

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

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

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

6.5. 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.



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 6-16.
3. On the master computer, choose **View → Display Engine Configuration Editor**. The Display Engine Configuration Editor Panel opens (Figure 6-2).
4. In the Display Engine Configuration Editor Panel, click the Connect a Display Engine icon (), or right-click the main display engine icon and choose **Connect a Display Engine**. The Connect To Display Engine dialog box opens (Figure 6-12).

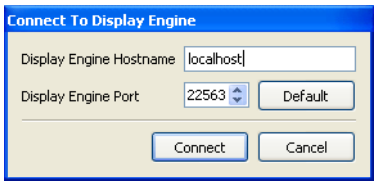


Figure 6-12. Connect to Display Engine dialog box

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.

6.5.1. 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 icon ( ), or right-click the display engine name and choose **Disconnect Display Engine** on the menu.

---

i You cannot disconnect the master display engine.

6.6. 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 6-13). 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 6-15, default window views). Therefore, for multiple views, you must configure the channels to calculate an offset from the master view.

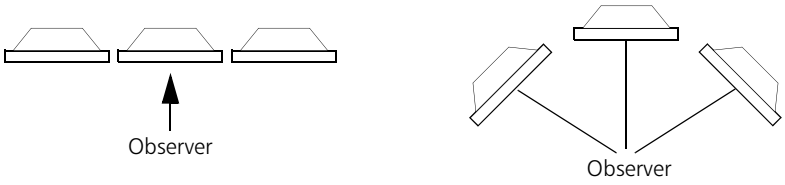


Figure 6-13. Multi-channel displays (top-down view)

The distribution of the view across multiple channels is controlled by the frustum. Figure 6-14 illustrates the default frustum for Channel 1. It has a 60° field of view, from -30° to +30°.

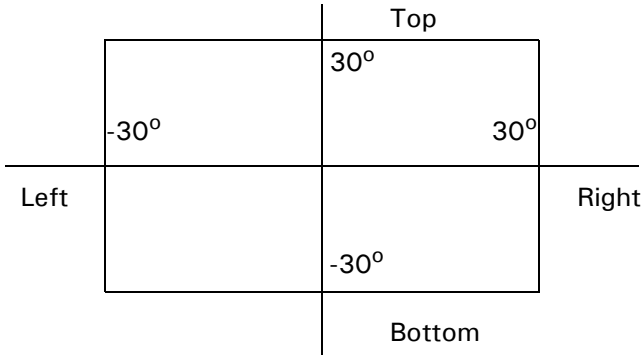


Figure 6-14. Default frustum for Channel 1

If you wanted to split the view in Figure 6-14 into, for example, three horizontal channels, you would edit the left and right frustum values for each channel, as shown in (Figure 6-15). The field of view is the same: -30° to +30°. However, now each channel shows a 20° segment of the total field of view.

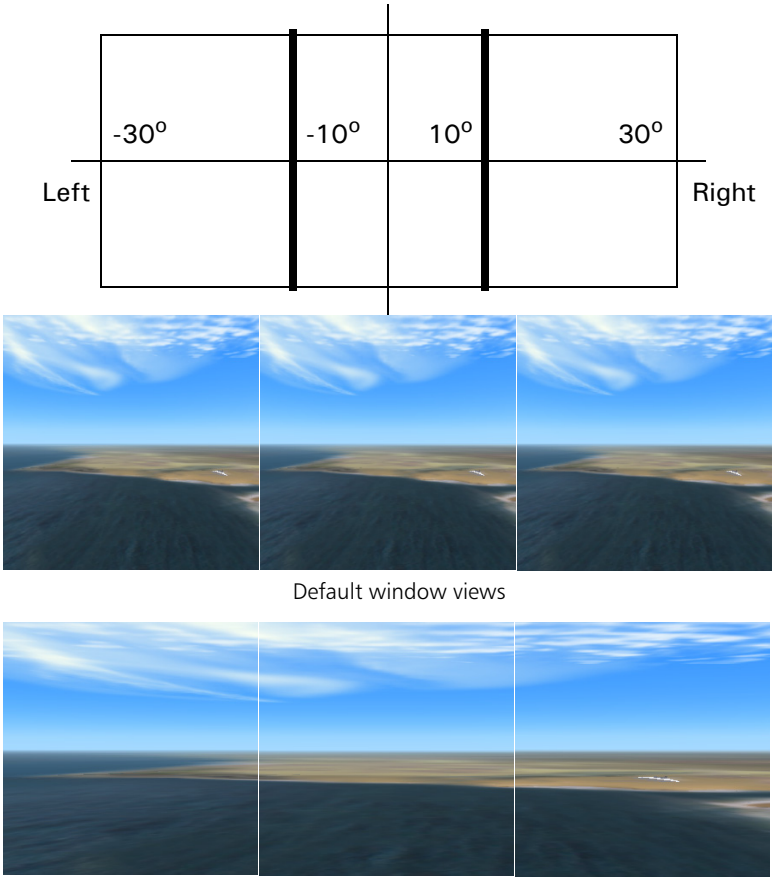


Figure 6-15. Frustum values for three channels

6.6.1. 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 6-16. (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).

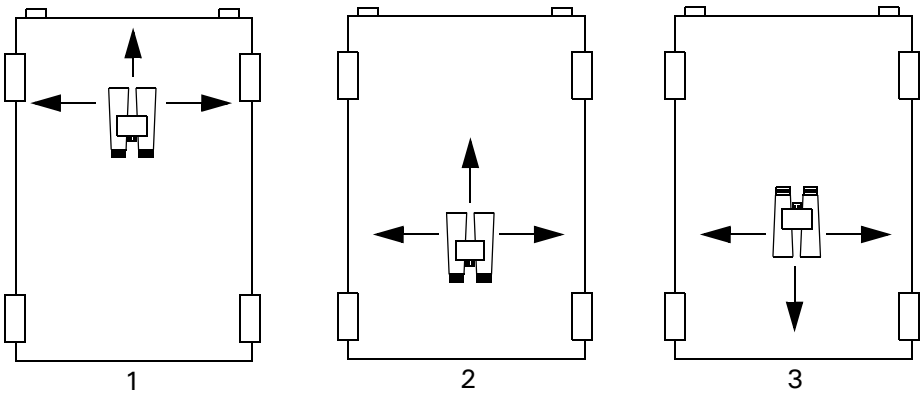


Figure 6-16. Position and orientation offsets

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).

6.6.2. Creating a Multichannel Configuration

A multichannel configuration is just a set of display engine configurations. You must save each configuration individually. Appendix C, *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 icon ( ).
   c. Type a name for the configuration.
   d. Click Save.

6.6.3. 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 6-7.

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 icon ( ).
   c. Select the configuration you want to load.
   d. Click Load.

6.7. 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.

6.7.1. 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

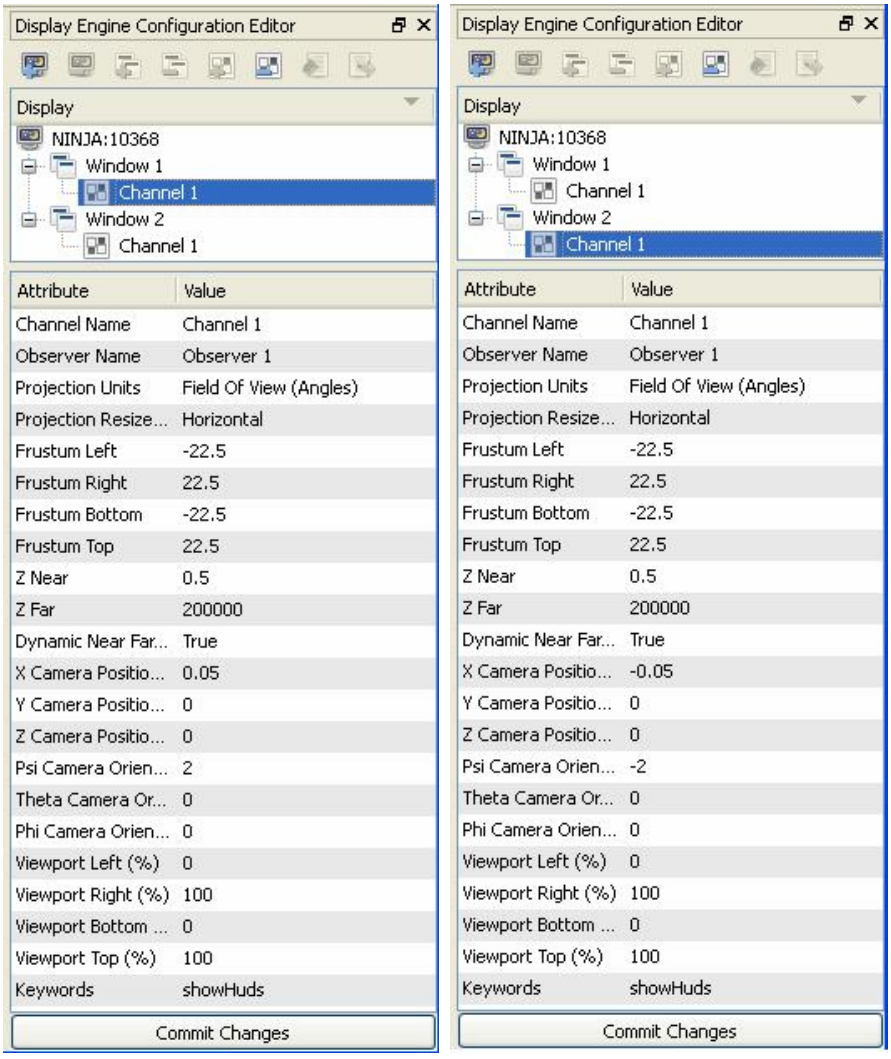
Environment Variable	Description	Default
OSG_STEREO	Turn stereo on.	ON
OSG_STEREO_MODE	Use anaglyphic stereo when in stereo.	ANAGLYPHIC
OSG_SCREEN_DISTANCE	Specifies the distance, in meters, that the viewer is from the screen.	0.50
OSG_SCREEN_HEIGHT	Specifies the height of the image, in meters, on the 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.

6.7.2. 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 6-17 shows an example configuration.



Left channel Right channel

Figure 6-17. 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.



Scenes and Environmental Effects

This chapter describes scenes and features that control the VR-Vantage window.

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Setting the Date and Time of Day 7-3
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- Setting Visibility (Fog) 7-4
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- Deleting a Cloud Layer 7-7
- Configuring Precipitation 7-8

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7.1. Working with Scenes

A scene contains an environment, the time of day, and possibly, a terrain. If particular environment settings are important to the simulations you are viewing, use of scenes can be an important convenience feature. A scene does not have to have a terrain. For example, when you start VR-Vantage, a default scene is loaded that does not have a terrain.

7.1.1. Creating a Scene

To create a scene:

1. Choose **File** → **New Scene**, or click the New Scene icon () 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 Local Terrain," on page 3-6 and "Terrain Agility and Composability," on page 4-2.
3. Specify environment settings, as described in "Configuring Environmental Effects," on page 2-4.

7.1.2. Saving a Scene

To save a scene:

1. Choose **File** → **Save Scene**, or click the Save Scene icon () on the Scene Toolbar. The Save Scene dialog box opens.
2. Type a name for the scene. Include the extension .msf.
3. Click Save.

7.1.3. Opening a Scene

To open a scene:

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

7.2. Setting the Date and Time of Day

VR-Vantage changes the ambient light based on the time of day. It can adjust the time of day at which it changes light based on the simulated date. Figure 7-1 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 7-1. 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 7-2).

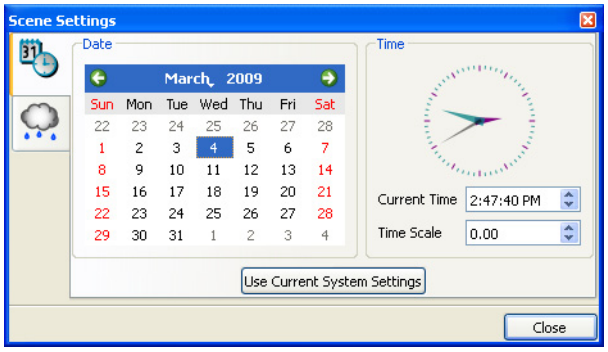


Figure 7-2. Date and Time page

3. To specify the date, select a date in the calendar.
4. To specify the time, in the Time group box, type a time value, in HH:MM:SS format, in the Current Time box, or set the value using the spinner controls. The analog clock display changes to reflect the current simulated time.
5. To set the date and time of day to the system settings, click Use Current System Settings.

7.2.1. 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 only affects VR-Vantage's display of ambient light. It has no relationship to or affect 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 7-2).
3. In the Time group box, type a value in the Time Scale box or use the spinner control to set it.

7.3. Configuring the Environment

Environment settings include clouds, visibility, and precipitation. 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 3-11.

7.3.1. Setting Visibility (Fog)

The visibility range 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 Settings page (Figure 7-4).

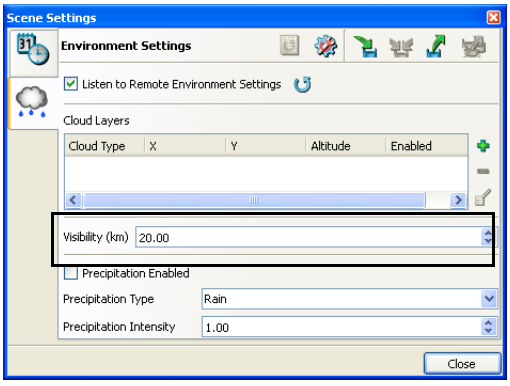


Figure 7-3. Environment Settings page

3. In the Visibility box, enter a range, in kilometers.

7.3.2. Enabling and Disabling the Display of Clouds

VR-Vantage supports display of multiple cloud layers, each of which has its own characteristics. You can add and remove cloud layers and can enable and disable the display of any of them.

To enable or disable the display of a cloud layer:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Settings page (Figure 7-4).

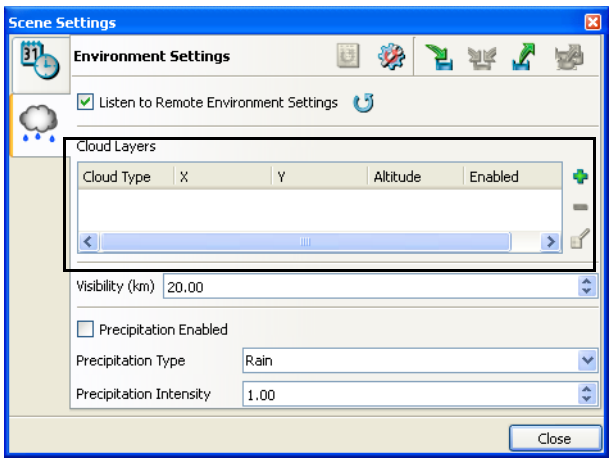


Figure 7-4. Environment Settings page

3. For each cloud type that you want to enable or disable, select or clear the cloud layer's check box in the Enabled column of the Cloud Layers list.

7.3.3. Adding a Cloud Layer

VR-Vantage includes a set of cloud models that you can add to a scene. A cloud layer does not extend indefinitely. It is placed over a specific area of the terrain. You can configure the location, size, and density of a cloud layer.

- Increasing the size or density of a cloud layer can affect performance.
- Nimbostratus clouds are intended to be viewed from below the cloud layer. They do not look good from above.

To add a cloud layer to the scene:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Settings page (Figure 7-4).
3. Click the Add icon (+) to the right of the list of cloud layers. The Add Cloud Layer dialog box opens (Figure 7-5).

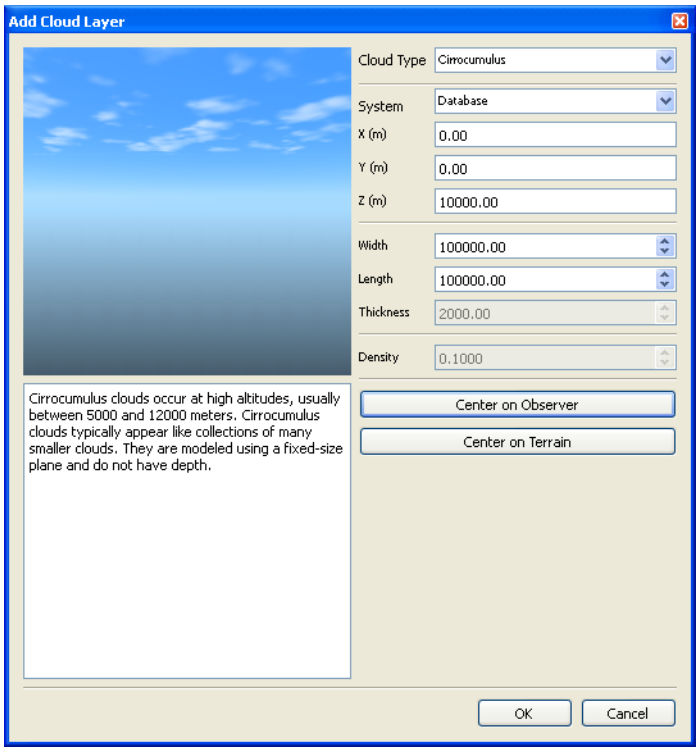


Figure 7-5. Add Cloud Layer dialog box

4. Select a cloud layer from the Cloud Type drop-down list. The dialog box displays a description of the cloud type.

5. Optionally, change the parameters of the cloud type. (Some parameters do not apply to every cloud type.) Parameters are defined as follows:
   - System. Specifies the coordinate system to use for specifying the location of the cloud layer.
   - The X and Y coordinates represent the center of the cloud layer.
   - The Z coordinate is the center for layers that have thickness. It is the Z value for layers that are planes.
   - Width, length, and thickness let you specify the size of the cloud layer. Thickness is the vertical depth of the cloud layer, not the density of the clouds themselves. Some cloud types do not have a thickness.
   - Density controls how much of the area of the cloud layer is filled with clouds.
6. Optionally, rather than specifying the cloud layer's location by typing in coordinates, you can center the cloud layer on the observer or the terrain. You cannot center on the terrain on geocentric terrains.
7. Click OK. The cloud layer is added to the Cloud Layers list.

7.3.4. Editing a Cloud Layer

After you create a cloud layer, you can change any of its parameters.

To edit a cloud layer:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Settings page (Figure 7-4).
3. In the Cloud Layers list, select the cloud layer that you want to edit.
4. Click the Edit icon ( ). The Edit Cloud Layer dialog box opens. (It is identical to the Add Cloud Layer dialog box (Figure 7-5).)
5. Change the parameters as desired.
6. Click OK.

7.3.5. Deleting a Cloud Layer

To delete a cloud layer:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Settings page (Figure 7-4).
3. In the Cloud Layers list, select the cloud layer that you want to delete from the scene.
4. Click the Delete icon ( ) to the right of the list. The layer is removed from the list.

7.3.6. Configuring Precipitation

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

Enabling and Disabling Precipitation

To enable or disable precipitation:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Settings page (Figure 7-4).
3. Select or clear the Precipitation Enabled check box.

Specifying Precipitation Type and Intensity

You can specify that precipitation be rain or snow. You can also specify how intense the precipitation is.

To specify the precipitation type and intensity:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Settings page (Figure 7-4).
3. On the Precipitation Type drop-down list, select the type of precipitation to display.
4. In the Precipitation Intensity box, specify the intensity. The range is 0.01 through 1.00, where 1.00 is the most intense.

7.4. 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 entities in a simulation interact with them in any way. However, some simulation applications can simulate weather effects and these effects do affect entity 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 precipitation and visibility.

To enable remote weather effects:

1. Choose **Settings** → **Scene**. The Scene Settings dialog box opens.
2. Select the Environment Settings page (Figure 7-4).
3. Select the Listen to Remote Environment Settings check box.
4. Click the refresh button.



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 9, *Moving the Observer*. For details about attaching the observer to entities and props, please see Chapter 10, *Attaching the Observer*.

- Changing the Observer Mode 8-2
- Creating and Editing Observer Modes 8-2
  - Creating an Observer Mode 8-3
  - Deleting an Observer Mode 8-4
  - Editing an Observer Mode 8-4
  - Renaming an Observer Mode 8-4
- Adding an Observer 8-5
  - Adding an Observer on the Observer Settings Page 8-6
  - Adding an Observer in the Display Engine Configuration Editor 8-7
- Removing an Observer 8-8
- Communicating Information About the Observer 8-9
  - Making the Observer Visible to Other Applications 8-9
  - Viewing and Attaching to Other Observers 8-10

8.1. Changing the Observer Mode

When you change the observer mode, terrain may be displayed differently and the model sets used to display entities and objects may change. For descriptions of the observer modes, please see "Observer Modes," on page 4-6.

➤ To change the observer mode, choose **Observer** → **Set Observer Mode** → *mode*, or on the Observer Settings Toolbar, choose an option from the Observer Mode drop-down list.



Figure 8-1. Observer Settings Toolbar

8.2. Creating and Editing Observer Modes

VR-Vantage comes with 3D and 2D observer modes. (Table 4-1 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.

8.2.1. 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 8-2).

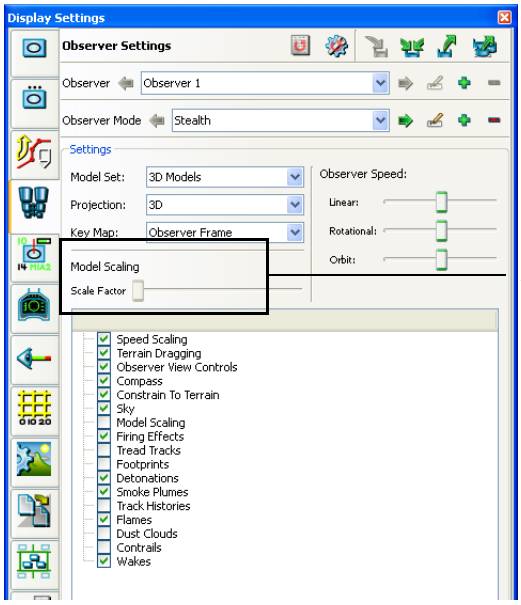


Figure 8-2. Observer Settings page

3. Click the Add icon (✚). The Create New Observer Mode dialog box opens (Figure 8-3).



Figure 8-3. Create New Observer Mode dialog box

4. Type a name for the new observer mode.
5. Click OK.
6. In the Settings group box, select a model set. (VR-Vantage XR only.)
7. Select a projection (2D or 3D). (VR-Vantage XR only.)
8. Select the key map you want to use.
9. Enable or disable the mode-specific settings. The list of settings varies depending on the projection and model set, and application.

8.2.2. 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 8-2).
3. In the Current Observer Mode list, select the observer mode that you want to delete.
4. Click the Delete icon ( ).

8.2.3. 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 8-2).
3. In the Current Observer Mode list, select the observer mode that you want to edit.
4. Edit the attributes of the observer mode as desired.

8.2.4. 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 8-2).
3. In the Current Observer Mode list, select the observer mode that you want to rename.
4. Click the Rename icon ( ). The Rename Observer Mode dialog box opens.
5. Type the new name.
6. Click OK.

8.3. 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.



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.

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.)

8.3.1. 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 8-4).

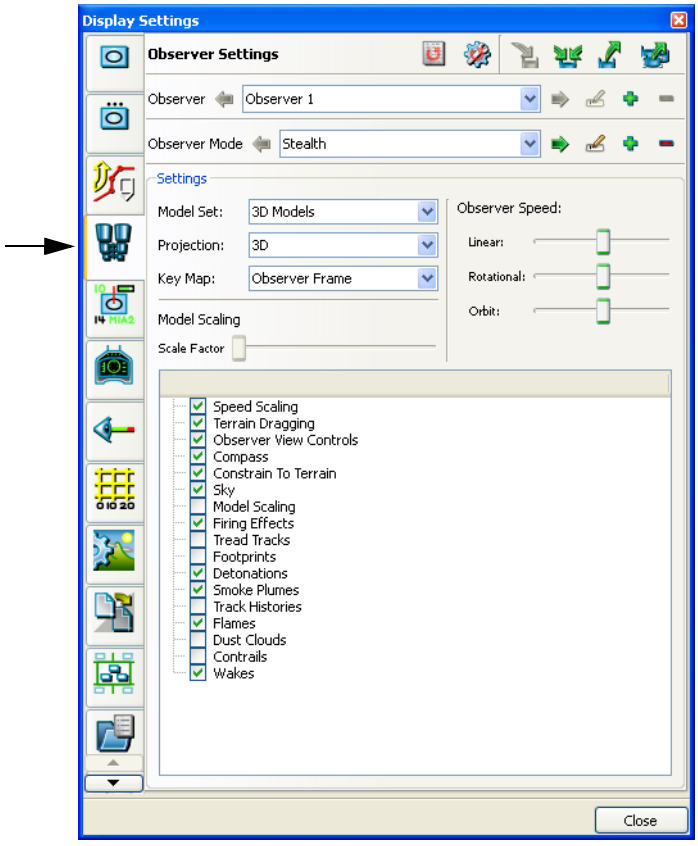


Figure 8-4. Display Settings dialog box, Observer Settings

3. Click the Add icon (✚) to the right of the Observer drop-down 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.)

8.3.2. Adding an Observer in the Display Engine Configuration Editor

To add an observer:

1. Choose **View** → **Display Engine Configuration Editor Panel**. The Display Engine Configuration Editor Panel opens (Figure 8-5).

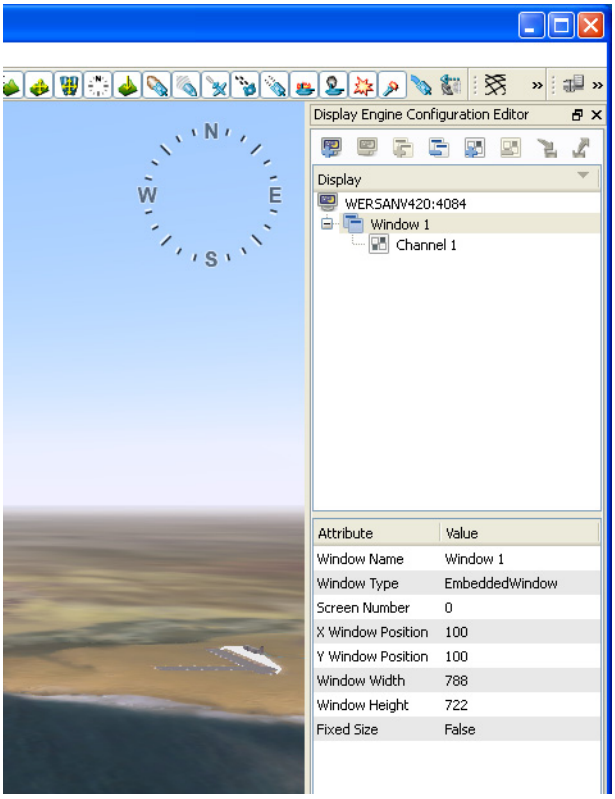


Figure 8-5. Display Engine Configuration Editor Panel

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 drop-down list, select New.
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.

8.4. 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 8-4).
3. In the observer drop-down list, select the observer that you want to remove.
4. Click the Delete icon (−). The observer is removed.
5. If the observer was saved as part of a display configuration, save the new display configuration.

8.5. 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.

8.5.1. 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 8-6).

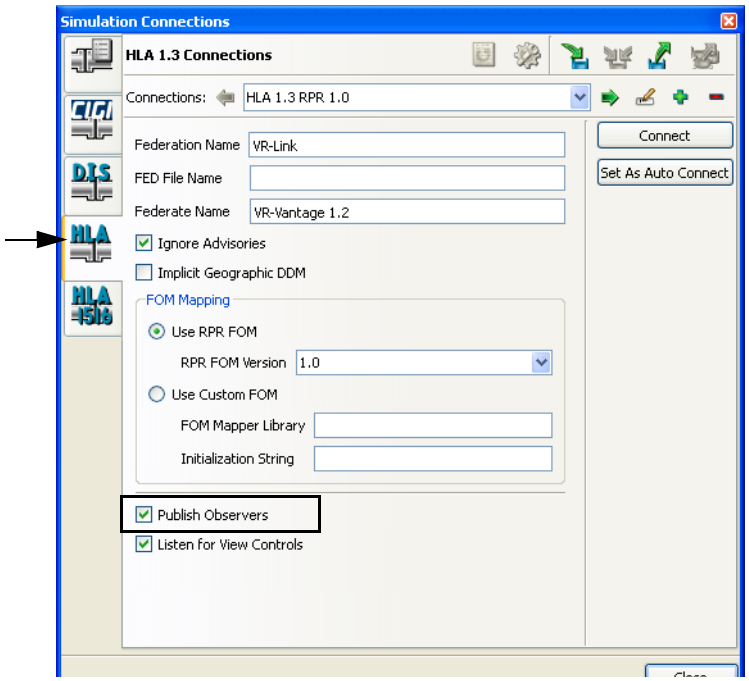


Figure 8-6. HLA 1.3 Connections page

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.

8.5.2. 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 entity.

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 11-30.



Moving the Observer

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

Moving the Observer 9-3
Using the Compass to View the Observer's Heading 9-4
Editing the Compass's Attributes 9-5
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3D Observer Movement Coordinate Systems 9-6
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9.1. 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 an entity, in which case it moves with the entity. (You can also attach the observer to a prop. For details about attaching the observer to an entity or prop, please see Chapter 10, *Attaching the Observer*.)

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 9-1).

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.

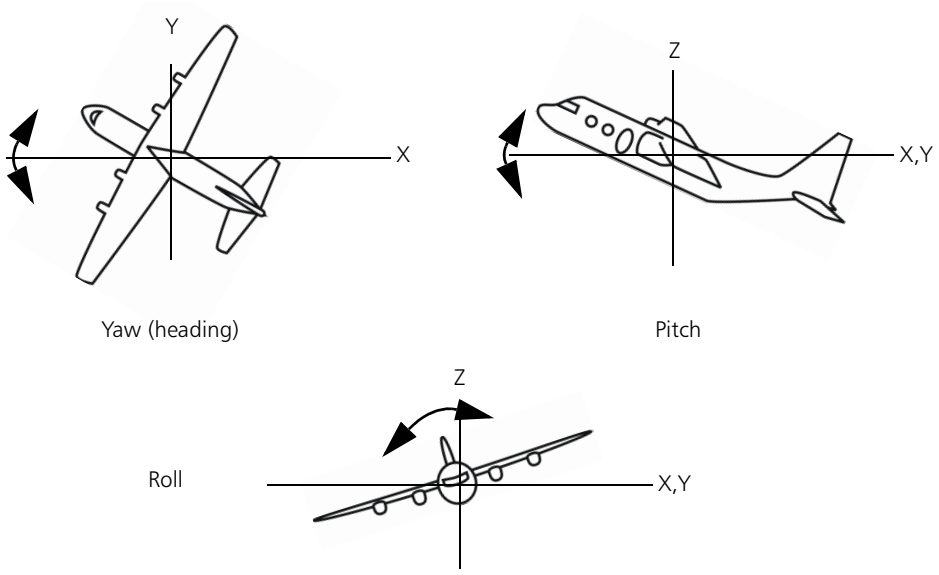


Figure 9-1. Orientation

9.1.1. 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. By default, it is enabled for Stealth, Plan View, and XR modes. In Figure 9-2, the observer's heading is approximately Northwest.

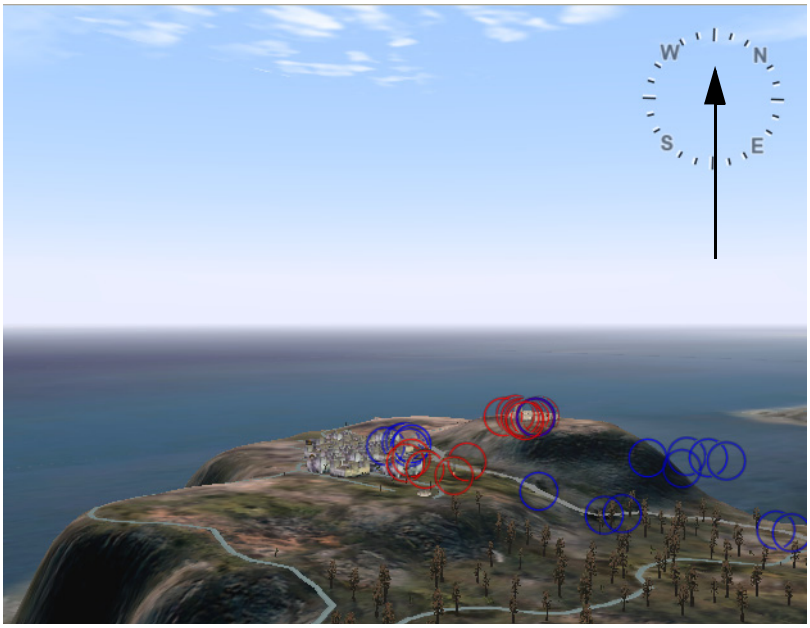


Figure 9-2. Compass

To enable or disable the compass:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 8-2).
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 icon ( ) on the Observer Settings Toolbar.

9.1.2. 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 17-3.)

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.

You can change the location of the compass 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.

9.2. 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 9-6.)

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 Appendix E, *Creating and Editing Key Mappings*.) This section describes how observer movement can vary based on the observer coordinate system and the attach mode.

9.2.1. 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.

9.2.2. 2D Observer Coordinate System

When you use the 2D projection (VR-Vantage XR 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.

9.2.3. 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 9-3 and Figure 9-4 illustrate the differences between moving the observer in an attached context and without an attached context.



The figures in this chapter use binoculars to represent the observer.

Figure 9-3 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.

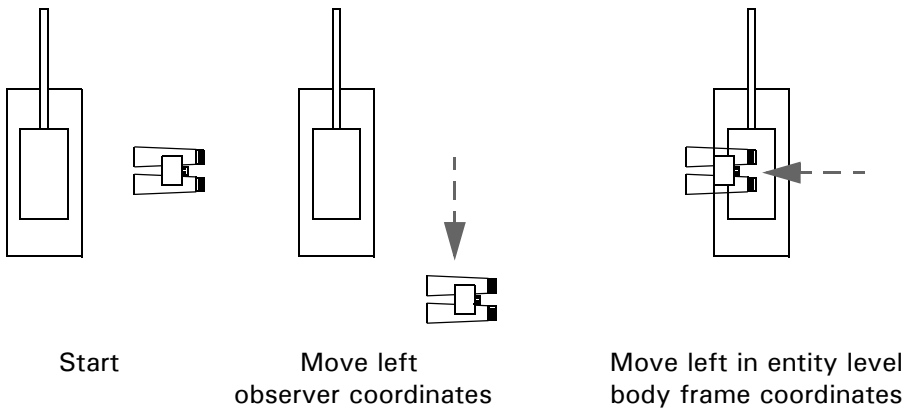


Figure 9-3. Observer movement in entity level body frame coordinates

Figure 9-4 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.

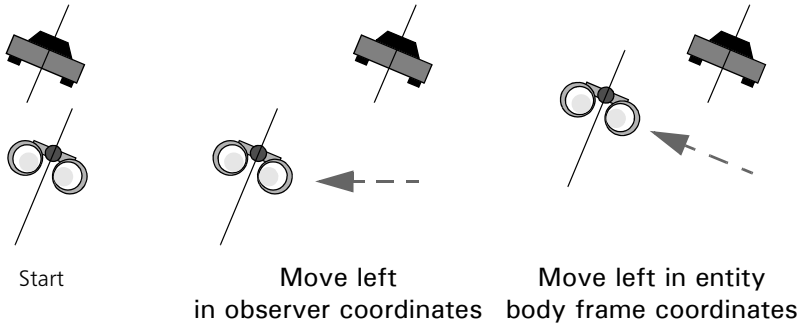


Figure 9-4. Movement in entity body frame coordinates

9.3. 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 an entity.

! 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 9-3, 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 9-5 illustrates the positional movement keys. Figure 9-6 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 9-5. Primary movement keys, observer coordinates (3D)

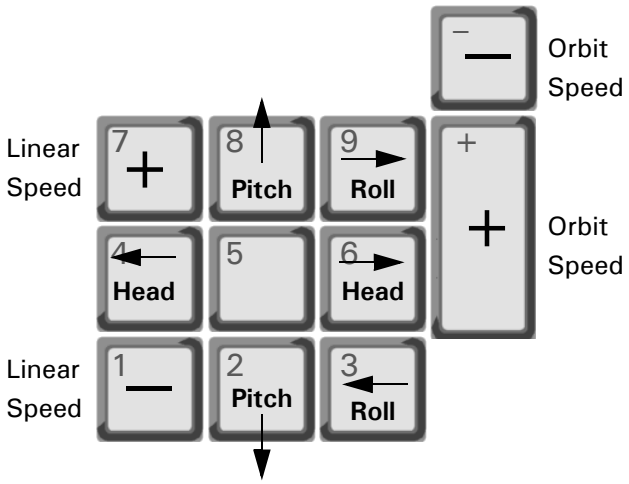


Figure 9-6. Keypad layout, heading, pitch, and roll (3D)

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.

9.3.1. 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.

For details about orbiting, please see "Orbiting," on page 9-12. For details about moving the camera, please see "Moving the Camera," on page 9-12.



When you view a geocentric terrain and zoom out more than 6 million meters, 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.

9.3.2. Orbiting

You can orbit the observer (revolve left, right, up, and down) around an attached 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 is always facing 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 an entity, detach (press **z**).
2. Press the right or left arrow keys.

9.3.3. 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.



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.

9.4. 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).

9.4.1. 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 9-7).

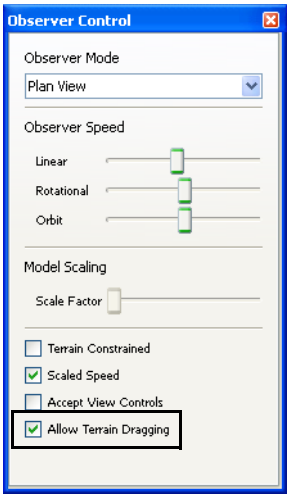


Figure 9-7. Observer Control Panel

9.4.2. 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.

9.4.3. 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.

9.4.4. Orbiting the Terrain with the Mouse

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

9.4.5. Teleporting the Observer

You can teleport the observer to an entity, 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 entity that you want to jump to.

9.5. 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 (XR and PVD Only)," on page 9-18.

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

Figure 9-8 illustrates the positional movement keys for the 2D projection. Figure 9-9 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 9-8. Primary movement keys, observer coordinates (2D)

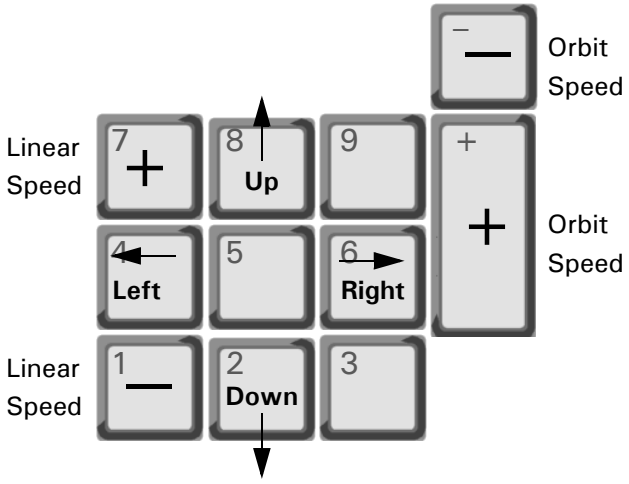


Figure 9-9. Keypad layout, heading, pitch, and roll (2D)

9.5.2. 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 9-13. 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

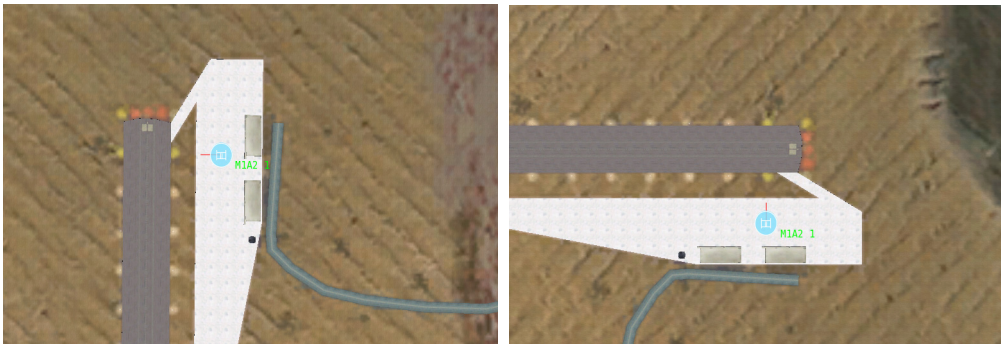
When Orient North is enabled, you cannot orbit. For information about Orient North, please see "Forcing Orientation North (XR and PVD Only)," on page 9-18.

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

9.6. Forcing Orientation North (XR and PVD Only)

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

Figure 9-10 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 9-10. 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 2-2).
3. In the Current 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 icon ( ) on the Observer Settings Toolbar.

9.7. 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 **/** (slash)
- Choose **Observer → Constrain to Terrain**
- On the Observer Control Panel (Figure 9-11), select or clear the Terrain Constrained check box
- Click the Constrain to Terrain icon () on the Observer Settings Toolbar.

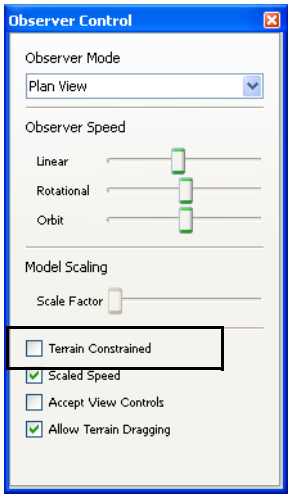


Figure 9-11. Observer Control Panel

9.8. 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.

9.8.1. 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 9-11), select or clear the Scaled Speed check box
- Choose **Observer** → **Speed Scaling**
- Press the multiply key (*) (not the asterisk key)
- Click the Speed Scaling icon () on the Observer Settings Toolbar.

9.8.2. 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 9-11) 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.

9.9. Saving and Recalling Views

At any given moment, the state of the observer is called its view. You can save views for later recall. If the observer is not attached to an entity, its view is its position and orientation in the simulated environment. If the observer is attached to an entity, 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 9-12).



Figure 9-12. Observer Views Panel

Its icons (as indicated by callouts) have the following meanings:

- Save the current view (1)
- Delete the selected view (2)
- Save all views to a file (3)
- Save the selected view to a file (4)
- Load a saved views file and append it to the list (5)
- Load a saved views file and replace the current list (6)
- Clear the list (7).



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 9-12).
2. Click the Add icon (). The current view is added to the list.



Views are remembered only while VR-Vantage remains running. To save a view for future recall, you must save it to a file. Please see "Saving Views to a File," on page 9-23.

9.9.1. Recalling a View

➤ To recall a view, select it in the Observer Views Panel. The view changes immediately.

9.9.2. Deleting Views

To delete a view:

1. In the Observer Views Panel, select the view you want to delete.
2. Click the Delete icon ( ).

Clearing the View List

➤ To remove all views from the list, in the Observer Views Panel, click the Clear List icon ( ).

9.9.3. 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.

To save the selected view to a file:

1. In the Observer Views Panel, click the Save Individual View icon ( ). 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. Include the extension .osrx.
3. Click OK.

To save all views to a file:

1. In the Observer Views Panel, click the Save All Views icon ( ). 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. Include the extension .osrx.
3. Click OK.

9.9.4. 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 9-12), click the Load Views and Merge icon ( ). 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 icon ( ). The Open Observer Views dialog box opens.
2. Select the saved views file that you want to load.
3. Click OK.

9.10. Controlling the Observer from Other Applications

VR-Vantage can respond to view control messages sent by applications such as the MÄK Logger. You can also write VR-Link-based applications to send view control messages to VR-Vantage using the classes in the Stealth Control Toolkit or VR-Vantage Control Toolkit. You can use view control messages to:

- Specify the attach mode and attached entity
- Set the observer's position and orientation.



The view control PDUs are experimental, and are not an official part of DIS. They are of PDU kind 202. VR-Vantage responds to move, absolute, tether, mimic, track, tether track, mimic track, follow, orbit, and compass view control PDUs. It does not support the other PDUs in 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. However, VR-Vantage continues to support PDUs sent from applications built with the Stealth Control Toolkit to the same extent it has in the past.

9.10.1. Enabling the Processing of View Control Messages

To enable or disable the processing of view control messages, use one of the following methods:

- On the Observer Control Panel (Figure 9-11), select or clear Accept View Controls.
- On the Connections page for the connector you are using, select or clear Listen for View Controls.
- Click the View Control icon ( ) on the Observer Settings Toolbar.



10

Attaching the Observer

This chapter describes attachment modes and how to attach the observer to entities and props.

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Attaching to an Articulated Part 10-3
Attaching the Observer in Mimic Track or Tether Track Mode 10-4
Filtering the Object Attachment List 10-4
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10.1. Attaching the Observer to an Entity or Prop

You can attach the observer to an entity and follow it as it moves through the simulation. You can also attach the observer to props.



This procedure applies to Follow, Tether, Track, and Mimic modes. To attach in Tether Track or Mimic Track mode, please see "Attaching the Observer in Mimic Track or Tether Track Mode," on page 10-4.

To attach the observer to an entity or prop, do one of the following:

- Right-click an object in the Objects List Panel (Figure 10-1) 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 10-5 and "Attach Modes in the 2D Projection," on page 10-10.)

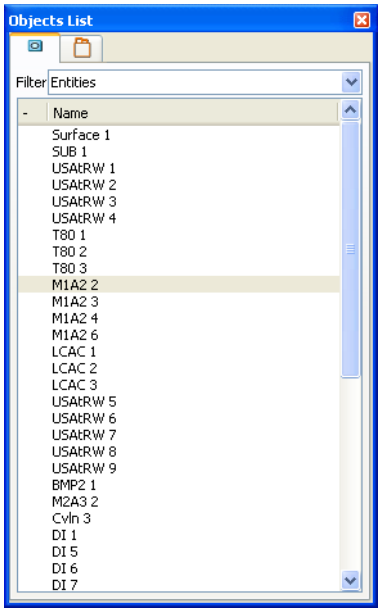


Figure 10-1. Objects List Panel

- Select an entity or prop. (For details about selecting entities and props, please see "Selecting Entities," on page 11-3 and "Selecting Props," on page 5-20.) In the Attachments Panel (Figure 10-2), click the Attach button ( ) to attach with the current attachment mode.
- On the Attachments Panel, click the next or previous arrows to attach to the next (or previous) object in the object list.

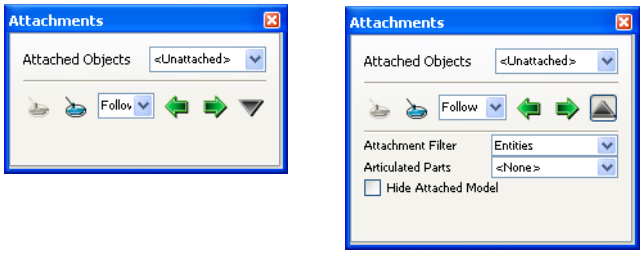


Figure 10-2. Attachments Panel

- Press greater than (**>**) to attach to the next entity 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 10-4.)
- Press period (**.**) to attach to the next entity 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 entity, 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 the **Spacebar**.

10.1.1. 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 an Entity or Prop," on page 10-2.
2. On the Attachments Panel (Figure 10-2), 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.

10.1.2. 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 attached entity and a secondary entity (the tracked entity).

To attach the observer in Mimic Track mode or Tether Track mode:

1. Right-click the primary entity 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 entity in the Objects List or in the window.

10.1.3. Filtering the Object Attachment List

Although you can attach to entities and props, it is likely that at any given time you will only want to attach to one type of object (usually entities). To reduce the number of objects that you have to iterate through when using the keyboard or Attachments Panel arrows to pick the next or previous object, you can filter the attachment list.

To filter the attachment list:

1. On the Attachments Panel (Figure 10-2), click the down arrow. The Attachments Panel expands.
2. In the Attachment Filter drop-down list, select the type of scene element that you want to attach to.

10.1.4. Detaching from an Entity

➤ To detach the observer from the entity to which it is attached, on the Attachments Panel (Figure 10-2), click the Detach icon (), or press **z**.

10.1.5. Hiding the Attached Model (3D Projection Only)

You can hide the model for the entity to which the observer is attached.

To hide the attached model:

1. On the Attachments Panel (Figure 10-2), click the down arrow. The Attachments Panel expands.
2. Select the Hide Attached Model check box.

10.1.6. Attaching to Props

Since props do not move, attaching the observer to a prop does not result in any observer movement. The principle 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.

10.2. 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 entity 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 an entity; it moves in space independently of all entities.
- Follow: The observer position and heading changes with the entity's position and heading.
- Mimic: The observer position and orientation changes with the entity's position and orientation.
- Tether: The observer's position changes with the entity's position.
- Track: The observer's heading changes to track the entity's position and heading.
- Tether Track: The observer's position changes with the entity's position while its heading is focused on a second entity.
- Mimic Track: The observer's position changes with the entity's position while its orientation is focused on a second entity.

The attach modes are described in detail in the following sections. For details about how to attach the observer to an entity, please see "Attaching the Observer to an Entity or Prop," on page 10-2.

10.2.1. Absolute Mode

In Absolute, or free-fly mode, the observer is not attached to an entity. Movement of entities does not affect the observer in any way.

10.2.2. Follow Mode

In Follow mode, the observer maintains its relationship to the attached entity as follows:

- When the entity's position changes, the observer's position changes to maintain its offset
- When the entity's heading changes, the observer's heading and position change to maintain the offset
- When the entity's pitch or roll change, the observer pitch and roll do not change.

Figure 10-3 illustrates the characteristics of Follow mode.

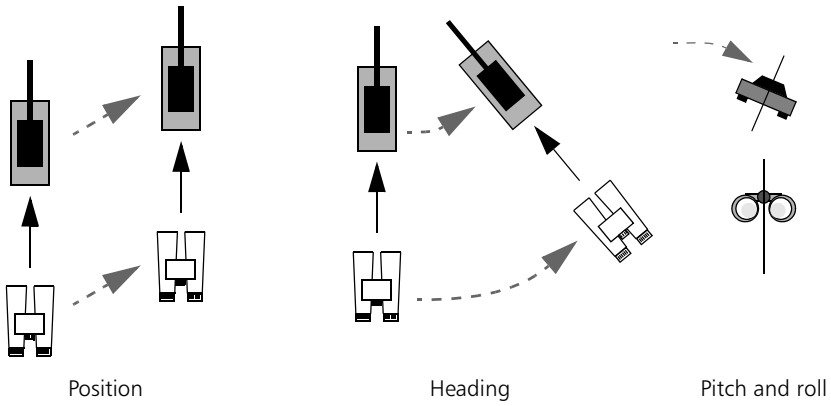


Figure 10-3. Follow mode

10.2.3. 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 attached entity is as follows:

- When the entity's position changes, the observer's position changes to maintain its offset
- When the entity's heading changes, the observer's heading and position change to maintain the offset
- When the entity'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 10-4 illustrates the characteristics of Mimic mode.

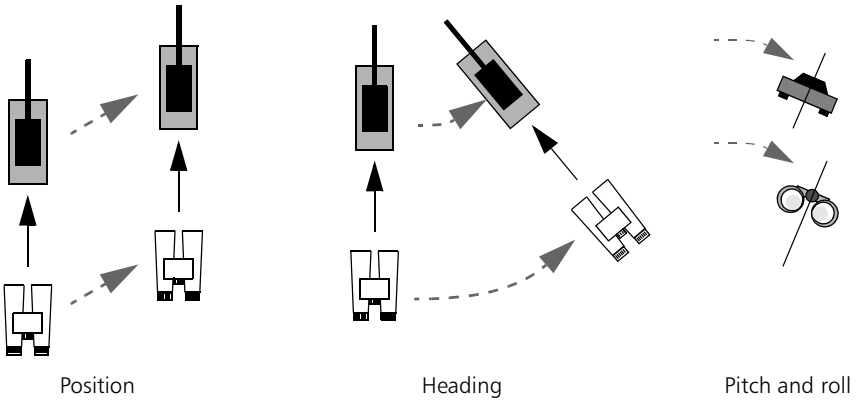


Figure 10-4. Mimic mode

10.2.4. 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.

10.2.5. Tether Mode

In Tether mode, the observer's maintains a constant offset from the attached entity, but it is not affected by the entity's heading, pitch, or roll, as follows:

- When the attached entity's position changes, the observer's position changes to maintain its offset
- When the attached entity's heading changes, the observer's heading does not change
- When the attached entity's pitch or roll change, the observer's pitch and roll do not change.

Figure 10-5 illustrates the characteristics of Tether mode.

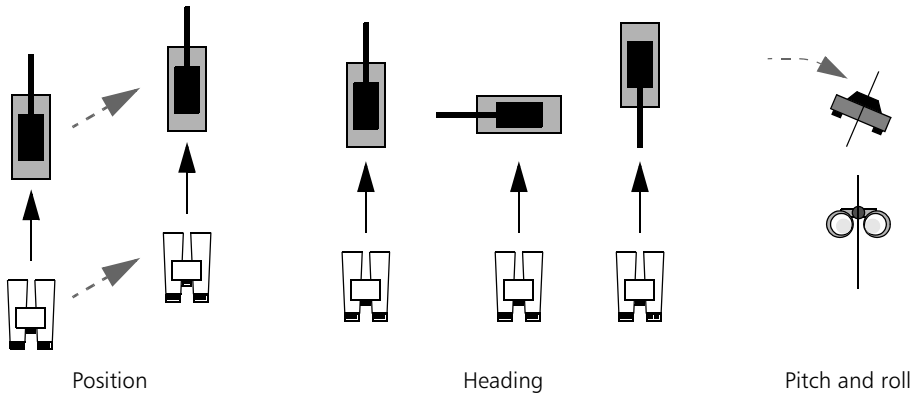


Figure 10-5. Tether mode

10.2.6. Track Mode

In Track mode, the observer's heading changes to track the attached entity's movement, keeping it centered in the field of view. The observer's position does not change. The observer maintains its relationship to the attached entity as follows:

- When the attached entity'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 attached entity's heading changes, the observer's heading does not change
- When the attached entity's pitch or roll change, the observer's pitch and roll do not change.

Figure 10-6 illustrates the characteristics of Track mode.

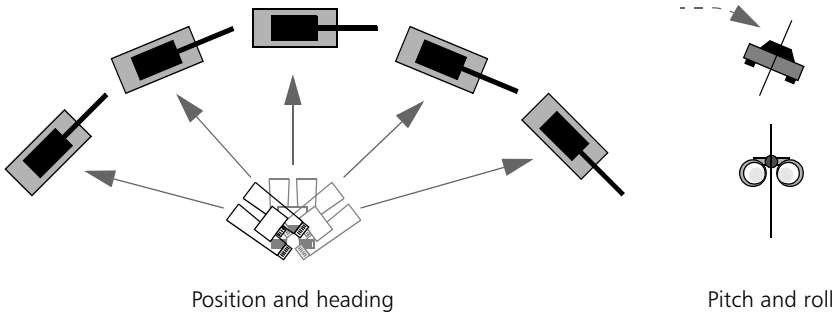


Figure 10-6. Track mode

10.2.7. 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.

10.3. 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 attached entity'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 10-1. If you then switch back to the 3D projection the original attach mode is restored.

Table 10-1: 3D to 2D attachment mode mapping

3D Attach Mode	2D Attach Mode
Mimic	Follow
Mimic Track	Follow
Follow	Follow
Tether	Tether
Tether Track	Tether
Track	Tether

10.4. 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. Be sure to add the extension .osrx.
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.

10.4.1. 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 maklandDemo recording.

To attach the observer to an entity at startup:

1. Start VR-Vantage IG.
2. Load the Makland terrain.
3. Start MÄK Data Logger.
4. Load maklandDemo (either the DIS or HLA version).
5. Connect VR-Vantage IG to the correct simulation network.
6. Run the maklandDemo recording.
7. Attach the observer in Mimic mode to FtrFw4.
8. If the Observer Views Panel is not open, choose **View** → **Observer Views Panel**.
9. On the Observer Views Panel, click the Add icon (+). The view is listed in the panel window.
10. Save the view to a file, for example *FtrFw4.osrx*.
11. Shut down VR-Vantage IG.
12. Start VR-Vantage IG with the following command line:

```
vrvIG --bindObservers "Observer 1,../appData/set-
  tings/vantageIG/FtrFw4.osrx" ../userData/terrains/Mak-
  land.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/van-
tageIG/FtrFw4.osrx" --dispSetting displayCOnfig.dcx ../userData/ter-
rains/Makland.mtf
```

You could also do this:

```
vrvIG --bindObservers "Observer A,Observer 1,../appData/settings/van-
tageIG/FtrFw4.osrx" --dispSetting displayCOnfig.dcx ../userData/ter-
rains/Makland.mtf
```

The observers get bound to views in the order in which they are listed.

VR-Vantage includes an example saved view, *FtrFw4.osrx*, that you can use to try out this example.

10.4.2. 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 as a saved view to each window.

The tutorial uses VR-Vantage XR 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 XR.
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 10-7).

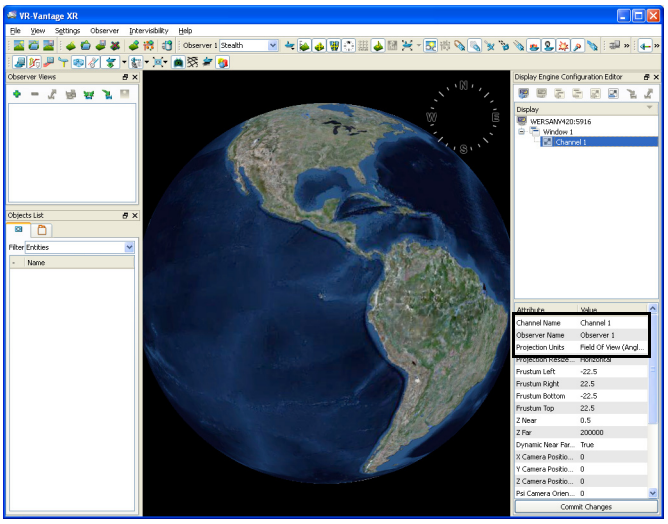


Figure 10-7. Observer 1

4. Choose **File** → **New Stealth Window**. A window titled Window 2 opens. It shows the same view as the main window. A window called Window 2 is added to the display engine configuration. The channel properties show that the window uses Observer 2 (Figure 10-8).

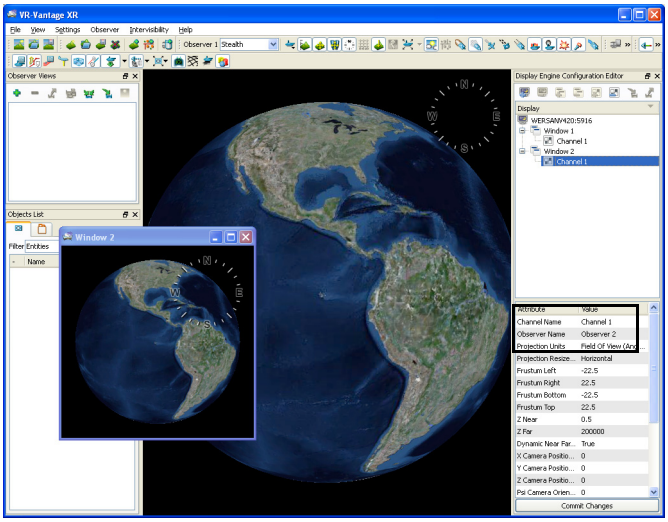


Figure 10-8. Observer 2

5. Choose **File** → **New Plan View Window**. A window titled Window 3 opens. It shows a portion of view in the main window. A window called Window 3 is added to the display engine configuration. The channel properties show that the window uses Observer 3 (Figure 10-9).

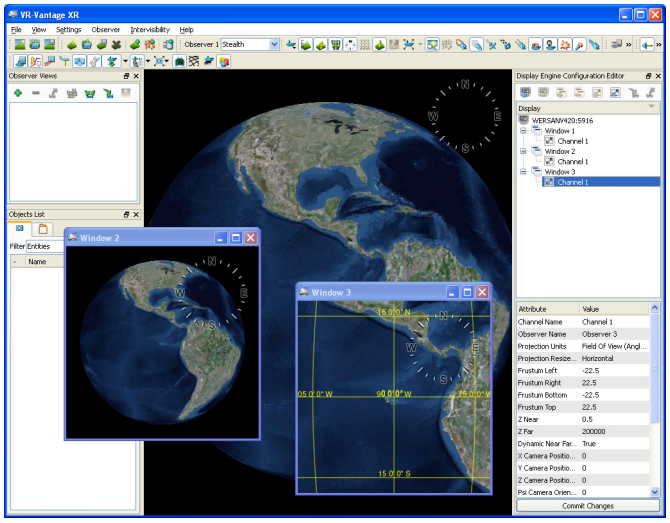


Figure 10-9. Observer 3

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 icon ( ). 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 icon ( ). 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 Window 2. 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 Window 3. 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.
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 icon ( ). The Save Observer Views dialog box opens.
14. Type a name for the saved views, for example, *BindObserversTutorialViews.osrx*.
15. Click Save.

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 XR with the following command:

```
C:\MAK\vrvantage1.3\bin\vrvXR.exe
  --dispSetting ..\appData\settings\vantageXR\BindObserversTutorial.dcx
  --bindObservers "Observer 1,Observer 2,Observer 3,
  ..\appData\settings\vantageXR\BindObserversTutorialViews.osrx"
  ..\userData\terrains\VR-TheWorldOnline.mtf
```

VR-Vantage XR starts up, loads the display engine configuration, opens the windows, and assigns the saved views to the windows (Figure 10-10).

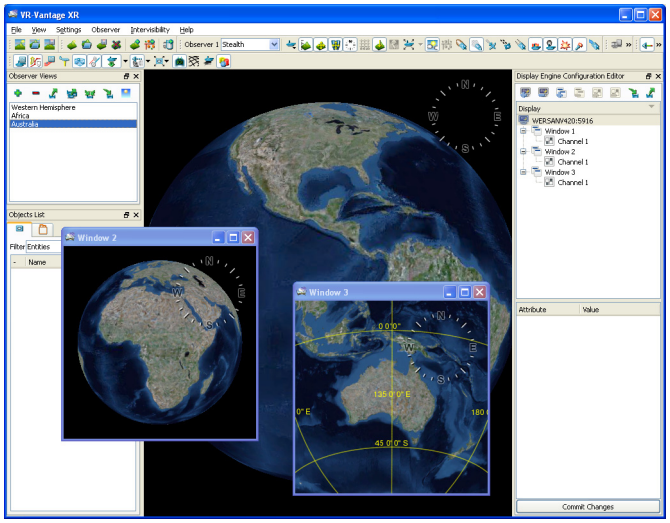


Figure 10-10. VR-Vantage XR with saved views assigned



11

Viewing Entities and Entity Effects

This chapter describes how to get information about entities and how to display various types of entity-related graphics.

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Displaying Entity Labels 11-4
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11.1. Selecting Entities

Many procedures require you to select one or more entities. When an entity is selected, a box is drawn around it (Figure 11-1) and it is highlighted in the Objects List Panel (Figure 11-2).

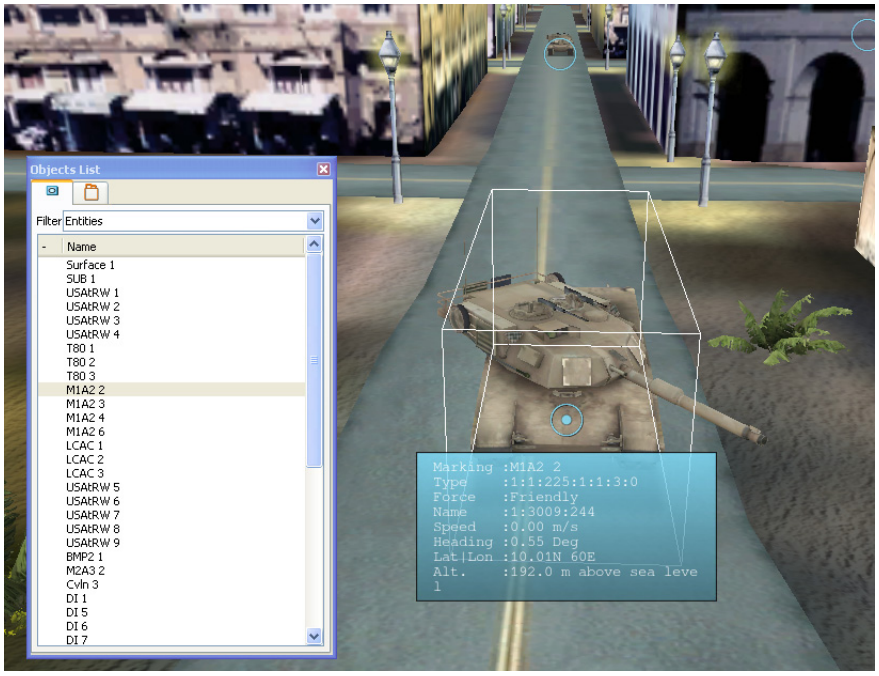


Figure 11-1. Selected entity

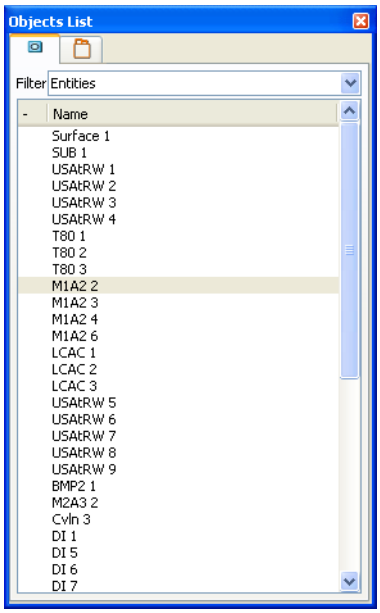


Figure 11-2. Objects List Panel

➤ To select an entity, 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.

11.2. Displaying Entity Labels

For 3D models, VR-Vantage displays entity labels that help you locate and identify entities (Figure 11-3). The entity label consists of an entity locator circle, which is always visible when entity 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.

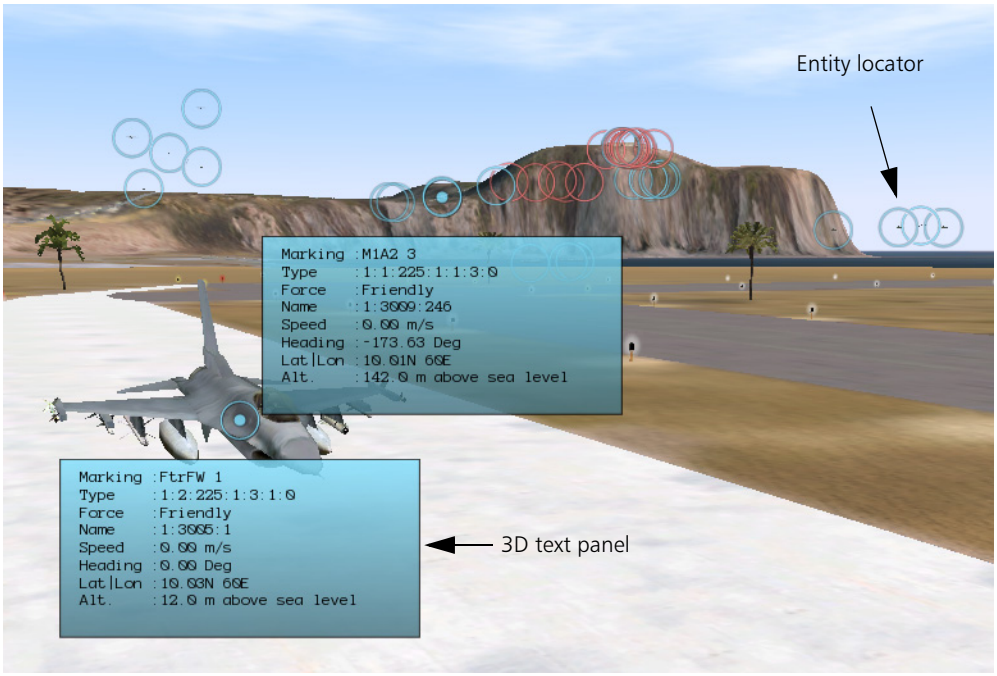


Figure 11-3. Entity labels for 3D models

For 2D icons (VR-Vantage PVD and VR-Vantage XR), entity labels are a set of individually enabled text labels (Figure 11-4). In VR-Vantage XR, 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 entity's:

- Name
- Orientation
- Velocity
- Acceleration
- Heading Indicator.

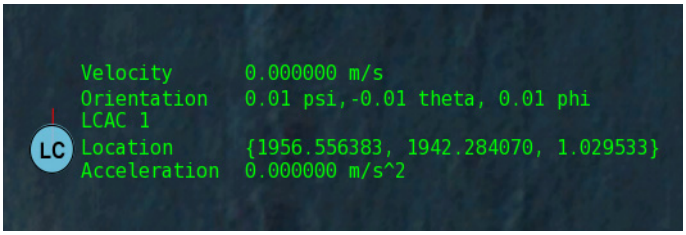


Figure 11-4. Entity labels for 2D icons

11.2.1. Displaying Text Labels for 3D Models (XR, IG, and Stealth)

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 Only Display Labels for Selected Entities (Figure 11-5). Then select the entity whose label you want to see.

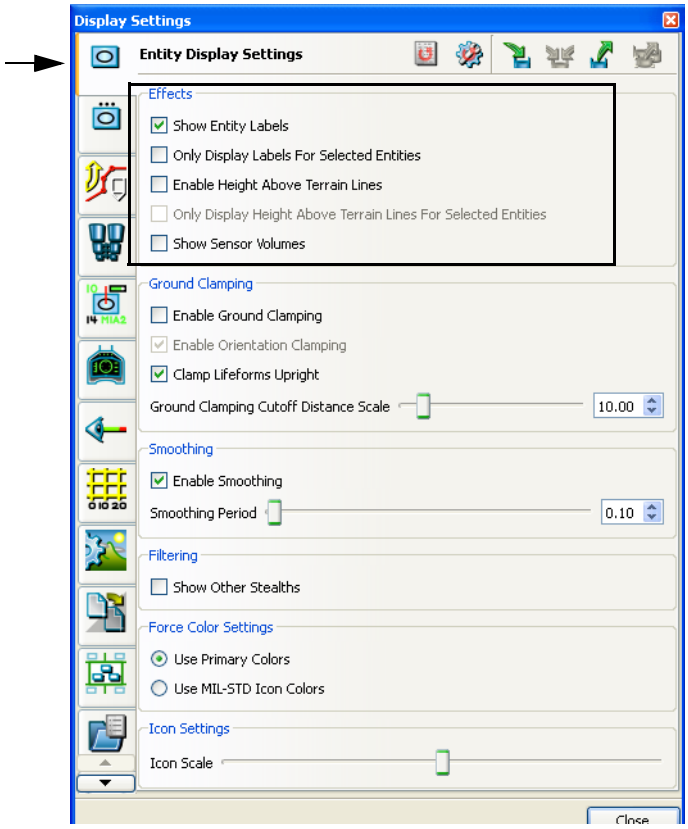


Figure 11-5. Display Settings, Entity Display Settings page

11.2.2. 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 11-5).
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 icon () on the Display Settings Toolbar.

11.2.3. 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 the 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 Only Display Labels for Selected Entities (Figure 11-5). Then, in the Objects List Panel, multi-select the entities whose labels you want to see.

11.2.4. Displaying Entity Labels for 2D Icons (XR and PVD Only)

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 entity 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 11-6).

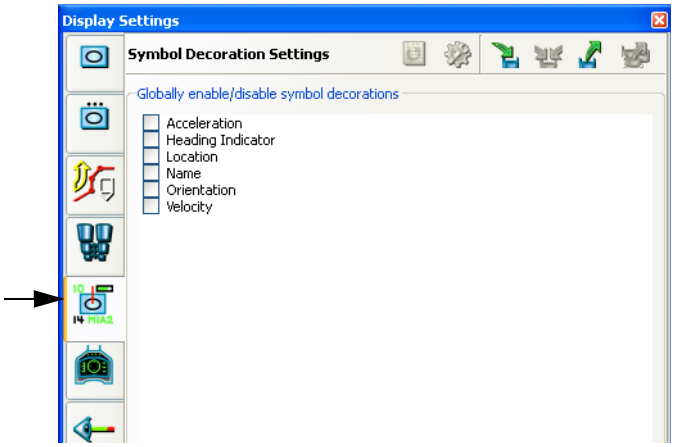


Figure 11-6. Symbol Decoration Settings page

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 icon 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 left side of the Entity Icon Scale icon (▾ ▾). A small panel is displayed. It is a persistent window.

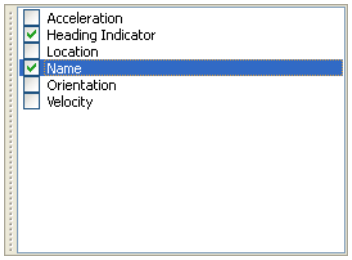


Figure 11-7. Symbol Decoration Panel

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 right-most arrow on the Entity Icon Scale icon.

11.3. Inset Views

You can display inset views of individual entities. Figure 11-8 shows a helicopter hovering over the runway in the Makland terrain with an inset view of an M1A2 tank driving through the town.

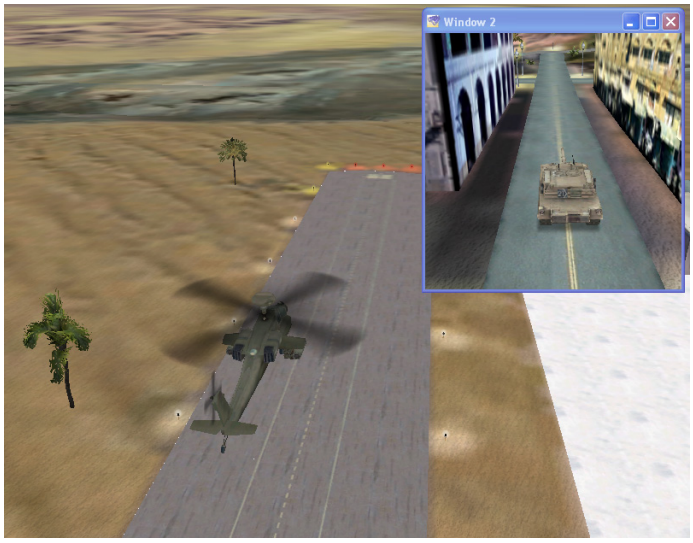


Figure 11-8. Inset view

! By default, when you create an inset view, the observer in the inset view is attached to the entity in Mimic mode. This has the side effect of causing the model in the main window to disappear. (The reverse occurs if you attach the observer in the main window to the entity 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.

To open an inset view of an entity:

1. Right-click the entity (or its entry in the Objects List Panel). A menu opens.
2. On the menu, choose **Create Inset View**.

11.4. 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 11-9).

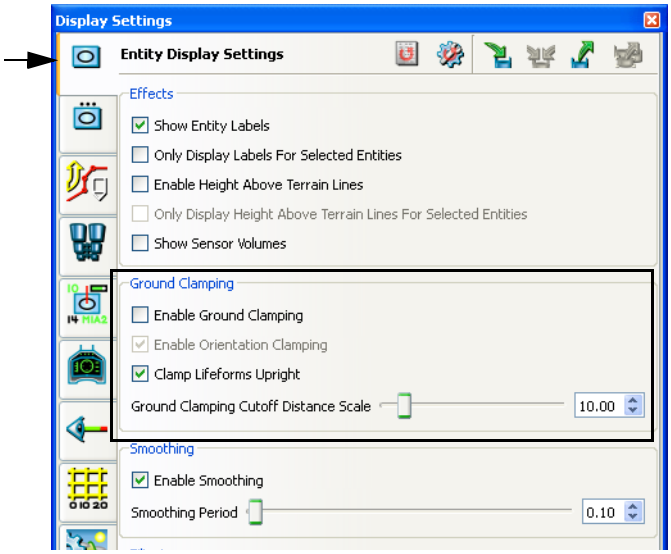


Figure 11-9. Ground clamping settings

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 icon ( ) on the Display Settings Toolbar.

11.4.1. 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 11-9).
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 spinner box. You can also access the Ground Clamping Cutoff Distance Scale slider by clicking the down arrow next to the Ground Clamping icon ( )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.

11.5. Trajectory Smoothing

From the time VR-Vantage receives a state update message for an entity, until it receives the next update, it calculates the location of the entity 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 entity, VR-Vantage moves it to the new position. If the actual position is significantly different from the dead-reckoned position, the entity could appear to jump from the dead-reckoned position to the actual position. VR-Vantage can eliminate these discontinuities by smoothing entity trajectories and rotation paths.

Figure 11-10 illustrates dead-reckoning and smoothing.

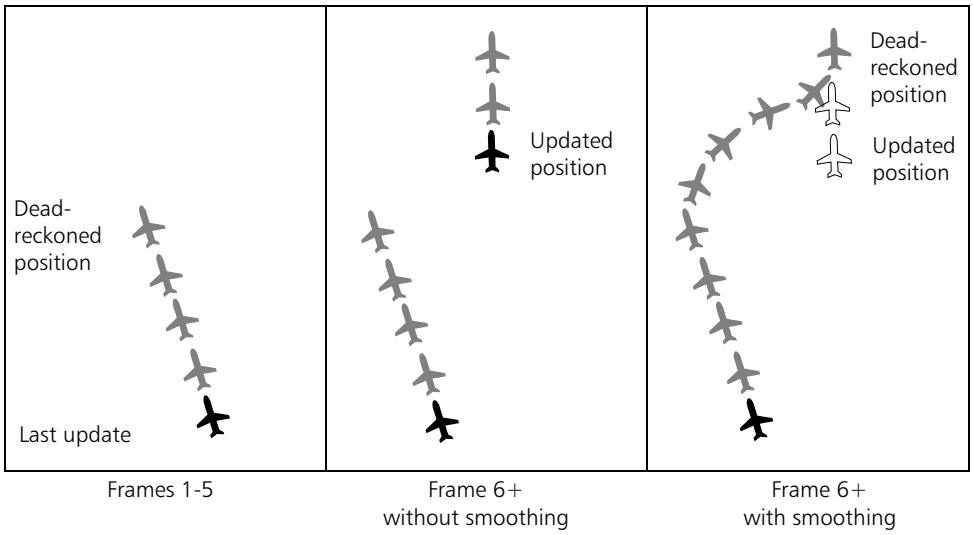


Figure 11-10. Dead-reckoning and smoothing

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.

11.5.1. Configuring Trajectory Smoothing

To configure trajectory smoothing:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page. Smoothing settings are in the Smoothing group box (Figure 11-11).

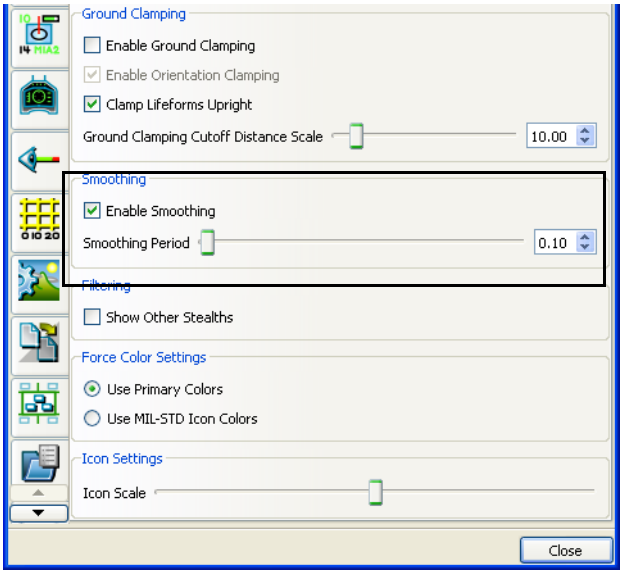


Figure 11-11. Smoothing settings

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 spinner box.

11.6. Displaying Trailing and Decal Effects

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 and decal effects are not supported in the 2D projection.

Trailing effects and decal effects are properties of an observer mode. You can enable and disable them on a per-observer basis.

Figure 11-12 illustrates some trailing effects.



Figure 11-12. 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 11-13).

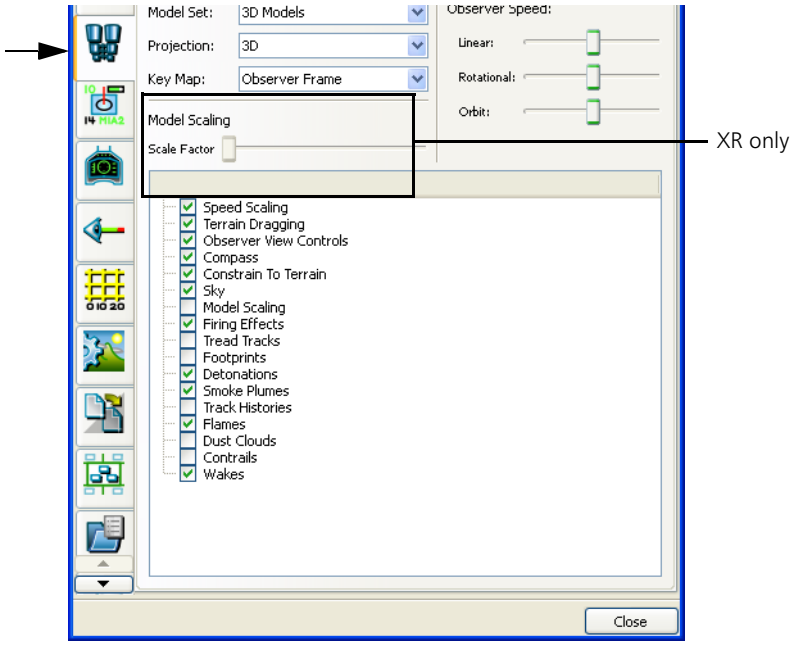


Figure 11-13. Display Settings dialog box, Observer Settings

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 icon on the Observer Settings toolbar.

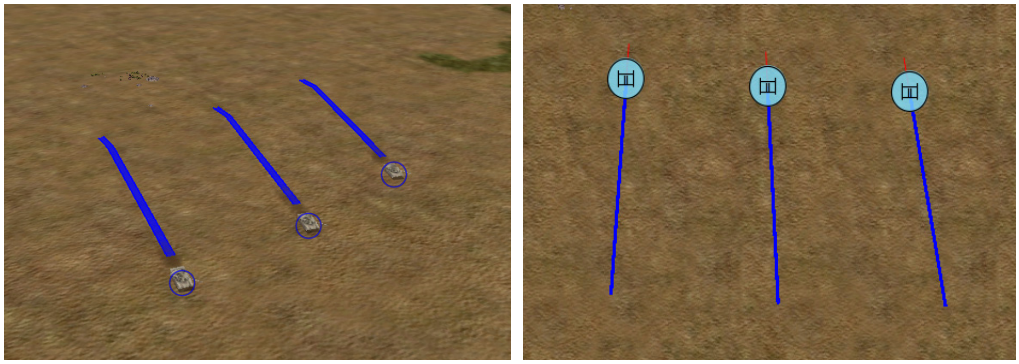
11.6.1. Specifying Models for Trailing Effects and Decal Effects

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 17-7.

11.7. Displaying Track Histories

Track histories allow you to track the paths of entities during an exercise, including the path of munitions as they travel from the shooter to the target. When track histories are enabled, each entity leaves a track ribbon. The ribbon is colored based on the entity's force. Figure 11-14 illustrates track histories.

Track histories are a property of an observer mode. You can enable and disable them on a per-observer basis.



3D 2D

Figure 11-14. Track history

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 11-13).
3. Select the observer mode for which you want to change the Track Histories setting.
4. Select or clear the Track Histories check box.

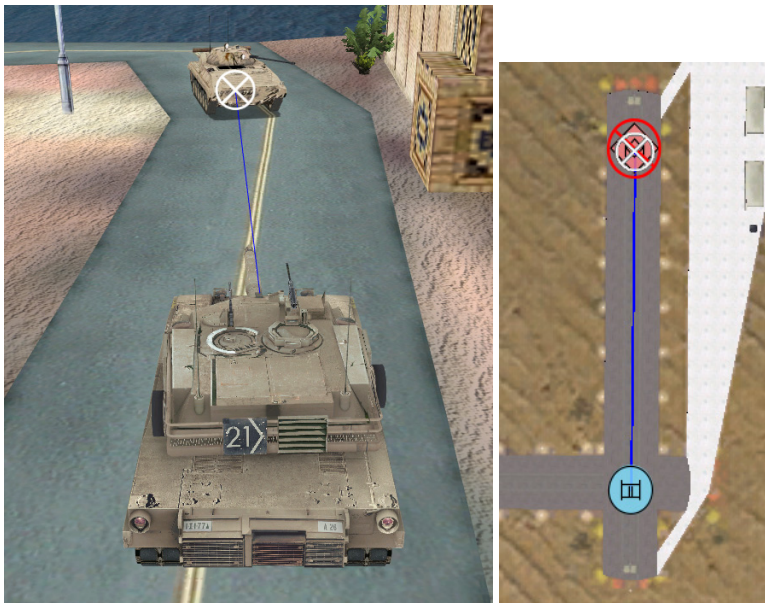


You can also enable or disable track histories by choosing **Observer** → **Track Histories** or clicking the Track Histories icon () on the Observer Settings Toolbar.

11.8. Viewing Fire and Detonation Graphics

If fire and detonation graphics 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 blue, red, or green for the force of the shooter (Figure 11-15).

Fire and detonation lines are not supported in VR-Vantage IG.



3D 2D

Figure 11-15. 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 graphics, choose **Settings** → **Fire / Detonate Lines** or click the Fire/Detonate Lines icon ( ) on the Display Settings Toolbar.

11.9. Changing Force Colors

By default, entity labels, detonation lines, and other force-related entity graphics (including the 3D Colorized Model model set in VR-Vantage XR) 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 11-22).
3. In the Force Color Settings group box, select the coloring option that you want.

11.10. Displaying Sensor Volumes

VR-Vantage can display sensor volumes for entities that have emitter systems (Figure 11-16). You can configure the colors used to represent emitter frequencies and you can configure the size of the sensor volumes.

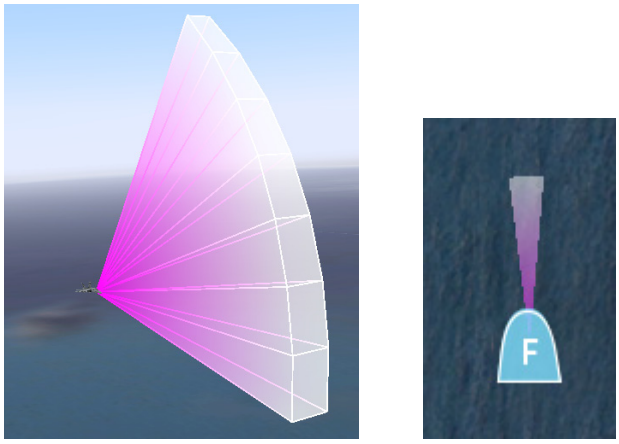


Figure 11-16. Sensor volumes

To enable or disable display of sensor volumes:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 11-5).
3. Select or clear the Show Sensor Volumes check box.



You can also enable or disable sensor volumes by choosing **Settings** → **Sensor Volumes**, or clicking the Sensor Volumes icon () on the Display Settings Toolbar.

11.10.1. Configuring Sensor Volumes

You can configure how VR-Vantage colors sensor volumes, how they are drawn, and how they are scaled for visibility. You can configure sensor volumes by editing the DefaultEllipsoidArc model definition or by creating customized ellipsoid arc model definitions and applying them to different entity models.

Configuring Sensor Volume Color

By default, sensor volumes are displayed using fixed colors for high frequency and low frequency. You can configure sensor volumes to be colored based on the emission frequency or pulse rate. When sensor 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 sensor volume is red. As frequency rises above the specified low value, sensor 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 sensor volume is violet.

To change coloring from the default, you must add the appropriate attributes to the sensor volume visualizer for the entities whose model definitions you want to change. Table 11-1 describes the sensor volume visualizer attributes that affect sensor volume color.

Table 11-1: Sensor 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 sensor 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.

Controlling Sensor Volume Radius

A sensor 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 sensor 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 sensor volume visualizer for the entities whose model definitions you want to change:

- linearScale. The amount of linear scaling applied to all sensor volumes. Default: 100.
- exponentialScale. The amount of exponential scaling applied to sensor volumes: Default: 0.1.

How VR-Vantage Calculates the Radius

VR-Vantage calculates sensor 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 );
```

Configuring Sensor Volume Segments

VR-Vantage displays a sensor volume as a group of spherical sections projecting from the sensing device. By default, for each 10 degrees (or portion thereof) in the sensor's field-of-view, VR-Vantage draws one segment. The figure shows segments set to 10° (the default) and 30°.

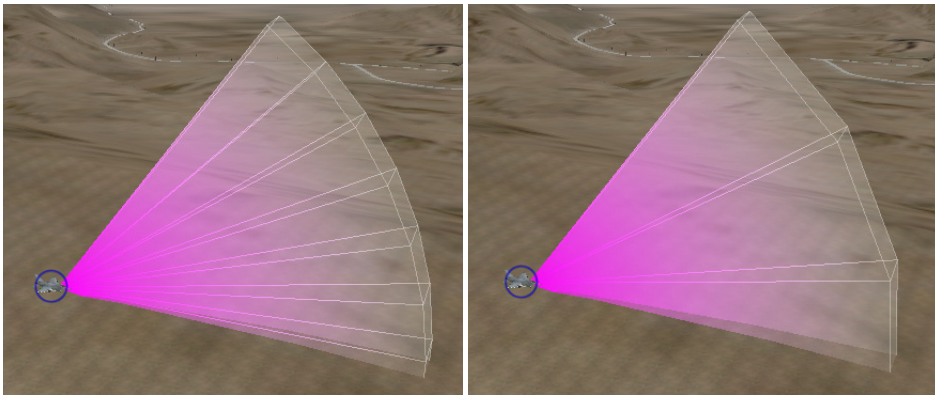


Figure 11-17. Sensor volume segments

Sensor volume segments are managed by the EllipsoidArc schema and model definitions based on it. VR-Vantage ships with one ellipsoid arc model definition – DefaultEllipsoidArc. You can edit this model definition or create copies of it and customize them. If you want to have different sensor 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 icon ( ) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
4. Select DefaultEllipsoidArc.
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 sensor volume.

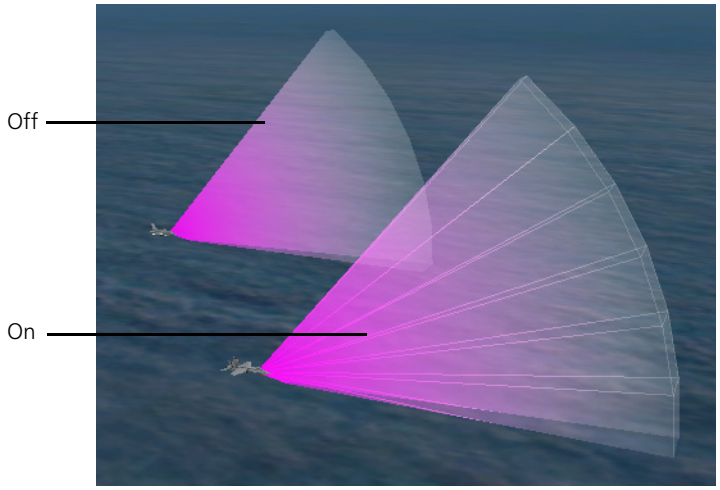


Figure 11-18. Segment outlines

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 icon ( ) 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 icon ( ) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
4. Select DefaultEllipsoidArc.
5. Click the Duplicate Model Definition icon ( ). 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 sensor 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 drop-down 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.

11.11. 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 17-21.



Cockpits are displayed only when the observer is attached to an entity in mimic mode.

To display cockpits:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Cockpit Display Settings page (Figure 11-19).

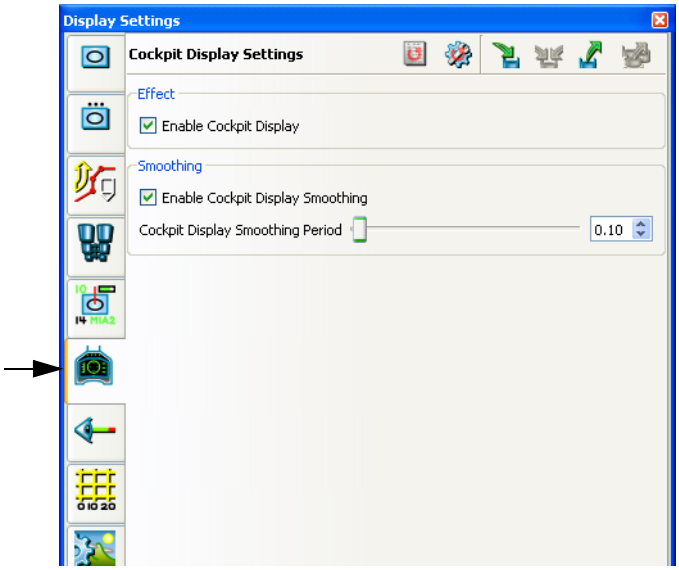


Figure 11-19. Cockpit display settings

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 icon ( ) on the Display Settings Toolbar.

11.12. Displaying HAT Lines for Entities (3D Only)

Height-above-terrain (HAT) lines are vertical lines that run from an entity to the ground. They help you understand the relationship of the entity to the terrain. The height, in meters, is displayed (Figure 11-20).

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.

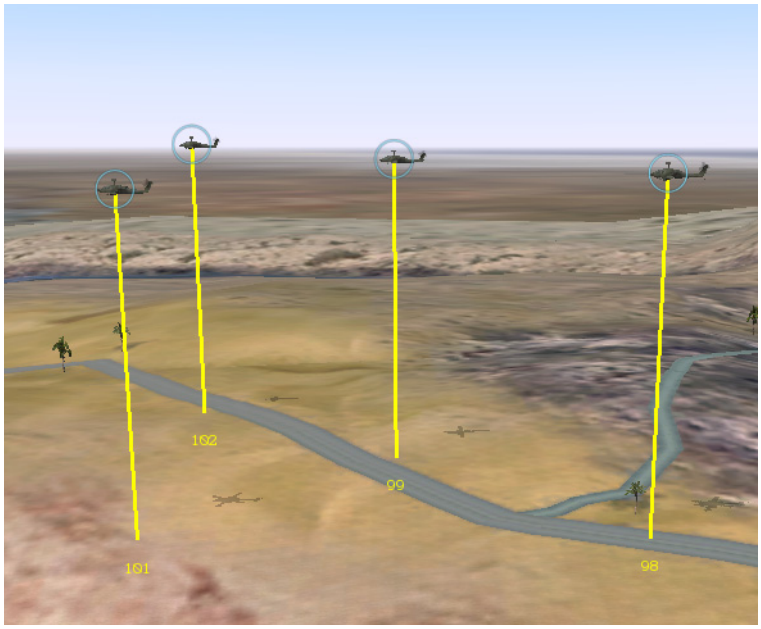


Figure 11-20. Entity height-above-terrain lines

! 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 11-5).
3. To display lines, select the Enable Height Above Terrain Lines check box.
4. To display lines only for selected objects, select the Only Display Height Above Terrain Lines For Selected Entities check box.



In VR-Vantage Stealth and VR-Vantage XR, 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 icon () on the Display Settings Toolbar.

11.13. Displaying Shadows (3D Only)

VR-Vantage can display shadows for entities. Shadows are cast only on the terrain. They are not cast on buildings (props) or on other entities. Therefore, for example, entities on an aircraft carrier do not cast shadows on the deck.

You can enable and disable shadows and you can configure shadow quality. By default, fixed-wing, rotary-wing, and DI-Guy entities cast shadows. You can configure other entities to cast shadows by setting the shadowCaster attribute in their model definitions to 1. (For information about model definitions, please see Chapter 17, *Model and Element Definitions*.)



Updated model definitions do not take effect immediately. To view shadows, you must shut down VR-Vantage, restart VR-Vantage, and connect to the simulation.

To enable and disable shadows globally:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 11-21).

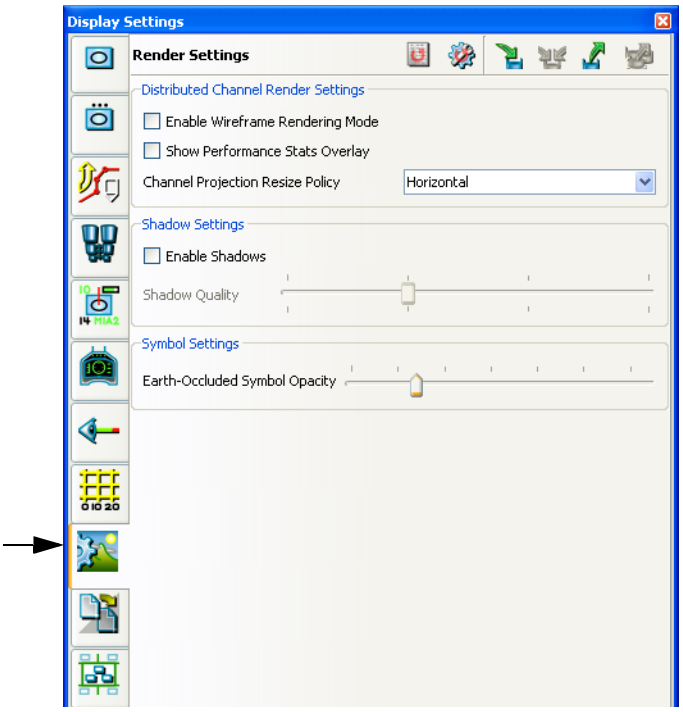


Figure 11-21. Display Settings, Render Settings page

3. In the Shadow Settings group box, select or clear the Enable Shadows check box.



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

11.13.1. Configuring Shadows

You can configure the quality of shadows. To use this feature you must have high quality hardware.

To configure how shadows are rendered:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 11-21).
3. Select Enable Shadows. The Shadow Quality slider becomes enabled.
4. Adjust the Shadow Quality slider.

11.14. Changing the Size of 2D Icons

The Plan View observer mode (VR-Vantage XR and VR-Vantage PVD only) uses the 2D Icons model set for entities. (In VR-Vantage XR, you can use these icons in the 3D observer modes too.) You can change the size of 2D entity icons. When many entities are close together, reducing the size of the icons can reduce overlap.

To change the size of entity icons:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 11-22).

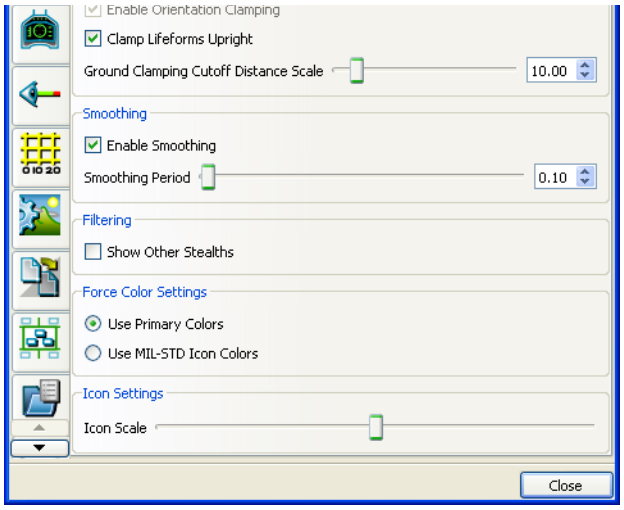


Figure 11-22. Entity Display Settings page

3. In the Icon Settings group box, adjust the Icon Scale slider.

You can also change the size of 2D icons from the Display Settings Toolbar.

To change the size of entity icons from the toolbar:

1. On the Display Settings Toolbar, click the Icon Scaling icon ( ). The Entity Icon Scale Factor slider opens.
2. Adjust the slider to change the size of the icons.



The Entity Icon Scale Factor slider is a dockable widget that you can undock and leave visible as long as icon scaling is enabled.

11.15. Viewing Occluded 2D Icons

If you are using VR-TheWorld or a similar terrain in the 2D projection, it is possible that entities 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 about 75% transparent. You can vary transparency from 100% tranparent 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 11-22).

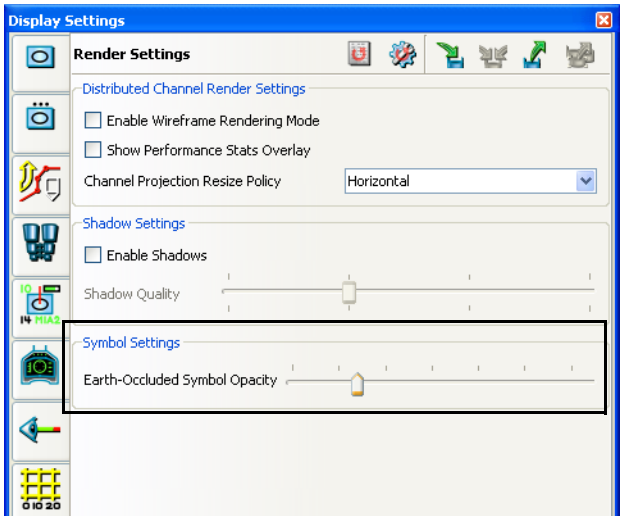


Figure 11-23. Render Settings page

3. Adjust the Earth-Occluded Symbol Opacity slider.

11.16. 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 11-5).
3. In the Filtering group box, select the Show Other Stealths check box.

11.17. Filtering Entities Using Interest Management

VR-Vantage can use interest management to improve its performance in simulations that have high entity counts. Interest management is an implementation of HLA data distribution management (DDM). When interest management is enabled, VR-Vantage filters out all entities that are more than a specified distance from the observer.

11.17.1. 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. Select the HLA 1.3 page or the HLA 1516 page.
3. Set Implicit Geographic DDM to Enabled.
4. Specify any other information required for the simulation.
5. Click Connect.

11.17.2. Configuring Interest Management

Interest management works by filtering out all entities 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 entities 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.

To configure interest management:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Interest Management Settings page (Figure 11-24).

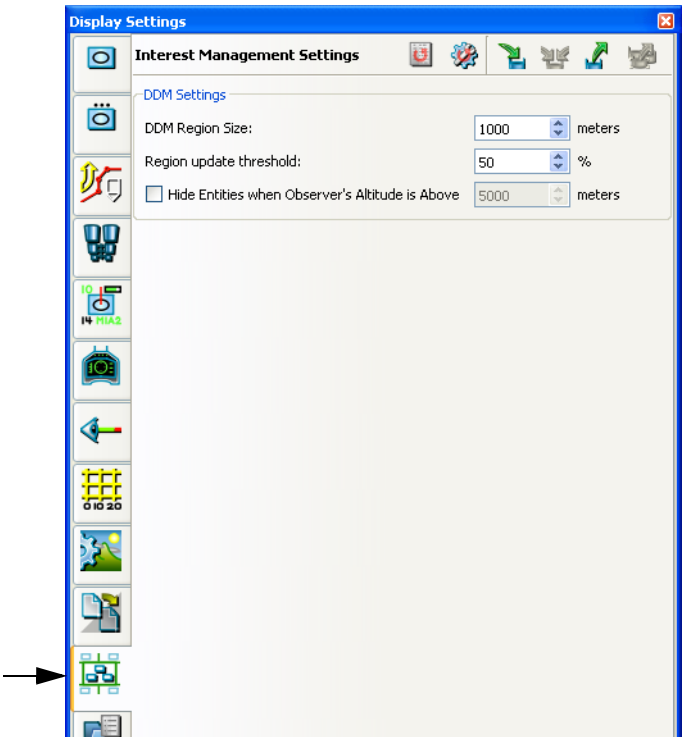


Figure 11-24. Interest Management Settings page

3. In the DDM Region Size box, type a value, in meters, for the region size.

4. In the Region Update Threshold box, type a value, as a percentage, for the update threshold.
5. Optionally, filter entities based on the observer's altitude, as follows:
   a. Select the Hide Entities When Altitude Higher Than check box.
   b. Specify the observer altitude at which to hide entities.

   For more information about filtering entities based on observer altitude, please see "Filtering Entities by Observer Altitude," on page 11-33.
6. Click OK.

11.17.3. Filtering Entities by Observer Altitude

DDM regions use a two-dimensional grid, so the altitude of the observer is not considered when filtering entities. 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 entity labels). Therefore, you may want to filter out entities based on the observer's altitude, thereby increasing performance.



Aggregate Entities

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 aggregate entities that are in the simulation.

Introduction to Aggregate Entities 12-2
Expanding and Collapsing Aggregates 12-3
Displaying Ghosted Icons 12-5
Displaying Aggregate Icons and Bounding Volumes 12-8
Specifying the Color Scheme for Aggregate Bounding Volumes 12-8

12.1. Introduction to Aggregate Entities

Aggregate entities are entities that represent organizational groupings of entities in a military hierarchy, such as platoons, companies, and brigades. VR-Vantage can represent the aggregate entities simulated by VR-Forces. VR-Forces can simulate aggregates in either of the following states:

- Disaggregated: Subordinates are simulated and published as individual entities (Figure 12-1). Members of the aggregate are displayed using individual models or icons.
- Aggregated: Subordinates are not simulated separately. The aggregate is represented by one icon.

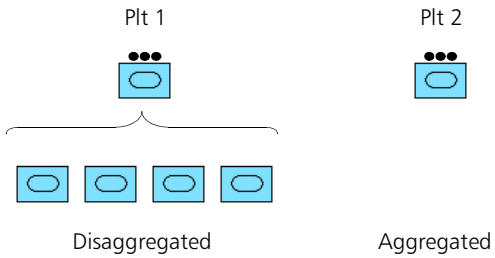


Figure 12-1. Disaggregated and aggregated entities

VR-Vantage can display disaggregated aggregates at the aggregate level, using a 2D icon (collapsed), or it can display the individual members of an aggregate (expanded). It can also display translucent volumes that show the bounding volume of the entire aggregate.

Since aggregated aggregates 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 aggregates, there will be aggregate icons in the display, but no corresponding entry in the Objects List. To see aggregates in the Objects List, change the filter to Aggregates or All.

12.2. Expanding and Collapsing Aggregates

You can display disaggregated aggregates in expanded or collapsed mode. When an aggregate is collapsed, it is displayed as one icon. When an aggregate is expanded, all the members of the aggregate are visible as individual entities and the aggregate icon is hidden. Multi-level aggregates 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.

When you Expand or Collapse an aggregate, you can expand or collapse one level of aggregation or all levels. When you Expand or Expand All, expansion is downward from the current aggregate and does not affect any sibling aggregates. When you Collapse, contraction is upward in the hierarchy. Collapse All collapses all members of the aggregate to the topmost level.

Figure 12-2 illustrates these relationships. Assume a company with three platoons, each of which has four vehicles.

- If you Expand the top level aggregate, 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 aggregate and expand all, it expands to the leaf level – 12 individual vehicles. (3)
- If the aggregate 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 aggregate and select Collapse All, the entire aggregate collapses. (5)

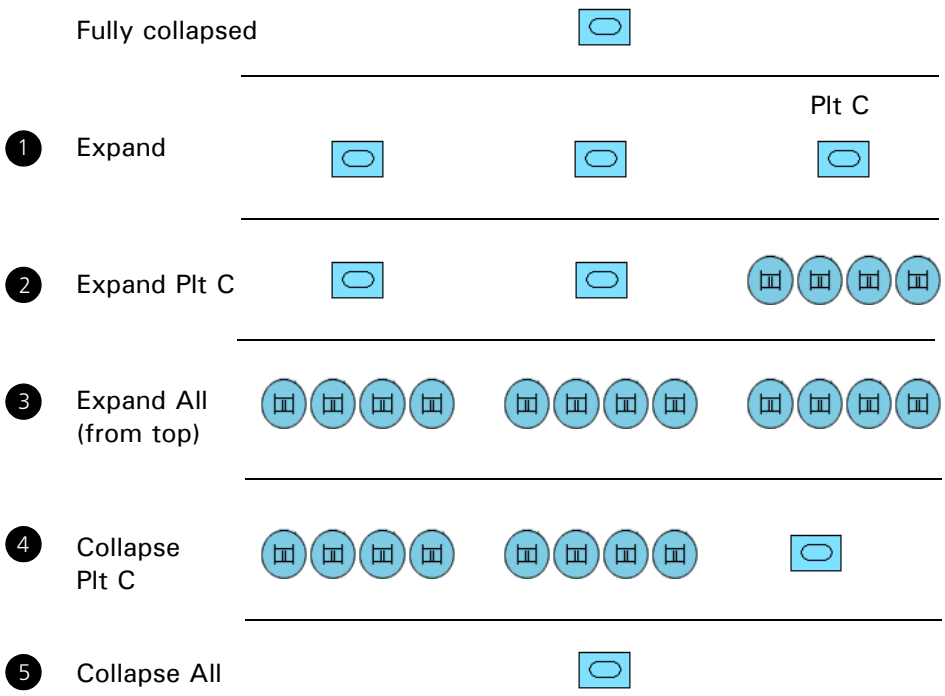


Figure 12-2. Aggregate expand and collapse

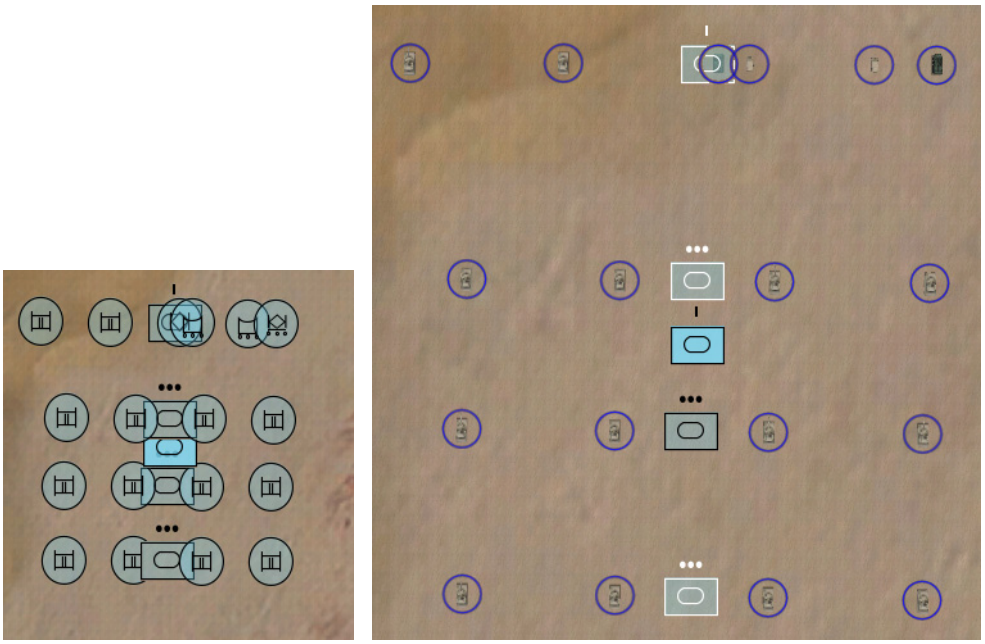
- To expand an aggregate, right-click the aggregate and choose **Expand** on the popup menu.
- To expand an aggregate and all its subordinate aggregates, right-click the aggregate and choose **Expand All** on the popup menu.
- To collapse an aggregate one level, right-click any member of the aggregate and choose **Collapse** on the popup menu.
- To collapse an aggregate to its root level, right-click any member of the aggregate and choose **Collapse All** on the popup menu.

12.3. Displaying Ghosted Icons

If you want to select aggregates, you need to collapse them so that you can select the aggregate icon. However, when you do this, you can no longer see where individual subordinate entities 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 how aggregate icons are displayed so that you can work with them in a way that best meets your visualization and entity management needs:

- Display ghosted icons for hidden entities
- Allow ghosted icons to be selected
- Display all aggregate members
- Manually expand and collapse the display
- Display leaf-level aggregate members.

In the Plan View observer mode, when you display ghosted aggregates, the aggregate icon is displayed normally, and the subordinate members are displayed using semi-transparent icons. In 3D observer modes, aggregates that are subordinate to the top level aggregate are displayed using semi-transparent icons. Leaf-level entities are displayed using the appropriate model for the observer mode (Figure 12-3).



2D 3D

Figure 12-3. Ghosted icons

To configure the display of aggregate icons:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Aggregate Display Settings page (Figure 12-4).

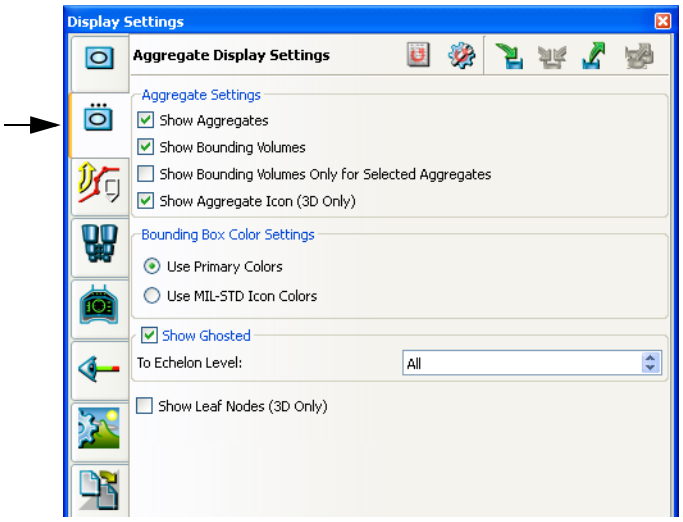


Figure 12-4. Aggregate Display Settings page

3. To display aggregate 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 12-5 illustrates the effect of changing the echelon level for displaying ghosted icons for the VR-Forces aggregate hierarchy shown.
   c. To allow selection of ghosted icons (2D view only), select Allow Selection of Ghosted Icons. (In 3D views, you can always select entities at the leaf level.)

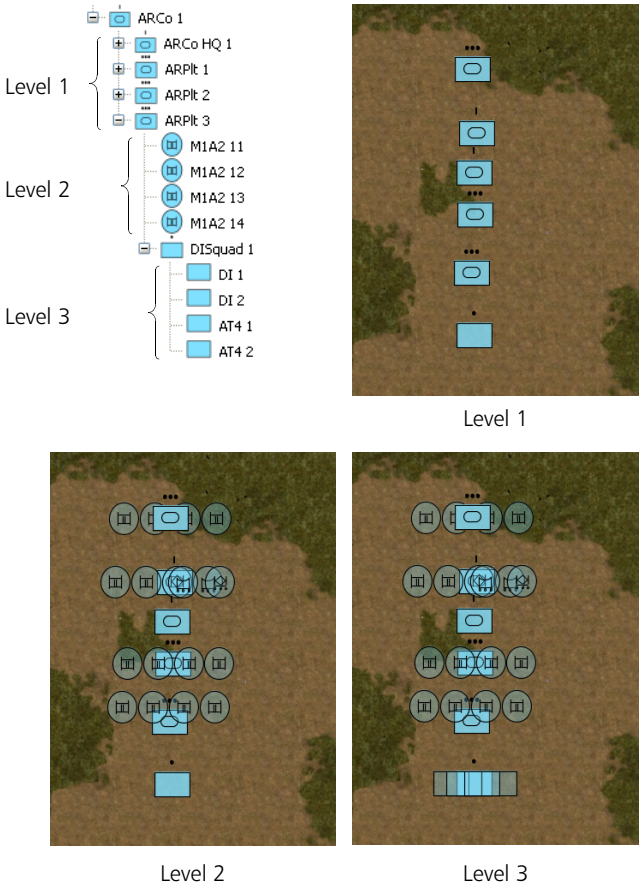


Figure 12-5. Displaying ghosted icons by echelon level

12.4. Displaying Aggregate Icons and Bounding Volumes

VR-Vantage lets you configure when to display aggregate icons and bounding volumes. Bounding volumes are translucent polygons that show the extents of the aggregate. 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 aggregates. When disabled, only the 2D icons or 3D models for leaf level aggregate members are displayed.
- Enable and disable the display of bounding volumes. Bounding volumes are displayed only for collapsed aggregates. You can restrict the display of bounding volumes to the selected aggregates.
- In 3D observer modes, enable or disable the display of aggregate icons.

You can display aggregate icons without showing bounding volumes and vice versa.

To configure the display of aggregate icons and bounding volumes:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Aggregate Display Settings page (Figure 12-4).
3. To enable the display of aggregate icons, bounding volumes, or both, select Show Aggregates.
4. To display bounding volumes for collapsed aggregates, select Show Bounding Volumes.
5. To restrict the display of bounding volumes to the selected aggregates, select Show Bounding Volumes Only for Selected Aggregates.
6. To display aggregate icons in 3D observer modes, select Show Aggregate Icon.



You can also enable and disable aggregates by choosing **Settings** → **Show Aggregates** or by selecting the Show Aggregates icon () on the Display Settings Toolbar.

12.4.1. Specifying the Color Scheme for Aggregate Bounding Volumes

Aggregate bounding volumes can be displayed using primary colors or MIL-STD colors.

To specify the color scheme to use for aggregate bounding volumes:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Aggregate Display Settings page (Figure 12-4).
3. In the Bounding Box Color Settings group box, select Use Primary Colors or Use MIL-STD Icon Colors.



13

Intervisibility Objects

Intervisibility objects show line-of-sight between entities or objects in the simulation.

Intervisibility (Line-of-Sight) 13-2
Types of Intervisibility 13-3
Point-to-Point Intervisibility 13-3
Intervisibility Fan 13-4
Entity Intervisibility 13-4
Intervisibility Objects can be Transient or Permanent 13-5
Creating a Transient Intervisibility Object 13-5
Creating a Permanent Intervisibility Object 13-6
Editing an Intervisibility Object 13-7
Configuring Intervisibility Lines and Fans 13-8
Pinning an Intervisibility Object to an Entity 13-9
Showing and Hiding Intervisibility Lines 13-9
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13.1. Intervisibility (Line-of-Sight)

You can display intervisibility (line-of-sight or LOS) between points, within areas, and between a point and all entities 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 entity.

VR-Vantage IG and VR-Vantage FreeView do not support intervisibility.

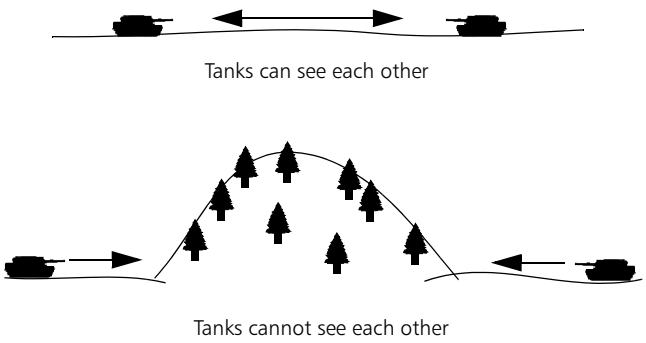


Figure 13-1. Intervisibility

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 entities 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, entities 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.

13.2. 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.

13.2.1. Point-to-Point Intervisibility

Point-to-point intervisibility (Figure 13-2) 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.

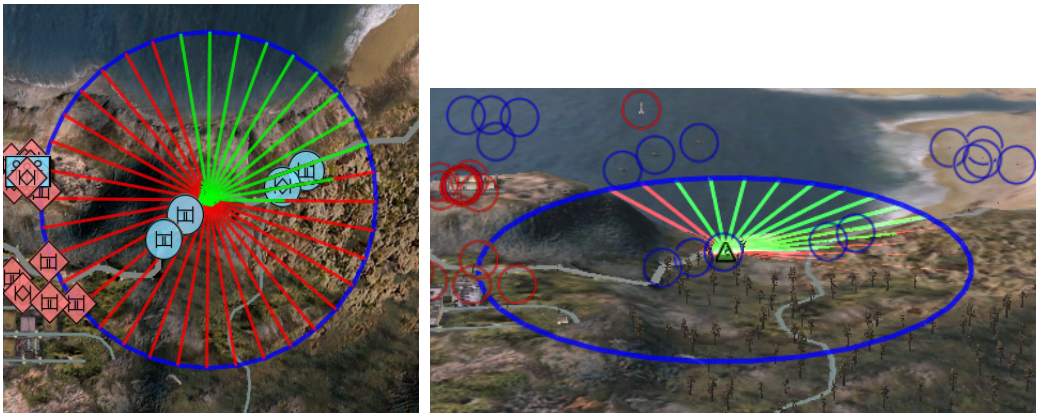


2D 3D

Figure 13-2. Point-to-point intervisibility

13.2.2. Intervisibility Fan

An intervisibility fan (Figure 13-3) 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 13-8.)



2D 3D

Figure 13-3. Intervisibility fan

13.2.3. Entity Intervisibility

Entity intervisibility (Figure 13-4) shows which entities are visible from the center of a defined area and whether or not the entities can see the center point. If you center the intervisibility circle on a point on the terrain, you can see which entities can see that point. If you lock the circle to an entity, you can see which entities can see that entity and which it can see. (For details, please see "Configuring Intervisibility Lines and Fans," on page 13-8.)



2D 3D

Figure 13-4. Entity intervisibility

13.3. 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 13-8.) 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.

13.3.1. 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 13-5).

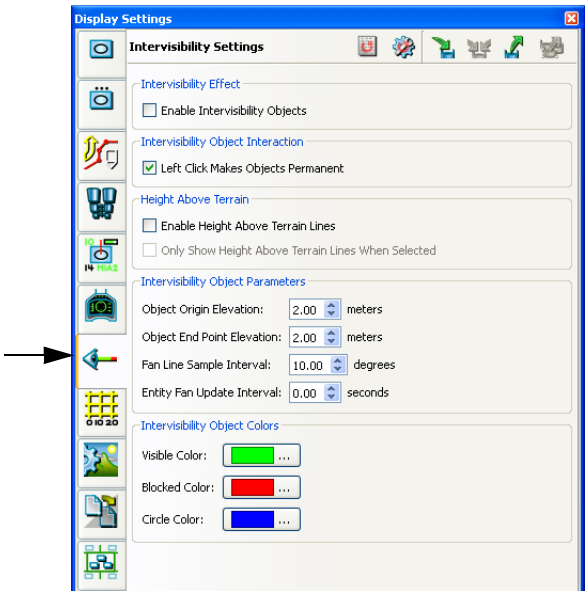


Figure 13-5. Intervisibility Settings page

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 icons 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.

13.3.2. 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 13-5).
3. Select 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 icons on the Intervisibility Toolbar.
5. Click on an entity 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.
6. Click on the terrain where you want to fix the end point of a line or border of a circle.

13.4. 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 an entity, 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.

13.5. 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.

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 13-5).
3. Change the settings described in Table 13-1.

Table 13-1: 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.
Origin Elevation	The height, in meters, above the terrain at the origin point from which to calculate intervisibility.
End Point Elevation	The height, in meters, above the terrain at the end point to use to calculate intervisibility.
Fan Mode Sampling Rate	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 Rate	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 an entity can see and the portion where visibility is blocked.
Circle Color	The color to use for the outer circle of an intervisibility fan.

4. To apply the changes to specific intervisibility objects, select the objects and click Apply to Selected.

13.6. Pinning an Intervisibility Object to an Entity

When you pin an intervisibility object to an entity, the intervisibility object moves with the entity and you know that its origin is centered on the entity.

To pin an intervisibility object to an entity:

1. Select the entity 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 icons on the Intervisibility Toolbar. The origin is placed on the entity icon or model.
3. Specify the end point for the intervisibility object.

13.7. 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 13-5).
3. Select or clear the Enable Intervisibility Objects check box.



You can also enable and disable display of intervisibility objects by choosing **Intervisibility** → **Intervisibility**, or by clicking the Enable/Disable Intervisibility icon () on the Intervisibility Toolbar.

13.8. Deleting Intervisibility Objects

➤ To delete an intervisibility object, select the object and choose **Intervisibility** → **Delete**.



14

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.

Showing and Hiding Tactical Graphics 14-2
- Overlays 14-3
- Showing and Hiding Tactical Graphics 14-4
- Showing and Hiding Vertex Labels 14-5
- Displaying HAT Lines for Vertices (3D Only) 14-5

Displaying Remote Graphics 14-6
- Viewing a List of Remote Graphics 14-7

14.1. Showing and Hiding Tactical Graphics

Tactical graphics are graphical objects that represent points, lines, and areal objects used for various purposes in simulations (Figure 14-1 and Figure 14-2). They could represent routes that entities 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.

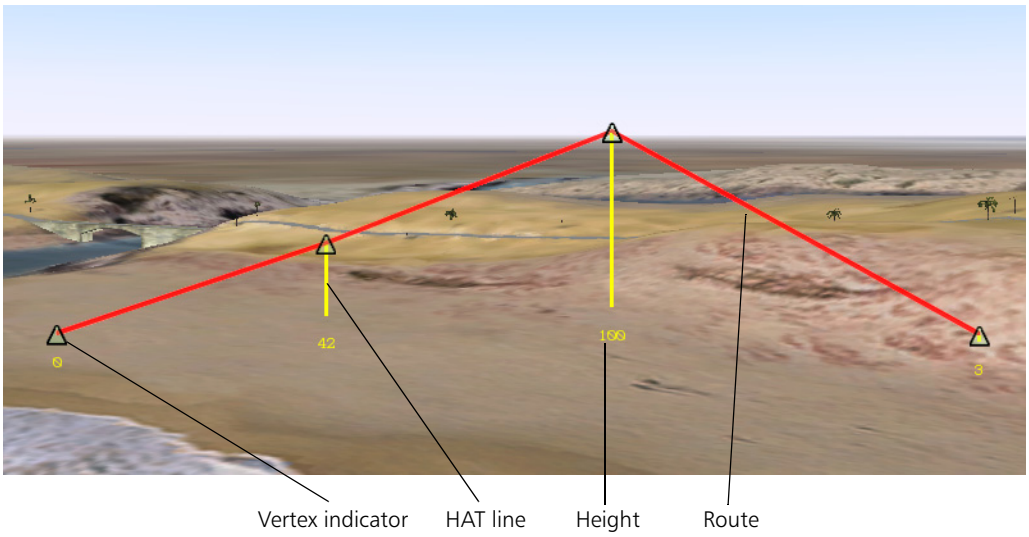


Figure 14-1. Tactical graphic with height-above-terrain lines (3D)

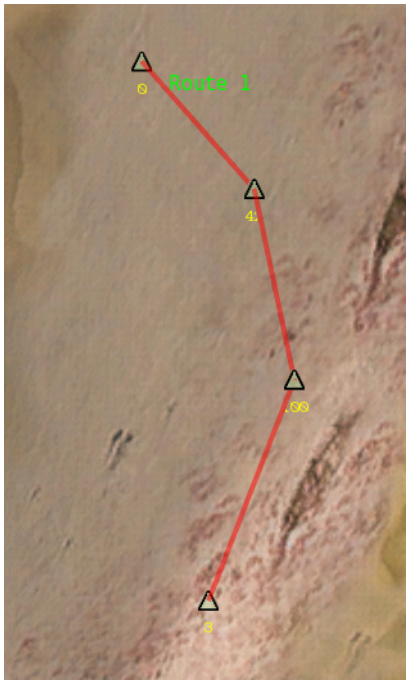


Figure 14-2. Tactical graphic (2D)

14.1.1. 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 14-3).

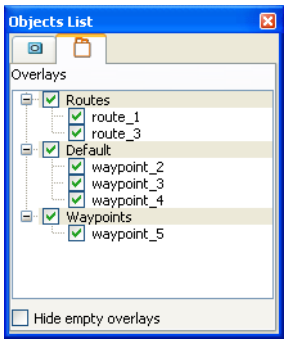


Figure 14-3. Overlays tab

14.1.2. 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 14-4).

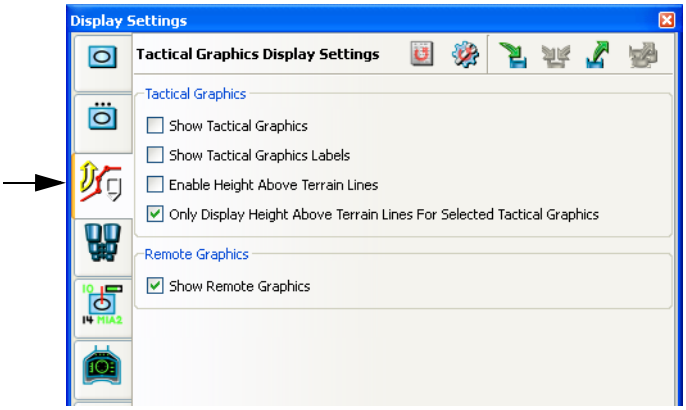


Figure 14-4. Tactical Graphics Display Settings page

3. Select or clear the Show Tactical Graphics check box.

In VR-Vantage Stealth, XR, and PVD, you can also enable and disable tactical graphics by choosing **Settings** → **Tactical Graphics** or clicking the the Tactical Graphics icon ( ) 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 14-3).
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.

14.1.3. Showing and Hiding Vertex Labels

In addition to displaying models for tactical graphics themselves, you can display graphics (labels) for the vertices of these objects. Vertex labels are enabled in Figure 14-1.



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 14-4).
3. Select or clear the Show Tactical Graphics Labels check box.



In VR-Vantage Stealth, XR, and PVD, you can also enable and disable tactical graphics labels by choosing **Settings** → **Tactical Graphics Labels** or clicking the the Tactical Graphics Labels icon () on the Display Settings Toolbar.

14.1.4. Displaying HAT Lines for Vertices (3D Only)

You can display 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, in meters, for each vertex is displayed (Figure 14-1).

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 14-4).
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.

14.2. Displaying Remote Graphics

VR-Vantage can display graphics sent from other applications using the VR-Vantage Remote Draw API (Figure 14-5).

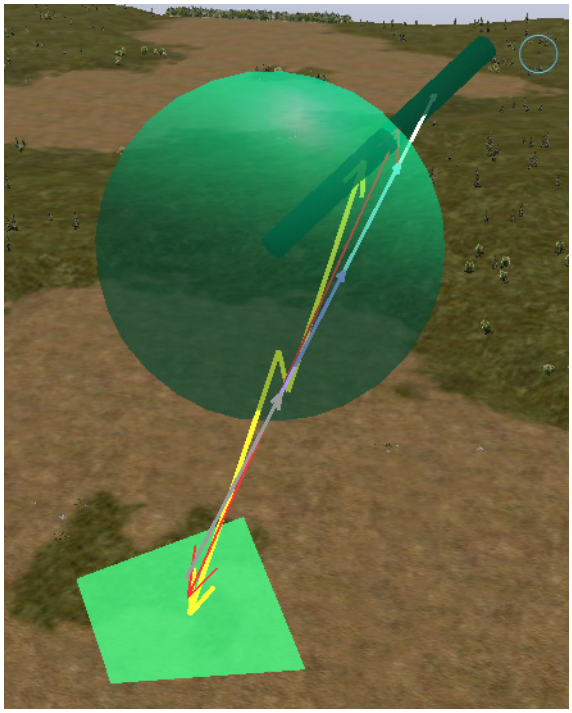


Figure 14-5. Remote graphics

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 14-6).

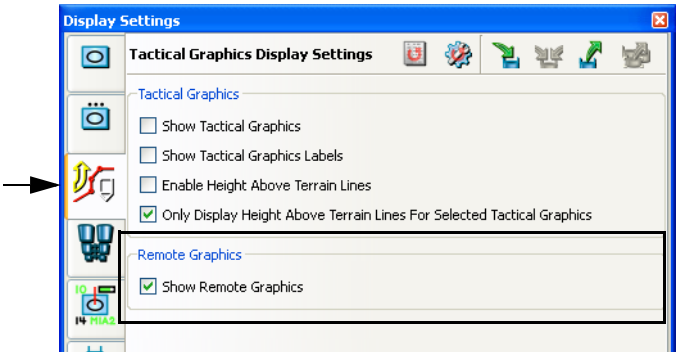


Figure 14-6. Tactical Graphics Display Settings page

3. Select or clear the Show Remote Graphics check box.



In VR-Vantage Stealth, XR, and PVD, you can also enable and disable remote graphics by choosing **Settings** → **Remote Graphics** or by clicking the Remote Graphics icon ( )on the Display Settings Toolbar.

14.2.1. 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 14-7 illustrates the attributes for the Entity and Packet attribute group templates displayed in Figure 14-8.

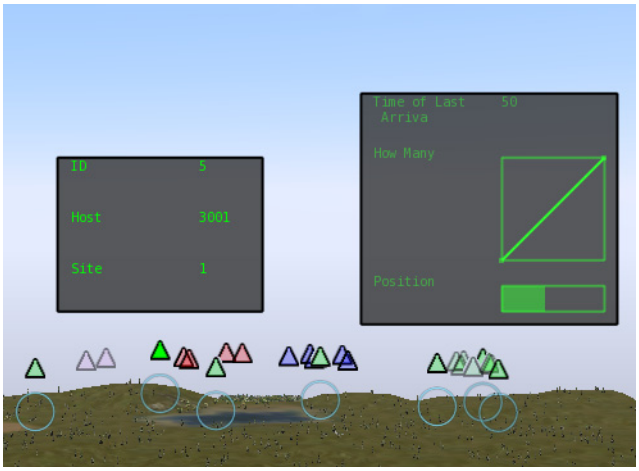


Figure 14-7. Remote graphics attribute group display

To view a list of remote graphics:

1. Choose **View** → **Remote Graphics Panel**. The Remote Graphics Panel is displayed (Figure 14-8). The Remote Graphics Sets tab lists remote graphics by set.

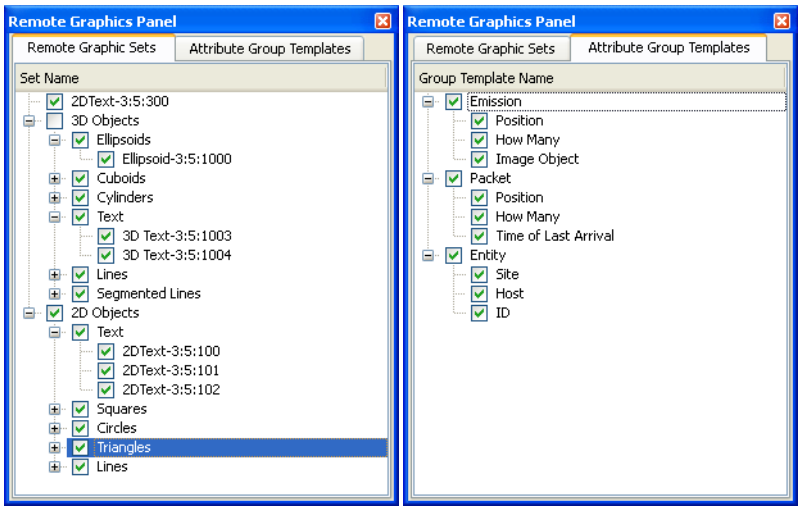


Figure 14-8. Remote Graphics Panel

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.



Using VR-Vantage XR

This chapter describes features that are unique to VR-Vantage XR.

Introduction to VR-Vantage XR 15-2
Switching Between the 2D and 3D Projections 15-3
VR-Vantage XR Model Sets 15-3
Changing the Model Set 15-3
Exaggerating the Scale of 3D Entity Models 15-4
Disabling Lighting and Clouds 15-8

15.1. Introduction to VR-Vantage XR

The Stealth observer mode (3D projection and 3D model set) in VR-Vantage Stealth, VR-Vantage IG, and VR-Vantage XR provides situational awareness at the entity or aggregate level. It is not ideal for getting the big picture of a simulation, because when you zoom out to see large areas of terrain, the entity models, which are scaled to the terrain, are too small to see. VR-Vantage XR solves this problem by providing additional model sets and features in the 3D projection and by providing a 2D projection that allows you to view a simulation in a plan view mode.

VR-Vantage XR lets you adjust the scale of entity models (hence, eXaggerated Reality) to help you understand relationships between entities and the terrain. The alternative model sets help entity models stand out from the terrain more than the 3D model set. Figure 15-1 illustrates model scaling with 3D colorized models.

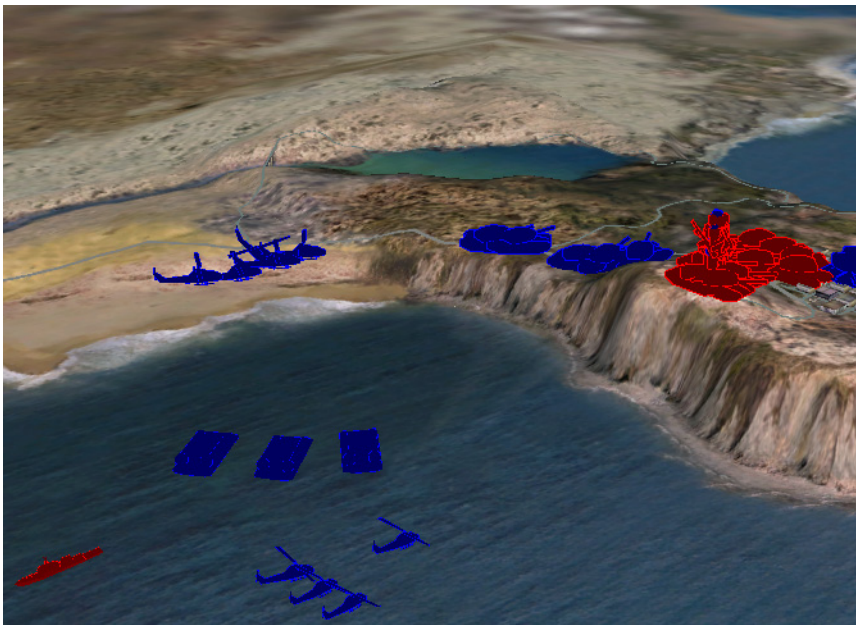


Figure 15-1. Model scaling and colorized models

15.2. Switching Between the 2D and 3D Projections

VR-Vantage XR 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 8-2.) 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).

15.3. VR-Vantage XR Model Sets

VR-Vantage XR includes the following model sets:

- 3D Models. Realistic, 3D, textured models with articulated parts.
- 3D Colorized Models. 3D model caricatures with minimal articulation. These models do not have textures, they are solid colors, by force. You can change the coloring between primary colors and MIL-STD icon colors.
- 2D icons. MIL-STD 2525B icons.

You can use any of the model sets in any of the observer modes. In Plan View observer mode, 3D models are displayed with a top-down view.

15.3.1. 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 8-4), 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 icon ( ) on the Observer Settings Toolbar. (The icon changes to show the currently selected model set.)

15.4. 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 15-2 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.



The visual effect of model scaling depends on the observer's distance from an entity. When the observer is close to an entity, scaling models may not make any noticeable difference in its size.

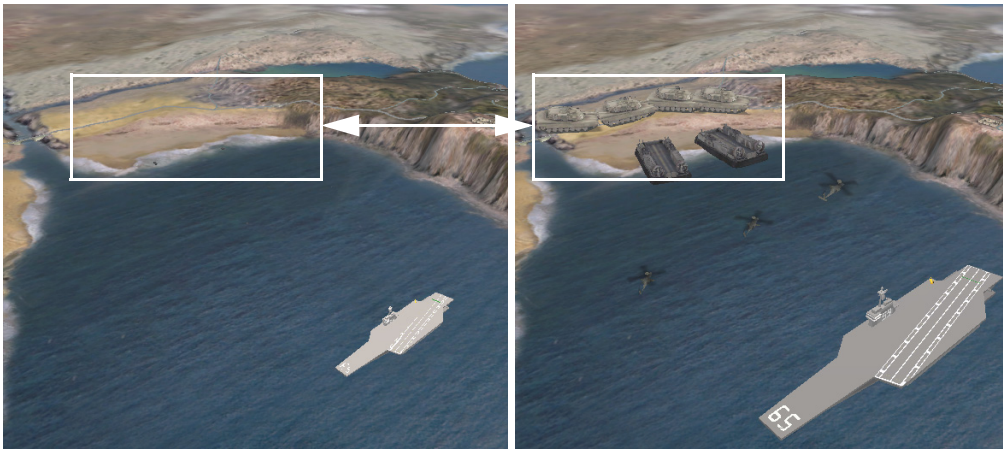


Figure 15-2. Model scaling off and on

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.

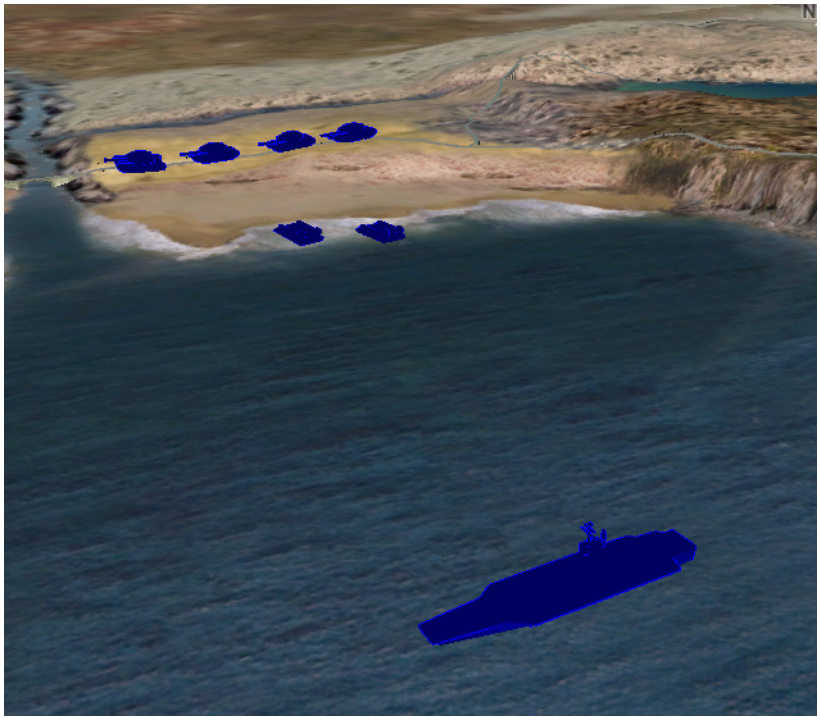


Figure 15-3. XR mode

To scale entity models:

1. Choose **Observer** → **Advanced Settings**. The Display Settings dialog box opens to the Observer Settings page (Figure 15-4).

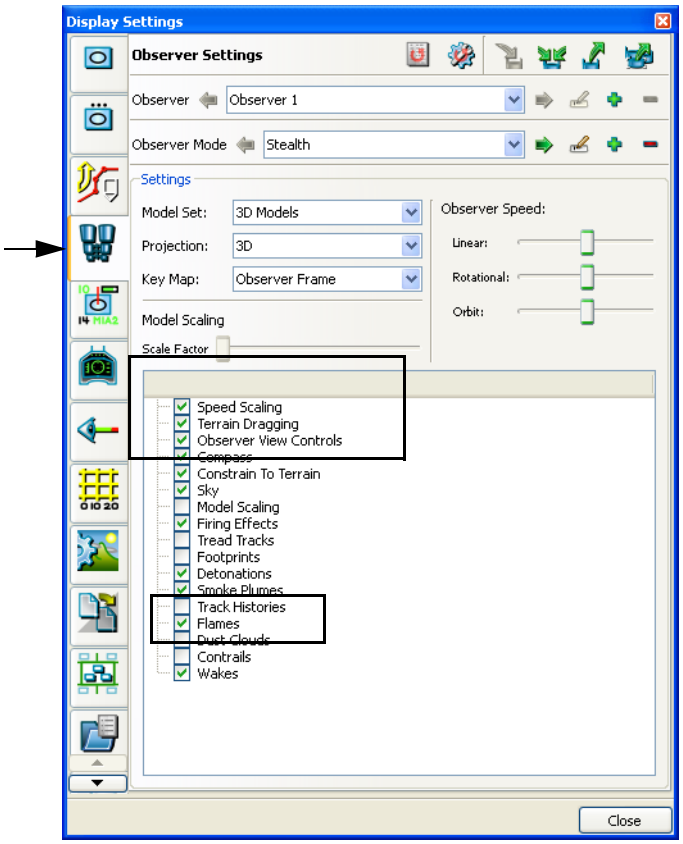


Figure 15-4. Observer Settings page

2. In the list of observer attributes, select Model Scaling.
3. Adjust the Scale Factor slider to the amount of scaling that you want.

You can also scale models from the Observer Settings Toolbar and the Observer Control Panel.

To scale models from the Observer Settings Toolbar:

1. If model scaling is not enabled, click the Model Scaling icon ( ) on the Observer Settings Toolbar.
2. Click the down arrow on the icon. The Scale Factor slider is displayed (Figure 15-5).



Figure 15-5. 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.

To scale models from the Observer Control Panel:

1. If model scaling is not enabled, enable model scaling in the Observer Settings page or click the Model Scaling icon () on the Observer Settings Toolbar. The scale on the Observer Control Panel becomes enabled (Figure 15-6).

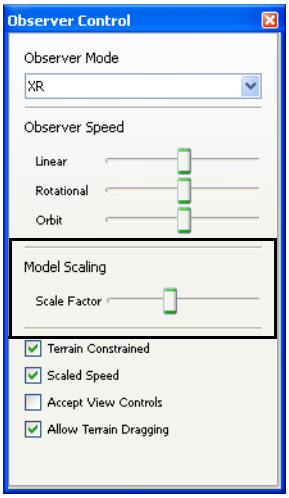


Figure 15-6. Observer Control Panel

2. Adjust the slider to scale the models.

15.5. Disabling Lighting and Clouds

When you are using XR observer mode and you zoom out from the terrain, the lighting and cloud effects can interfere with your ability to view entities. Therefore, VR-Vantage XR 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 icon () on the Observer Settings Toolbar.



16

Mapping Models and Effects

This chapter explains how to map models to DIS and HLA entity types. For information about mapping CIGI models and components, please see Chapter 18, *Mapping CIGI Models and Components*. Chapter B, *Model Tutorials* walks you through the process of adding a model.

Mapping Models to Entities and other Scene Elements 16-2
- Adding a Model Mapping 16-3
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16.1. Mapping Models to Entities and other Scene Elements

Model mapping is the process of associating an entity or other scene element with an element definition.

DIS and HLA objects are specified by an entity type enumeration. An entity 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 entity type refers to a specific 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. For complete details about entity 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 an entity, it reads the enumeration and then displays the entity using the element definition that is mapped to the enumeration. (Element definition is a generic term that includes entity definitions, tactical graphic definitions, and other scene elements.)

You map models in the Entity Type Mappings dialog box. It has pages for mapping:

- Entity models
- Aggregate entity models
- Firing effects
- Detonation effects
- Tactical graphics
- Cockpit displays.

The mapping process is the same for all model types. You can add new model mappings, edit existing model mappings, and delete mappings.



- You can map more than one element definition to an entity 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.
- The procedures in this section are for entities (and hence refer to entity definitions). However, the procedures are the same for all of the pages on the Entity Type Mappings dialog box.

16.1.1. Adding a Model Mapping

This procedure describes how to map an element definition to an entity type enumeration. The element definition must already exist.

To add a model mapping:

1. Choose **Settings** → **Entity Type Mappings**. The Entity Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure 16-1). The page shows a list of entity type enumerations in the Entity Type column. The entity definition mapped to the entity type is listed in the Entity Definition column. By default, the list of entity types is filtered to just show entities.

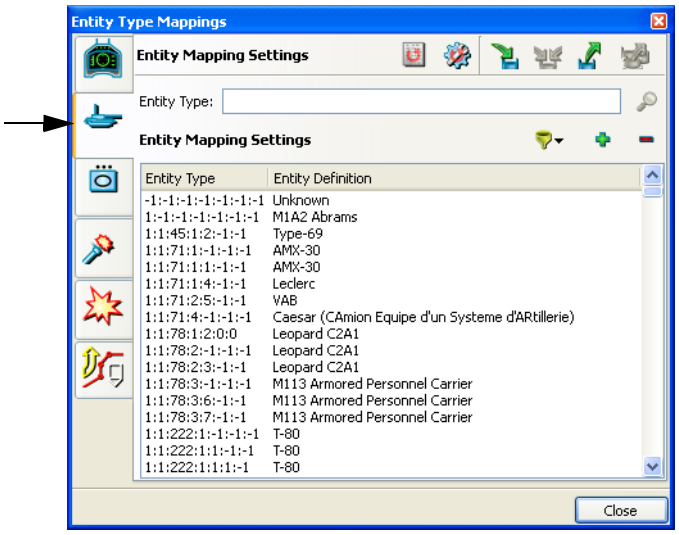


Figure 16-1. Entity Mapping Settings page

3. Click the Add icon (+). The Create New Entity Type Model Mapping dialog box opens (Figure 16-2). It lists a default entity type enumeration.

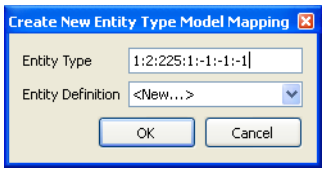


Figure 16-2. Create New Entity Type Model Mapping dialog box

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 drop-down list, select the element definition that you want to map to this entity type.

6. Click OK.
7. The new model mapping is added to the list.

16.1.2. Editing a Model Mapping

This procedure describes how to edit a model mapping for an entity. The procedure is the same for any page on the Entity Type Mappings dialog box.

To edit a model mapping:

1. Choose **Settings** → **Entity Type Mappings**. The Entity Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure 16-1).
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 icon (🔎). 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 Element Definition List," on page 16-5.)
   b. In the Entity Definition column, click the element definition to make it an editable list (Figure 16-3)).
   c. Select the new element definition from the drop-down list.
   d. Click someplace else in the window.

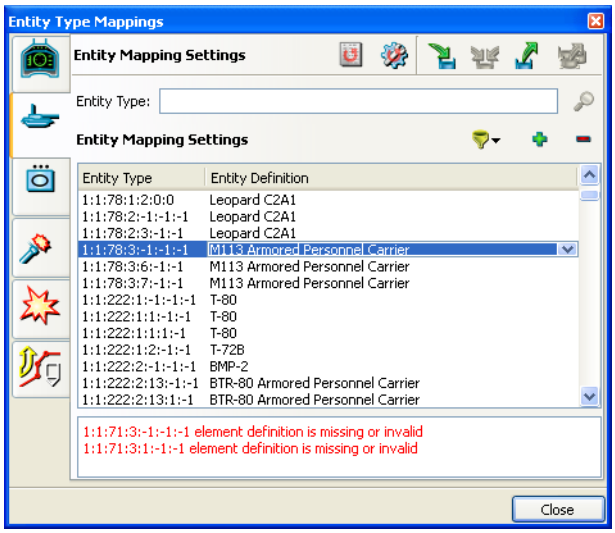


Figure 16-3. Editable entity definition

16.1.3. Filtering the Element Definition List

You can filter the list of element definitions that are available in the drop-down list for mapping to entity types.

To filter the list of element definitions:

1. On any page of the Entity Type Mappings dialog box, click the Filter icon ( ). 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 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.

16.1.4. Deleting a Model Mapping

The procedure for deleting a model mapping is the same for any page on the Entity Type Mappings dialog box.

To delete a model mapping:

1. Choose **Settings** → **Entity Type Mappings**. The Entity Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure 16-1).
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 icon (🔎). VR-Vantage highlights the entry for that enumeration if it is present.
4. Click the Delete icon (➖).

16.1.5. 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.

16.2. Configuring Model Instancing

When model instancing is enabled, models that use the same resources can share them. Usually, models can share geometry and textures. Use of model instance caching decreases memory use and improves performance.

To enable or disable model instancing:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the File Caching Settings page (Figure 16-4).

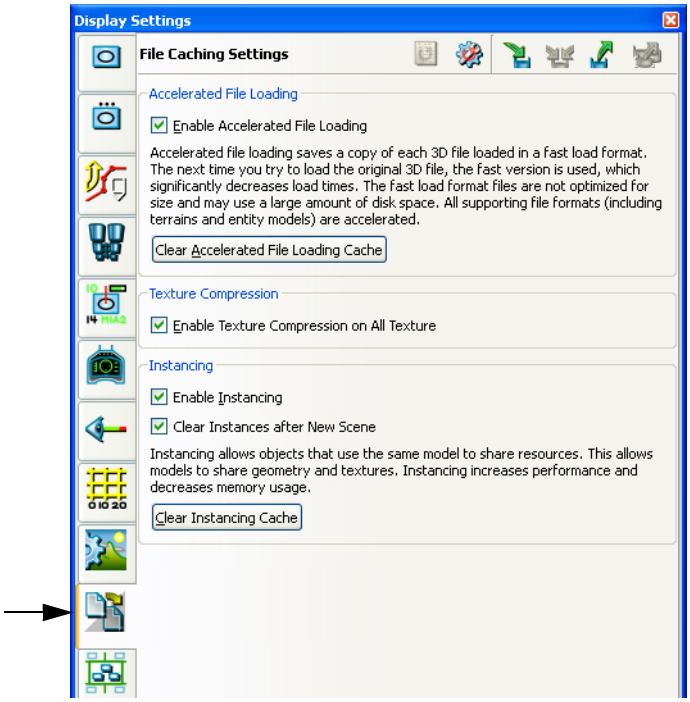


Figure 16-4. File Caching Settings page

3. In the Instancing group box, select or clear the Enable Instancing check box.

16.2.1. Clearing the Model Instancing Cache

You can clear the model instancing cache if you need the disk space.

To clear the model instancing cache:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the File Caching Settings page (Figure 16-4).
3. In the Instancing group box, Click the Clear Instancing Cache button.

16.3. 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 *./bin/medfTool.exe*. The compression tool supports the 3D modeling formats supported by VR-Vantage, such as OpenFlight, 3DS, OBJ, and raster formats such as RGB and PNG. The syntax for medfTool is as follows:

```
medfTool [-q simple_filename ... -p <integer> -t -s
  directory ... -z optimization -i -o -m extensions ...
  -x extensions ... --norecurse --directory directory
  -f filename -- -v -h]
```

Table 16-1 describes the arguments.

Table 16-1: 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.
`(-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. Acdepted multiple times.

Table 16-1: medfTool arguments

Argument	Description
`(-s | --search)` *directory*	Adds a directory to the search path when resolving external references. During processing any external references not found will be removed from the generated files. Files in the search path are not converted.
`(-t | --noTexturesInMedf-File)`	Specifies that MEDFs do not have embedded MEIF textures. Embedded textures cannot be shared between separate models and result in higher memory usage and slower loading.
`(-v | --version)`	Display version information and exit.
`(-x | --extensions)` *extension*	Specifies the extensions of geometry file formats which 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%/bin/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%/bin/medfTool.exe --directory
  %MAK_DATADIR%/Lifeforms --norecurse --extensions flt
  --image_extensions rgb --image_extensions rgba
  --image_extensions png --image_extensions dds
```



Model and Element Definitions

In "Introduction to VR-Vantage Object Modeling," on page 4-8, we describe the interplay of schemas, model definitions, entity definitions, and model mapping. This chapter explains how to create and edit model definitions and model schemas. "Adding a Model to VR-Vantage," on page B-2 walks you through the process of adding a model.

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- Deleting Schemas 17-5
- Copying Schemas 17-5
- Adding a Parameter to a Schema 17-6
- Deleting a Parameter from a Schema 17-6
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17.1. 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 3-11.

VR-Vantage includes model definition schemas. 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
- GridLines
- ParticleSystem
- Ribbon
- SpeedTree
- Terrain
- Tree
- WidgetTheme.
- Selection Visualizer.

17.1.1. 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 17-1).

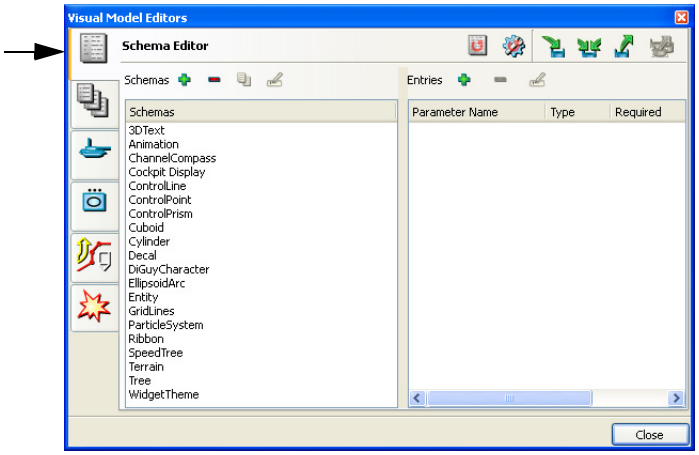


Figure 17-1. Schema Editor page

3. Click the Add icon (+) next to the Schemas label. The Create Instance dialog box opens (Figure 17-2).

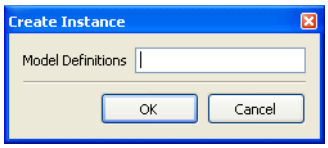


Figure 17-2. Create Instance dialog box

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 17-6.

17.1.2. Deleting Schemas



If a schema is used by a model definition, you cannot delete it. The Delete Schema icon 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 17-1).
3. In the Schemas list, select the schema you want to delete.
4. Click the Delete icon () next to the Schemas label. You are prompted to confirm the deletion.
5. Click Yes. The schema is removed from the list.

17.1.3. 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 17-1).
3. Select the schema that you want to copy.
4. Click the Duplicate icon (). 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 17-7.

17.1.4. 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 17-1).
3. In the Schemas list, select the schema to which you want to add a parameter.
4. Click the Add icon (+) next to the Entries label. A parameter called "key" is added to the parameter list.
5. Double-click "key" to enter edit mode.
6. Type a name for the parameter.
7. If the parameter has a specific type, edit the value in the Type column.
8. If the parameter is required, edit the value in the Required column.
9. Optionally, add a description. The description provides context sensitive help on the element definitions pages.

17.1.5. 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 17-1).
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 icon (−) next to the Entries label.

17.1.6. 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 17-1).
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.

17.2. Creating and Editing Model Definitions

Each model displayed in VR-Vantage is defined by a set of parameters that are appropriate to the model type. (The parameters are specified in the model's schema. For information about model schemas, please see "Creating and Editing Schemas," on page 17-3.) 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.

All model configuration is done in the Model Definition Editor page of the Visual Model Editors dialog box (Figure 17-3). The icons all have tooltips. For more information, please see "Managing VR-Vantage Settings," on page 3-11 and "Common VR-Vantage Icons," on page F-5.

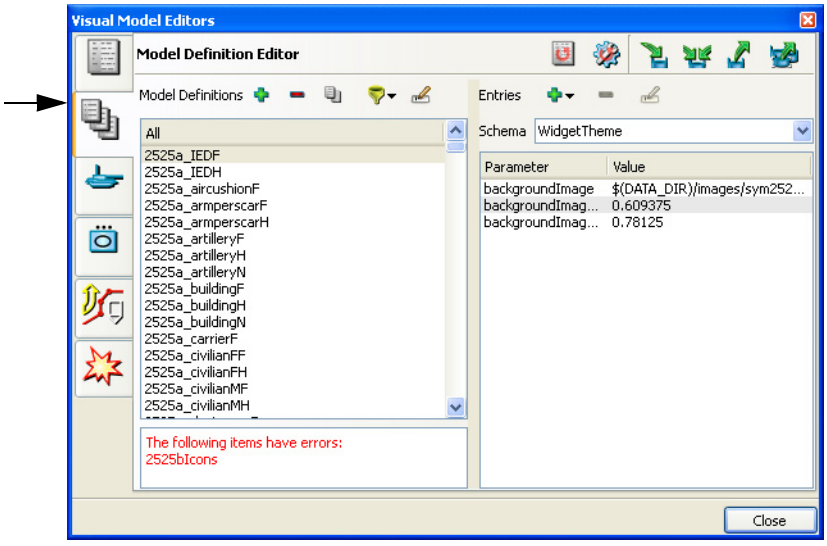


Figure 17-3. Model Definition Editor page

17.2.1. 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 17-3).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 17-10.)
4. Click the Add icon (+) next to the Model Definitions label. The Add Model Definition dialog box opens (Figure 17-4).

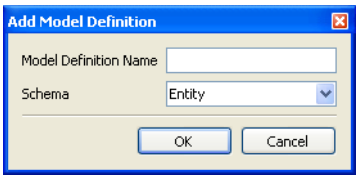


Figure 17-4. Add Model Definition dialog box

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 drop-down 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 17-10.

17.2.2. 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 17-3).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 17-10.)
4. Select the model that you want to delete.
5. Click the Delete icon () next to the Model Definitions label. You are prompted to confirm the deletion.
6. Click Yes. The model definition is removed from the list.

17.2.3. 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 17-3).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 17-10.)
4. Select the model that you want to copy.
5. Click the Duplicate icon (). The Duplicate Model Definition dialog box opens (Figure 17-5).

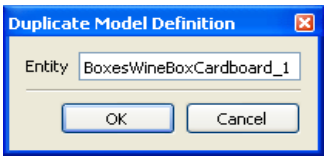


Figure 17-5. Copy model definition

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 17-10.

17.2.4. 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 icon ( ) and select a schema type from the list.

17.2.5. 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 an entity that is already in the scene, the updated definition is not applied to the entity. To apply an edited model definition to all entities, 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 17-3).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 17-10.)
4. Select the model for which you want to add a parameter.
5. Click the Add Parameter icon ( ). A list of parameters is displayed (Figure 17-6).

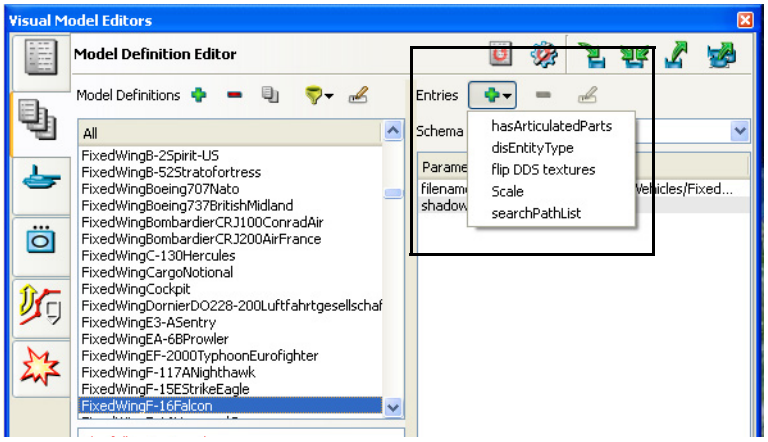


Figure 17-6. Add parameter list

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 17-7).

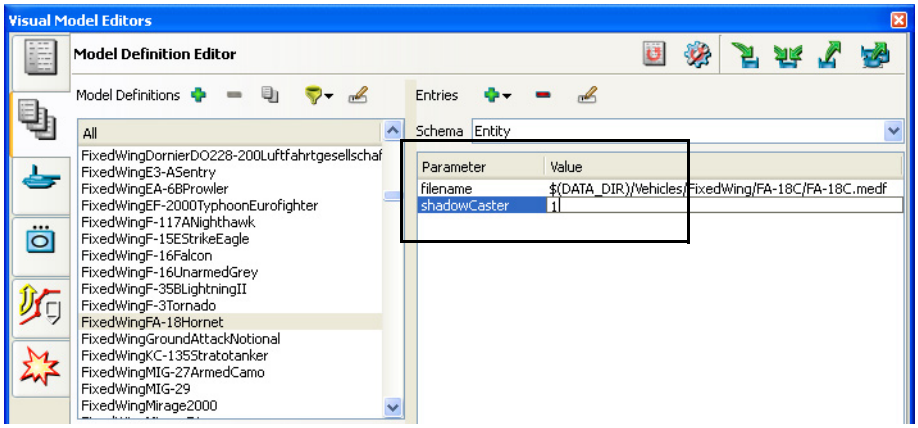


Figure 17-7. Editable parameter

8. Type 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 17-3).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 17-10.)
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 17-7).
6. Type a 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 17-3).
3. Optionally, filter the model definitions in the list. (For details, please see "Filtering the List of Model Definitions," on page 17-10.)
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 icon () next to the Entries label. The parameter is removed.

17.2.6. 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 3-11.

17.3. Creating and Editing Element Definitions

Element definitions let you assign visualizers to scene elements (entities, tactical graphics, interactions, and aggregates). Element definitions use a tree-style hierarchy to assign visualizers. At any level of the hierarchy an element definition inherits the visualizers of its parents. This makes it possible to assign a visualizer 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 visualizer.

You can create and edit element definitions for entities, tactical graphics, and interactions. The procedures are the same for each element type.

17.3.1. 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 (Figure 17-8).

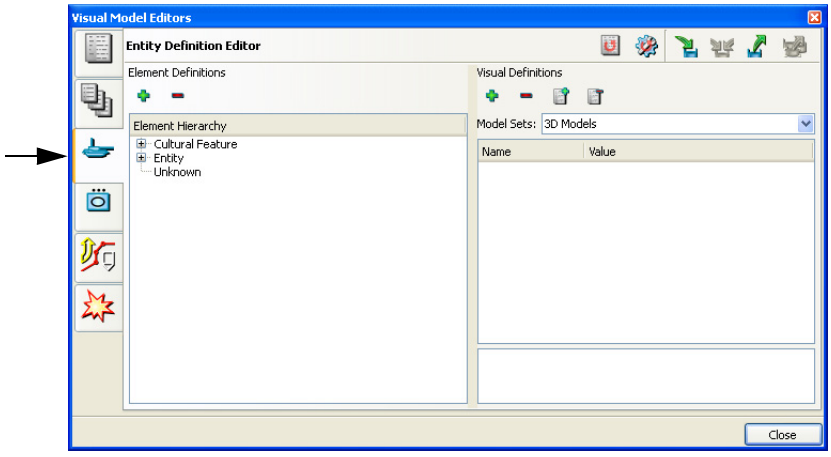


Figure 17-8. Entity Definition Editor page

3. Expand the element definition hierarchy to the level at which you want to add an element definition and select the parent element.
4. Click the Add icon (). 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 visualizers assigned to the element. For details, please see "Editing a Visualizer," on page 17-16.
8. Optionally, add a visualizer to the element. For details, please see "Adding a Visualizer," on page 17-15.
9. Optionally, save the element. For details, please see "Saving Element Definitions," on page 17-18.

17.3.2. Editing an Element Definition

An element definition consists of a list of visualizers for that element. You can add visualizers and you can edit a visualizer's parameters. In most cases, you cannot delete an inherited visualizer.

Adding a Visualizer

To add a visualizer 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 17-8).
3. Select the element definition that you want to edit.
4. Optionally, on the Model Sets drop-down list, select the model set you want to use. (VR-Vantage XR only)
5. Click the Add icon (+) next to the Visual Definitions label. The Create Visualizer Definition dialog box displays a list of available visualizers.
6. Select the visualizer that you want to add.
7. Click OK. The visualizer is added to the element.
8. Optionally, edit the parameters for the visualizer. For details, please see "Editing a Visualizer," on page 17-16.

Editing a Visualizer

Visualizers and their parameters are displayed either as grey, italicized text or as black text. Italicized text indicates that the visualizer or parameter is inherited from a parent element. Visualizers and parameters that are not italicized are particular to that element. (These entries could be inherited by child elements.)

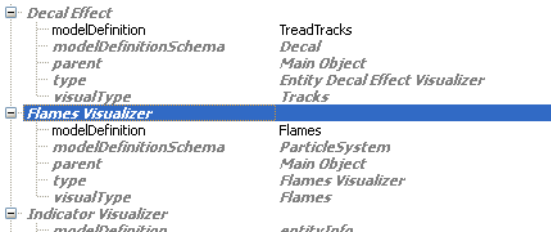


Figure 17-9. Visualizer entry

To edit a visualizer 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 17-8).
3. Select the element definition that you want to edit.
4. In the visualizer pane, click the value of the parameter that you want to edit. Depending on the parameter, a drop-down list of available values is displayed, a dialog box is displayed, or the field becomes editable.
5. For a drop-down 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 drop-down list, click the Add icon (). A drop-down 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 visualizer 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 visualizer 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 17-8).
3. Select the element definition that you want to edit.
4. In the visualizer pane, click the value of the modeldefinition or modeldefinition-schema 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 drop-down lists (Figure 17-10).

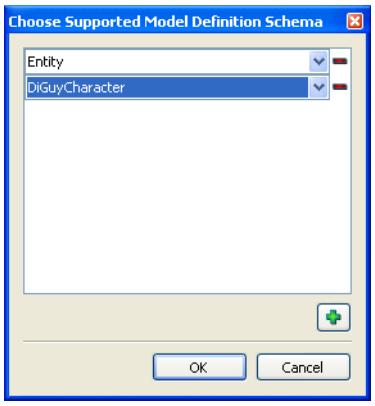


Figure 17-10. Parameter with multiple values

5. To add a value, click the Add icon (+). A new list is added to the window.
6. Select a value from the new list.
7. To remove a value, click the Delete icon (−) next to the list for that value.
8. Click OK, The visualizer list does not show all of the values, but clicking it will open the dialog box again and show the selected values.

17.3.3. Deleting an Element Definition



You cannot delete an element definition if is 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 17-8).
3. Select the element definition that you want to delete.
4. Click the Delete icon (−) next to the Entity Definitions label.
5. Confirm the deletion.

17.3.4. 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 3-11.

17.4. Editing 2D Icons

2D icons (VR-Vantage XR and VR-Vantage PVD) are configured in the Military Symbol Icon Visualizer, which is part of an entity's entity definition. You can change an entity's icon by changing the fillGlyph and outlineGlyph attributes.

To change an entity's icon:

1. Choose **Settings** → **Visual Model Editors**. The Visual Model Editors dialog box opens.
2. Select the Entity Definition Editor page (Figure 17-8).
3. Select the entity whose icon you want to edit.
4. In the Model Sets drop-down list, select 2D Icons. (XR only)
5. To change the fill glyph:
   a. Under the Military Symbology Icon visualizer, select the fillGlyph attribute (Figure 17-11).

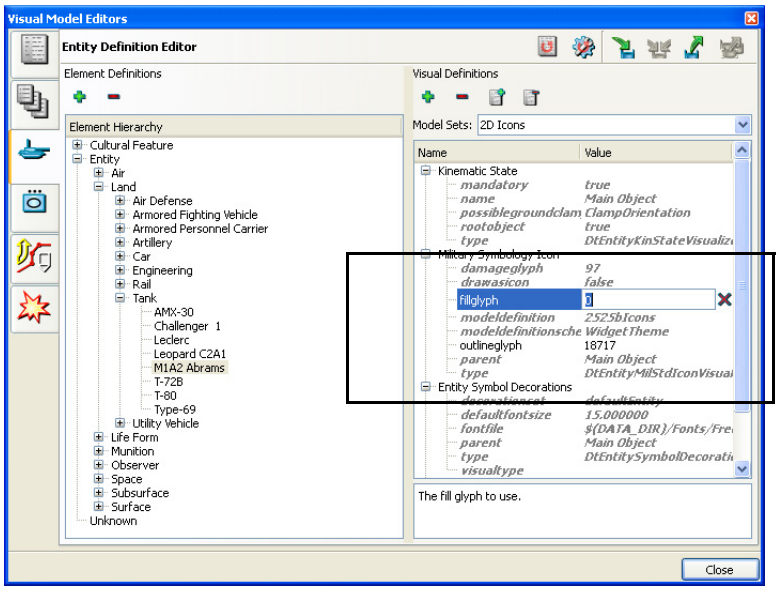


Figure 17-11. Military Symbol Icon Visualizer

   b. Click the value in the Value column. The Choose Font Glyph Index dialog box opens (Figure 17-12).

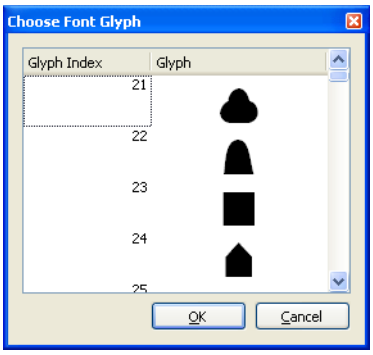


Figure 17-12. Choose Font Glyph dialog box

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.

17.5. 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 17-13 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.

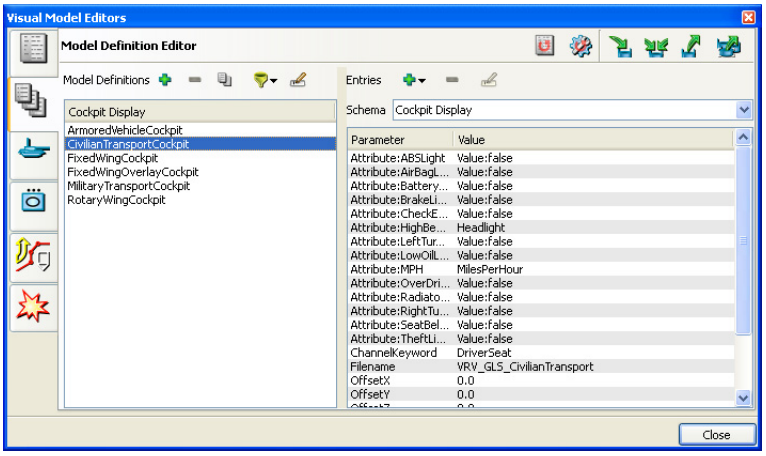


Figure 17-13. Cockpit model definition

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 entity types to the model definition, as described in "Adding a Model Mapping," on page 16-3.

17.5.1. 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.

17.5.2. 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 17-8. Be sure to select Cockpit Display as the schema. A new model definition is added to the display (Figure 17-14). The message window lists the parameters that you must add. These are the parameters defined by the schema.

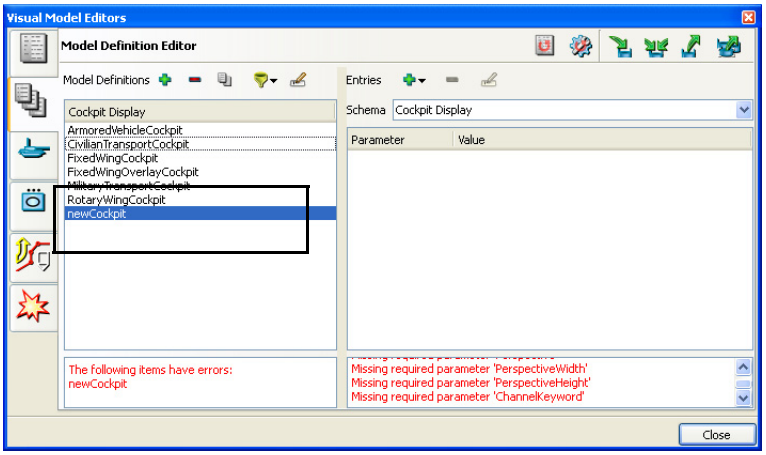


Figure 17-14. New cockpit model definition

2. Add the required parameters, as described in "Adding Parameters to a Model Definition," on page 17-10. Table 17-1 describes the required parameters.

Table 17-1: 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. Currently, only 2D cockpit displays are provided with VR-Vantage.

Table 17-1: 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 17-10.
   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 17-2.
4. Map an entity type to your definition, as described in "Adding a Model Mapping," on page 16-3.

Table 17-2: 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 17-2: 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.

17.6. 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 5-26.)

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 17-3).
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 icon () to see if this is a valid parameter for this model. If it is, you can add the parameter and set it to 1.

17.7. Configuring SpeedTree Trees

SpeedTree trees are high resolution models of trees. To improve performance, you can set clipping plane and levels-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 6-11.

To configure SpeedTree trees:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the SpeedTree Settings page (Figure 17-15).

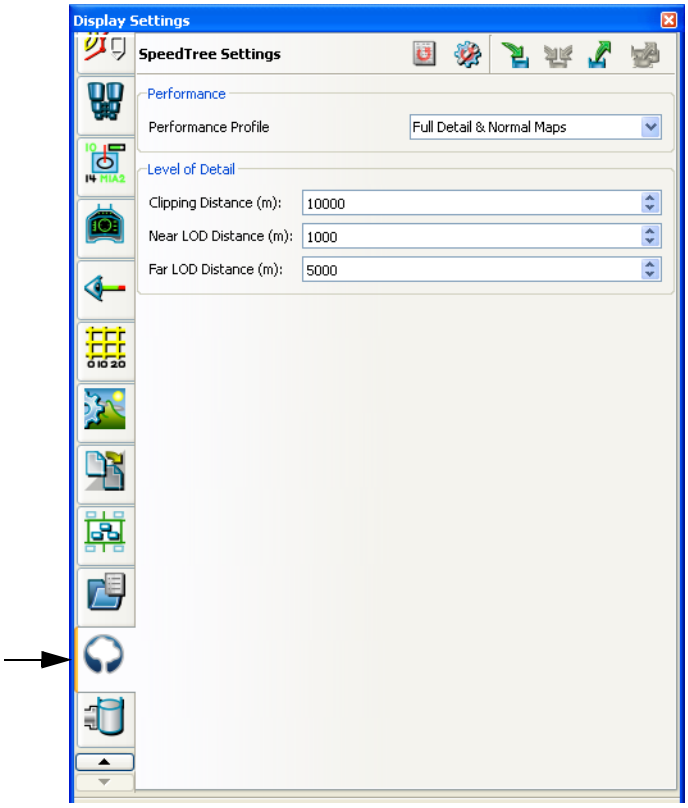


Figure 17-15. SpeedTree Settings page

3. In the Performance group box, select a performance profile. (For details, please see "Specifying the SpeedTree Performance Profile," on page 17-26.)
4. In the Level of Detail group box, specify the clipping distance, and the near and far LOD distance.
5. Click Close.

17.7.1. Specifying the SpeedTree Performance Profile

The number of SpeedTree objects in a scene can affect performance. Therefore, VR-Vantage provides several profiles for display of SpeedTrees so that you can balance performance against visual quality. You specify the performance profile on the Speed-Tree Settings page of the Display Settings dialog box. Table 17-3 describes the profiles.

Table 17-3: SpeedTree Performance Profiles

Profile	Branch Texture	Frond Texture	Vertical Billboards	Horizontal Billboards
Disabled				
Single Color Map	Color	Color	Low LOD	
Partial Detail & Normal Maps	Color Detail Normal map	Color	Low LOD	
Full Detail & Normal Maps	Color Detail Normal map	Color Normal map	Low LOD	
Full Detail & Normal & Shadow Maps	Color Detail Normal map Shadow	Color Detail Normal map	Low LOD	Low LOD

17.8. Best Practices for Creating Models for VR-Vantage

If you build your own models for use in VR-Vantage, following the guidelines in this section 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.



18

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 18-2
CIGI Packet Support 18-3
Mapping Entity Models for CIGI 18-4
Adding an Articulated Part Mapping to an Entity Model 18-5
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Prototypical Host – IG Configurations 18-11

18.1. 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. Appendix D, *CIGI Host Emulator Tutorial* describes how to use the host emulator to control VR-Vantage.

18.1.1. 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.

18.1.2. 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.

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 Appendix H, *CIGI Packets Supported*.

18.2. 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 18-1).

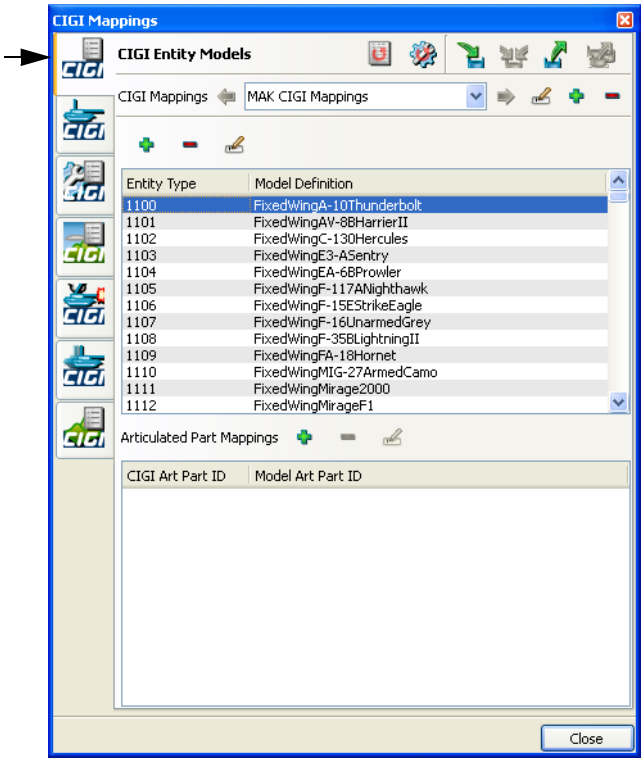


Figure 18-1. CIGI Entity Models page

3. Click the Add icon (✚) above the list of entity types. The Create New Entity Type Model Mapping dialog box opens (Figure 18-2).

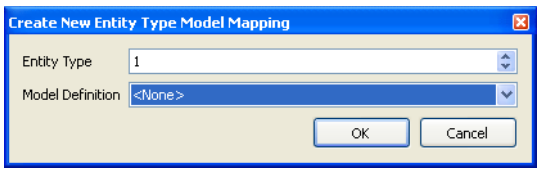


Figure 18-2. Create New Entity Type Model Mapping dialog box

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.

18.2.1. 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 18-1).
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 icon (+) next to the Articulated Part Mappings label. The Create New Art Part Mapping dialog box opens (Figure 18-3).

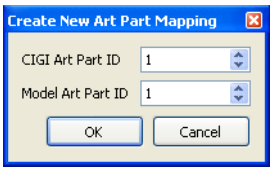


Figure 18-3. Create New Art Part Mapping dialog box

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.

18.3. 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 18-1).
2. Select the page for the type of component you want to map.
3. Click the Add icon (+) above the mapping window. The Create New Component Mapping dialog box opens (Figure 18-4).

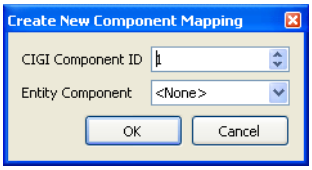


Figure 18-4. Create New Component Mapping dialog box

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 drop-down 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.

18.3.1. 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 18-1: 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 18-2: 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.

Table 18-2: Animation speed component control

Data 1	Speed (float).
Data 2	Not applicable.

Table 18-3: 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 18-4: 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 18-5 describes the fields and values for the shadow component control.

Table 18-5: 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 18-6: 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 18-7: 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.

18.4. 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 will load it. If a database are 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 18-1).
2. Select the CIGI Database Mapping page (Figure 18-5).

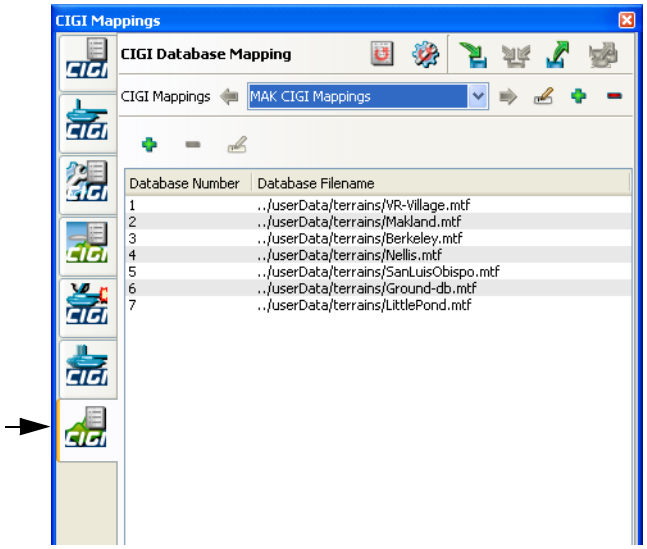


Figure 18-5. CIGI Database Mappings page

3. Click the Add icon (✚) 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 18-6).

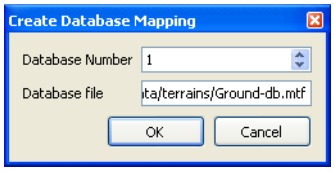


Figure 18-6. Create Database Mapping dialog box

6. Type a number for the database. If you choose a number that is in use, this database will replace the currently mapped database.

7. Click OK.

18.5. 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 18-7), 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.

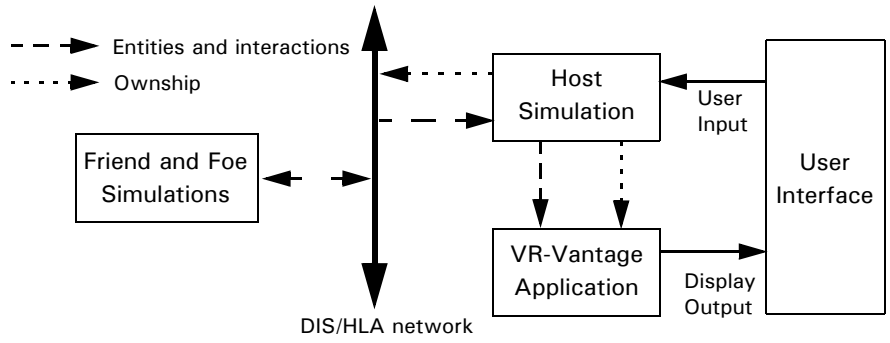


Figure 18-7. Classic IG Configuration

In the networked IG configuration (Figure 18-8), 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.

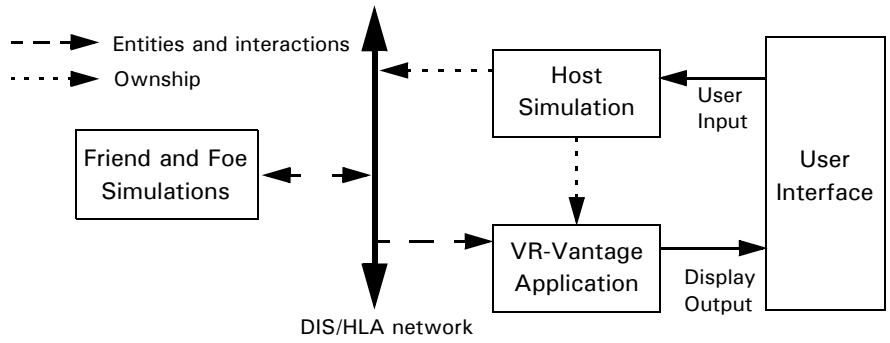


Figure 18-8. Networked IG Configuration

In the distributed visual/simulation configuration (Figure 18-9), 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.)

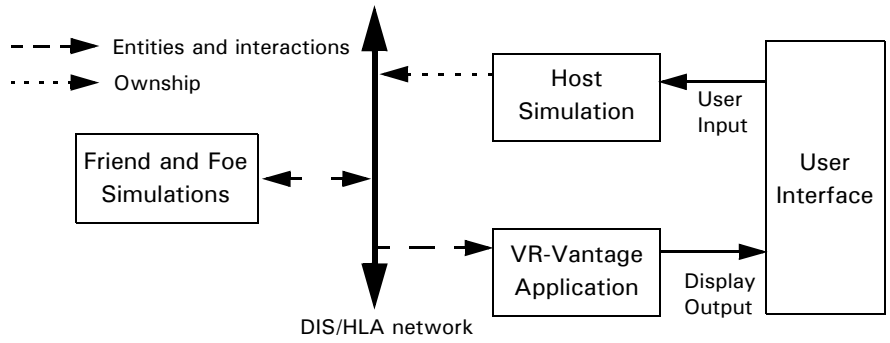


Figure 18-9. Distributed Visual/Simulation Application IG Configuration

In the integrated visual/simulation application (Figure 18-10), 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.

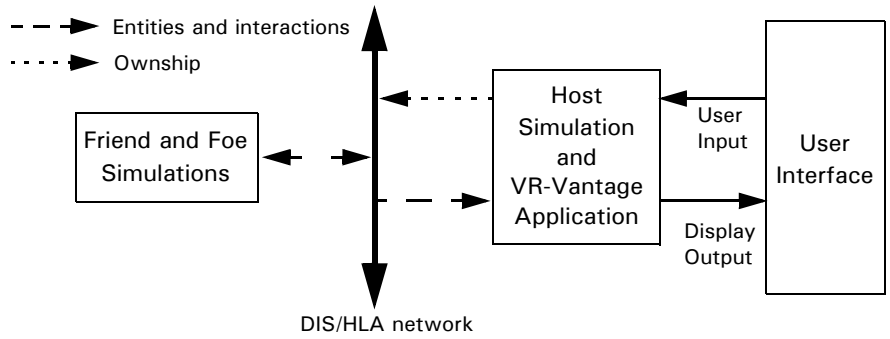


Figure 18-10. Integrated Visual/Simulation Application Configuration



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 appendix contains tutorials that demonstrate how to combine various procedures to create terrains and how to create a local terrain server.

Composing a Terrain A-2
- Add Elevation Data (Add a Terrain Patch) A-3
- Add Imagery A-4
- Add a Feature Layer A-8
- Add Props A-9

Adding a Terrain Server A-13
- Connect to the SanLuisObispo Terrain Server A-16

Extracting Props from a Terrain A-18
- Create a New Terrain and Add a Terrain Patch A-18
- Extract the Props A-19
- Change the Model Definition for a Prop A-21

Adding Feature Data to a GDB Terrain A-23
- Create a New GDB Terrain in the TDB Tool A-24
- Add a Point Feature to the Terrain A-26
- Add the GDB Terrain to VR-Vantage as a Feature Layer A-30

A.1. Composing a Terrain

This tutorial shows how to compose a terrain by combining elevation data, imagery, and feature data. 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 videos that illustrate this tutorial, on the Start menu, choose **VR-Vantage** 1.3 → **Documentation** → **VR-Vantage Video Tutorials**, or open *./doc/vrvantage_tutorialvideos.htm*.

The basic steps for composing a terrain are:

1. Add elevation data (a terrain patch) ("Add Elevation Data (Add a Terrain Patch)," on page A-3).
2. Add imagery ("Add Imagery," on page A-4).
3. Add a feature layer ("Add a Feature Layer," on page A-8).
4. Add props ("Add Props," on page A-9).

A.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 A-1).

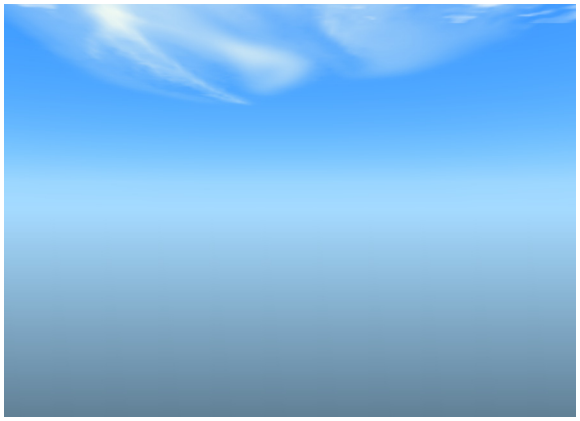


Figure A-1. No terrain loaded

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 A-2).

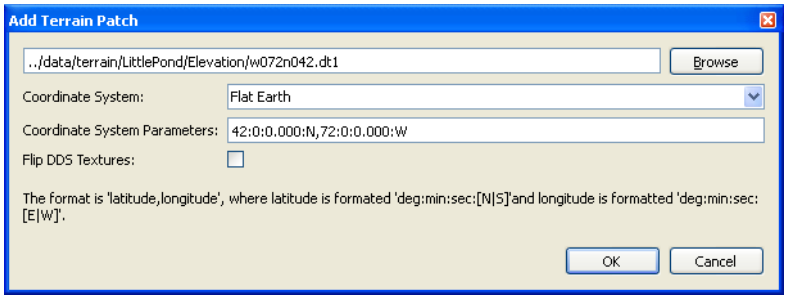


Figure A-2. Add Terrain Patch

6. Click OK. The terrain is added to the scene (Figure A-3).

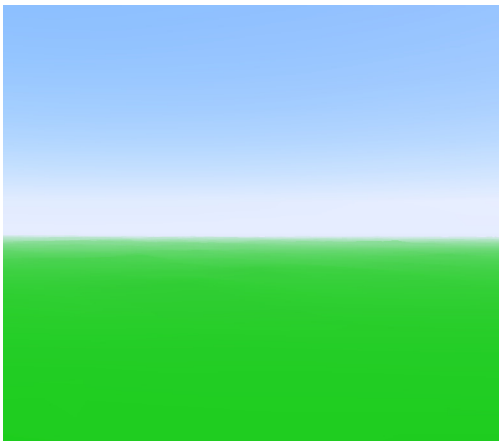


Figure A-3. Terrain patch added

A.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 A-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.

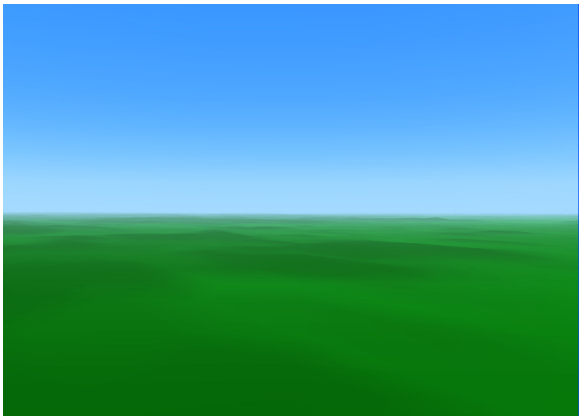


Figure A-4. Elevation coloring

To add image data:

1. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
2. Select the Raster Maps page (Figure A-5).

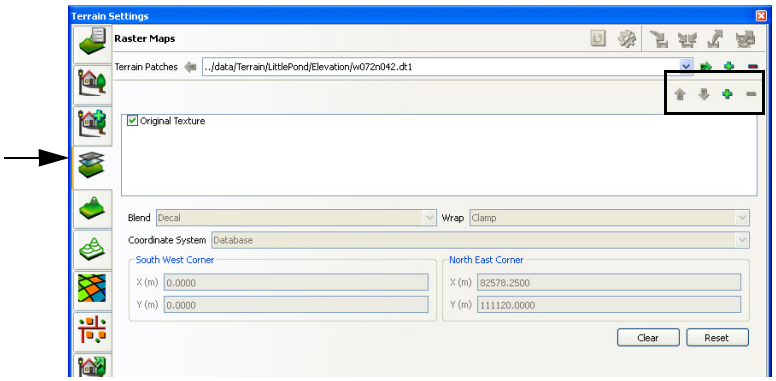


Figure A-5. Raster Maps page

3. Click the Add icon (+) that is at the upper right of the list window (Figure A-5). A line labeled Image 1 is added to the list in the window (Figure A-6).

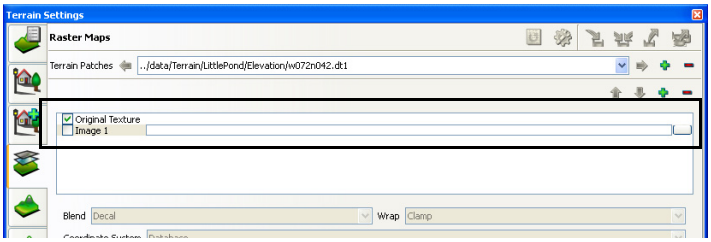


Figure A-6. New image

4. Click the Browse button at the right end of the image entry. The Image File dialog box opens.
5. In the Image File dialog box, navigate to *./data/Terrain/LittlePond/imagery*.
6. Select *W72N42.tif*.
7. 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 A-7).

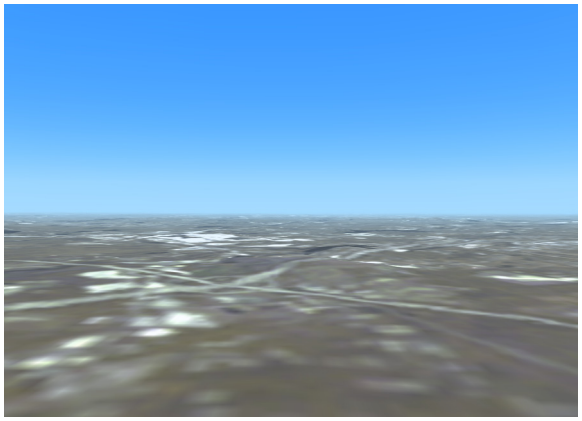


Figure A-7. Low resolution image

8. Add another image. This time, select *LittlePond.tif*.
9. Select the check box for the *LittlePond.tif* image (Figure A-8). A high resolution image is added to the Little Pond Area of the terrain (Figure A-9). (The high resolution image might be hard to find. The next section explains how to find it quickly.)

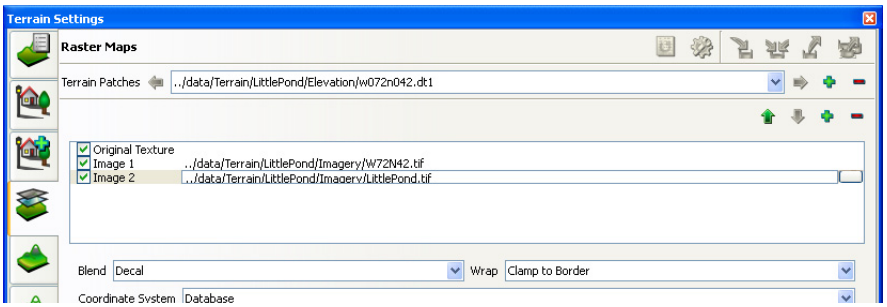


Figure A-8. Raster Maps page with both images added

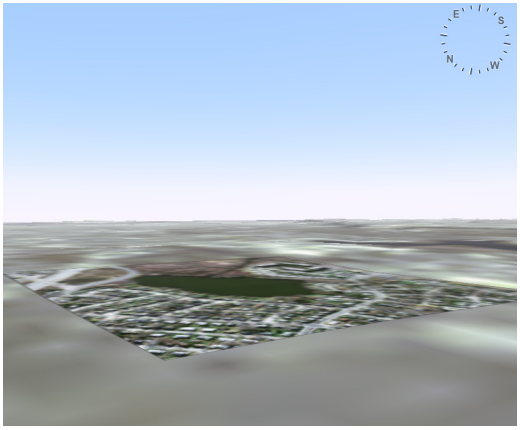


Figure A-9. Little Pond image

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 icon ( ). 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 A-9.

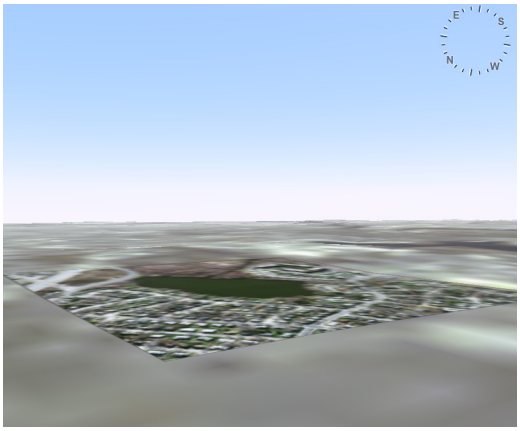


Figure A-10. Little Pond image



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.

A.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 A-11).

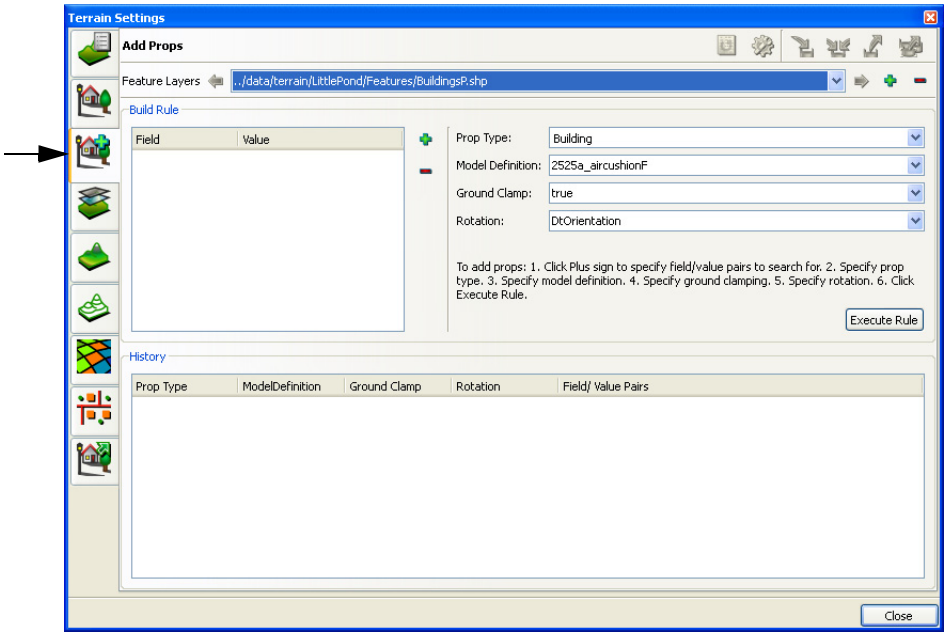


Figure A-11. Add Props page

3. Click the Add icon (+) 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.

A.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 icon (+) (Figure A-12). The Build Field/Value Pair dialog box opens.

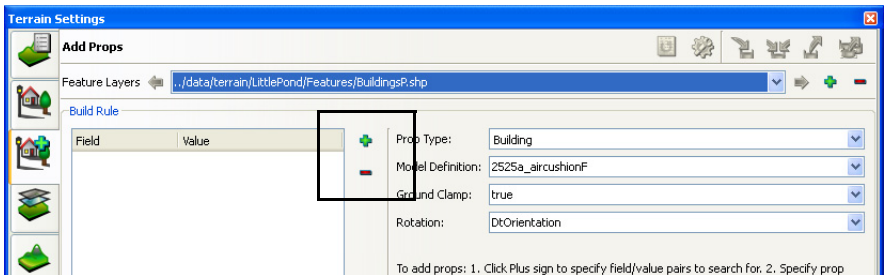


Figure A-12. Add build rule

2. In the Field drop-down list, select TYPE.
3. In the Value drop-down list, select HousesColonialGarrison (Figure A-13).

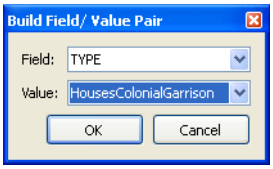


Figure A-13. Build Field/Value Pair dialog box

4. Click OK.
5. In the Prop Type drop-down list, select the prop type for the rule. In this case, select Building.
6. In the Model Definition drop-down list, select HousesColonialGarrisonClapboardWhite.
7. In the Ground Clamp box, specify whether or not you want the prop to be ground-clamped.
8. In the Rotation drop-down 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 A-14.

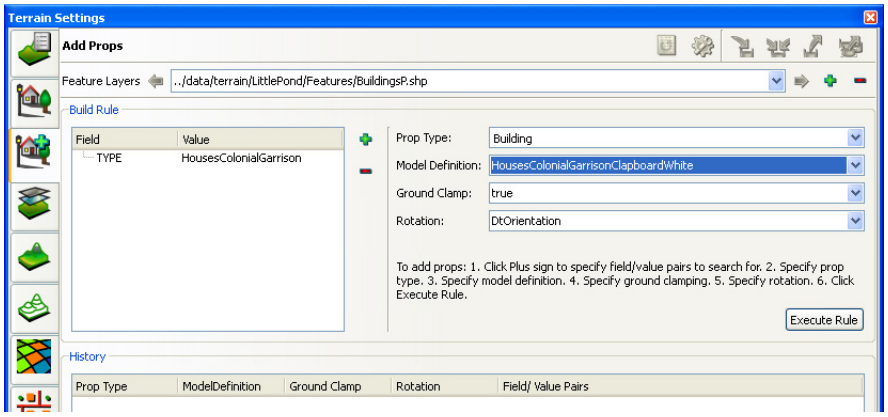


Figure A-14. Completed rule

9. Click Execute Rule. The rule is executed. The Add Props page is updated (Figure A-15) and houses are added to the terrain. Zoom in for a better look at them (Figure A-16). (You might need to close the Feature Layer Settings dialog box or move it out of the way to see the terrain.)

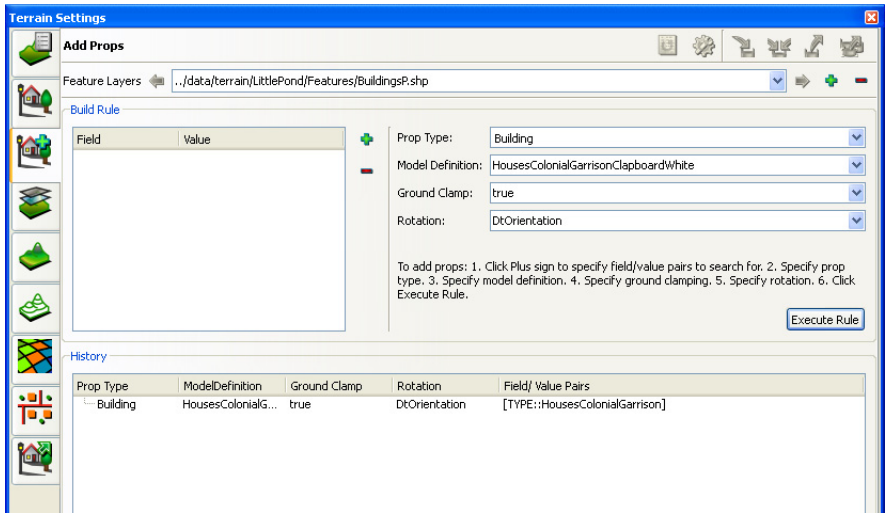


Figure A-15. Build rule implemented

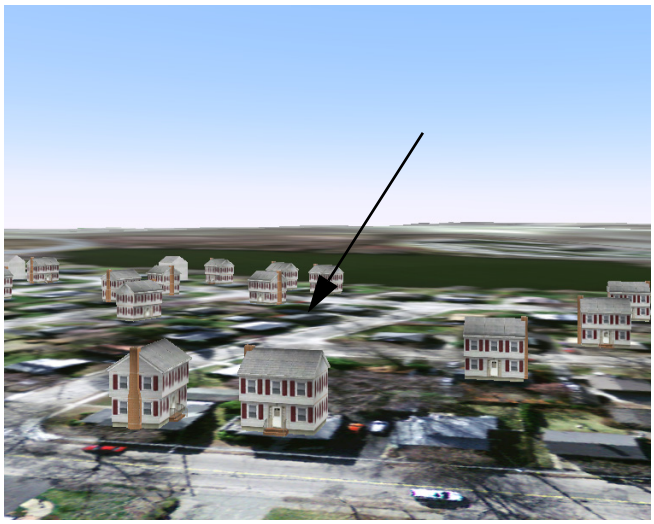


Figure A-16. Props added to terrain

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 icon (+) 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 icon (+). The Build Field/Value Pair dialog box opens.
7. In the field drop-down list, select VEG.
8. In the Value drop-down list, select TreesBigLeafMaple.
9. Click OK.
10. In the Prop Type drop-down list, select Tree.
11. In the Model Definition drop-down list, select TreesBigLeafMapleST. The build rule should look like (Figure A-17).

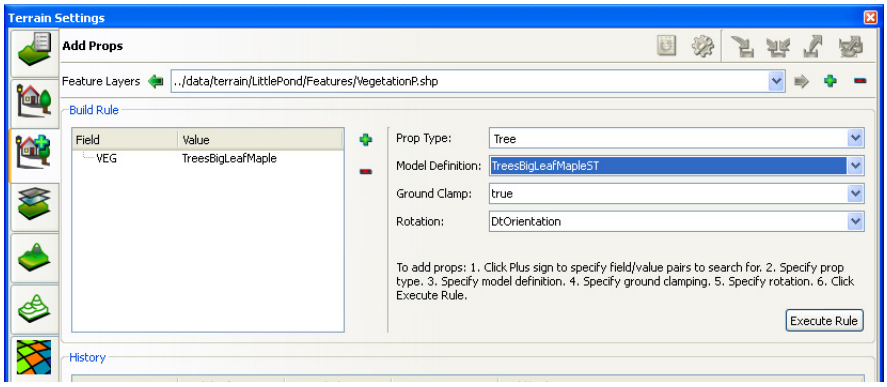


Figure A-17. Rule for big leaf maples

12. Click Execute Rule. The page is updated and trees are added to the terrain (Figure A-18).



Figure A-18. Little Pond with maples

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.

A.2. Adding a Terrain Server

This tutorial explains how to add a terrain server that streams data from directories on your local network. It uses the San Luis Obispo terrain data, which is provided with VR-Vantage. In the tutorial, we copy an existing *.earth* file. Then we change the elevation and imagery data paths to point to the correct files and directories in *./data/Terrain/SanLuisObispo*.

To add a terrain server:

1. Choose **Settings** → **Display**. The Display Settings dialog box opens.
2. Select the Server Settings page (Figure A-19).

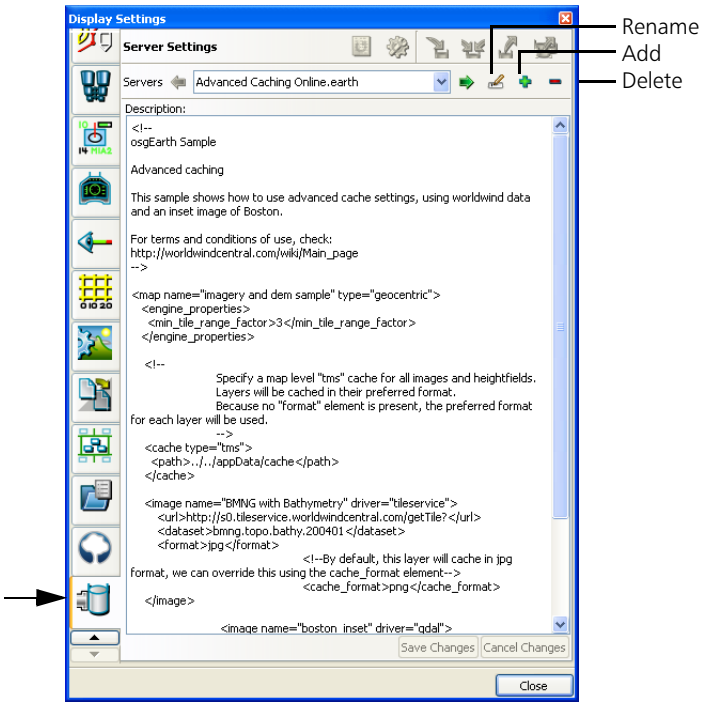


Figure A-19. Server settings page

3. In the Servers list, select *Local World.earth*.
4. Click the Add icon (✚). A new configuration file is added to the list. It copies the contents of *Local World.earth* and names it *Local World_1.earth*.
5. The image element reads as follows:

```
<image name="World Imagery" driver="gdal">
      <url>../../data/Terrain/World/Imagery/World4km.tif</url>
```

```
  </image>
```

The SanLuisObispo/Imagery directory has multiple files, so we want to point the imagery URL to the directory, not to a specific file. VR-Vantage will use all of the files as needed.

Change the imageelement name and URL to:

```
<image name="SanLuisObispo Imagery" driver="gdal">
  <url>../../data/Terrain/SanLuisObispo/Imagery</url>
</image>
```

6. The elevation section of the file reads as follows:

   ```
   <url>../../data/Terrain/World/Elevation/earthnew/w001001.adf</url>
   ```

   If there is only one elevation file, the URL must specify the file. If there are multiple elevation files, the URL must specify the directory.

   Change the elevation URL line to:

   ```
   <url>../../data/Terrain/SanLuisObispo/Elevation</url>
   ```

7. Change the heightfield element's name value from:

   ```
   <heightfield name="World Elevation" driver = "gdal">
   ```

   to:

   ```
   <heightfield name="SanLuisObispo Elevation" driver = "gdal">
   ```

8. Click the Rename icon ( ). (If you are prompted to save changes, click Save.) The Rename Server dialog box opens.

9. Change the name to *mySanLuisObispo.earth*. (If you are prompted to save changes, click Save.) The completed server should look like Figure A-20.

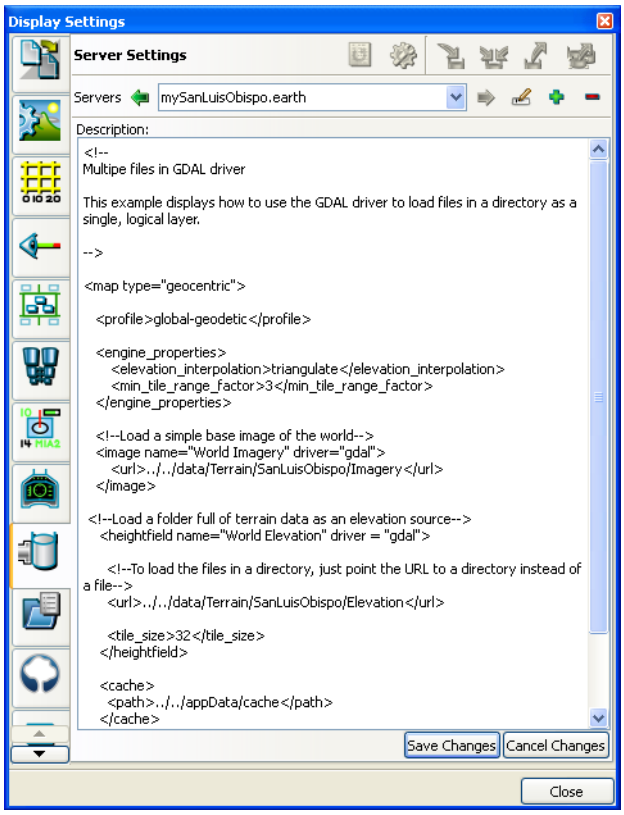


Figure A-20. SanLuisObispo.earth server

10. Click Save Changes. The new server file is saved to *./userData/servers*.
11. Close the Display Settings dialog box.

A.2.1. Connect to the SanLuisObispo Terrain Server

Now we will connect to the new server. We can also compare it to the San Luis Obispo terrain that ships with VR-Vantage, which was created using the composable terrain method.

To connect to the server:

1. Choose **New** → **Scene**.
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 *mySanLuisObispo.earth*.
6. Click Connect. The server is loaded. It will be visible as a small speck in the window (Figure A-21), so you will have zoom in on it (Figure A-22). Notice how as you zoom in, the terrain imagery gets paged in at greater levels of detail.

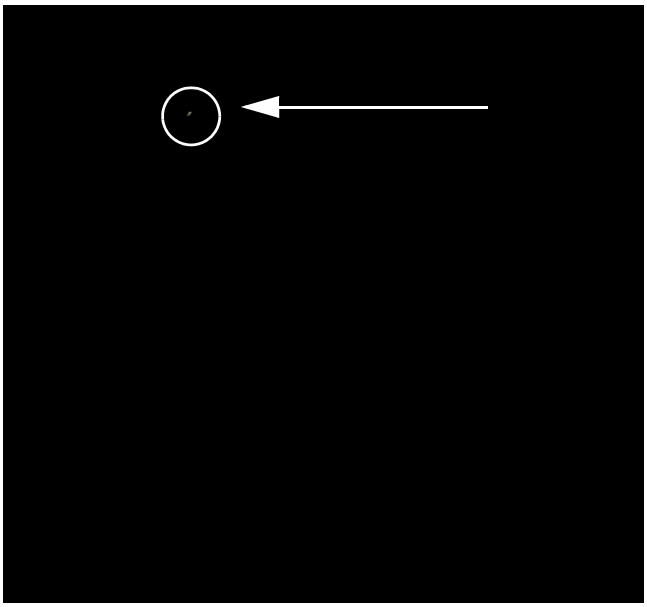


Figure A-21. SanLuisObispo.earth initial view

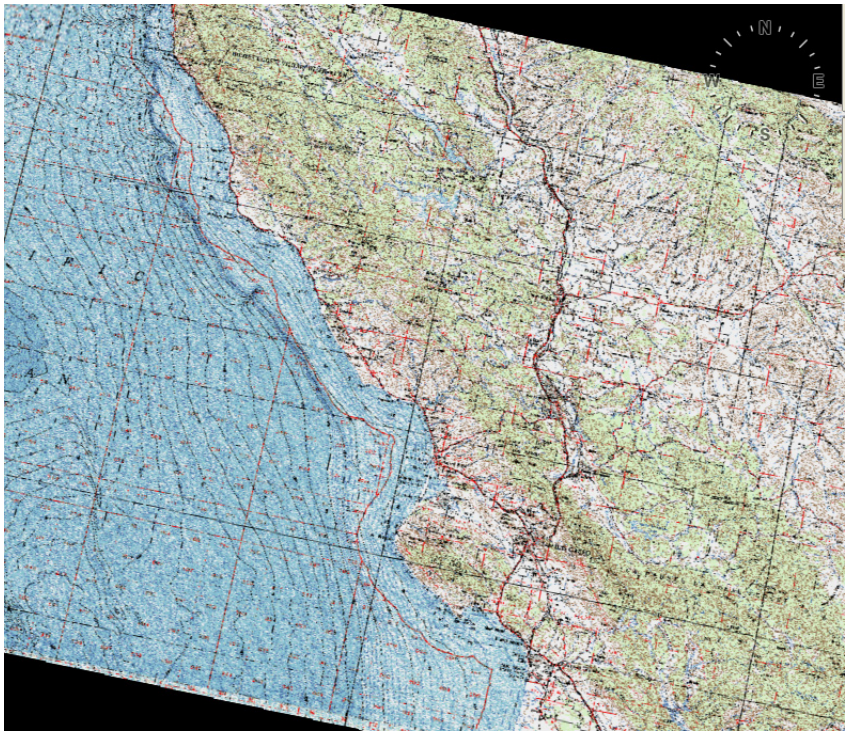


Figure A-22. SanLuisObispo.earth zoomed in

7. Choose **File** → **Save Terrain**. The Save Terrain dialog box opens.
8. Type a name, such as mySanLuisObispoEarth. (Do not name it SanLuisObispo or you will overwrite the terrain shipped with VR-Vantage.)
9. Click Save.
10. Choose **File** → **Close Terrain**.
11. Open the *SanLuisObispo.mtf* terrain. Then open the *SanLuisObispoTopoGdal.mtf* terrain. Compare these terrains to each other and the one you just built.

A.3. Extracting Props from a Terrain

In the tutorial "Composing a Terrain," on page A-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 A-18).
2. Select the external references that you want to extract as props and extract them ("Extract the Props," on page A-19).
3. Optionally, change the model definitions ("Change the Model Definition for a Prop," on page A-21).

A.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.

A.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 A-23.



Figure A-23. 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 A-24). 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.

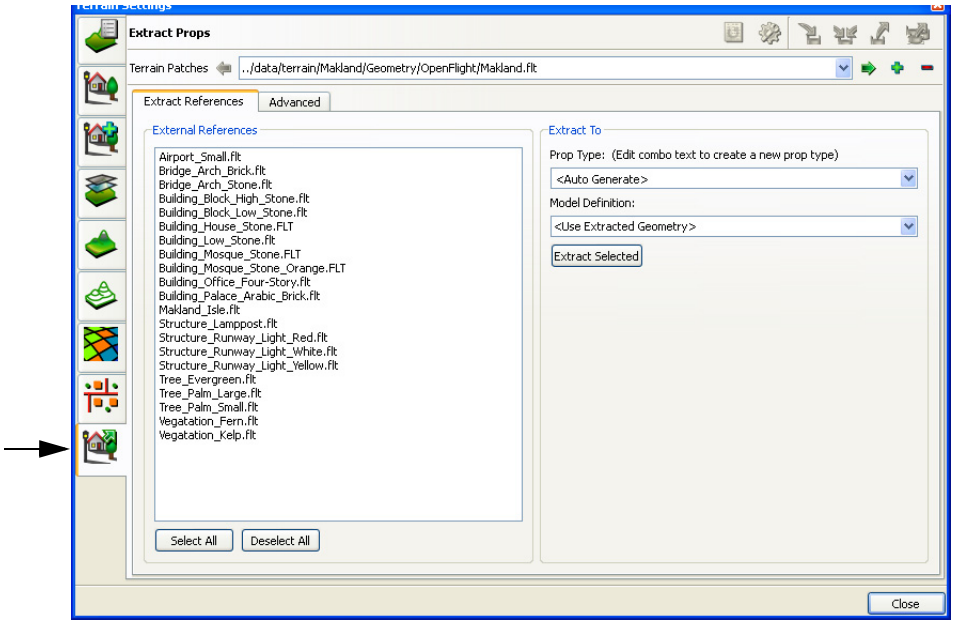


Figure A-24. Extract props page

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 A-25). 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 A-25. Selected props

A.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.

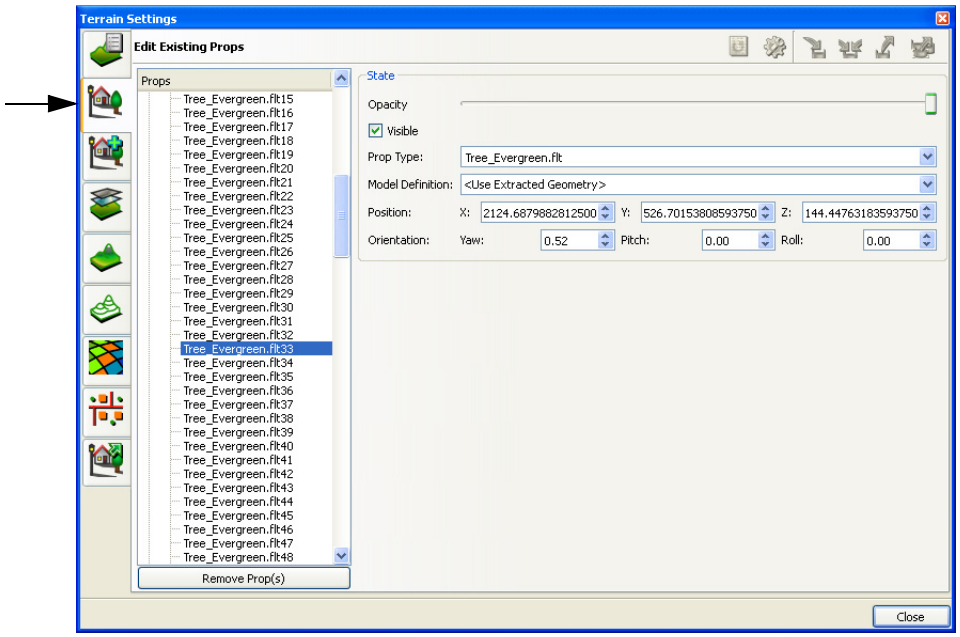


Figure A-26. Edit Existing Props page

4. In the Model Definition box, select a model definition from the drop-down list, such as TreesGiantRedwoodST. The tree changes to the new model definition (Figure A-27).



Figure A-27. 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.

A.4. Adding Feature Data to a GDB Terrain

The documentation for creating props focuses on adding props from terrain data files that already contain feature data. However, what if you do not have shapefiles or other feature data for your terrain? How would you add a SpeedTree or a building? The MÄK Terrain Database Tool, which is included with VR-Vantage, lets you add feature data to a GDB terrain. You can then extract these features and map them to models as described in this manual.

This tutorial shows you how to add a tree point feature to a terrain and then add it as a feature layer. A companion tutorial explains how to extract the feature and map it to a Speed Tree model. (For that portion of the tutorial, please see "Extracting a Point Feature as a Prop (Adding a SpeedTree)," on page B-12.) The process for adding a building or some other object would be similar.

To see a set of videos that illustrate this tutorial, on the Start menu, choose **VR-Vantage** 1.3 → **Documentation** → **VR-Vantage Video Tutorials**, or open *./doc/vrvantage_tutorialvideos.htm*.

The general process is as follows:

1. Create a new GDB terrain in the TDB Tool or open an existing terrain ("Create a New GDB Terrain in the TDB Tool," on page A-24).
2. Add point features in the locations where you want them ("Add a Point Feature to the Terrain," on page A-26).
3. Save the GDB file.
4. In VR-Vantage, add the GDB file as a feature layer ("Add the GDB Terrain to VR-Vantage as a Feature Layer," on page A-30).

A.4.1. Create a New GDB Terrain in the TDB Tool

This step of the tutorial minimally describes the process for creating a new terrain in the TDB Tool. Please refer to *MAK Terrain Database Tool Users Guide* for details about creating projects, GDB files, and MTD files. This tutorial uses the Little Pond terrain.

To create a Little Pond GDB file and add feature data:

1. Start the TDB Tool. (Choose **Programs** → **MÄK Technologies** → **VR-Vantage 1.3** → **Tools** → **TDB Tool**. The TDB Tool opens (Figure A-28).)

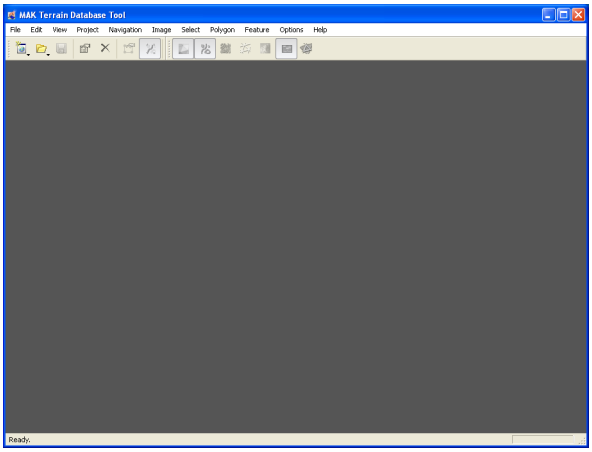


Figure A-28. TDB Tool window

2. Choose **File** → **New** → **Terrain Project**. The Utility Bar is added to the window (Figure A-29).

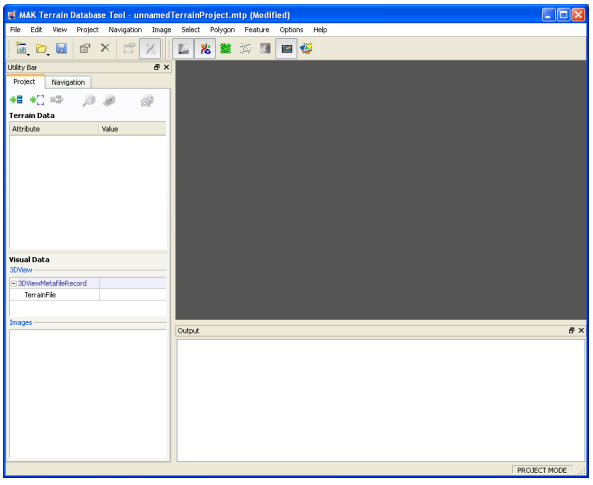


Figure A-29. New project

3. Choose **Project** → **Add Data From File**. The Add Data dialog box opens.

4. Navigate to *./data/terrain/LittlePond/Elevation* and choose *w072n042.dt1*.
5. Click Open. The data is added to the project. By default, the TDB Tool sets the projection for DTED files to UTM. However, the default for DTED in VR-Vantage is Flat Earth, so you must change the projection.
6. In the Terrain Data panel on the Project tab, scroll through the Attribute list until you see the Projection attribute.
7. Click on the value (UTM). The value becomes editable (as a list).
8. In the list, select FlatEarth (Figure A-30).

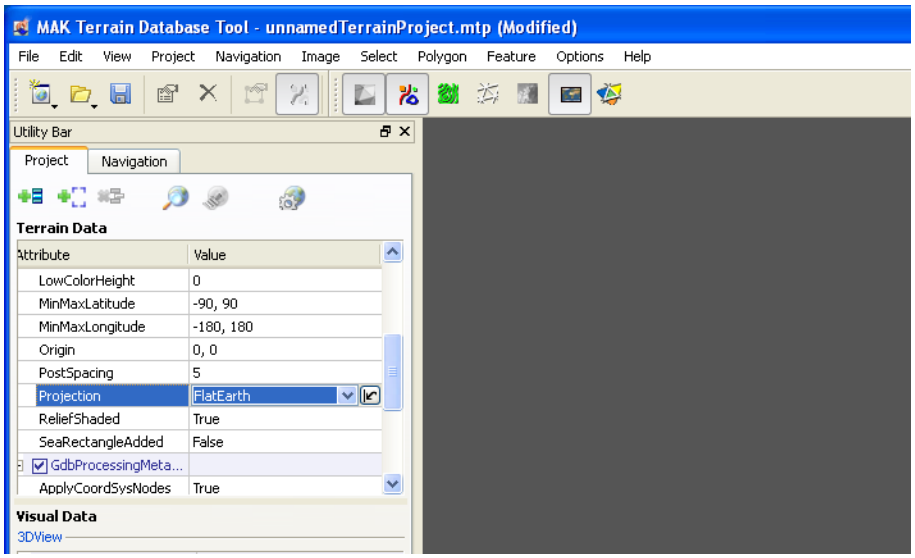


Figure A-30. Change the projection to FlatEarth

9. Choose **Project** → **Build Terrain**. The Build Terrain dialog box opens.
10. Type a name for your project, such as *myLittlePondFeatures*.
11. Click Save. The terrain is built and the TDB Tool asks you if you want to open the *myLittlePondFeature.mtd* and *myLittlePondFeatures.gdb* files.
12. Click Yes.
13. Optionally, save the project when prompted. The terrain is displayed (Figure A-31).

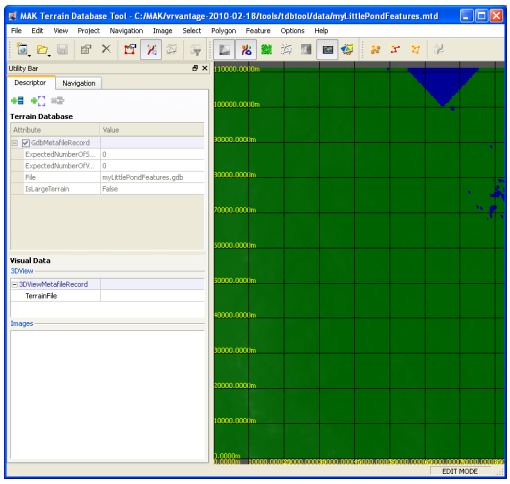


Figure A-31. New terrain

A.4.2. Add a Point Feature to the Terrain

This step of the tutorial minimally describes the process for adding point features in the TDB Tool. It uses the terrain created in the previous section. Please refer to *MAK Terrain Database Tool Users Guide* for details about creating projects, GDB files, and MTD files.

To add a point feature to the terrain:

1. On the Descriptor tab of the Utility bar, click Add Data. The Add Image Data dialog box opens.
2. Navigate to *./data/terrain/LittlePond/Imagery* and choose *LittlePond.tif*.
3. Click Open. The image is added to the terrain (Figure A-32). Its purpose is to give us an easily identified location on which to place our point features.

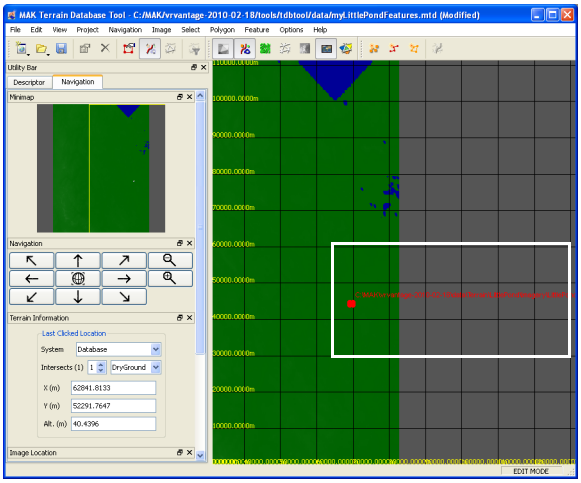


Figure A-32. Terrain with image added

4. Use the controls on the Navigation tab to zoom in on the image. Get close enough to see the roads easily, as in (Figure A-33).



Figure A-33. Zoomed-in view of image

5. Choose **Feature** → **Add Point Feature**. The cursor changes to a point and the Add Point Feature dialog box opens (Figure A-34).

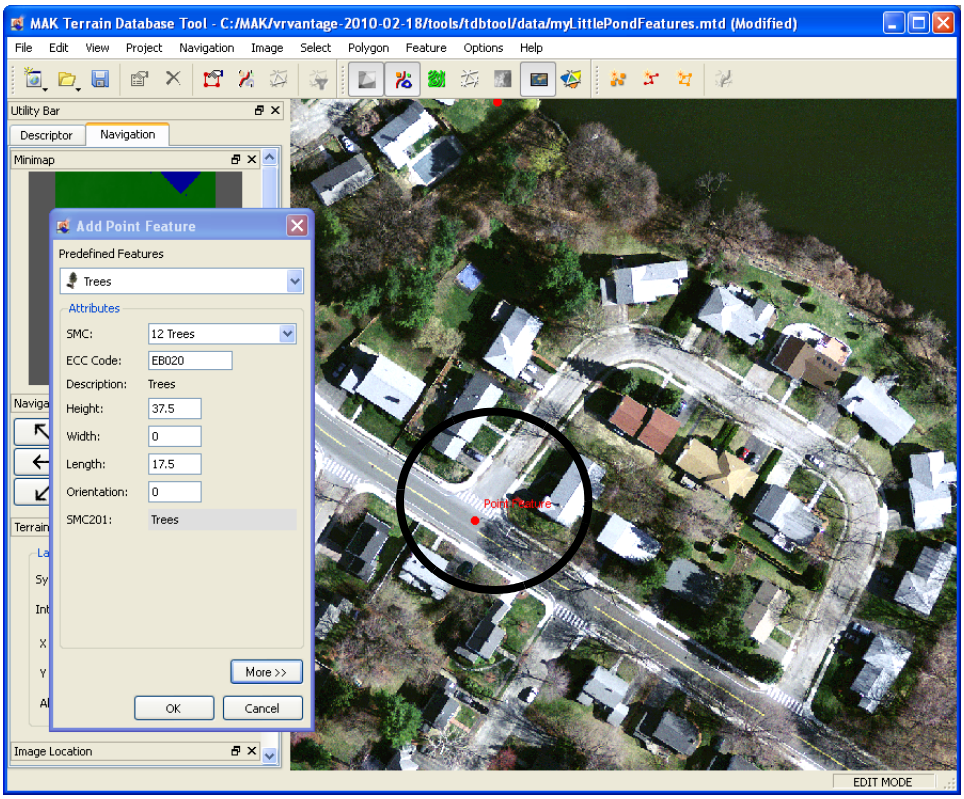


Figure A-34. Add Point Feature dialog box and new point

6. In the Predefined Features List, select Trees.
7. Click on the image in a place where your feature will be obvious, such as in the middle of the road (Figure A-34).
8. Click OK. The feature is added to the terrain (Figure A-35).

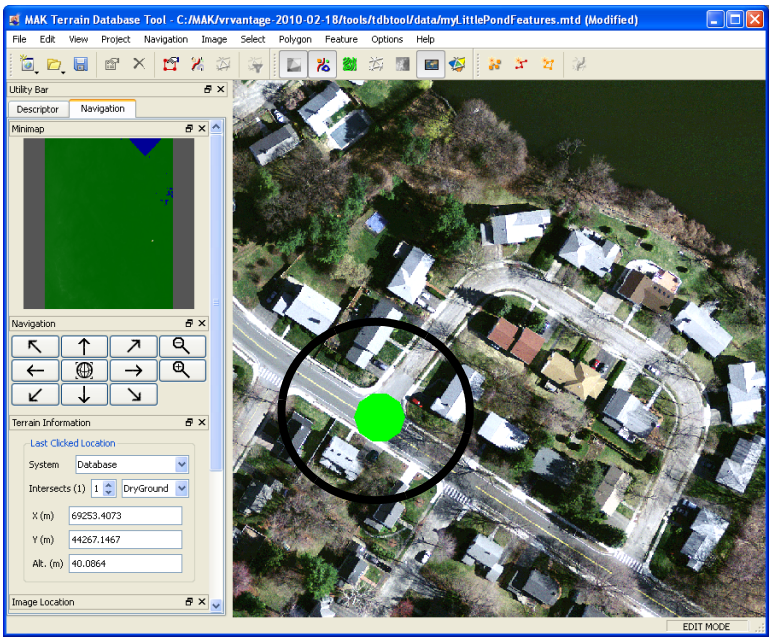


Figure A-35. Point feature added

9. Choose **File** → **Save**.
10. Close the TDB tool.

A.4.3. Add the GDB Terrain to VR-Vantage as a Feature Layer

In this step, we take the GDB terrain that we created in the previous steps and add it as a feature layer in VR-Vantage.

To add a feature layer:

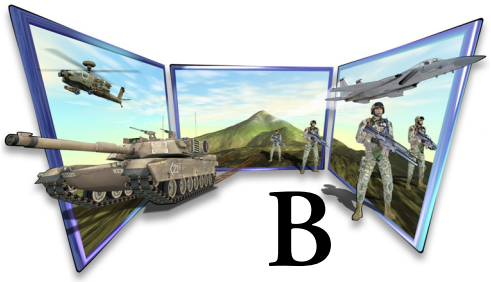
1. Start VR-Vantage.
2. Open the *LittlePond.mtf* terrain.
3. Orient your view of the terrain so that you are viewing the area in which you created the point feature in the GDB file (Figure A-36). (If you open the Observer Views Panel and load the *LittlePond.osrx* saved views file, you can select the saved view and jump right to the inset.)



Figure A-36. 3D view of Little Pond

4. Select the Terrain Contents page.
5. Choose **File** → **Add Feature Layer**. The Select Source File for Feature Layer dialog box opens on top of the Feature Layer Settings dialog box.
6. Select the file *./userData/terrains/myLittlePondFeatures.gdb*.
7. Click Open. The file is added to the list of feature layers.

To complete the tutorial by extracting the new point feature as a prop, please see "Extracting a Point Feature as a Prop (Adding a SpeedTree)," on page B-12.



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. This appendix contains several tutorials that demonstrate how to combine various procedures to add models.

Adding a Model to VR-Vantage B-2
- Create a Model Definition B-2
- Add an Element Definition B-5
- Add a Model Mapping B-8
- Test the Model Mapping B-10

Extracting a Point Feature as a Prop (Adding a SpeedTree) B-12

B.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.

The basic steps are:

1. Create a model definition ("Create a Model Definition," on page B-2).
2. Add an element definition ("Add an Element Definition," on page B-5).
3. Map the new model to an entity or object type enumeration ("Add a Model Mapping," on page B-8).
4. Test the new model ("Test the Model Mapping," on page B-10).

B.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 B-1).

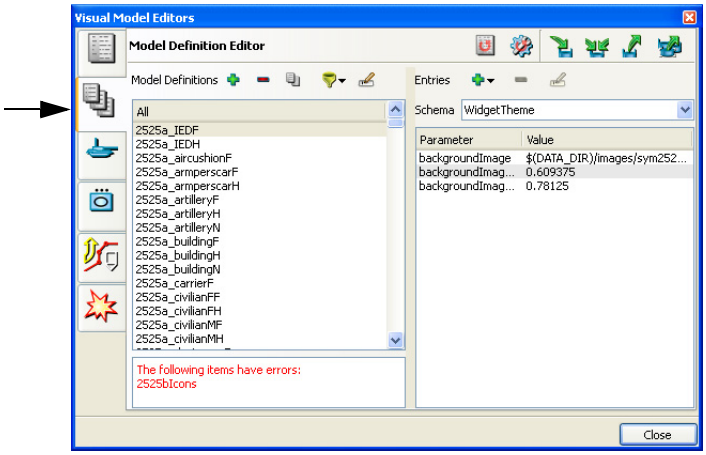


Figure B-1. Model Definition Editor page

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 17-10.)
4. Click the Add icon (+) next to the Model Definitions label. The Add Model Definition dialog box opens (Figure B-2).

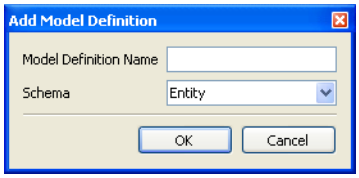


Figure B-2. Add Model Definition dialog box

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 drop-down list, select Entity. The dialog box now looks like (Figure B-3).

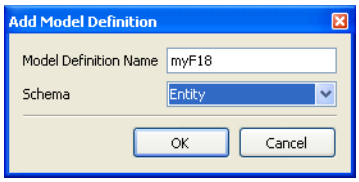


Figure B-3. New model definition

7. Click OK. The new definition is added to the list (Figure B-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.

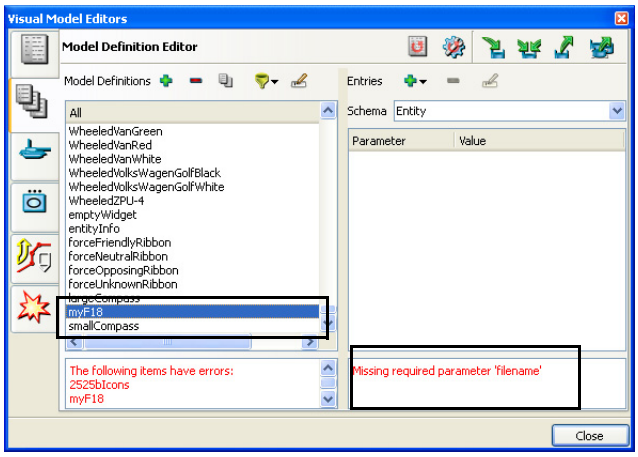


Figure B-4. New model definition in list

8. Click the Add Parameter icon (). A list of parameters is displayed (Figure B-5).

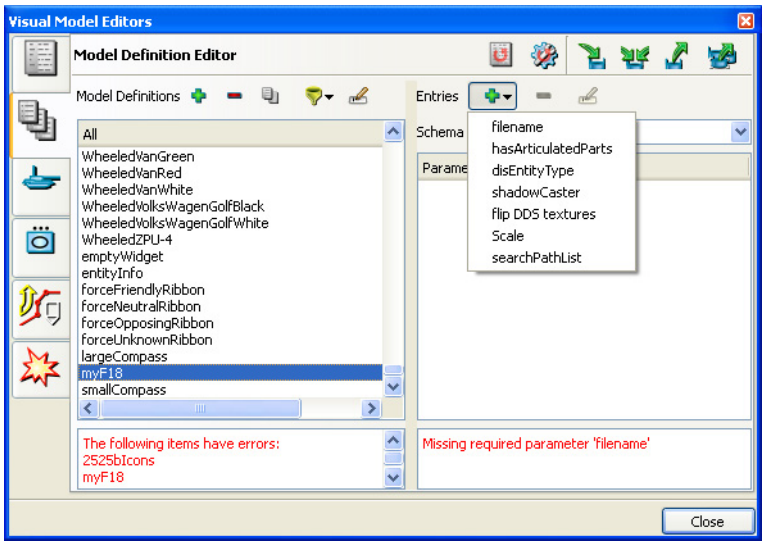


Figure B-5. List of parameters

9. Select filename. It is added to the parameter list.
10. Click the value for the parameter. A file selection dialog box opens.
11. Navigate to *./data/Vehicles/FixedWing/FA-18_Hornet* and select *FA-18_Hornet.flt*.
12. Click OK. The value is updated (Figure B-6).

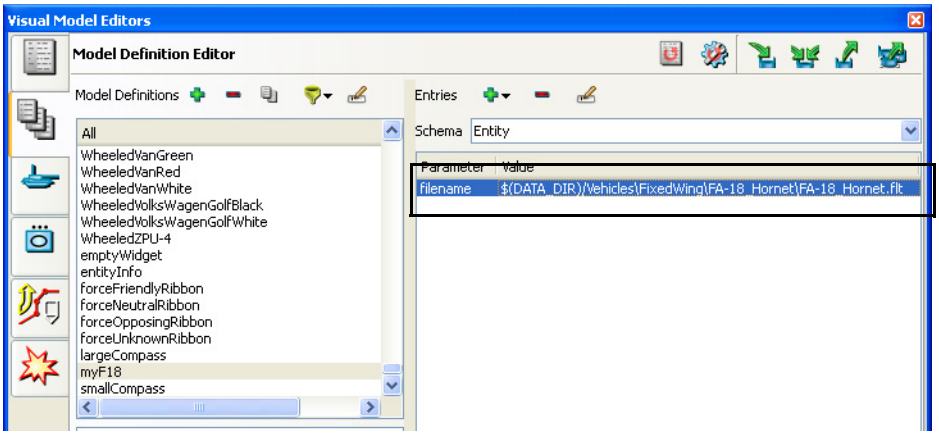


Figure B-6. Model definition parameter

B.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 B-1).

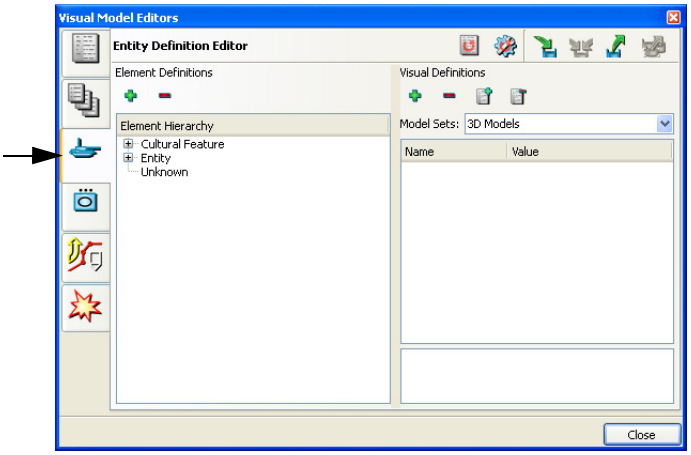


Figure B-7. Entity Definition Editor page

3. Expand the Entity section of the hierarchy and then expand the Air section.
4. Select Fixed Wing.
5. Click the Add (+) next to the Entity Definitions label. The Create Element Definition dialog box opens.
6. Type a name for the new entity, for example, myF18.
7. Click OK. An entry called myF18 is added to the list of fixed wing entities (Figure B-8). It has the same list of visualizers as the fixed wing parent level.

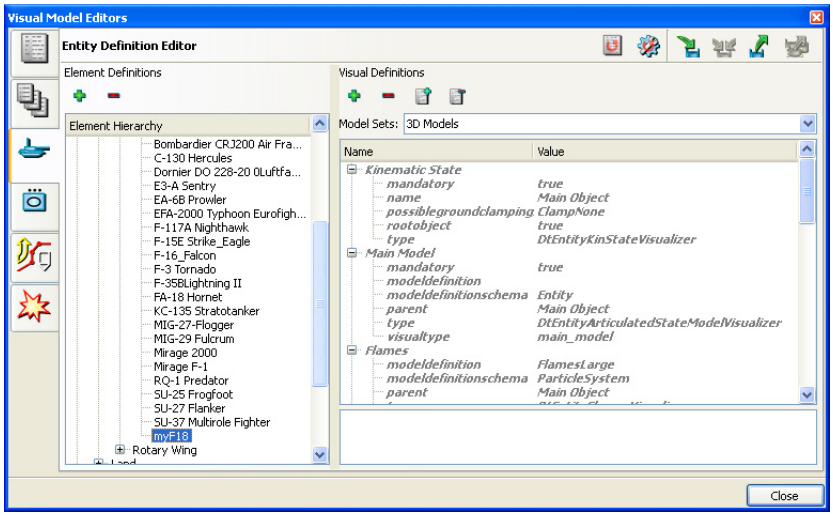


Figure B-8. New entity definition

8. Scroll through the list of visualizers until you find the Main Model Visualizer. This visualizer specifies the model definition that this element should use.
9. Click the Value column for the modelDefinition attribute to make it editable. The Choose Model Definitions dialog box opens (Figure B-9).

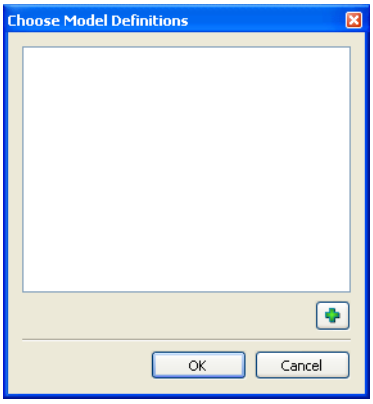


Figure B-9. Choose Model Definitions dialog box

10. Click the Add (✚) icon. A drop-down list of model definitions is added to the dialog box Figure B-10().

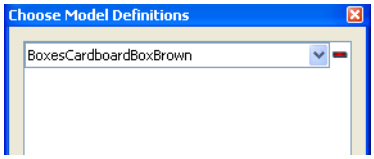


Figure B-10. Choose Model Definitions dialog box with list of definitions

11. Select the new model definition (myF18) and click OK. The model definition is now specified (Figure B-11).

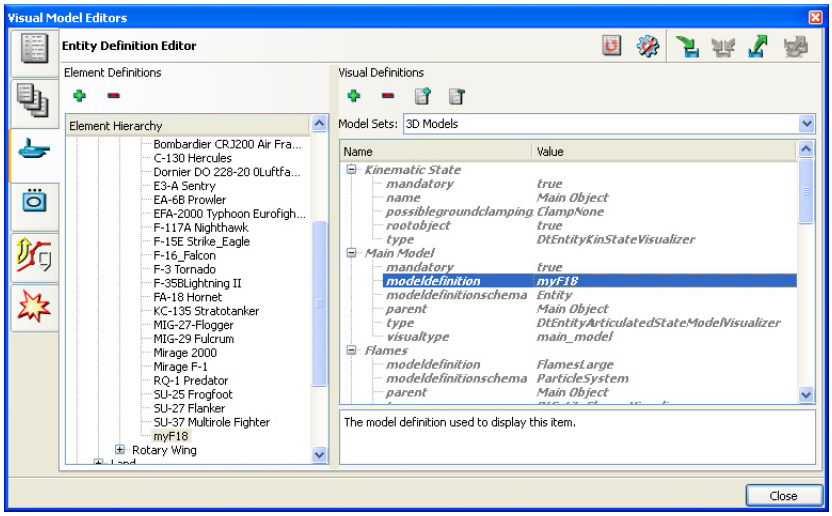


Figure B-11. Model Definition for Model Visualizer

12. Close the Visual Model Editors dialog box.

B.1.3. Add a Model Mapping

Now, you have to map the new model definition to an entity type enumeration.

To add a model mapping:

1. Choose **Settings** → **Entity Type Mappings**. The Entity Type Mappings dialog box opens.
2. Select the Entity Mapping Settings page (Figure B-12).

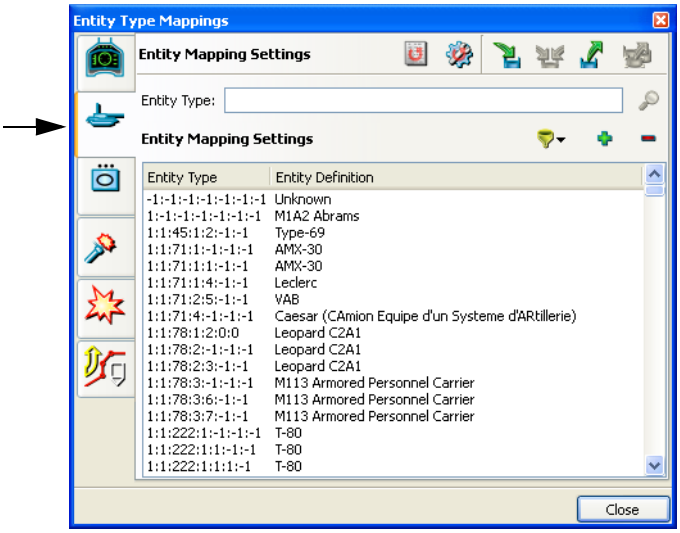


Figure B-12. Entity Mapping Settings page

3. Click the Filter icon ( ).
4. In the list, select **Entity** → **Air** → **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 icon ( ). The Create New Entity Type Model Mapping dialog box opens (Figure B-13). It lists a default entity type enumeration.

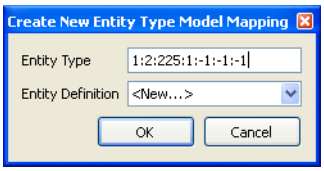


Figure B-13. Create New Entity Type Model Mapping dialog box

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 entity 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 entity type.

7. In the Entity Definition drop-down list, select the model definition that you added in the previous procedure (myF18) (Figure B-14).

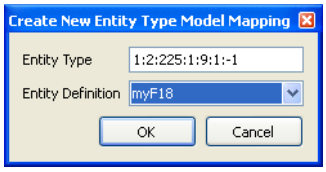


Figure B-14. Create new model mapping

8. Click OK.
9. The new model mapping is added to the list.

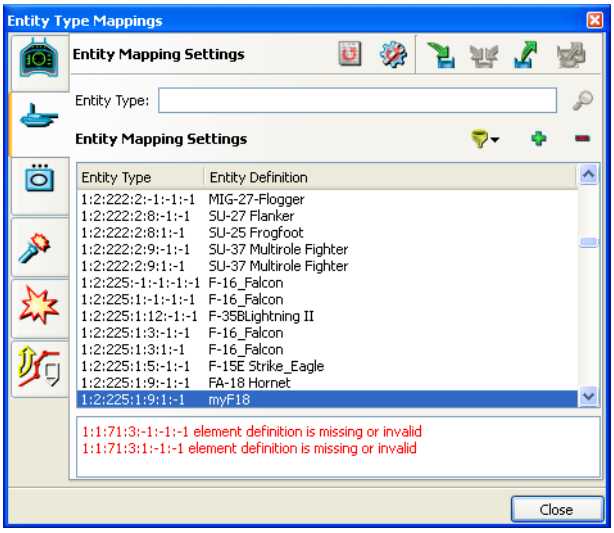


Figure B-15. New model mapping

B.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 B-16).

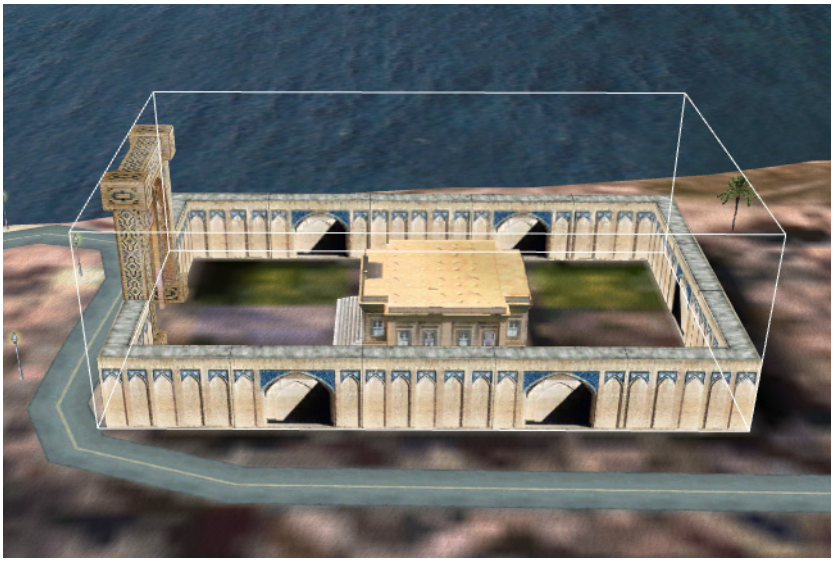


Figure B-16. Palace

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 B-17).

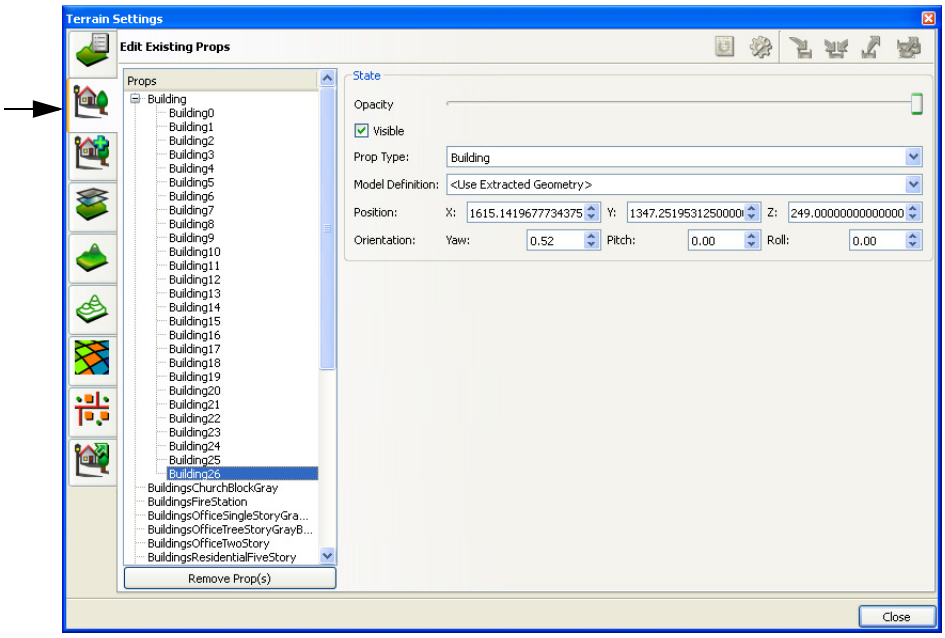


Figure B-17. Edit Existing Props page

6. In the Model Definition drop-down list, select the model definition that you added earlier in this tutorial (Figure B-18). The model of the palace is replaced with the model for the F/A-18 (Figure B-19). 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.

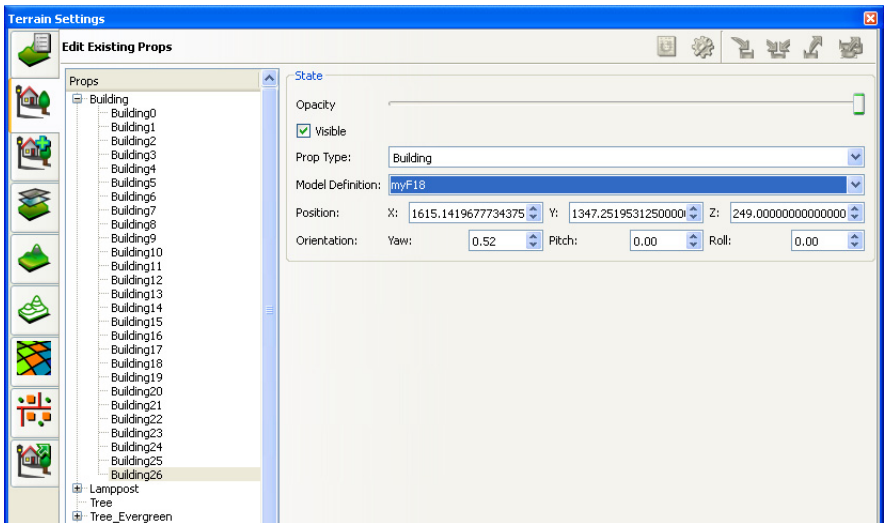


Figure B-18. Changed model definition

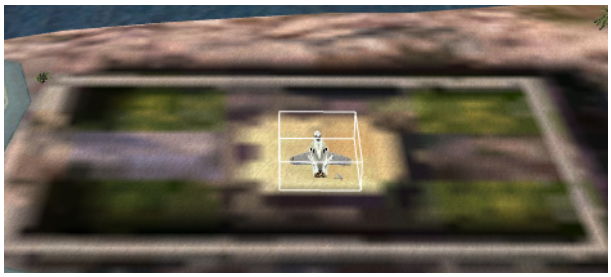


Figure B-19. F/A-18 replaces the palace

7. If you are going to use this terrain for simulations, change the model definition back to Use Extended Geometry.

B.2. Extracting a Point Feature as a Prop (Adding a SpeedTree)

In the tutorial "Adding Feature Data to a GDB Terrain," on page A-23, we explain how to add a point feature to a GDB terrain and add the terrain as a feature layer. In this tutorial, we extract the point feature and map it to a SpeedTree model. This tutorial assumes that you have completed the companion tutorial. Once the GDB file is added as a feature layer, you can extract the feature as a prop and map it to a model.

To extract a feature as a prop:

1. Load the LittlePond terrain.
2. Choose **Settings** → **Terrain**. The Terrain Settings dialog box opens.
3. Select the Add Props page.
4. Click the Add icon (✤) next to the list of Feature Layers.
5. Select *myLittlePondFeatures.gdb*.
6. In the Build Rule group box, click the Add icon (✤). The Build Field/Value Pair dialog box opens.
7. In the Field list, select DtFeatureName. The Value should be automatically set to Trees (Figure B-20).

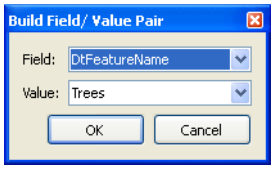


Figure B-20. Build Field/Value Pair dialog box

8. Click OK.
9. In the Prop Type list, select Tree.

10. In the Model Definition list, select the type of tree that you want to add, such as TreesGiantRedwoodSt (Figure B-21).

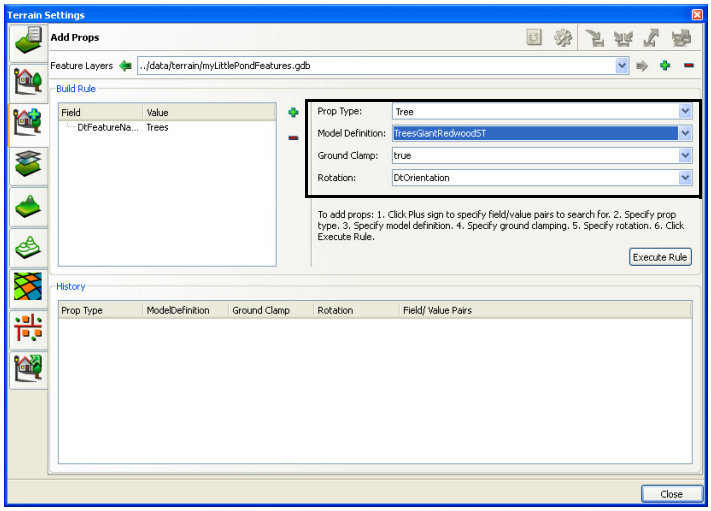


Figure B-21. Full build rule specified

11. Click Execute Rule. The tree is added to the scene where the point feature was located in the GDB file (Figure B-22).



Figure B-22. New tree in Little Pond



Display Engine Tutorials

This appendix 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 C-2
- Connect a VR-Vantage Display Engine C-2
- Save Display Engine Configurations C-5
- Load the Display Engine Configurations in the GUI C-7
- Load Display Engine Configurations from the Command Line C-8

C.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.

C.1.1. Connect a VR-Vantage Display Engine



- To declutter the screen for figures, we have closed all of the information panels.
- 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 C-1).

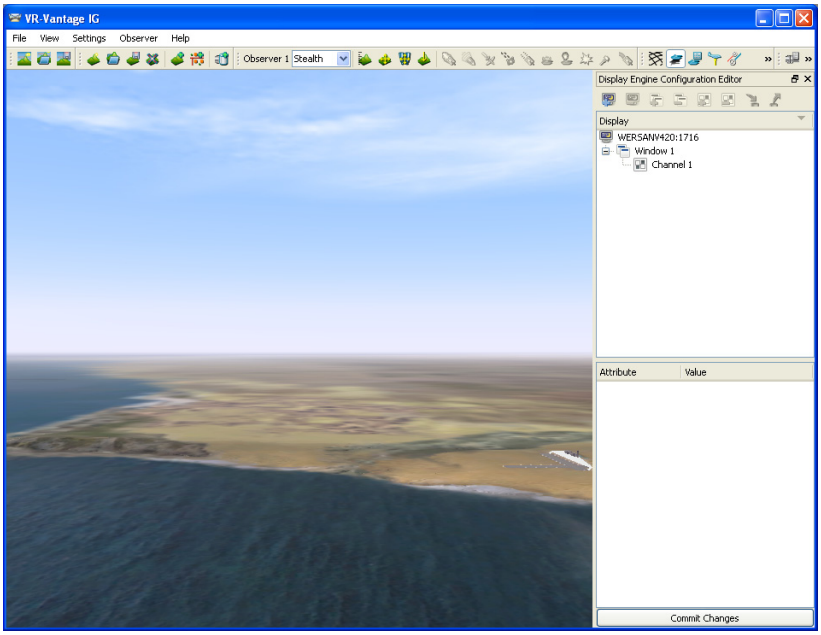


Figure C-1. Display Engine Configuration Editor Panel and default window

4. On computer 2, choose **Start** → **Programs** → **MAK Technologies** → **VR-Vantage** 1.3 → **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 icon ( ). 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.)

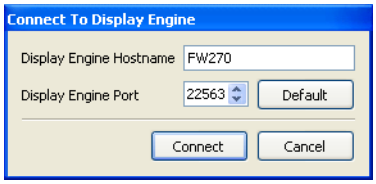


Figure C-2. Connect to Display Engine dialog box

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

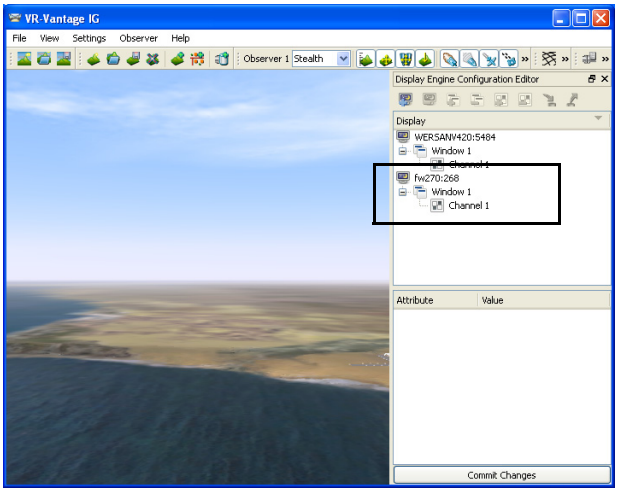


Figure C-3. Remote display engine connected

C.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 C-4).

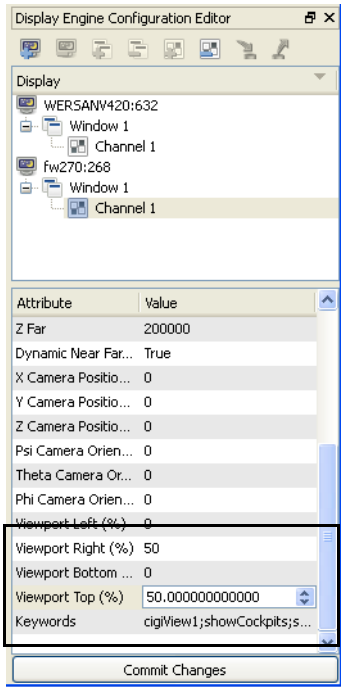


Figure C-4. Channel with changed viewports

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

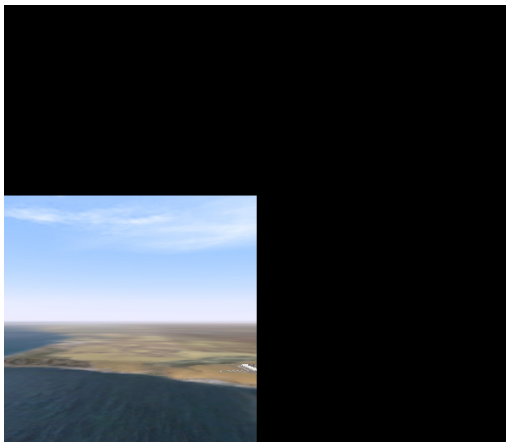


Figure C-5. Remote display engine view after changing configuration

4. Select the display engine on the VR-Vantage application (in this example, WERSANV420).
5. Click the Save Display Engine Configuration icon ( ). 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, fw270).
9. Click the Save Display Configuration icon. A save dialog box opens.
10. Call this configuration “remotedisplay.dcx”.
11. Click Save.

C.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 icon (). 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.

C.1.4. Load 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, 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 – FW270. 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@FW270;../appData/settings/vantageIG/remotedisplay.dcx
```

To load the tutorial configurations from the command line:

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

   ```
   vrvIG.exe --dispSetting ../appData/settings/vantageIG/mainwindow.dcx
     -W 22563@FW270;../appData/settings/vantageIG/remotedisplay.dcx
   ```

   On Linux, enter the command:

   ```
   vrvIG.exe --dispSetting ../appData/settings/vantageIG/mainwindow.dcx
     -W 22563@FW270:../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 Panell, confirm that VR-Vantage is connected to the remote display engine.



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) D-2
Start the Host Emulator D-3
Connect VR-Vantage to the CIGI Host Emulator D-4
Create an Ownship Entity on the Host Emulator D-5
Create a Simulated Entity on the Host Emulator D-6
Change an Entity's Model State D-6
Add an Effect D-8
Change the Weather D-9

D.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 D-1 illustrates connection settings that must be the same on the host emulator (Section D.1.1, "Start the Host Emulator") and the CIGI connection in VR-Vantage (Section D.1.2, "Connect VR-Vantage to the CIGI Host Emulator").

- For best results, shut down VR-Vantage before you start this tutorial. Start it when instructed to do so.
- To see a set of videos that illustrate this tutorial, on the Start menu, choose **VR-Vantage** 1.3 → **Documentation** → **VR-Vantage Video Tutorials**, or open *./doc/vrvantage_tutorialvideos.htm*.

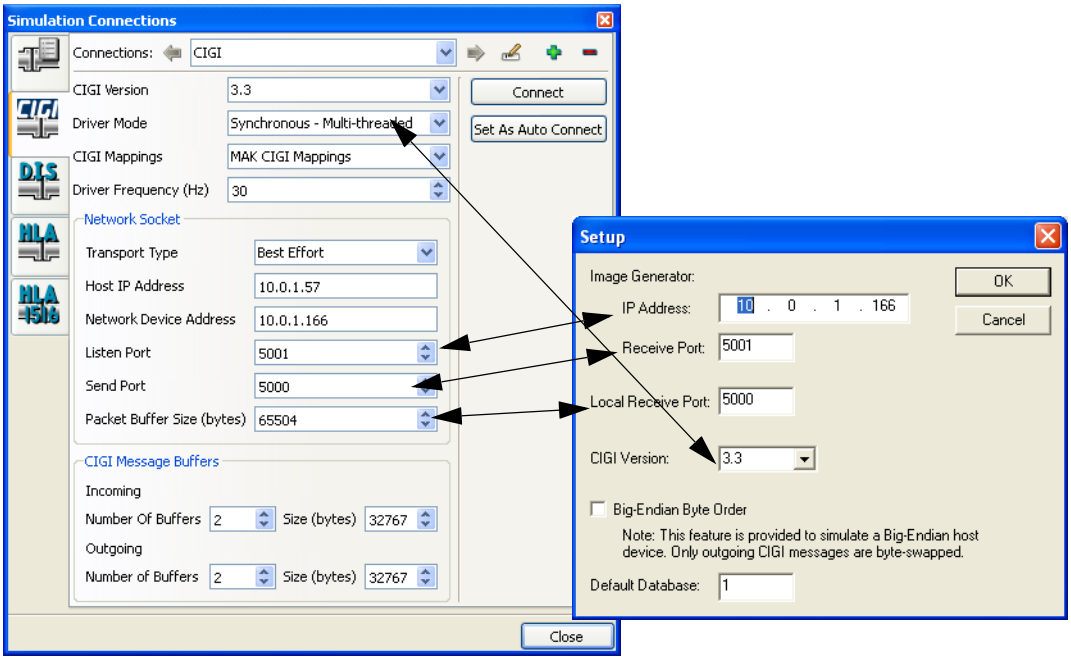


Figure D-1. Connection settings and host emulator setup

D.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 **Programs** → **VR-Vantage** 1.3 → **Tools** → **CIGI Host Emulator**. The host emulator starts up (Figure D-2). The first time you run it, the Setup dialog box opens automatically (Figure D-3). (Thereafter, to change the setup, in the host emulator, choose **File** → **Setup**.

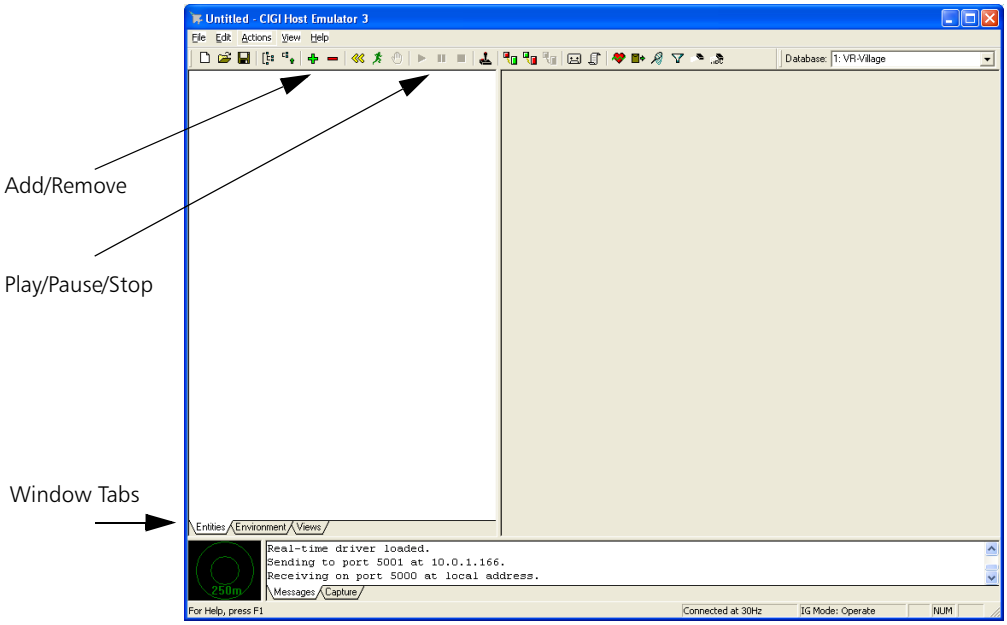


Figure D-2. CIGI host emulator

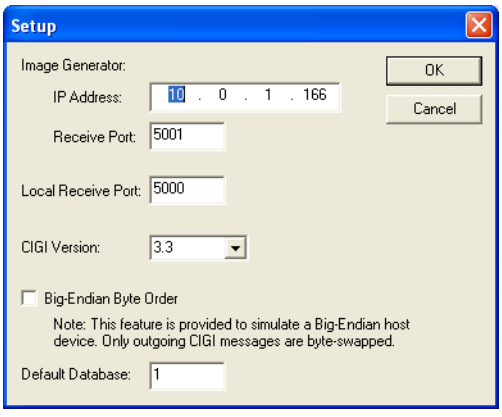


Figure D-3. Setup dialog box

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.

D.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 D-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.

D.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 D-2). The window is empty because there are no entities.
2. On the toolbar (Figure D-2), click the Add icon (✚). The New Entity dialog box opens (Figure D-4).

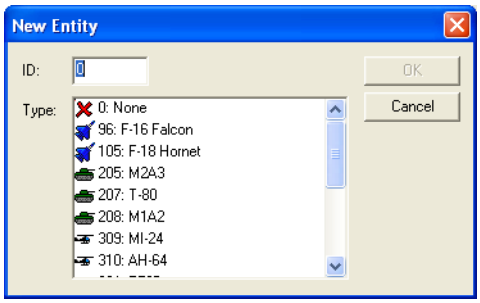


Figure D-4. New Entity dialog box

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 D-5).

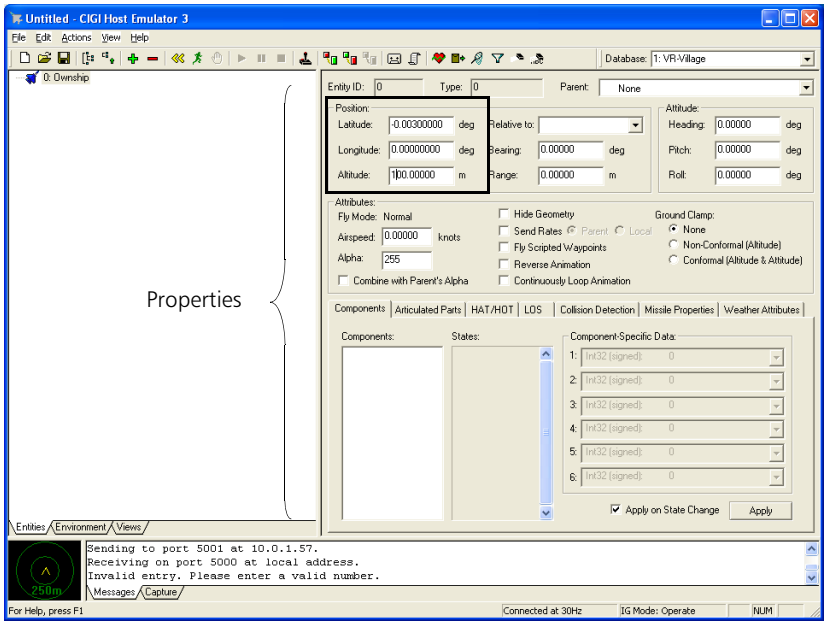


Figure D-5. Entity properties for ownship entity

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 D-5). The view in VR-Vantage changes.

D.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 D-2).
2. On the toolbar (Figure D-2), click the Add icon (+). The New Entity dialog box opens (Figure D-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.

D.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 D-6).

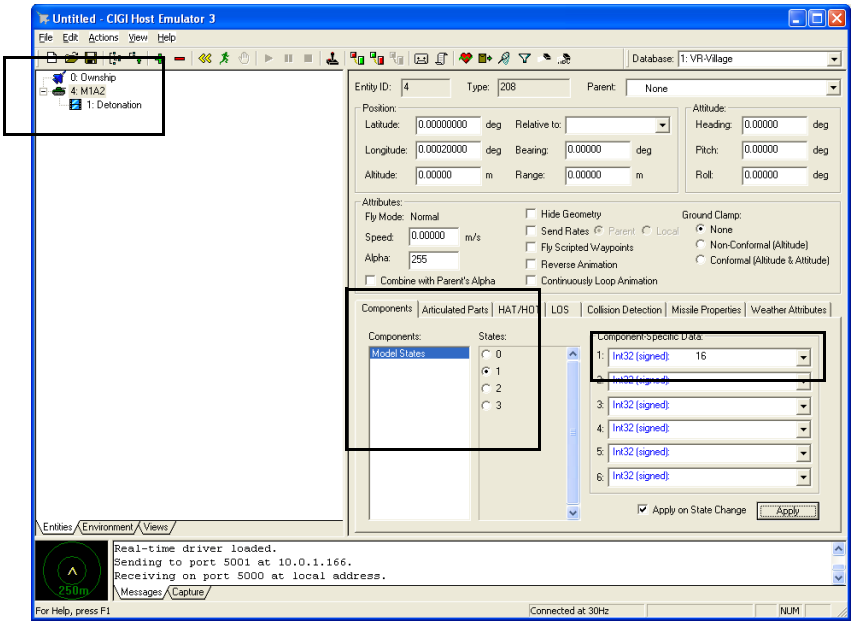


Figure D-6. Entity attributes

5. In the properties panel, select the Components tab (Figure D-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 D-7).



Figure D-7. Brake lights

D.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 D-2).
2. On the toolbar (Figure D-2), click the Add icon (+). The New Entity dialog box opens (Figure D-4).
3. Select Detonation.
4. Click OK. The effect is added to the entity list.
5. On the properties panel, in the Parent drop-down list, select M1A2. In the entity list, the Detonation is now subordinate to the M1A2 entity (Figure D-6).

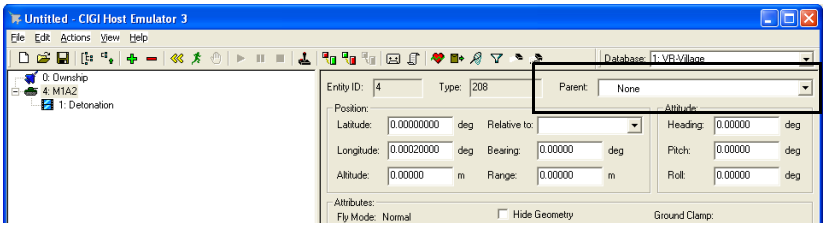


Figure D-8. Entity attributes

6. To display the detonation, click the Play button (Figure D-2).

D.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 D-9).

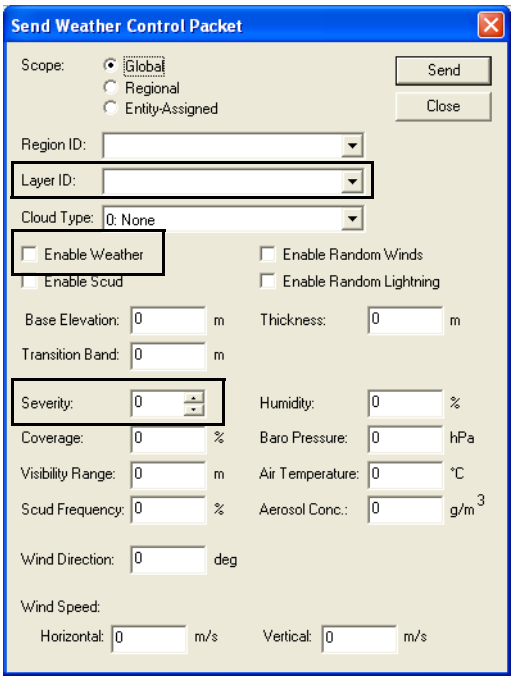


Figure D-9. Send Weather Control Packet dialog box

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.



Creating and Editing Key Mappings

This appendix explains how to edit key mappings and create new key mappings.

Introduction E-2
The Key Mapping Editor E-2
Binary Key Mappings E-3
Editing a Key Map E-3
Adding a Key Mapping E-4
Changing a Key Mapping E-5
Deleting a Key Mapping E-6
Using Combined Key Mappings E-6
Filtering the Function List E-7
Creating a Key Map E-7
Deleting a Key Map E-7

E.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.

To see a list of all keyboard and mouse button mappings, please see "VR-Vantage Quick Reference Card".

E.2. The Key Mapping Editor

The Key Mapping Editor (Figure E-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.

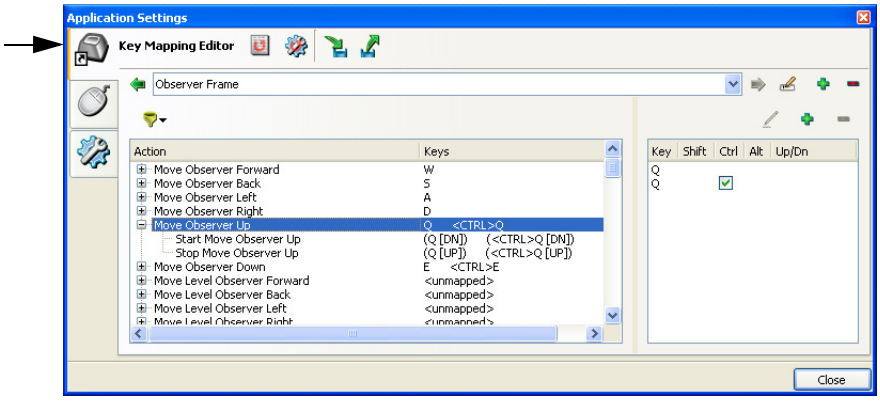


Figure E-1. Key Mapping Editor

E.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 entity.) 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 E-1.

E.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 E-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 E-4
   - "Changing a Key Mapping," on page E-5
   - "Deleting a Key Mapping," on page E-6.
5. Optionally, export the key map to a file.
6. Click OK.

E.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 E-7.
2. Select the function to which you want to add a key mapping.
3. Click the Add icon (✚) above the Key Map window (Figure E-2). The Key Entry dialog box opens (Figure E-3).

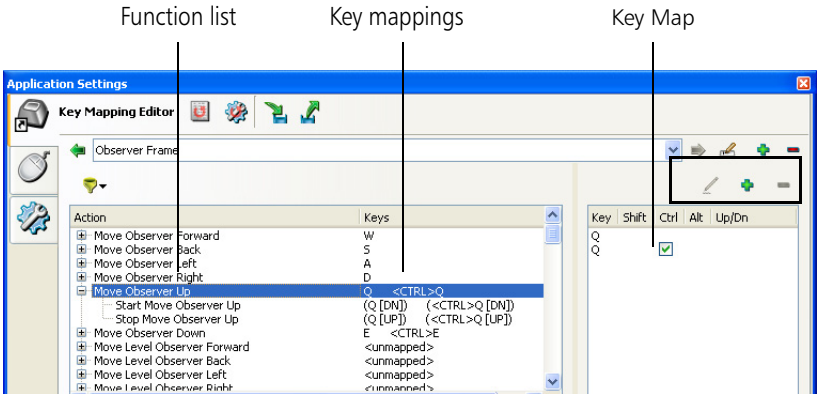


Figure E-2. Key Mapping Editor

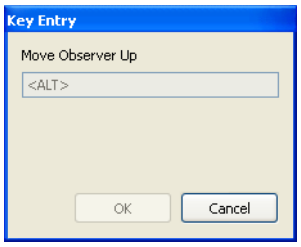


Figure E-3. Key Entry dialog box

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 E-6.) The mapping is added to the function and is listed in the Keys column of the function list and in the Key Map window.

E.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 E-2).
2. In the Key Map window, select the key mapping that you want to change.
3. Click the Edit Key Mapping icon ( ). The Key Entry dialog box opens (Figure E-4). It shows the current key mapping.

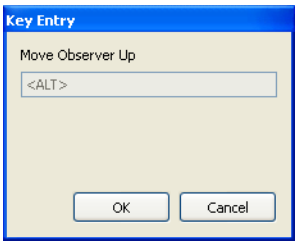


Figure E-4. Key Entry dialog box

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.

E.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 E-2).
2. In the Key Map window, select the key mapping that you want to delete.
3. Click the Delete icon (−) above the Key Map window. The mapping is deleted. The function list is updated.

E.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 entity. The **`Space Bar`** resets the observer view to the default view. Suppose that whenever you detach from an entity, 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 entity 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 E-5). It lists the functions that already use this key mapping.

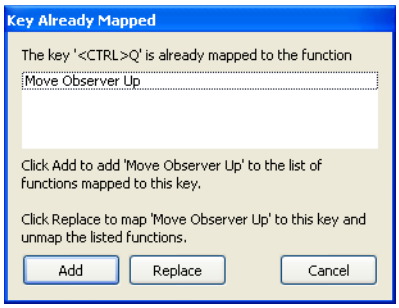


Figure E-5. Key Already Mapped dialog box

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.

E.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 icon ( ) and select an option on the list.

E.6. Creating a Key Map

To create a key map:

1. Choose **Settings** → **Application**.The Application Settings dialog box opens.
2. Select the Keyboard Mappings page (Figure E-1).
3. Click the Add icon ( ). 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 E-4.

E.7. Deleting a Key Map

To delete a key map

1. Choose **Settings** → **Application**.The Application Settings dialog box opens.
2. Select the Keyboard Mappings page (Figure E-1).
3. In the key mapping list, select the key mapping that you want to delete.
4. Click the Delete icon ( ).
5. Confirm that you want to delete the selected key map.



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 appendix describes some features that might not be immediately obvious.

Dockable Panels and Toolbars F-2
- Docking and Undocking a Panel F-2
- Docking and Undocking a Toolbar F-3
- Displaying and Hiding Panels and Toolbars F-3
- Restoring the Layout of Toolbars and Panels F-4

Viewing the Window in Full Screen Mode F-4

Using Context-Sensitive Menus F-5

Common VR-Vantage Icons F-5

File Extensions F-6

F.1. Dockable Panels and Toolbars

VR-Vantage has floating, dockable panels for many of its important functions (Figure F-1). It also has toolbars that let you quickly access the commands available on the menus.

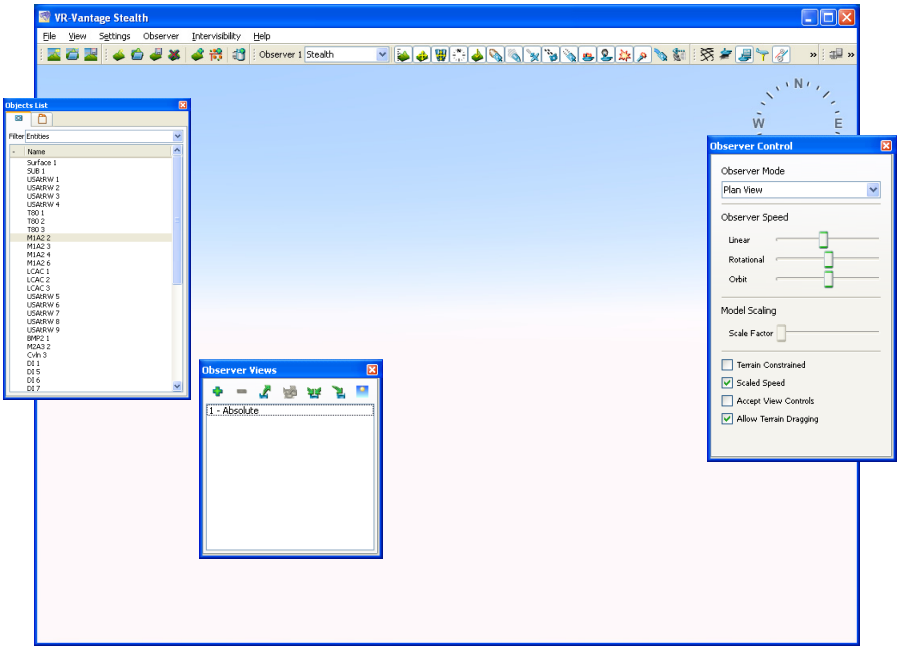


Figure F-1. VR-Vantage window and undocked panels

F.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.

F.1.2. Docking and Undocking a Toolbar

To undock a toolbar:

1. Place the cursor over the handle.



Figure F-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 .

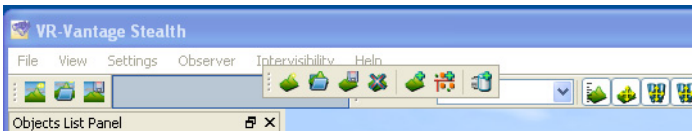


Figure F-3. Docking a toolbar

F.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.

F.1.4. Restoring the Layout of Toolbars and Panels

VR-Vantage saves the layout of toolbars and panels when you shut down. 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 F-4).

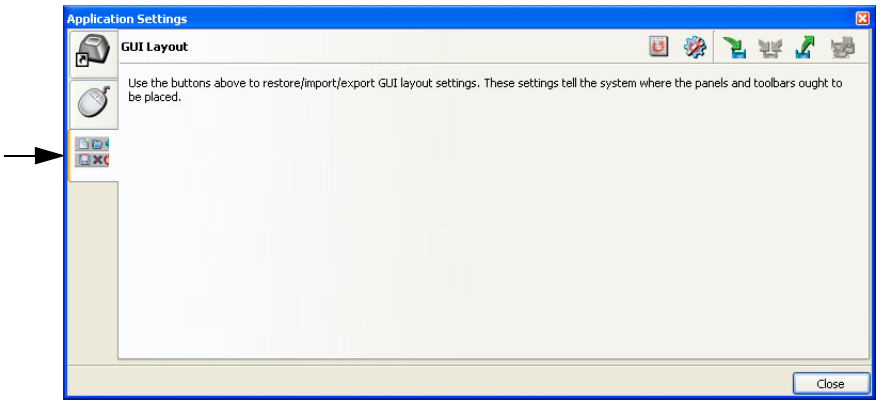


Figure F-4. GUI Layout page

3. Click the settings icon for the operation you want to perform. (For a summary of common settings icons, please see "Managing VR-Vantage Settings," on page 3-11.)

F.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 entities 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.

➤ 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`**.

F.3. Using Context-Sensitive Menus

VR-Vantage has context sensitive menus that you can display by clicking the right mouse button.

If you right-click an entity, 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.

F.4. Common VR-Vantage Icons

VR-Vantage dialog boxes have a common set of icons (Figure F-5). The callouts in (Figure F-5) correspond to the numbers in the list of icon descriptions.



Figure F-5. Common icons

- Add an item (definition, model, and so on) (1)
- Remove the selected item (2)
- Copy the selected item and add the copied version to the list (3)
- Select a filter of some type (4)
- Rename the selected item (5)
- Add from a list (6)
- Move up in the list (7)
- Move down in the list (8)
- Move upward in the hierarchy (to the parent level) (9)
- Move downward in the hierarchy (become a child) (10)
- Copy the selected object to the clipboard (11)
- Paste an object that has been copied to the clipboard (12)
- Add attribute (13)
- Remove local attribute definition and use the parent's definition (14)
- Search (15).

F.5. File Extensions

Table F-1 lists the file extensions for VR-Vantage file types:

Table F-1: VR-Vantage file extensions

File type	Extension
Terrain	mtf
Scene	msf
View	osrx
Display configuration	dcx
Schema	smtx
Model definition	ommx
Entity definition Aggregate definition Tactical graphics definition Interaction definition	elem
Cockpit mapping	mhtx
Entity 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
Aggregate 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

Table F-1: VR-Vantage file extensions

File type	Extension
Loader settings	mlsx
Speedtree settings	forx



Managing Network Connections

This appendix provides details about how to configure network connections.

Managing Simulation Connections G-2
- Displaying Connections G-3
- Adding a Simulation Connection G-4
- Renaming a Simulation Connection G-5
- Deleting a Simulation Connection G-5

Configuring Connection Settings G-6
- HLA Connection Settings G-7
- DIS Connection Settings G-8
- CIGI Connection Settings G-9

G.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.

G.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 G-1).

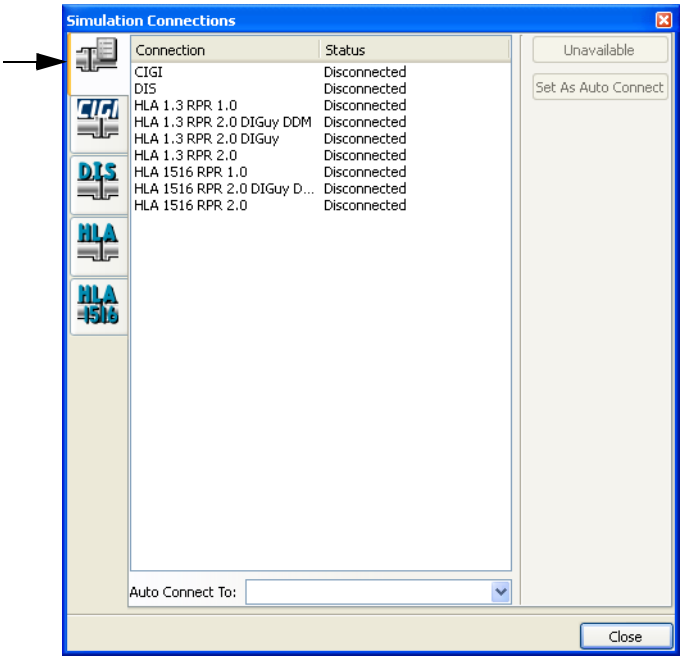


Figure G-1. Simulation Connections dialog box, Connection Status page

G.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 3-3).
2. Select the page for the connection type you want to add (Figure G-2).

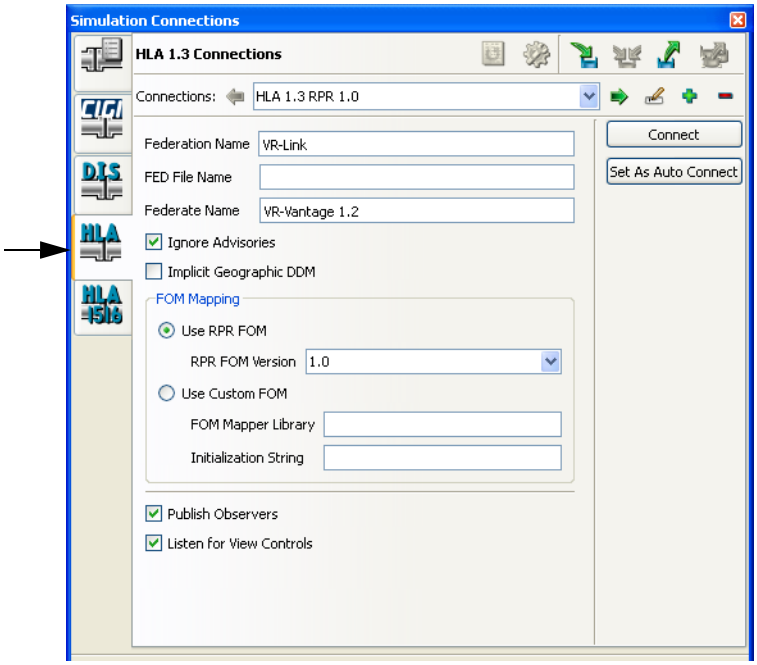


Figure G-2. Protocol-specific page

3. Click the Add icon (✚) to the right of the Connections drop-down 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 G-5.)
4. Set the connection parameters to the desired values. (For details about connection parameters, please see "Configuring Connection Settings," on page G-6.)
5. Optionally, click Set As Auto Connect to have VR-Vantage automatically connect using this connection when it starts up.
6. Click Close.

G.1.3. Renaming a Simulation Connection

To rename a simulation connection:

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

G.1.4. Deleting a Simulation Connection

To delete a simulation connection:

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

G.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. They each have default connections configured for RPR FOM 1.0 and RPR FOM 2.0 draft 17.



The RPR FOM 2.0 DI-Guy connection has extensions to the FOM that provide support for changing DI-Guy characters based on messages sent from VR-Forces, MÄK's computer generated forces application. Generic support for DI-Guy is provided by all connections.

To configure connection settings:

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

G.2.1. HLA Connection Settings

Table G-1 describes the connection settings for HLA 1.3 and HLA 1516.

Table G-1: HLA connection settings

Parameter	Description
Federation Name	Specifies the federation execution name.
Federate Name	Specifies the federate name.
FED File Name	Specifies the FED file. Default: the federation name with *.fed* appended.
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, or 2.0017. 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.
Implicit Geographic DDM	Enables or disables use of implicit DDM. Valid only with the MÄK RTI.
Use Advisories	Enables or disables use of HLA advisory messages.
FOM Mapper	Select to specify that you are using a FOM Mapper.
FOM Mapper Library	Specifies the name of a FOM Mapper library.
FOM Mapper 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.
Publish Observers	Specifies whether or not to publish an entity for the observer that is using this connection.
Listen for View Controls	Specifies whether or not to respond to view control messages sent by other applications.

G.2.2. DIS Connection Settings

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

Table G-2: DIS connection settings

Parameter	Description
Port	The DIS port to connect to.
Exercise ID	Specifies the exercise ID for VR-Vantage.
Application Number	VR-Vantage can send PDUs to the network to communicate its 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.
Site ID	Specifies the site ID for VR-Vantage.
Use Asynchronous IO	Enables or disables asynchronous IO. Use of asynchronous IO can reduce dropped packets.
Destination Address	Specifies the destination address for outgoing PDUs. Default: the computer's broadcast address.
Device Address	On computers with multiple network cards, the address of the network card to use.
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.
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.
DIS Version	Specifies the DIS version (4, 5, or 6).
Publish Observers	Specifies whether or not to publish an entity for the observer that is using this connection.
Listen for View Controls	Specifies whether or not to respond to view control messages sent by other applications.



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.

G.2.3. CIGI Connection Settings

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

Table G-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 18, *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.



CIGI Packets Supported

This appendix lists the various CIGI packets and the fields that VR-Vantage supports.

CIGI Packet Support H-2

H.1. CIGI Packet Support

The tables in this section describe VR-Vantage support for the following CIGI packet types:

- IG Control (Table H-1)
- Entity Control (Table H-2)
- Component Control (Table H-3)
- Short Component Control (Table H-4)
- Articulated Part Control (Table H-5)
- Short Articulated Part Control (Table H-6)
- Rate Control (Table H-7)
- Celestial Sphere Control (Table H-8)
- Weather Control (Table H-9)
- View Control (Table H-10)
- View Definition (Table H-11)
- HAT/HOT Request (Table H-12)
- Line-of-sight Segment Request (Table H-13)
- Line-of-sight Vector Request (Table H-14).

Table H-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 H-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 H-3: Component control packets

Field	Supported	Unsupported
Component ID	X	
Instance ID	X	
Component Class	X	
Component State	X	
Component Data	X	

Table H-4: Short component control packets

Field	Supported	Unsupported
Component ID	X	
Instance ID	X	
Component Class	X	
Component State	X	
Component Data	X	

Table H-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 H-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 H-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 H-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 H-9: 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
Vertical Wind Speed		X
Wind Direction		X
Barometric Pressure		X
Aerosol Concentration		X

Table H-10: 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 H-11: 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 H-12: 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 H-13: 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 H-14: Line-of-sight vector request packets (Sheet 1 of 2)

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	

Table H-14: Line-of-sight vector request packets (Sheet 2 of 2)

Field	Supported	Unsupported
Material Mask		X
Update Period	X	



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 appendix 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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I.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 appendix 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 appendix 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://local.wasp.uwa.edu.au/~pbourke/dataformats/wrm/.

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.

I.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.

I.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.

I.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.

I.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.

I.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.

I.3.2. DAL Keywords

The WRM Spec supports the following keywords:

- `articulated_part` *`part`*. Identifies the moveable 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 described below.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 I-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 I-2.

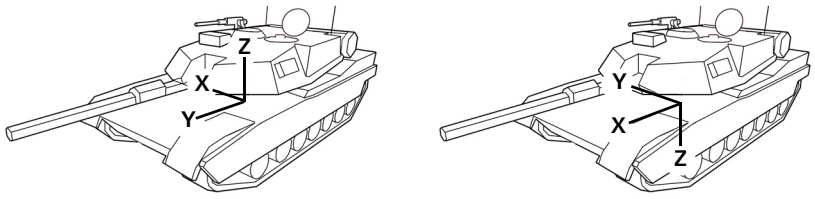
- `state` *`state`*,*`state`*... . Specifies the state of the appearance attribute with a DIS appearance state code. This keyword is placed in a Group node just below the switch node. For a list of supported values, please see Table I-2.

I.3.3. Model Coordinate Systems

OpenSceneGraph and the DIS Standard use different right-hand coordinate systems. Table I-1 describes the two systems. Figure I-1 illustrates them.

Table I-1: Model coordinate systems

Coordinate	OpenSceneGraph	DIS
X	Right	Forward
Y	Forward	Right
Z	Up	Down



Model coordinate system DIS coordinate system

Figure I-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.

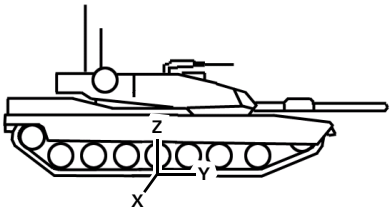
Location of the Origin for Models

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.

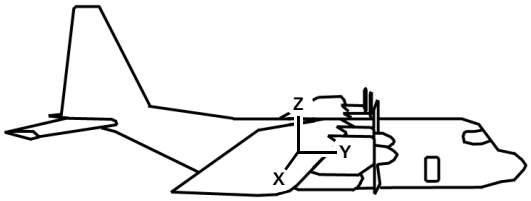
Figure I-2 illustrates the location of a model's origin for each platform domain.

Land



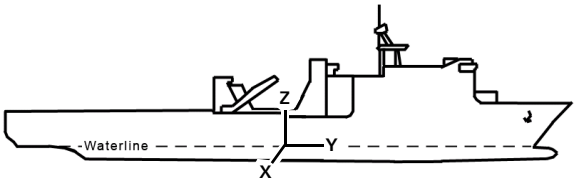
On the plane of ground contact, at the axis of yaw rotation.

Air



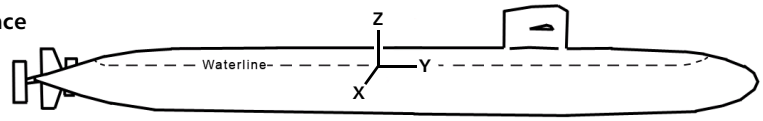
At the center of gravity.

Surface



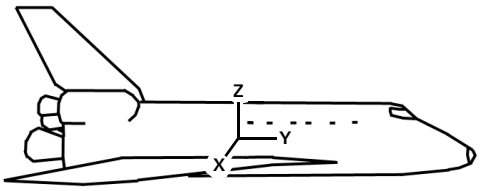
On the axis of the center of buoyancy, in the plane of the waterline for an unloaded ship.

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 I-2. Location of origin by domain

I.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.

I.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.) "Entity Appearances," on page I-8, lists the attributes you can use with VR-Vantage.

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 I-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.

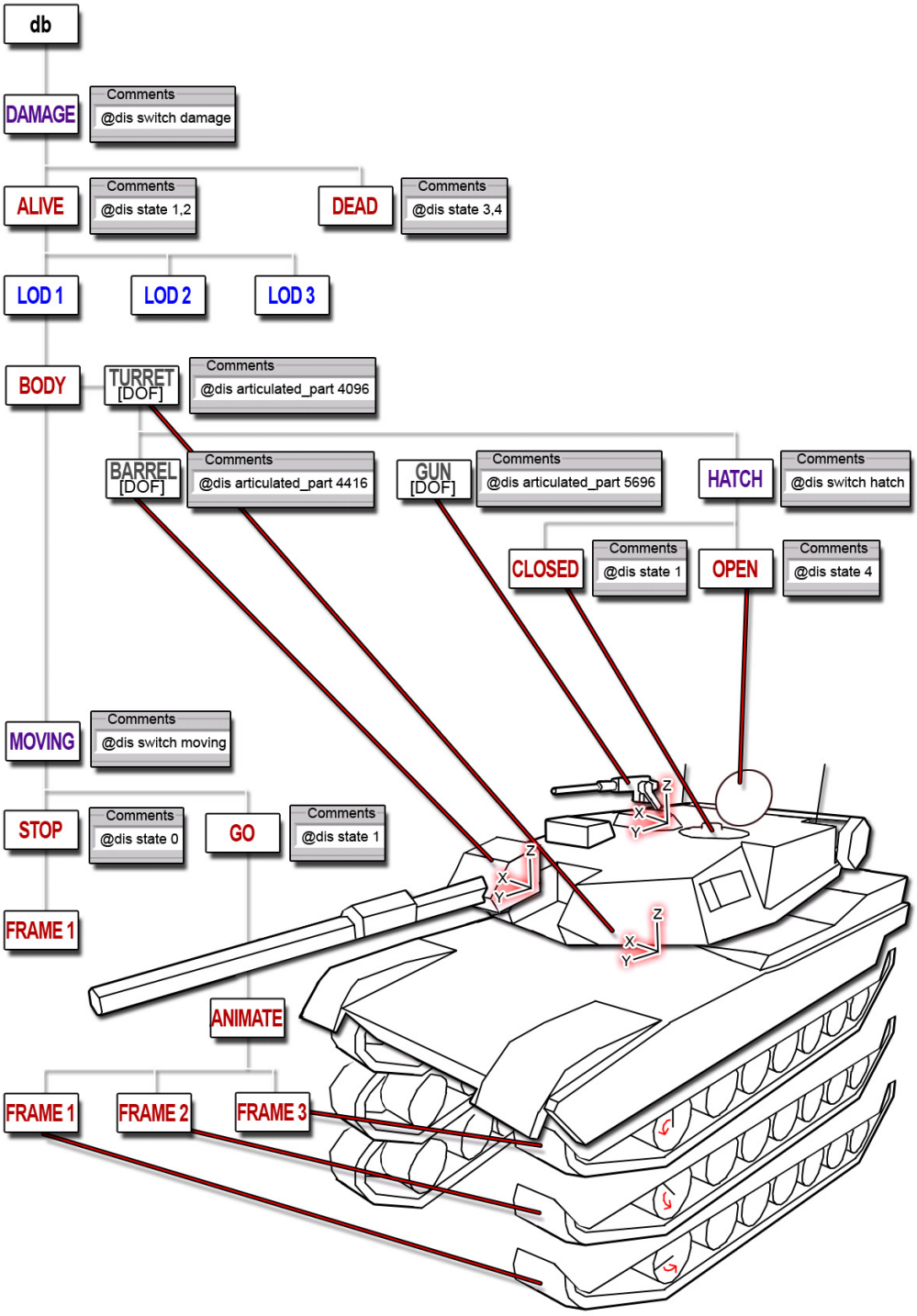


Figure I-3. 3D model structure

I.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.

I.7. DIS Keyword Values

Table I-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.

Table I-2: DIS Appearance and States (Sheet 1 of 5)

Values	Description	State/Description
afterburner	Status of an air platform's afterburner.	0 = Off 1 = On
anticollision lights	Status of anti-collision lights.	0 = Off 1 = On
blackout brake lights	Status of blackout brake lights.	0 = Off 1 = On
blackout lights	Status of blackout lights.	0 = Off 1 = On
brake lights	Status of brake lights.	0 = Off 1 = On
camouflage_type	Type of camouflage.	0 = Desert 1 = Winter 2 = Forest 3 = Unused

Table I-2: DIS Appearance and States (Sheet 2 of 5)

Values	Description	State/Description
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
concealed	Type of concealment.	0 = Not Concealed 1 = In Concealed Position
damage	Damaged appearance of an entity.	0 = None 1 = Slight 2 = Moderate 3 = Destroyed
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
flaming	Status of flames are rising from an entity.	0 = No 1 = Yes
flashlight	State of lights.	0 = Off 1 = On
formation lights	Describes whether formation lights are on or off.	0 = Off 1 = On
frozen_status	Frozen status of an entity.	0 = Not Frozen 1 = Frozen

Table I-2: DIS Appearance and States (Sheet 3 of 5)

Values	Description	State/Description
hatch	Status of the primary hatch.	0 = Not Applicable 1 = Closed 2 = Popped 3 = Popped and Person 4 = Open 5 = Open and Person 6 = Custom1 7 = Custom2
head lights	Status of headlights.	0 = No 1 = Yes
health	State of injury.	0 = None 1 = Slight 2 = Moderate 3 = Fatal
interior_lights	Status of interior lights.	0 = Off 1 = On
landing lights	Status of landing lights.	0 = Off 1 = On
launch_flash	Describes the presence of a guided munitions launch flash.	0 = No 1 = Yes
launcher	Status of the platform's primary launcher.	0 = Not Raised 1 = Raised
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

Table I-2: DIS Appearance and States (Sheet 4 of 5)

Values	Description	State/Description
lights	State of lights.	0 = Off 1 = On
mobility	Characteristics of mobility kill.	0 = No 1 = Yes
navigation lights	Status of navigation lights.	0 = Off 1 = On
paint_scheme	Paint scheme of an entity.	0 = Uniform 1 = Camouflage
power_plant_status	Status of the entity's power-plant.	0 = Off 1 = On
ramp	Status of a ramp.	0 = Down 1 = Up
running lights	State of running lights.	0 = Off 1 = On
smoke	Status or location of smoke and vapor emanating.	0 = None 1 = Plume 2 = Engine 3 = Engine and Plume
spot lights	Describes whether spotlights are on or off.	0 = Off 1 = On
state	Status of an entity.	0 = Active 1 = Deactivated
tail lights	Status of tail lights.	0 = Off 1 = On
tent	Status of a tent extension.	0 = Not Extended 1 = Extended
trailing_effects	Size of the trailing effect for the entity.	0 = None 1 = Small 2 = Medium 3 = Large

Table I-2: DIS Appearance and States (Sheet 5 of 5)

Values	Description	State/Description
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 I-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 I-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
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

Table I-3: DIS Articulations (Sheet 2 of 5)

Value	String	Description
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
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

Table I-3: DIS Articulations (Sheet 3 of 5)

Value	String	Description
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
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

Table I-3: DIS Articulations (Sheet 4 of 5)

Value	String	Description
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
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

Table I-3: DIS Articulations (Sheet 5 of 5)

Value	String	Description
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



Processing MetaFlight Files

To display MetaFlight files in VR-Vantage applications, you must first process them. This appendix explains how to do so.

Processing MetaFlight Files for Use in VR-Vantage J-2
Splitting Datasets into Individual MetaFlight files J-2
Convert Virtual Texture Datasets to Tiled Textures J-2
The mftTool J-3
Using the mftTool to Process MetaFlight Files J-4
Convert Geometry Grid Datasets with Tiled Textures J-5
Convert All Other Source Data into MEDF format J-5
Create an MTF File for the MetaFlight Terrain J-6

J.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 appendix. If you try to load an unprocessed MetaFlight file, VR-Vantage displays an error message. When running our processing tools, a MetaFlight database which does not conform will cause an error message to be sent to the console window.

To process a MetaFlight file, you must:

1. Split each dataset into its own MetaFlight file.
2. Convert geometry from using virtual texture datasets into using tiled textures. (If the terrain does not use virtual textures, you can skip this step.)
3. Convert all other source data into MEDF and MEIF format.
4. Use the VR-Vantage terrain composition process to combine the MetaFLight terrain files and save them in MTF format.

J.2. Splitting Datasets into Individual MetaFlight files

Our 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 will identify which 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).

J.3. Convert Virtual Texture Datasets to Tiled Textures

The VR-Vantage display engine does not handle virtual textures at runtime. Therefore you must convert the virtual texture datasets into tiled textures. This is done with the mftTool. It creates the highest resolution textures possible from the virtual texture dataset and binds them to individual tiles.

J.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. Table J-1 describes the command-line options. 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 -- -v -h]
```

Table J-1 describes the command-line options.

Table J-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 will be generated in the MEIF file format. If not specified the file format will be DDS.
(-f |--file) *filename*	The name of the MetaFlight file which contains the GGDS
(-g | --generateFiles)	Generate tiled textures from the Virtual Texture and generate tiles in MEDF format from the FLT tiles which use the new textures. Also a MFT file will be 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. The above example would create a new MetaFlight file named *yourTerrain_medf.mft* in the same directory as *yourTerrain.mft*.* If the generated tiled texture already exists the file will not be regenerated.
(-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 will result in the number of threads equaling the number of logical processors the host machine has.

Table J-1: MftTool command-line options

Option	Description
(-r | --searchDir) *directory*	Adds a directory to the search path when resolving external references. During processing any external references not found will be 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 which contains the VTDS. The arguments -s and -t are mutually exclusive.
(-u | --publishMftOnly)	Publish a new MetaFlight file which 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. The above example would create a new MetaFlight file named *yourTerrain_medf.mft* in the same directory as *yourTerrain.mft*.* The -u and the -g arguments are mutually exclusive.
(-v | --version)	Display version information and exit.
(-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 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.

J.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 Flight 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.

J.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 16-8.

To only publish a new MetaFlight for the cultural dataset, do the following:

```
mftTool C:\yourTer-
   rain\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 medf-Tool, as follows:

```
medfTool -s C:\yourTerrain\flt\textures -s C:\yourTer-
   rain\flt\objects --directory C:\yourTer-
   rain\flt\ds7_culture_db5_building_area_new-hier_cult -x
   flt -t -m rgb -m rgba -m jpg -m bmp -p 0 -z 1
```

The medfTool is described in "Compressing Model Files," on page 16-8.

The medfTool should never be run on a directory which contains GGDS tiles which use Virtual Textures.

J.4. Convert All Other Source Data into MEDF format

Many file formats, including OpenFlight files, are often slow to load so it is best to convert them to our fast loading MEDF (MAK Encrypted Data Format) format. This should be done on terrains without virtual textures (it is done automatically when creating GGDSs from virtual texture datasets) and on cultural feature datasets. This should be done on all data files being loaded, but is required by all external references used by MetaFlight terrains.

To convert external references in separate directories:

```
medfTool -s C:\yourTerrain\flt\textures -directory
   C:\yourTerrain\flt\objects -x flt -t -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 -t -m rgb
   -m rgba -m jpg -m bmp -p 0 -z 1
```

J.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.

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.

Any missing models or white objects usually indicate missing external references. Fixing any missing search paths passed to the tools should resolve most problems.



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.

AMO

See Application Management Object.

Application Management Object

An Application Management Object (AMO) is a standard TENA object that is supposed to be used by every TENA application. It gives other applications information about the local application. The VR-Link exercise connection, by default, publishes an AMO object, updates it at a specified rate (the rate is part of the AMO's state repository; the default is 30 seconds), and updates the number of objects published and proxies (TENA reflected objects) held.

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.

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.

execution

The TENA term for one or more interacting simulation applications.

Execution Manager

An Execution Manager governs a TENA execution for applications joining, resigning, or changing subscriptions to that execution.

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

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

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.

Logical Range Object Model

The data definition file for TENA exercises. It contains the set of object and message definitions that may be used in the exercise.

LRC

See Local RTI Component.

LROM

See Logical Range Object Model.

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.

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.

Network Naming Service

Acts as a registry for TENA Execution Managers.

NNS

See Network Naming Service.

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.

proxy

In TENA, a reflected object (Stateful Distributed Object).

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.

range resource

A participant in a TENA execution (similar in concept to the HLA federate).

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.

SDO

See Stateful Distributed Object.

servant

A published object (SDO) in TENA.

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.

Stateful Distributed Object

An object in a TENA exercise.

tape

An alternative term for a Logger recording. Not a physical magnetic tape.

TENA

See Test and Training Enabling Architecture.

TENA Middleware

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.

Test and Training Enabling Architecture

Test and Training Enabling Architecture (TENA) is an interoperability architecture used to pass data in the form of object updates and messages (like HLA objects and interactions) from one application to another.

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 VR-Vantage remotely.

view floor

In MÄK Stealth 6.x and earlier, a minimum height above the terrain in Absolute or Track mode, below which the observer is not allowed to go. The view floor is measured relative to the terrain surface.



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VR-Vantage Quick Reference Card

VR-Vantage Command Line Options

Option	Description
(-- | --ignore_rest)	Ignore all command-line options after this one.
--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 | --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).
--dispSetting *filename*	Specifies the display engine configuration to load.
--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.
--fullScreen	Start in full screen mode.
(-G | --locale) *language*	Specifies the locale (for localization).
(-h | --help)	Displays command-line usage information.
(-l | --logFileName) *filename*	Specifies the log file name.
(-L | --loadObservers *filename1 filenamen*	Loads the saved observers in the specified files.
(-n | --notifyLevel) *notify_level*	Specifies the notification level for application messages. Range: 0-4.
--noGui	Start without the graphical user interface.
--plugin *filename*	Load the specified plug-in. Can be used multiple times.
--showConsole	Display a console window.
(*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.
--vsync	Start with vsynched windows.
-W | --withDisplayEngine *port@netAddress;displayConfigFile name1 .... n*	Connect to a display engine running in subordinate mode on another computer.

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VR-Vantage 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 heading and pitch.	Right Drag	
Drag terrain.	Left-click + drag	Terrain or prop
Object remains selected, deselect all others.	Left-click	Selected entity or prop
Orbit drag terrain.	**Ctrl** + left-click + drag	Terrain 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
Drag the view.	Middle mouse button drag	
Mouse wheel while observer is not moving		
Scroll forward.	Mouse wheel forward	
Scroll back.	Mouse wheel back	
Mouse wheel while moving observer		
Increment linear speed.	Mouse wheel forward	
Decrement linear speed.	Mouse wheel back	
Increment linear speed.	**Ctrl** + mouse wheel backward	
Decrement linear speed.	**Ctrl** + mouse wheel forward	
Scroll level forward.	**Shift** + mouse wheel forward	
Scroll level backward.	**Shift** + mouse wheel backward	

VR-Vantage Keyboard Mappings

K = numeric keypad (K8 means press Keypad 8). To use the numeric keypad for navigation, NumLock must be on.

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**	←	←
Level yaw right.	K **6**	K **6**	→	→
Level pitch up.	**Shift**+**j**	**Shift**+**j**	**Shift**+**j**	unmapped
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**

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Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Zoom In	unmapped	unmapped	unmapped	**e**
Zoom Out	unmapped	unmapped	unmapped	**q**
Suppress constrain to terrain.	**x**	**x**	**x**	**x**
Reset observer: In absolute mode, go to the center of the scene. If attached, reset the attach position and orientation.	**Space**	**Space**	**Space**	**Space**
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
Reset the camera.	K **0**	K **0**		K **0**
Detach.	**z**	**z**	**z**	**z**
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.	**<**	**<**	**<**	**<**
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 **–**
Toggle speed scaling on or off.	K *****	K *****	K *****	K *****
Toggle constrain to terrain on or off.	**/**	**/**	**/**	**/**
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**
Toggle view controls on or off.	**Shift** + **c**	**Shift** + **c**		**Shift** + **c**
Toggle entity labels on or off.	unmapped	unmapped	unmapped	unmapped



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