MAK TECHNOLOGIES

VR-Vantage Users Guide



Version 3.0.3

ST Engineering North America

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MAK PRODUCTS GLOSSARY

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VR-VANTAGE QUICK REFERENCE CARD



Preface

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

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

How This Manual is Organized

This manual is organized thematically in the following major sections:

- "Section I. Installation, Startup, and Concepts" on page 33
  - "Chapter 1. Introduction to VR-Vantage" on page 35 describes the basic features of VR-Vantage.
  - "Chapter 2. Installing VR-Vantage and SensorFX" on page 45 explains how to install VR-Vantage and SensorFX software, the license manager, and an RTI.
  - "Chapter 3. Running VR-Vantage Applications" on page 61 explains how to start and stop VR-Vantage, load a terrain, and connect to a simulation.
  - "Chapter 4. Managing Network Connections" on page 83 explains how to configure network connections.
  - "Chapter 5. Optimizing Performance" on page 91 describes issues that may affect performance.
- "Section II. Display Engine, Video Streaming, Head Mounted Displays" on page 109
  - "Chapter 6. Windows, Channels, and Display Engines" on page 111 explains how to add windows and channels and how to configure them. It also explains how to set up multi-channel displays.
  - "Chapter 7. Display Engine Tutorials" on page 141 shows how to create display engine configurations, save them, and load them.
  - "Chapter 8. Using Streaming Video" on page 149 explains how to send the view in the VR-Vantage window to a video stream.
  - "Chapter 9. Using Head Mounted Displays for Virtual and Mixed Reality" on page 175 explains how to set up VR-Vantage to work with the Oculus Rift head mounted display.
  - "Chapter 10. Using Multiple Projectors with VR-Vantage" on page 183 explains how to set up VR-Vantage to set up two PC’s and two projectors to project a large, seamless, edge blended display of VR-Vantage.
- "Section III. Scenes and Environmental Effects" on page 191
  - "Chapter 11. Scenes and Environmental Effects" on page 193 explains how to configure the environment, including date and time, clouds, and precipitation.
  - "Chapter 12. Using Sensors" on page 217 explains how to view the terrain as if you had night vision goggles or an infrared view.
  - "Chapter 13. Lighting Effects" on page 223 describes the lighting effects in VR-Vantage and how to configure them.

- "Section IV. The Observer" on page 241
  - "Chapter 14. The Observer and Observer Modes" on page 243 explains how to create and change observer modes, how to add observers, and how to communicate information about the observer.
  - "Chapter 15. Moving the Observer" on page 255 explains how to navigate the observer through the 2D and 3D scenes.
  - "Chapter 16. Attaching the Observer to Objects" on page 287 explains attach modes and how to attach the observer to entities and props.
  - "Chapter 17. Inset Views, Sensor FOV, and HUDs" on page 307 describes several types of special secondary windows – inset views, instrument panels, and sensor fields of view. It also covers cockpit displays.
  - "Chapter 18. Exaggerating Models and Terrain" on page 315 describes features that only apply to XR observer mode.
- "Section V. Viewing Simulation Objects" on page 323
  - "Chapter 19. Viewing Simulation Objects" on page 325 explains how to select entities and how to view information about them, including entity labels, force coloring, and height-above-terrain lines.
  - "Chapter 20. Displaying Units" on page 345 explains how to manage the display of aggregate entities.
- "Section VI. Visual and Audio Effects" on page 353
  - "Chapter 21. Viewing Entity Effects" on page 355 explains how to display various types of entity-related graphics.
  - "Chapter 22. Intervisibility Objects" on page 379 explains how intervisibility objects function.
  - "Chapter 23. Sound Effects" on page 389 explains how to enable and configure sound effects.
  - "Chapter 24. Configuring Emitter Volumes" on page 395 explains how to configure the display of emitter volumes.
- "Section VII. Terrain" on page 401
  - "Chapter 25. Changing How the Terrain Displays" on page 405 explains how to learn more about the terrain by displaying grid lines and coloring by elevation.
  - "Chapter 26. Composing Terrains in VR-Vantage" on page 415 explains how compose terrains in the GUI.
  - "Chapter 27. Using MetaFlight Terrains" on page 421 explains how to process MetaFlight files so that you can open them in VR-Vantage.
- "Section VIII. Graphics" on page 425
  - "Chapter 28. Tactical Graphics and Remote Graphics" on page 427 explains how to manage tactical graphics and remote graphics.

- "Section IX. VR-Vantage Support for CIGI" on page 435
  - "Chapter 29. Mapping CIGI Models and Components" on page 437, explains how to map CIGI models and components, which are different from the mappings used for DIS and HLA.
  - "Chapter 30. CIGI Host Emulator Tutorial" on page 459 shows how to use the CIGI host emulator with VR-Vantage.
  - "Chapter 31. CIGI Utilities" on page 469 describes a set of scripts that you can use to test your CIGI connection to VR-Vantage.
  - "Chapter 32. CIGI Packets Supported" on page 475 lists CIGI packets and the extent to which they are supported by VR-Vantage.
- "Section X. SensorFX" on page 497
  - "Chapter 33. Using SensorFX" on page 499 introduces SensorFX and explains how to use it. This chapter is the user-level documentation for SensorFX.
  - "Chapter 34. Adding GenesisMC Models to SensorFX" on page 521 explains how to add the files created using GenesisMC to SensorFX. GenesisMC is the application from JRM Technologies that you use to sensorize terrain and models.
  - "Chapter 35. Setting Sensor Parameters Using the API" on page 527 explains how to use the SensorFX API to set sensor parameters.
- "Section XI. Configuring the Graphical User Interface" on page 537
  - "Chapter 36. The VR-Vantage User Interface" on page 539 describes some of the basic features of the VR-Vantage graphical user interface (GUI).
  - "Chapter 37. Creating and Editing Key Mappings" on page 549 explains how to use the Key Map Editor to create and edit key maps for keyboard navigation.
- "Section XII. Appendixes" on page 557
  - "Appendix A. Troubleshooting" on page 559 covers common problems and how to address them.
  - "Appendix B. Articulated Part IDs for DI-Guys" on page 561 lists articulated part numbers for controlling DI-Guy movement.

"MAK Products Glossary" on page 563 defines DIS and HLA terms and terms specific to VR-Vantage and other MAK products.

The "VR-Vantage Quick Reference Card" on page 607 at the end of the manual, lists command-line options, key mappings, and mouse button mappings.

Documentation Set

VR-Vantage documentation is provided as manuals in PDF format, online help, and HTML class documentation. Electronic versions of the documentation are in vrvantagex.x/doc. On Windows, you can access the documentation from the VR-

Vantage folder on the Start menu. You can also find the most current documentation for each product's release at https://www.mak.com/mak-one/support/help/specs. The VR-Vantage documentation set is as follows:

- *VR-Vantage Users Guide* describes how to use the VR-Vantage applications.
- *VR-Vantage Migration Guide* collates the most substantial migration details for recent releases.
- *Adding Content to MAK ONE Applications Reference Manual* explains how to add visual models and terrain to VR-Vantage.
- First Experience Guides. First Experience Guides provide a brief guided tour of the most important features of each application. They are primarily for new users and people evaluating VR-Vantage.
- Online help. The online help, accessible from the Help menu, replicates most of the information in the *VR-Vantage Users Guide* and *Adding Content to MAK ONE Applications Reference Manual*.
- *VR-Vantage Developers Guide*. The developers guide provides a high level introduction to the APIs, and class documentation, which is generated from the header files. You can open the developers guide and class documentation from the Windows Start menu on the VR-Vantage Documentation submenu or by opening *./doc/classdoc/index.html*.
- *VR-Vantage Release Notes* lists system requirements, release-specific requirements, new features and updates, bug fixes, and known problems.

Try the Online Help

MAK's online help is the best way to use our documentation. It's easy to navigate, with improved natural language search tools that include filters to reduce long lists of search results. You can click the illustrations to see high-resolution enlargements that show more detail. And it's built into the product — just press **F1** to launch the help in your browser. You do not need to be connected to the internet to use it.

Links Between PDFs

Many MAK PDF documents link to each other. For example, the description of a new feature in the release notes might include links to detailed information in a user guide, and there are also many links from user guides to the *Adding Content to MAK ONE Applications Reference Manual* and back. These links between PDFs rely on two things:

- The linked PDF files must be in the same directory. MAK installers put the PDFs for each product in that product's *doc* directory — in Windows, *./vrvantage/doc*. If you move or copy a PDF away from that directory or download a new one to another location, any links between that PDF and the others stop working.
- You must use Acrobat Reader to read MAK PDFs. Links between PDFs do not work when you read with a web browser. Acrobat Reader is free; you can get it from Adobe at https://get.adobe.com/reader.

MAK Products

The MAK Technologies 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.

- MAK RTI. An RTI (Run-Time Infrastructure) is required to run applications using the High Level Architecture (HLA). The MAK 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 2D and 3D views of a simulated environment.

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

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

- VR-Vantage™. VR-Vantage is a line of products designed to meet your simulation visualization needs. It includes VR-Vantage and the VR-Vantage Toolkit.

  - VR-Vantage displays a realistic, 3D view of your virtual world, a 2D plan view, and an exaggerated reality (XR) view. Together these views provide both situational awareness and the big picture of the simulated world. You can move your viewpoint to any location in the 3D world and can attach it to simulation objects so that it moves as they do.

  - SensorFX. SensorFX is an enhanced version of VR-Vantage that uses physics based sensors to view terrain and simulation object models that have been materially classified. It is built in partnership with JRM Technologies.

  - The VR-Vantage Toolkit is a 3D visual application development toolkit. Use it to customize or extend MAK'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.

- MAK Data Logger. The Data Logger, also called the Logger, can record HLA and DIS exercises and play them back for after-action review. You can play a recorded file at speeds above or below normal and can quickly jump to areas of interest. The Logger has a GUI and a text interface. The Logger API allows you to extend the Logger using plug-in modules or embed the Logger into your own application. The Logger editing features let you merge, trim, and offset Logger recordings.
- VR-Exchange™. VR-Exchange allows simulations that use incompatible communications protocols to interoperate. For example, within the HLA world, using VR-Exchange, federations using the HLA RPR FOM 1.0 can interoperate with simulations using RPR FOM 2.0, or federations using different RTIs can interoperate. VR-Exchange supports HLA, TENA, and DIS translation.
- VR-TheWorld™ Server. VR-TheWorld Server is a simple, yet powerful, web-based streaming terrain server, developed in conjunction with Pelican Mapping. Delivered with a global base map, you can also easily populate it with your own custom source data through a web-based interface. The server can be deployed on private, classified networks to provide streaming terrain data to a variety of simulation and visualization applications behind your firewall.
- DI-Guy™. DI-Guy is an SDK that allows you to embed the DI-Guy library in your real-time application and populate your world with lifelike human characters. DI-Guy provides high-fidelity human characters that move realistically, respond to simple high-level commands, and travel throughout the environment as directed by the hosting visual application. It comes with thousands of ready-to-use characters, appearances, and motions. DI-Guy character simulation is an integral part of all MAK's visual applications, including VR-Engage, VR-Forces, and VR-Vantage.
- RadarFX. RadarFX is a client-server application that simulates synthetic-aperture radar (SAR). The server application, which is based on VR-Vantage and SensorFX, loads a terrain database and, optionally, connects to simulations. A client application requests SAR images from the server. RadarFX includes a sample client application.
- VR-Engage. VR-Engage is a multi-role virtual simulator that lets users play the role of a first person human character, a ground vehicle driver, gunner or commander, a sensor operator, or the pilot of a fixed wing aircraft or helicopter. It incorporates the VR-Force simulation engine and the VR-Vantage graphics rendering capabilities.
- WebLVC Server. WebLVC Server implements the server side of the WebLVC protocol so that web-based simulation federates can participate in a distributed simulation. It is part of the WebLVC Suite, which includes the server and several sample applications that work with VR-Forces and VR-Vantage.

- MAK Legion. MAK Legion is a collection of applications and an SDK designed to support simulations with millions of simulation objects.

How to Contact Us

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

Telephone

Call or fax us at:	Voice:	617-876-8085
	Fax:	617-876-9208

E-mail

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

Internet

MAK website home page:	www.mak.com
License key requests:	www.mak.com/support/get-licenses
Technical support:	www.mak.com/mak-one/support/portal
Product version and platform information:	www.mak.com/support/product-versions
For the free, unlicensed MAK RTI:	www.mak.com/support/bonus-material

Post

Send postal correspondence to:	MAK Technologies 10 Fawcett Street, Suite 204 Cambridge, MA 02138 USA

When requesting support, tell us the product you are using, the version, and the platform on which you are running. If you are using VR-Vantage, VR-Forces, VR-Engage, or DI-Guy, please also include your data compatibility version and date.

Document Conventions

This manual uses the following typographic conventions:

Sans Serif Bold	Indicates a key on the keyboard or menu options. Also indicates parameters.
`Monospaced`	Indicates values you enter such as commands or arguments.
`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 MAK products run on both Linux and Windows PC platforms, we use the / (slash) for generic discussions of pathnames.
Italic	Indicates a file name, pathname, or a class name.
➤	Indicates a 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 *./vrvantage3.0.3/doc* appears in the text as *./doc*.

For anything in the data directory, the path is shown starting with *./SharedData/16/latest* to be clear that it is not in the VR-Vantage home directory. That is the default installation path. If you installed the data in a different directory, substitute your path.

Mouse Button Naming Conventions

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

Third-Party Licenses

MAK software products may use code from third parties. This section contains summary license information and, where required, specific license documentation required by these third parties.

Third-Party Libraries Supported

VR-Vantage 3.0.3 uses the indicated versions of the following libraries:

- VR-Link 5.8
- Qt 5.15.2 (VC 15 and Red Hat 8)
- OpenSceneGraph 3.6.4
- Boost 1.63.0
- FreeGlut 2.4.0 (Windows), 2.6.0 (Linux)
- GL-Studio 7.0 (VC 15)
- DI-Guy 13.6 (development version)

- Triton 4.43
- SilverLining 6.20
- SpeedTree 6.3.2
- Oculus Rift Development Kit 1.26
- CDB API 2.2 (Windows), 2.1 (Linux)
- osgEarth 3.2
- CUDA 11.7
- CIGI - CCL 4.0.4

Library Licensing

The following libraries are covered by the GNU Lesser General Public License (LGPL) license:

- CIGI
- DevIL
- GEOS
- GStreamer
- LibIconV
- LibWebSockets
- OPCODE
- OpenAL
- OSG
- OsgEarth
- Pthread
- Qt
- Qwt

The following libraries are covered by the ZLib license:

- Bullet Physics
- LibPNG
- LibSDL
- Minizip
- Zlib

The following libraries are covered by the MIT license:

- Expat
- FreeGLUT
- GDAL
- GeoTIFF
- GLM
- HarfBuzz
- LibCURL
- LibSquish
- LibXML
- LUA
- LuaBind
- Proj
- SMHasher
- TCLAP
- Qt Visual Graph Editor
- ZeroBrane Studio

The following libraries are covered by the BSD license:

- FreeType
- GLEW
- JPEG
- LibTiff
- Protobuf
- PCRE
- Ogg Vorbis

The following libraries are covered by the commercial licenses:

- FLEXlm
- Gameware
- GLStudio
- JRM Technologies SenSimRT and SigSimRT
- OpenFlight
- SpeedTree
- Sundog Triton
- Sundog SilverLining
- CDB API

The following libraries are covered by custom licenses:

- NVIDIA CG Toolkit
- FreeImage (FreeImage Public License)
- Boost (Boost Software License)
- Poco (Boost Software License)

COLLADA DOM is covered by the SCEA Shared Source license.

Thread Building Blocks is covered by the GPL license:

SQLLite is in the public domain.

SWIG is covered by the GPL license.

Boost License

VR-Link, and all MAK ONE products that use VR-Link, uses some code that is distributed under the Boost License. All header files that contain Boost code are properly attributed. The Boost website is: www.boost.org.

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

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DISTRIBUTING THE SOFTWARE BE LIABLE FOR ANY DAMAGES OR OTHER LIABILITY, WHETHER IN CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

libXML and libICONV

VR-Link, and all MAK ONE products that use VR-Link, links in libXML and libICONV. On some platforms the compiled libraries and header files are distributed with MAK products. MAK has made no modifications to these libraries. For more information about these libraries, see the following websites:

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

Freefont OpenType Font Set

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

NVIDIA

The HDR implementation uses the HDR NVIDIA gameworks SDK example that has the following copyright notice:

Multiple Files in folder: es3aep-kepler\HDR/

SDK Version: v2.11

Email: gameworks@nvidia.com

Site: https://developer.nvidia.com

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Third-Party Licenses for VR-Vantage Applications

VR-Vantage applications use a variety of third-party libraries. Developers who want to use these libraries may be required to purchase developer's licenses. Please see "1.2. Third-Party Software and Content" on page 41 for details.



I. Installation, Startup, and Concepts

VR-Vantage is MAK Technologies' line of visualization products. It is designed to meet your needs for visualizing the simulated environment. The VR-Vantage product line consists of the VR-Vantage Toolkit and VR-Vantage, which is built with it.

VR-Vantage is your 2D/3D information station. It has a 3D view for situational awareness, simulation debugging, or after action review; a 2D view to provide the "big picture" of a simulation; and an exaggerated reality (XR) mode to improve your understanding of the 3D view when the observer is not close to entities. Entities in the 2D Plan View are represented using MIL-STD 2525B icons that are color coded to represent their force. VR-Vantage provides the most data about your networked virtual world and presents it in a clear and accessible way.

The VR-Vantage Toolkit is an API that comes with all the software you need to completely rebuild visual applications like VR-Vantage and 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 MAK partners.

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

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

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



1. Introduction to VR-Vantage

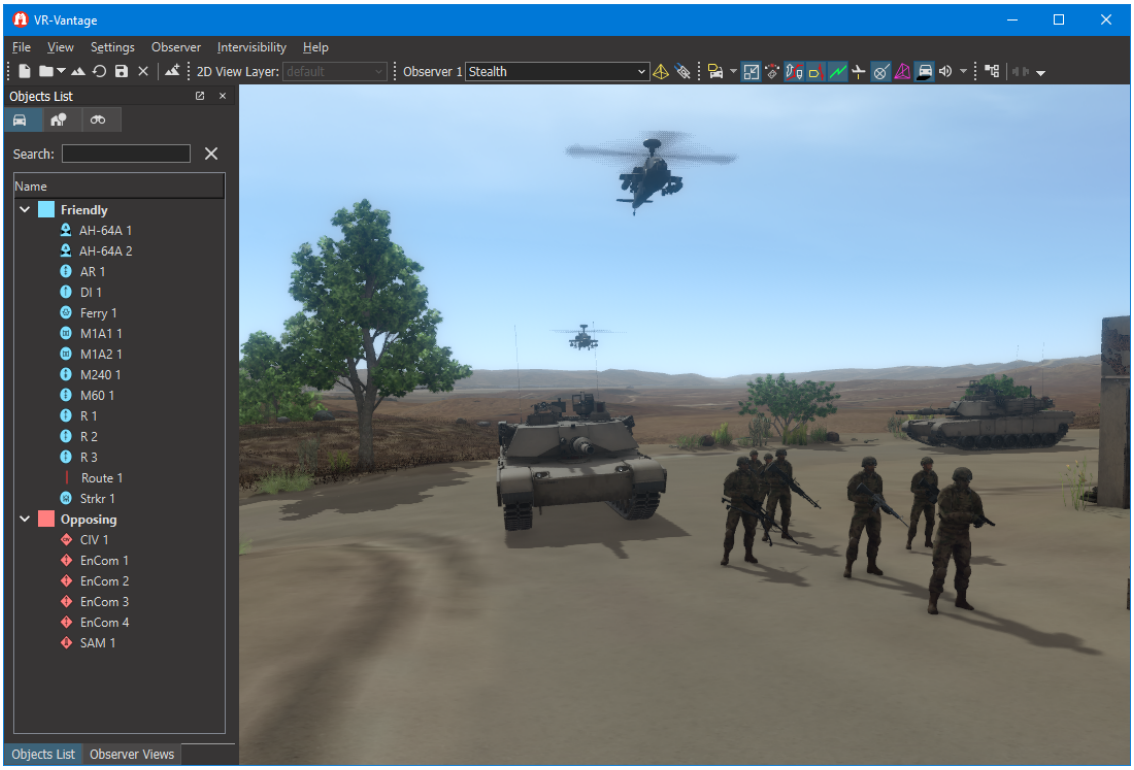
This chapter introduces you to the main features of VR-Vantage.

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1.1. VR-Vantage Features

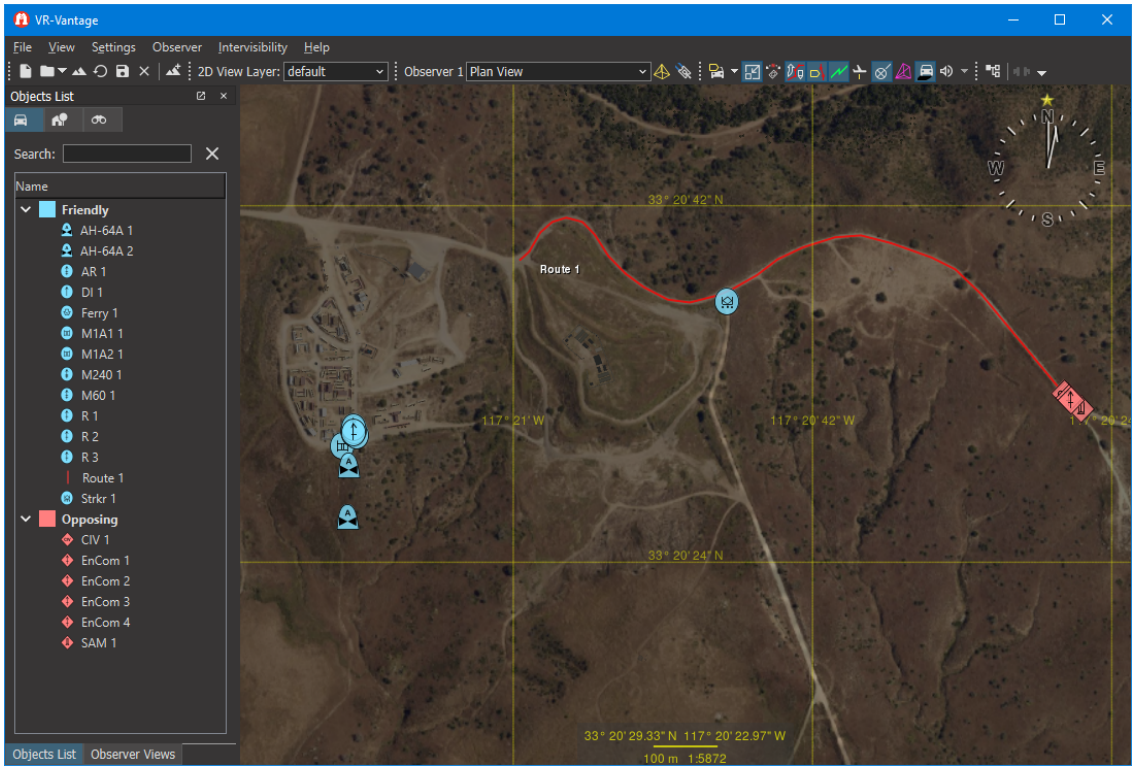
VR-Vantage delivers a realistic, three-dimensional view of terrain, vehicles, and other objects (Figure 1). VR-Vantage's navigation controls give you complete freedom to travel anywhere as an unobtrusive observer. You can place the observer at a specific location, or link it to a vehicle for automatic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

Figure 1. VR-Vantage (3D)



VR-Vantage also provides a two-dimensional plan view-style display (Figure 2).

Figure 2. VR-Vantage (2D)



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

1.1.1 Support for HLA, DIS, and CIGI

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

- HLA 1.3, HLA 1516, and HLA Evolved. VR-Vantage supports the HLA 1.3 specification, the current draft of the IEEE 1516 C++ API maintained by the SISO Dynamic Link Compatible RTI API Product Development Group, and HLA Evolved (IEEE 1516-2010). It has built-in support for the HLA RPR FOM and can support other FOMs through the FOM Mapping feature.
- Distributed Interactive Simulation (DIS) protocols DIS 4, 5, 6, and 7.
- Common Image Generator Interface (CIGI) 3.2, 3.3, and 4.0. CIGI is an interface that allows an image generator (IG) to receive messages from a host to control what is drawn by the IG.

1.1.2 Realistic Display of Vehicles and Terrain

The VR-Vantage 3D projection provides a realistic display using terrain and moving-model geometry in the OpenFlight format. It includes many 3D vehicle models, some of which display movement of articulated parts, such as turrets and rotors. These models can change to show a damaged or destroyed state. You can provide your own

models and map them to entity types. For details about terrain, please see "Section VII. Terrain" on page 401. For details about models, please see the *Adding Content to MAK ONE Applications Reference Manual*.

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 11. Scenes and Environmental Effects" on page 193.

1.1.3 Multiple Attach Modes

VR-Vantage offers attach modes that let you:

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

For more information, please see "Chapter 15. Moving the Observer" on page 255.

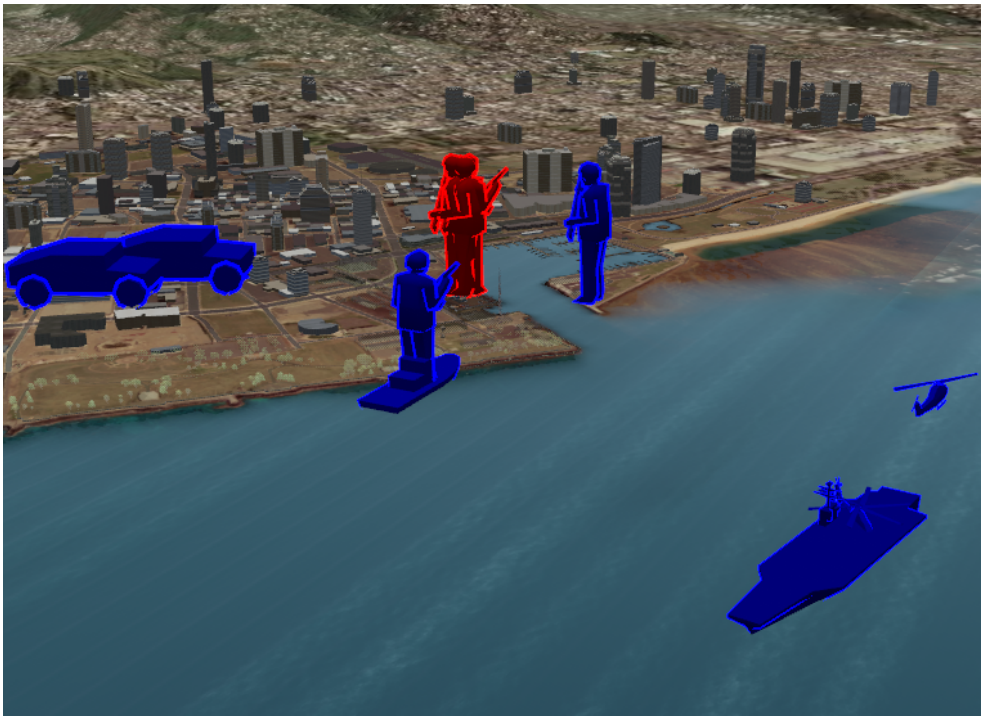
1.1.4 Accurate Vehicle Positioning

VR-Vantage can smooth the trajectories of moving vehicles to compensate for discontinuous positional data. The ground clamping feature can ensure that all ground entities are placed correctly on the terrain surface. For details, please see "21.2.1 Configuring Trajectory Smoothing" on page 358 and "21.1. Using Ground Clamping" on page 356.

1.1.5 eXaggerated Reality (XR)

The XR observer mode enhances your ability to understand the layout of forces in the 3D projection. The colorized notional icons are scaled to be visible regardless of the observer's distance from the entities. You can resize the icons to ensure that you have the right view for your needs. For more information, please see "Chapter 18. Exaggerating Models and Terrain" on page 315.

Figure 3. Model scaling and colorized models



1.1.6 Plan View Display

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

1.1.7 Terrain Agility and Composability

VR-Vantage allows you to build your terrain at runtime using a variety of database and vector formats. It can load OpenFlight, DTED, MetaFlight, CDB, and GDB (MAK 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, see "Chapter 26. Composing Terrains in VR-Vantage" on page 415.

1.1.8 Dynamic Ocean

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

1.1.9 Lighting Effects

VR-Vantage supports a variety of lighting effects:

- Dynamic lighting
- Forward+ lighting
- Ocean planar reflection
- High dynamic range (HDR)
- Lens flare
- Crepuscular (sun) rays
- Shadows

Using Shader-based Effects Maps

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

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

To see the effect of effects maps, you must enable advanced lighting and shading. For more information about shader-based effects maps, please see "Using Shader-based Effect Maps" in the *Adding Content to MAK ONE Applications Reference Manual*.

1.1.10 Streaming Video

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

1.1.11 Remote Control

You can control VR-Vantage remotely through view control messages, which can be generated by MAK applications such as the Data Logger and VR-Forces, and by programs that use the VR-Vantage Control Toolkit. For details, please see "15.13. Controlling the Observer from Other Applications" on page 284.

1.1.12 DI-Guy

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

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

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

- Develop new character types, or alter the geometry, appearances, textures, or motions of DI-Guy characters.
- Directly access the DI-Guy API to modify or extend the way that VR-Vantage uses the DI-Guy API or access DI-Guy functionality that MAK 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.

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, it will no longer try to guess and will expect to be told how to render that lifeform for the remainder of the simulation.

1.1.13 Flexible, Intuitive Graphical User Interface

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

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

The GUI follows standard conventions for modern windowing systems. For additional details, see "Chapter 36. The VR-Vantage User Interface" on page 539. For descriptions of individual windows and dialog boxes, see the online help.

1.2. Third-Party Software and Content

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

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



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

1.2.1 SilverLining

VR-Vantage uses SilverLining software and content to compute lighting and to render the sky, clouds, sun, and moon. SilverLining is developed by Sundog Software (https://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 MAK 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.

By default, SilverLining (and therefore VR-Vantage) uses a hard-coded star catalog. You can override this by setting the **star-catalog-file** parameter for the star catalog in the config file, *./data/Environment/Sky/SilverLining.config*. The comments include a reference to the example file *starcat.csv*, also located in the *Sky* directory; it shows the format SilverLining expects for the catalog.

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

1.2.2 Triton Ocean SDK

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

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

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

resulting product includes the Triton Ocean functionality, then you need a Triton Ocean Developer's License.

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

1.2.3 GL Studio

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

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

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

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

1.2.4 SpeedTree

VR-Vantage uses SpeedTree software and content for animated real-time 3D foliage and vegetation. SpeedTree is developed by Interactive Data Visualization (IDV) (https://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 MAK delivers. You may build and run plug-ins to our out-of-the-box applications without a SpeedTree license, as long as your plug-ins do not need to directly access the SpeedTree API.

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

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

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

1.2.5 3D Models, Terrain, and Graphical Content

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

- Many of the high-quality vehicle models come from Simthetiq (https://simthetiq.com).
- Some models come from Real DB.
- Some of the middle-eastern building models and urban clutter objects that are used in our sample terrain databases were licensed from Turbosquid (https://turbosquid.com).

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

1.2.6 OpenSceneGraph

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

MAK will provide modified source code for OSG upon request, as per the OSGPL license. Please MAK support at https://www.mak.com/mak-one/support/portal to obtain the download links for our modified source.

1.2.7 osgEarth

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

MAK will provide modified source code for osgEarth upon request, as per the OSGPL license. Please MAK support at https://www.mak.com/mak-one/support/portal to obtain the download links for our modified source.



2. Installing VR-Vantage and SensorFX

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

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2.1. Installing VR-Vantage

A full VR-Vantage installation includes the application, data, the License Manager software and, for HLA operation, an RTI (or Runtime Infrastructure). If your license includes SensorFX, that is installed automatically with VR-Vantage. If you have a key for the SensorFX toolkit, you are prompted to enter that as part of the installation.

VR-Vantage has an application installer and a data package (*.MAK-targz*) that has multiple files. You must run the application installer and then install the data package. The application installer can automatically install the data package if you configure it to do so. MAK also provides optional data packages that have additional terrains.

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

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

2.1.1 Installing VR-Vantage on Windows

When you install large applications on Windows, 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 Windows scans setup programs before it executes them. If you experience this problem, turning off User Access Control can reduce or eliminate this delay.

Windows versions of VR-Vantage are provided as executable installer files on DVD, or as downloaded files. The installers are named to indicate the compiler used to build that version of VR-Vantage.

➤ To install VR-Vantage, run the application installer. Follow the instructions in the installation wizard. You can specify that the application installer automatically find and install the application's data (it must be in the same directory as the application installer), or you can specify that the MAK Data Setup Wizard open and allow you to select the data to install.

Default Windows Installation Directory

On Windows, the default is that VR-Vantage installs in the *C:/MAK* directory. You can use another directory by defining a MAK_INSTALL_DIR environment variable. If you set up this environment variable, the product installs in the directory you specify instead of *C:/MAK*.

2.1.2 Installing VR-Vantage on a Linux System

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

➤ **To install VR-Vantage on Linux:**

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

   ```
   tar -vxzf application.tar.gz
   ```

   where *application* is the product release identification.
4. The data package consists of multiple files that have the extension *MAK-targz*. Uncompress and untar the data package files and copy them into the installation directory, or uncompress them and redirect the output, as follows:

   ```
   tar -xzf makData<version>.MAK-targz -C /path-to-vrvantage3.0.3
   ```

2.1.3 Installing VR-Vantage PDB Files for Debugging Purposes

When a MAK ONE application crashes, it can be difficult to determine the cause of the crash. The application generates a *.dmp* file that contains valuable information about the state of the application at the time of the crash. MAK technical support can analyze this file to help diagnose the issue.

In addition, when you install the PDB (program database) files for the application, that enables the application to generate a call stack log file (*.callstack.log*) of the application at the time of the crash. The call stack log provides information in plain text about the sequence of functions that were called leading up to the crash, which is also helpful in identifying the specific cause.

By providing the *.dmp* or *.callstack.log* files to technical support, you help support personnel to resolve the issues. They use specialized debugging tools to analyze the files and determine the cause of the crash, and that information aids in the development of a solution to prevent future crashes.

Due to security reasons or organization policies, some customers cannot send the *.dmp* file to technical support. Because the call stack log file is a plain text file, it is easier to inspect and analyze than the *.dmp* file. Users can easily attach it to an email and pass it out of secure areas with visual inspection, making it a convenient option for customers with restrictions on sharing binary files.

It is important to note that the call stack log file alone might not be sufficient for support personnel to fully diagnose the issue. They may require more information to gain a complete understanding of the issue.



Support for the generation of the call stack log file was introduced in VR-Vantage 3.0.3. It is supported only in that and later versions.

Installing PDB Files

Before installing the PDB files, you must install VR-Vantage. Next, make sure that the PDB files you are installing are from the same build as the application. When you download the installer from the MAK ONE Product Downloads page, the appropriate PDBs are also available for download.

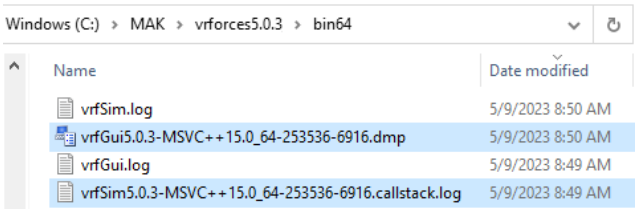
➤ **To install the PDB files:**

1. After installing VR-Vantage, unzip the associated PDB files.
2. Copy all of the PDB files to the *./bin64* directory.

Reporting the Crash with *.callstack.log* and *.dmp* Files

Send both the *.callstack.log* and *.dmp* files to MAK support through the Support Portal (https://www.mak.com/mak-one/support/portal) or support@mak.com, along with anything you experienced when the crash occurred. The files will have similar names and are located in the *./bin64* directory.

Figure 4. Example of *.callstack.log* and *.dmp* files



2.1.4 Installing SensorFX with VR-Vantage

The SensorFX plug-in installation is included with the VR-Vantage installer. If you have the license, you can install SensorFX at the same time as VR-Vantage.

2.1.5 Installing the Toolkit

The SDK toolkit is an API that allows developers to create and add functionality to VR-Vantage, and it also includes examples about how to use the SDK.

The VR-Vantage installer includes a step where you can install the toolkit. This requires that you purchase a separate license, which comes with its own installation code.

If you skipped the toolkit installation when you installed VR-Vantage but you now have a toolkit installation code, you must rerun the application installer and enter the code when prompted.

Required Software for Toolkit Users

If you plan to build VR-Vantage applications using the VR-Vantage Toolkit, you must download and install VR-Link 5.8.

To build VR-Vantage applications, you must link with VR-Link 5.8. If you plan to build the VR-Vantage GUI, you must also download and install Qt 5.15.2 (Windows VC 15 and Linux Red Hat 8). You can download it from the Bonus Downloads page on the website (https://www.mak.com/mak-one/support/help/bonus-material).

Qt is also available as a free download under the LGPL version 2.1 license at https://www.qt.io. This version should be satisfactory for most VR-Vantage customers. If you need a Qt commercial license, you must purchase the license from Qt.

If you plan to extend CIGI functionality, you must use the CIGI Class Library 4.0.3.2 (CCL) provided in your installation of VR-Vantage (in ./packages). Even if you are not working with CIGI 4, you must use this version of the CCL.

2.1.6 The makData Package

The MAK Data Packages are used by multiple MAK ONE applications. The applications need to be able to find the data, wherever you install it. VR-Vantage looks for data in a default location or uses a collection of environment variables to find the data in the location where you installed it. You have several options for installing the data and telling VR-Vantage where to look for it.

MAK Data Installation Directory

The shared data files are stored in a directory file hierarchy. This structure allows for multiple versions of data to be installed for use with different versions of VR-Vantage.

The directory looks like *shared-data-root/data-compatibility-version/stem/data-folders*, where:

- *shared-data-root* is the location of the shared data directory. The default is *C:/MAK/SharedData* on Windows and *~/MAK/SharedData* on Linux.
- *data-compatibility-version* is a number, such as 16.
- *stem* is the directory holding the data files, for example, *latest* for the most recent installation of that compatibility version or the date of a previous installation, such as *2022-11-13*.
- *data-folders* hold the various files that make up the MAK data files (models, audio files, fonts, and so on).

Advanced Windows users may want to install MAK Data Packages in a very specific way, for example, installing the data on a shared drive and configuring any machines with MAK ONE applications to look there for the data. Refer to the *MAK ONE Installation Guide* for instructions.

Installing the makData Package

➤ **To install the data:**

1. Install the MAK ONE Software Manager.
2. Run the MakOneSoftwareManager executable in the .*bin64* folder.

   On Windows 10, you can also open the Start menu and then choose **MAK Technologies > MAK ONE Software Manager**. (To launch MAK ONE products more easily than the Windows Start menu, please see the *MAK ONE Installation Guide* or this blog entry: Tech Tip: Starting MAK ONE Applications on Windows 10.)
3. Click Select and Install Data Packages in the welcome page.
4. Specify the directory where you saved the data files. The default is your Downloads folder, but you can click the folder icon to navigate to another folder.
5. Select the data files that you want to install.

> MAK Technologies recommends that you install all of the data files if you have the space and are not absolutely sure which files you require.
>
> You must install the Core data for VR-Vantage to function. To have access to other terrains and to see anything other than notional models, install the other data packages provided by MAK. If you do not install any other data, it is assumed that you are providing your own models and terrains.

6. Optionally, choose the location where you want to install the data.

   MAK recommends that you install the files in the default location. While MAK ONE products allow for diverse installations, the typical use is the standard installation. If you require a more complex installation, refer to the *MAK ONE Installation Guide*.

7. If you have a previous installation of data for the same compatibility version, you are prompted to choose whether to back up the previously installed data, delete it, or overwrite it. See "Options When Installing a Data Package" below.

8. Click Install. The MAK ONE Software Manager shows the progress of the data installation.

9. When the installation is complete, click Exit.

Options When Installing a Data Package

When installing a data version using the MAK ONE Software Manager, if you have no preexisting installations of that compatibility version, it simply installs the data files in the *./SharedData/##/latest* folder (where *##* is the compatibility version).

If there is already a previous release of the same compatibility version installed, however, you are prompted to choose whether to back up, delete, or overwrite the data from the previous release.

- Backup. If you install a newer release and choose to create a backup the previous release, the files in the *latest* directory are moved to a new directory named for the data version's date in the same compatibility folder and the new files are then installed in the latest folder. For example, the old files move to *./SharedData/16/2022-11-13* and the new files are installed in *./SharedData/16/latest*.

  Creating a backup is the recommended option in most circumstances. It allows all MAK ONE applications to use the newest data, while also giving you the option to revert to a previous release using command-line options or setting a Windows environment variable. See the *MAK ONE Installation Guide* for details.

- Delete. The installer deletes the old data from the *latest* directory and then installs the new data.

- Overwrite. The installer overwrites the previous data files in the *latest* directory with the newer ones you chose to install. It also adds files that are new and ignores files that were previously installed if the package you are installing does not include that file.

2.1.7 Uninstalling VR-Vantage from Windows

MAK Technologies product installations include an uninstaller application, which you can find in the installation directory. When you uninstall VR-Vantage, the uninstaller does not remove the data package; that is in a separate directory (*./SharedData/16/latest*). Files such as scenarios or SMSs that reside in the product directory are deleted when you uninstall VR-Vantage. Be sure to copy any custom files from the product directory before uninstalling.

2.1.8 Uninstalling VR-Vantage from a Linux System

To uninstall MAK Technologies product installations from Linux, simply delete the installation directory. This catches everything.

2.2. The VR-Vantage Directory Structure

The installation process creates the VR-Vantage directory. On PCs, the default installation directory is *C:\MAK\vrvantage#.#*.)

Table 1 describes the contents of the directories.

Table 1. Contents of VR-Vantage directories

Directory	Directory contents
./appData	Subdirectories contain data required by the VR-Vantage applications, such as saved settings. Can also include data required by the SensorFX plug-in for VR-Vantage.
./appSrc	Source code for rebuilding the VR-Vantage applications.
./bin64	Executables and dynamic link libraries.
./compatibility	Scripts for updating include files to be compatible with newer versions of VR-Link.
./data	Model definitions, 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), including those for SensorFX (if installed).
./include	Header files for the VR-Vantage Toolkit API.
./lib64	Libraries for building applications with the VR-Vantage Toolkit API.
./packages	Header files and libraries for third-party and supplementary APIs that developers may need to build against.
./plugins64	Plug-in shared libraries.
./sensorFX	Source code for SensorFX SDK.
./tools	Helper applications such as the CIGI Host Emulator.
./translations	Translation files for localizing VR-Vantage menus.

2.3. Installing and Setting Up the MAK License Manager

Before you can use a MAK product, you must obtain a valid license file, install the MAK 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 MAK 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 MAK 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 MAK installation media. It is separate from the product installers. You can download the installers from our web site at https://www.mak.com/support/license-support.

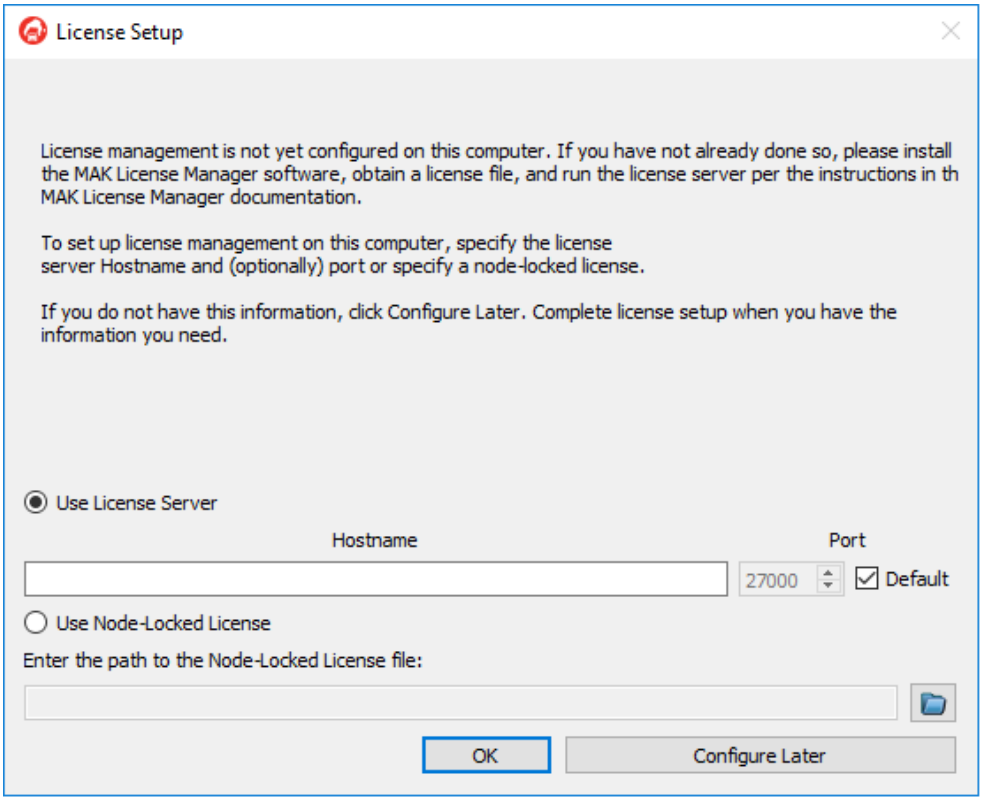
Complete installation and configuration instructions are included with the License Manager installer. Instructions are also available at the license support page.

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

2.3.1 Specifying the License Server

The first time you run a MAK application on a particular computer, the License Setup dialog box opens (Figure 5). It prompts you to enter the hostname of the license server and optionally, a port number.

Figure 5. 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 MAK applications until you set up license management.

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

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

- If you are running MAK 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 MAK application.
- You can clear the saved license configuration by deleting the cache file. On Windows, it is *C:\Users\user_name\AppData\Roaming\MAK\licenses<n>.txt*. (The *AppData* directory is hidden by default.) On Linux, it is *.mak/license<n>.txt*. (There may be more than one cache file, for example, *licenses1.txt* and *licenses2.txt*.) You can also clear the cache in the RTI Assistant.

The MAKLMGRD_LICENSE_FILE Environment Variable

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

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

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

Windows

➤ **To add the MAKLMGRD_LICENSE_FILE in Windows:**

1. On the Start menu, click the Settings button. The Settings window opens.
2. In the search box, type environment. A list of choices is displayed.
3. Select Edit the System Environment Variables. The System Properties dialog box opens.
4. Click Environment Variables. The Environment Variables dialog box opens.
5. In the System Variables group box, click New. The New System Variable dialog box opens.
6. In the Variable Name field, enter MAKLMGRD_LICENSE_FILE.
7. In the Variable Value field, enter *@server_name*, where *server_name* is the name of the license server.
8. 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 MAK 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 MAK products, please see the release notes for your MAK application.

2.4.1 Installing the MAK RTI

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

Configuring Your System to Use the MAK RTI

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

- Linux — LD_LIBRARY_PATH
- Windows — PATH

The MAK 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 MAK RTI

➤ **To run a MAK application with the MAK RTI:**

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

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

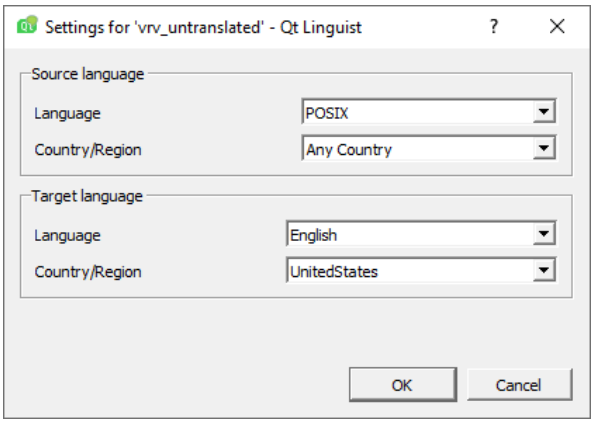
2.5. Localizing the Graphical User Interface

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

➤ **To edit a resource file:**

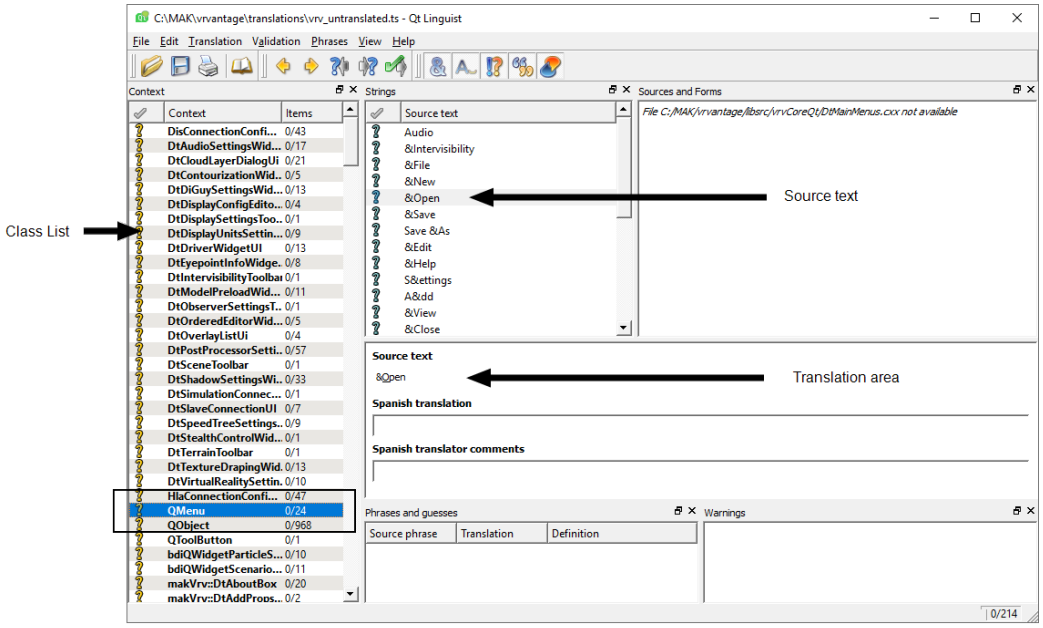
1. Start the Qt Linguist utility. It is *./translations/linguist.exe*
2. In the Qt Linguist window, choose **File > Open**. Select the file *./translations/product_untranslated.ts*. The Settings for filename dialog box opens (Figure 6).

Figure 6. 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 7).

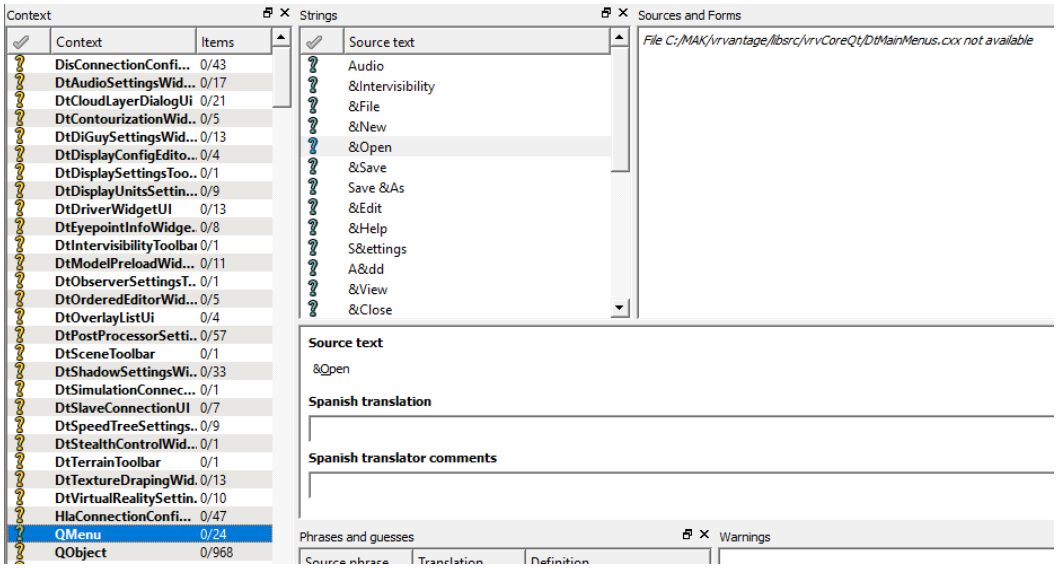
Figure 7. Linguist window



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 only need to translate the text. In Figure 7, **QMenu** is selected. The Strings window lists text that can be translated. Text that has not been translated has a blue question mark in the checkmark column.

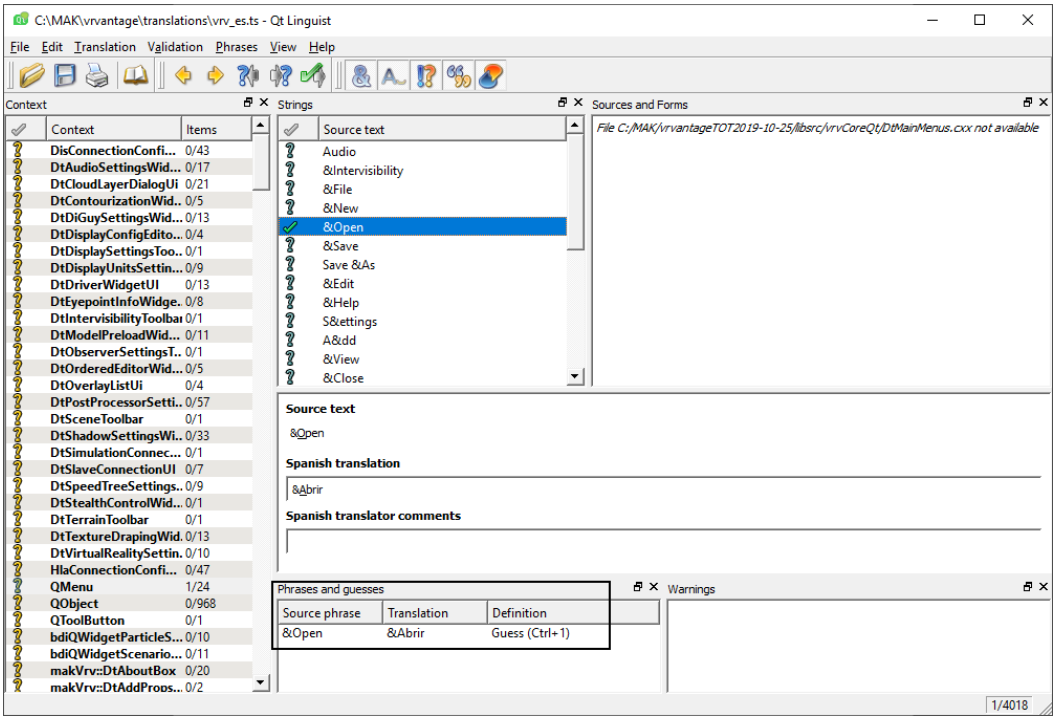
6. In the Source Text list, select the word you want to translate. The text is displayed under Source Text in the translation area (the window below the source text list). Figure 8 shows the text Open selected.

Figure 8. 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 9). 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 9. Completed translation for Open



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

2.5.1 Translating Other Interface Files

The *vrvantage_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 the 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 *vrvantage_untranslated.ts*.

2.5.2 Applying the Language Files

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

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



3. Running VR-Vantage Applications

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

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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 "2.4. Installing an RTI" on page 54.
- Before you can start VR-Vantage, the license manager must be running.

3.1.1 Starting VR-Vantage on Windows

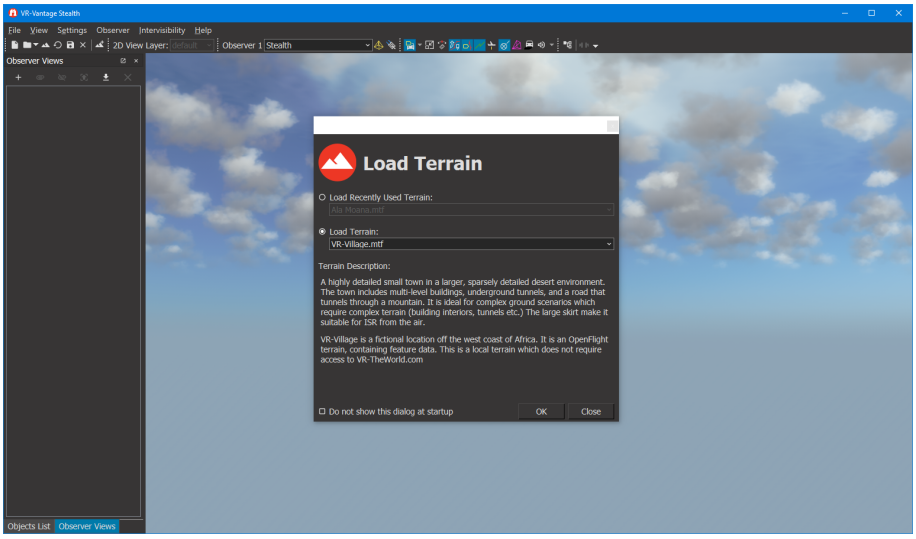
➤ **To start VR-Vantage on Windows:**

1. On the Windows Start menu, choose **MAK Technologies > VR-Vantage**.

Windows 10 has a flatter Start menu structure than previous versions of Windows. It does not support nested folders. If you are interested in using a nested menu to start MAK applications on Windows 10, please read this blog: https://www.mak.com/learn/blog/entry/tech-tip-from-fred-starting-mak-applications-on-windows-10.

The VR-Vantage window opens (Figure 10). The Load Terrain dialog box opens on top of the window.

Figure 10. VR-Vantage window at startup

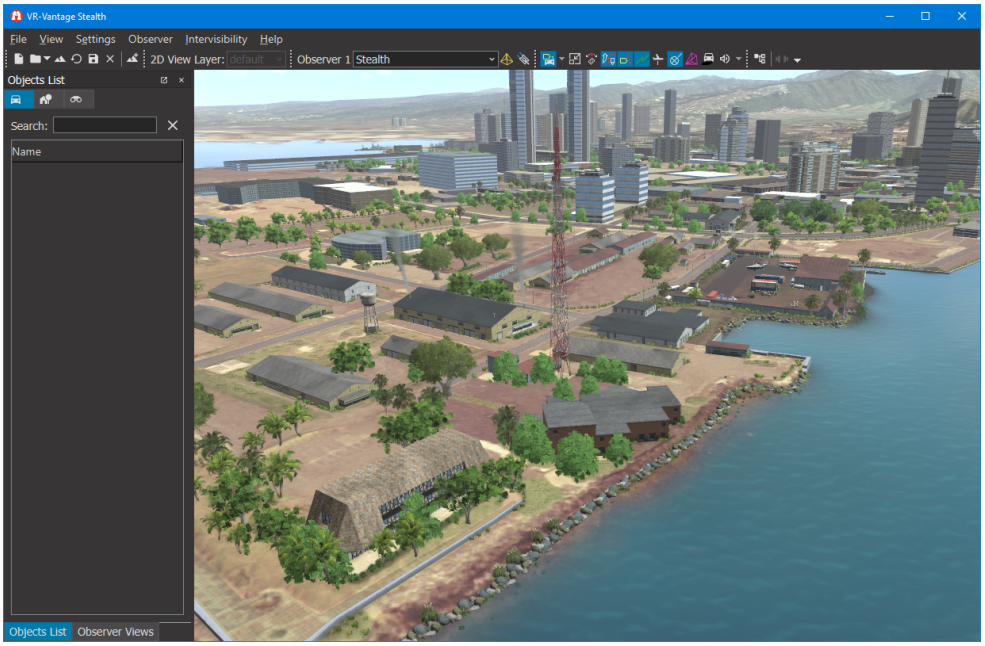


> When you start VR-Vantage, if you receive the following message, it means that you did not install the data package:
>
> `Data package not found in specified data directory: 'directory path'. Please make sure the data package is installed.`
>
> VR-Vantage has an application installer and a data installer. You must install both of them; see "2.1.6 The makData Package" on page 49.

2. Select one of the terrain loading options:
   - Load Recently Used Terrain.
   - Load Terrain.

   If you do not want to load a terrain, click Close, the dialog box closes and no terrain loads. Clicking Close does not close VR-Vantage. You can always load a terrain as described in "3.3. Opening a Terrain" on page 73.
3. Select the terrain you want to load from the list for the selected option.
4. Click OK. VR-Vantage loads the selected terrain (Figure 11).

Figure 11. VR-Vantage window with a terrain loaded



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

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

1. Change directory to *./bin64*.
2. Enter:

   application [*options*]

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

VR-Vantage starts as described in the previous section.

"3.1.3 Command-Line Options" below describes the VR-Vantage command-line options.

3.1.3 Command-Line Options

Table 2 lists VR-Vantage's command-line options.

Table 2. VR-Vantage command-line options

Option	Description
`(-- | --ignore_rest)`	Ignore all command-line options after this one. This option is useful for disabling part of a command line in a script for test purposes so that you do not have to retype all of the command options at a later point.
`--antiAliasing` *level*	Set the anti-aliasing level (0, 2, 4, 8, or 16). Default: 4. Depending on your graphics card and driver, some combinations of anti-aliasing and bit settings (`--depthBits`, `--stencilBits`, and `--alphaBits`) may be incompatible. For example, if you set stencil bits to 8, the depth must be set to 24 and anti-aliasing may need to be set to 0 or 2.
`--appCacheDir` *directory*	Use `--appCacheDir` to specify a directory for the cache. This allows you to run multiple remote display engines (RDEs) or other instances of VR-Vantage from the same installation. Running two RDEs on the same machine helps compensate for the limited threading in VR-Vantage.
`--appDataDir` *directory*	Specifies the location of application data.
`--autoReconnectPeriod` *period*	Specifies the amount of time, in seconds, to wait before trying to attach to disconnected remote displays.

Table 2. VR-Vantage command-line options (continued)

Option	Description
(-B | --bindObservers) *"observer1,..., observern,../saved_views_file" "../terrain_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 must specify a terrain database for this command to work. You would ordinarily also specify a display configuration that contains the observers with --dispSetting. For more information about using this command-line option, see "16.4. Attaching the Observer at Startup" on page 300, the attaching the observer to an entity at startup tutorial.
(-c | --showConsole)	Display a console window.
(-C | --autoConnect) *{filepath | connector_name}*	Automatically connect to the network using the specified connector.
--dataDir *directory*	Specifies the location of the data directory (terrains and so on).
--depthBits *bits*	Sets the depth of graphics to 24 bits or 32 bits. This has no effect when reverse Z is enabled, which is the default for VR-Vantage. The number of depth bits in reverse Z is always 32 bits float.
--disableDynamicTerrain	Disables the dynamic terrain engine. May slightly speed up terrain loading and paging.
--disableErrorDialog	Prevents error messages from displaying. Errors print to the console instead.
--disableIndirectEntities	Disables indirect rendering of entities. To enable indirect rendering, use --enableIndirectEntities.
--disableNvidiaBindlessFix	Do not use this option unless directed to do so by MAK technical support.

Table 2. VR-Vantage command-line options (continued)

Option	Description
`--disableOcclusionCulling`	Disables occlusion culling. This may improve performance.
`(-z | --disableReverseZBuffer)`	Disables use of reverse Z buffering, which is enabled by default. Leaving reverse Z buffering enabled can reduce Z-fighting when viewing the terrain from a distance. (3D observer modes only.)
`--disableTerrainObserverViews`	Disables the loading of terrain observer view files. Loading a terrain does not clear the observer views and the terrain's observer views do not load.
`--discoveredModelPreloadFileName` *filename*	Specifies a file to which the list of models discovered during a session that were not preloaded is written.
`--displayEnginePort` *port*	Specifies the display engine port used by a remote display engine. Used only if `--slave` is specified.
`--dispSetting` *filename*	Specifies the display engine configuration to load.
`(-e | --extraArgs)` *string* | "*string1 ... stringn*"	Allows you to send arbitrary strings to the initializer, which can be queried for by plug-ins. This option works around the restriction on adding new command-line arguments. It can take one argument or multiple arguments. Multiple arguments must be wrapped in double quotes.
`(-E | --entTypeMap)` *filename*	Load the specified object type mapping file. The file extension determines the type of mapping.
`--enableDofConstraints`	Enables the use of degree(s) of freedom constraints on simulation object models.
`--enableTracyProfiling`	Enables the Tracy Client when you launch the application.
`--enableVSync`	Turns on VSync.
`--entDispSetting` *filename*	Specifies the entity display setting to load.
`--entityDefsDir` *directory*	Loads the *.hier* and *.leaf* files in the specified directory.
`--envSetting` *filename*	Specifies the environment configuration file to load.

Table 2. VR-Vantage command-line options (continued)

Option	Description
`--factoryRootDir` *directory*	Set the root directory used to restore settings to factory defaults.
`--forceTextShaping`	Force all text to use HarfBuzz shaping. Use this option if you need support for right-to-left languages. It may affect performance.
(`-F` | `--frameRate`) *rate*	If rate is 0, the frame rate is variable. Otherwise, specifies a fixed frame rate for rendering.
`--fullScreen`	Start with the window in full screen mode.
(`-G` | `--locale`) *language*	Specifies the locale (for localization).
`--guiWindowRectangle "`*width height x y*`"` `--guiWindowRectangle` *width*`,`*height*`,`*x*`,`*y*	Specifies the window size and location at startup.
(`-h` | `--help`)	Display command-line usage information.
`--highestPriority`	Changes the priority of the application and the main render thread to the highest available priority. This command may starve other processes.
(`-K` | `--disableKDTrees`)	Disable creation of KD trees for intersections.
(`-l` | `--logFileName`) *filename*	Specifies the log file name.
`--limitEntityTextures "`*width height*`"`	Uses only mipmap levels at or below the resolution for entities. Use two integers for the maximum width and height of the texture mipmap to use, for example, "1024 1024" or "2k 2k". To turn off the texture limit function, use `--limitEntityTextures "-1 -1"`.
`--limitTerrainTextures "`*width height*`"`	Uses only mipmap levels at or below the resolution for terrain. Use two integers for the width and height, for example, "1024 1024" or "2k 2k".

In most situations, using `--limitEntityTextures` and `--limitTerrainTextures` prevents crashes with high VRAM. If you continue to experience crashes, use `--limitGpuMemoryPercentage` in addition to these command-line options.

Table 2. VR-Vantage command-line options (continued)

Option	Description
`--limitGpuMemoryPercentage` *integer*	Set the cutoff percentage as a value between 0 and 100. (Typical values are between 85 and 100.) Beyond the specified percentage, VR-Vantage does not make new textures or buffers as a percentage of the available video RAM. This applies only to VR-Vantage-side textures: terrain insets, entities, indirected osgEarth layers (feature_geom and buildings). It does not apply to SilverLining, Triton, or osgEarth tiles. The latter are controlled by the *.earth* file options.
 Typically, you would use `--limitGpuMemoryPercentage` in conjunction with `--limitEntityTextures` and `--limitTerrainTextures` when you see crashes with high VRAM.	
`--mainScreenNum` *num*	Specifies the display that the main window should use. The screen number can be a number from 0 to the number of screens -1. This number matches the screen number used in the Display Engine Configuration Editor for a window.
`--mergeEntityTypeMap` {*directory* | *filename*}	Merges all entity type mapping files (**.metx*) in a directory or individual entity type mapping files. Can be used multiple times.
`--mergeHierarchyEntityDef` {*directory* | *filename*}	Merges the *.hier* files in the specified directory or the individual *.hier* file into the default hierarchy (usually loaded from *./SharedData/16 /latest/ModelData/Configuration/Original/Definitions*.) Merging is additive only. No nodes in a previously loaded hierarchy are replaced. Can be used multiple times.
`--mergeHierarchyTacticalGraphicsDef` {*directory* | *filename*}	Merges the specified *.hier* file(s) into the default hierarchy (usually loaded from *./SharedData/16 /latest/ModelData/Configuration/Original/Definitions*.) Merging is additive only. No nodes in a previously loaded hierarchy are replaced. Can be used multiple times.

Table 2. VR-Vantage command-line options (continued)

Option	Description
`--mergeHierarchyUnitDef {`*`directory`* `|` *`filename`*`}`	Merges the specified *.hier* file(s) into the default hierarchy (usually loaded from *./SharedData/16 /latest/ModelData/Configuration/Original/Definitions*.) Merging is additive only. No nodes in a previously loaded hierarchy are replaced. Can be used multiple times.
`--mergeLeafEntityDef {`*`directory`* `|` *`filename`*`}`	Merges the leaf files in the specified directory or the individual leaf file into the default entity element definitions. Can be used multiple times.
`--mergeLeafTacticalGraphicsDef {`*`directory`* `|` *`filename`*`}`	Merges the leaf files in the specified directory or the individual leaf file into the default tactical graphics element definitions. Can be used multiple times.
`--mergeLeafUnitDef {`*`directory`* `|` *`filename`*`}`	Merges the leaf files in the directory or the specified individual leaf file into the default unit element definitions. Can be used multiple times.
`--mergeModelDefs {`*`directory`* `|` *`filename`*`}`	Merges all model definition files (**.ommx*) in the specified directory or individual model definition files. Can be used multiple times.
`--mergeTacticalGraphicsTypeMap {`*`directory`* `|` *`filename`*`}`	Merges all tactical graphics type mapping files (**.mtgx*) in a directory or individual tactical graphics type mapping files. Can be used multiple times.
`--mergeUnitTypeMap {`*`directory`* `|` *`filename`*`}`	Merges all unit type mapping files (**.magx*) in a directory or individual unit type mapping files. Can be used multiple times.
`--modelPreloadFileName` *`filename`*	Specifies a file that has a list of models to preload.
`(-n | --notifyLevel)` *`notify_level`*	Specifies the notification level for application messages, where *notify_level* is a number from 0 through 4. The least verbose message level is 0, the highest is 4. The default is 2.

Table 2. VR-Vantage command-line options (continued)

Option	Description
`--noAppDataEntityDefs`	Do not load the entity element definitions in *./SharedData/16/latest/ModelData/Configuration/Definitions*.
`--noAppDataEntityTypeMap`	Do not load entity type mappings in *./SharedData/16/latest/ModelData/Configuration/Definitions*.
`--noAppDataModelDefs`	Do not load model definitions in *./SharedData/16/latest/ModelData/Configuration/Definitions*.
`--noAppDataTacticalGraphicsDefs`	Do not load the tactical graphics element definitions in *./SharedData/16/latest/ModelData/Configuration/Definitions*.
`--noAppDataTacticalGraphicsTypeMap`	Do not load tactical graphics type mappings in *./SharedData/16/latest/ModelData/Configuration/Definitions*.
`--noAppDataUnitDefs`	Do not load the unit element definitions in *./SharedData/16/latest/ModelData/Configuration/Definitions*.

Table 2. VR-Vantage command-line options (continued)

Option	Description
`--noAppDataUnitTypeMap`	Do not load unit type mappings in *./SharedData/16/latest/ModelData/Configuration/Definitions*.
`--noGui`	Start without the graphical user interface.
`(-O | --hasNTPSync)`	Enables the synchronization of all time-based features between different VR-Vantage applications, such as VR-Vantage and the VR-Forces front-end. System clocks must be synchronized. Time-based features include the rendering of ocean waves, clouds, and SpeedTrees.
`--plugin` *filename*	Load the specified plug-in. Can be used multiple times.
`--pseudoFullScreen`	Use pseudo full screen for full screen mode. This may improve performance when using dynamic ocean.
`(-s |--slave)`	Run as a remote display engine.
`(-S | --suppressHatIntersectOnAttach)`	Suppress the periodic HAT intersection when attached. This setting can improve performance if you need to attach the observer to ground vehicles a lot, but do not need to attach to air vehicles.
`--sharedDataDir` *directory path*	Defines the location of the shared data directory if you installed it somewhere other than the default.
`--sharedDataRoot` *directory root*	Defines the location of the shared data root.
`--sharedDataStem` *directorystem*	Defines the location of the shared data stem.
`--stencilBits` *bits*	Sets the number of stencil bits (0 or 8). Default: 0.
`--tcpSendTimeout`	Sets the timeout (in seconds) for the master display engine to wait for a remote display engine before giving up on a send. Default: 30 seconds.

Table 2. VR-Vantage command-line options (continued)

Option	Description
(*terrain_MTF_file* | *scene_MSF_file*) *terrain_MTF_file*	Specifies a terrain (MTF) or scene (MSF) file to load. The path must be a relative path (from *./bin64*) to the file, for example, *../userData/terrains/MTF_file*.
`--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.
Windows syntax: `-W | --withDisplayEngine` *port@netAddress;displayConfigFilename1 .... n* Linux syntax: `-W | --withDisplayEngine` *port@netAddress:displayConfigFilename1 .... n*	Connect to a display engine running on another computer. For more information, see "Loading Multiple Display Engine Configurations from the Command Line" on page 119 under "6.2.6 Loading a Display Engine Configuration" on page 118.
(`-Z` | `--ignoreZoomForSpeedtreeLod`)	Disable zoom for SpeedTree LOD.

3.1.4 Shutting Down VR-Vantage

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

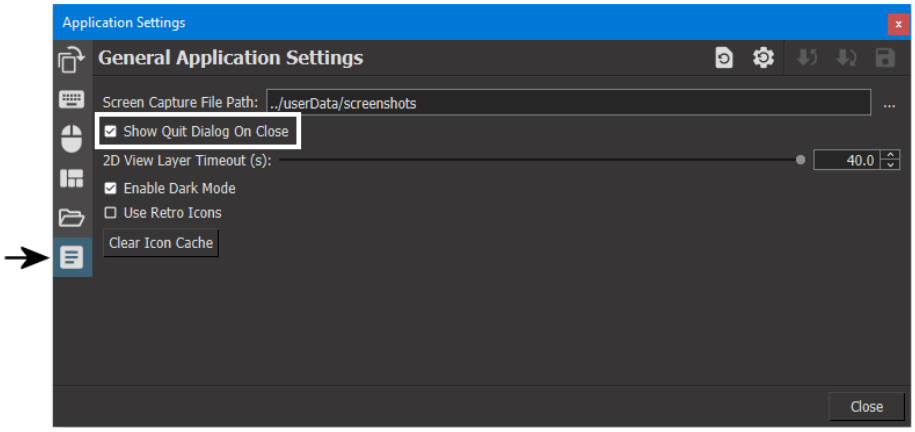
Disabling the Quit Prompt

When you exit VR-Vantage, you are prompted to confirm that you want to exit. You can disable this prompt.

➤ **To disable the quit prompt:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the General Application Settings page (Figure 12).

Figure 12. General Application Settings page



3. Clear the Show Quit Dialog On Close check box.

3.2. Introduction to the VR-Vantage Graphical User Interface

The VR-Vantage graphical user interface (GUI) uses features that are common to most windowed applications, such as menus, toolbars, dockable panels, and context-sensitive help. For a brief introduction to these features and descriptions of common icons used in VR-Vantage, please see "Chapter 36. The VR-Vantage User Interface" on page 539.

3.3. Opening a Terrain

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

(If you want to open files directly from their native formats, you do so by loading terrain patches, raster maps, and feature layers. You can then save the resulting terrain to an MTF file. For details, please see "26.1. Terrain Agility and Composability" on page 416. You can also learn about other terrain topics in the *Adding Content to MAK ONE Applications Reference Manual*:

- The *Composing Terrains* chapter explains how to compose a terrain from source data.
- The *Loading Data Using Earth Files* chapter explains how to load streaming terrains using an earth file.
- The "Connecting to Terrain Servers" section explains how to open a geocentric terrain from a terrain server.

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

➤ **To open a terrain:**

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

You can also open a terrain by dragging and dropping the *.mtf* file onto the main window.

3.3.1 Closing a Terrain

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

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

3.3.2 Reloading a Terrain

You can quickly reload a terrain without using a file selection dialog box.

➤ To reload a terrain, choose **File > Reload Terrain**, or click the Reload Terrain button ( ) on the Terrain Toolbar.

3.3.3 Loading Recently Used Terrains

VR-Vantage maintains a list of recently used terrains. You can select one of these terrains to load in either of the following ways:

- Choose **File > Open Recent Terrain >** *terrain*, where *terrain* is one of the terrains listed on the submenu.
- Click the down arrow next to the Open Terrain button ( ) on the Terrain Toolbar and select a terrain from the list.

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), HLA 1516 (RPR FOM 1.0 and RPR FOM 2.0, draft 17), and HLA Evolved (IEEE 1516-2010, also referred to as HLA 1516e). You can change the configuration values of the default connectors and you can add connectors. For details about creating and editing connections, see "Chapter 4. Managing Network Connections" on page 83 .

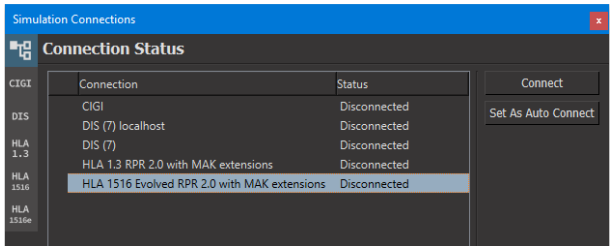
When VR-Vantage starts up, it does not automatically connect to a simulation network unless you configure it to do so. The auto connect feature lets you specify that VR-Vantage automatically connect to a network through a connection when it starts up. If you do not use auto connect, you must connect 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, see "3.4.3 Using the Simulation Connections Toolbar" on page 78 .

➤ **To connect to a simulation network:**

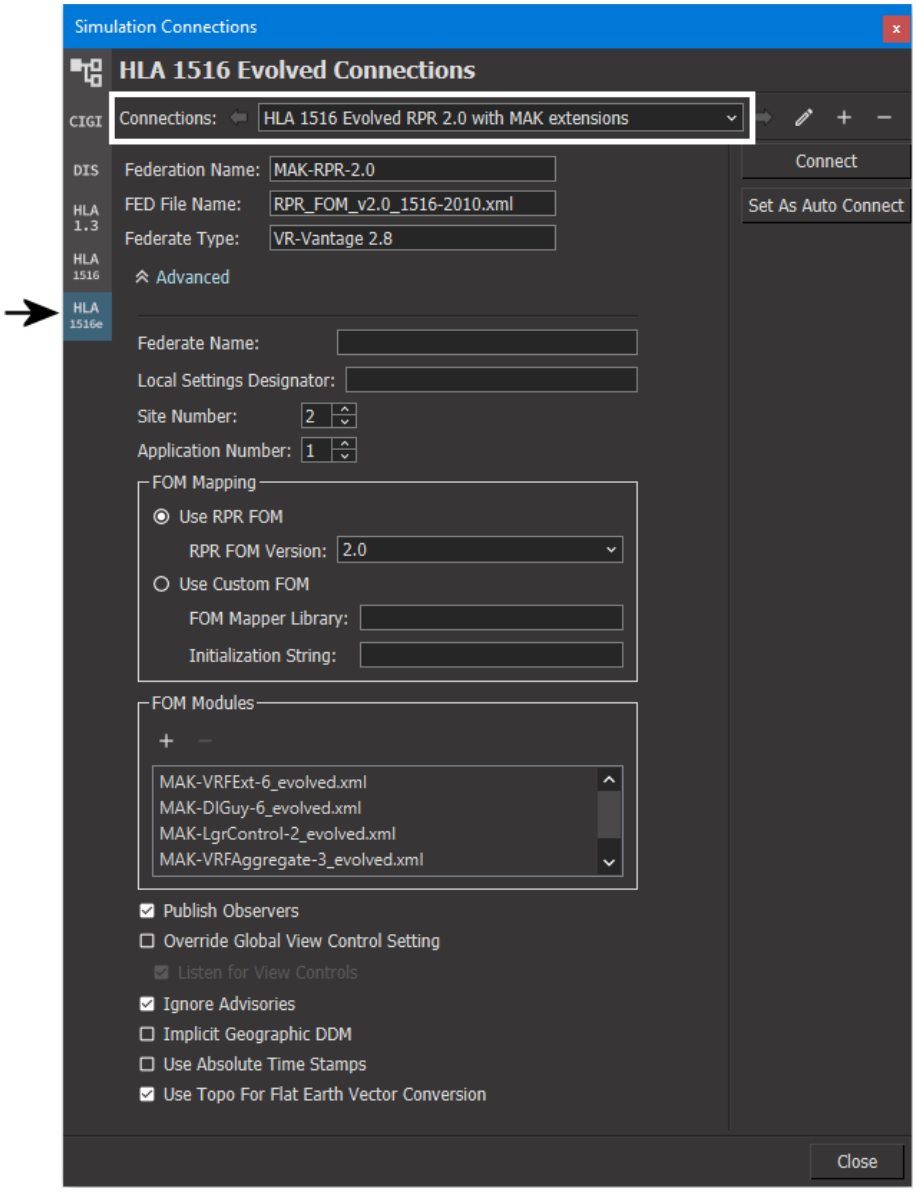
1. Choose **Settings > Connection**. The Simulation Connections dialog box opens (Figure 13).

Figure 13. Connection Status page



2. Select the page for the connection type that you want to use.
3. Select a connector in the Connections list (Figure 14).

Figure 14. HLA Evolved Connections page

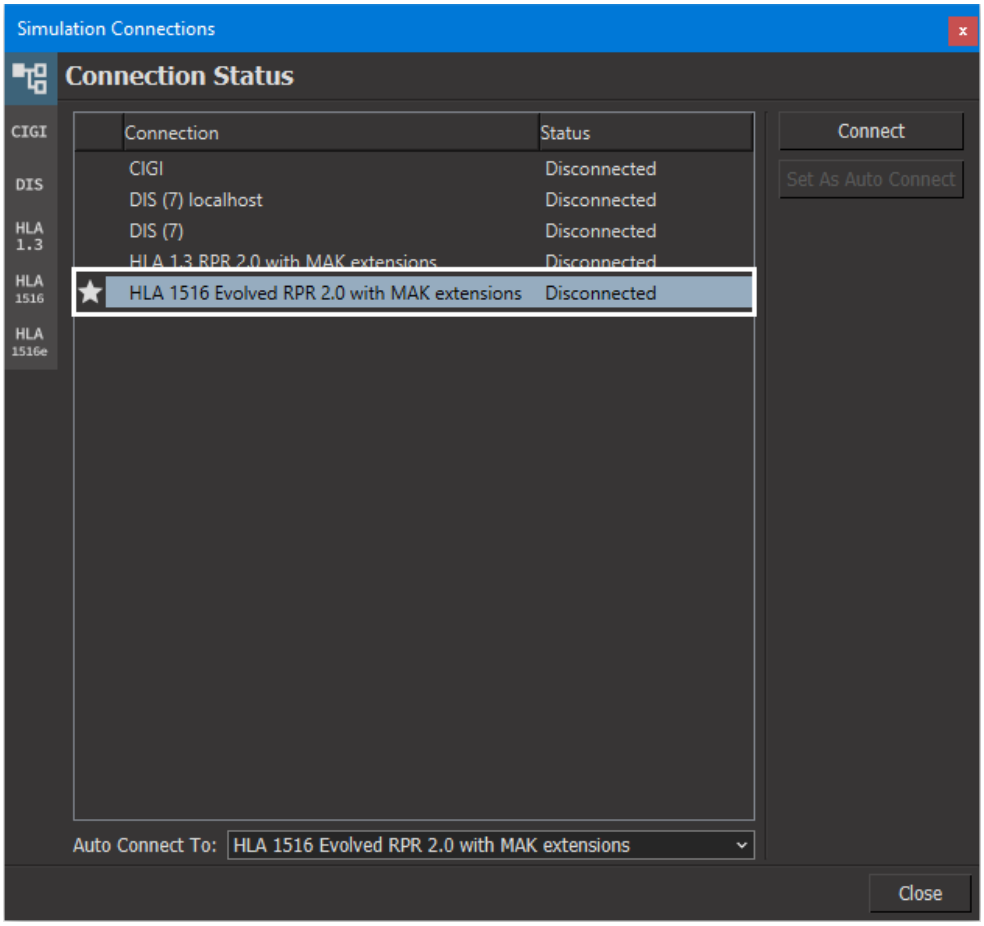


4. Click Connect.

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 15).

Figure 15. 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 13 on page 75):
   a. Select the Connection Status page.
   b. Do one of the following:
      — Select the desired connection in the Connection list and click Set As Auto Connect.
      — Select a connection from the Auto Connect To list. (To disable auto connection, select the blank line.)

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

3.4.2 Disconnecting from the Simulation Network

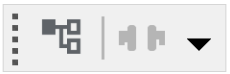
➤ **To disconnect from the simulation network:**

1. Choose **Settings > Connection**. The Simulation Connections dialog box opens (Figure 13 on page 75).
2. On the Connection Status page or on a protocol-specific page, select the connection that you want to disconnect.
3. Click Disconnect.

3.4.3 Using the Simulation Connections Toolbar

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

Figure 16. Simulation Connections Toolbar

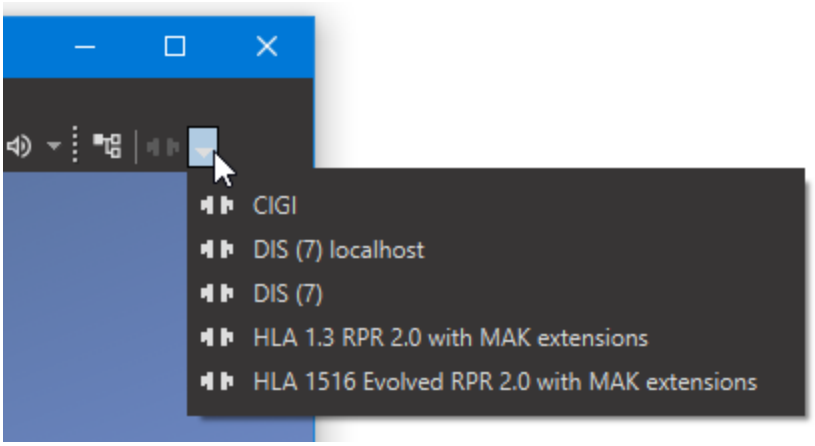


➤ To view connection status, click the Connection Status button ( ).

➤ **To quickly connect to selected simulation connections:**

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

Figure 17. Connection list



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



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

3. Click the Connect button.

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

3.5. Managing VR-Vantage Settings

VR-Vantage has the following types of settings:

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

  Independent settings are categorized as being global settings or observer-specific settings. Global settings apply regardless of the observer mode. Observer-specific settings can be different for each observer mode. For more information, see "3.5.2 Global Settings and Observer-Specific Settings" on page 81.
- Dependent settings are the schemas, model definitions, element definitions, and object type mappings that collectively determine how simulation objects and objects are modeled in the scene. Changing a dependent setting, such as a model definition may affect settings that depend on it, such as an entity definition.

VR-Vantage manages settings as follows:

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

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

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

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

- When you initiate a save or restore operation on independent settings, it saves or restores all of 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 restore operation on dependent settings, related settings may also be restored. VR-Vantage displays a message listing the settings that will be restored.
- When you save dependent settings, you either export all settings of a given type or selected settings. For details, see the relevant chapters in *Visual Models in MAK Applications* in the *Adding Content to MAK ONE Applications Reference Manual*.

Figure 18 illustrates the common settings management buttons. (The Visual Model Editors dialog box has some additional buttons.)

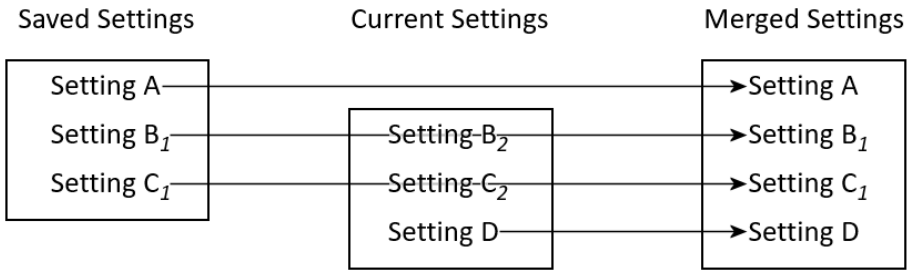
Figure 18. Settings buttons



- Revert to the default settings. Overrides any changes made to settings during this session.
- Restore the factory settings. Changes settings to the settings used when VR-Vantage was installed. (The factory settings and default settings may be different.)
- Import settings from a file. Replaces the current settings with those stored in the selected file.
- Merge in settings from a file. 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 19 illustrates how merged settings work. Setting A in the saved settings has no match in current settings, so it is added to the merged settings. Current settings B_2 and C_2 are replaced with saved settings B_1 and C_1. Current setting D has no match in saved settings, so it is retained in the merged settings.

Figure 19. Merged settings



- Save all settings to a file. Saves the current settings to the selected file.
- Export selected setting to a file.

- The buttons described in this topic are disabled on dialog box pages where their function is not supported. This includes most of the pages on the Terrain Settings dialog box.
- Each VR-Vantage application saves model definition and element definitions to *./SharedData/16/latest/ModelData/Configuration/Definitions*. Other settings are saved to *./appData/settings/stealth* or *./appData/settings/vantageIG*, depending on the application.
- If you load an alternative settings file at startup, it is treated like an imported settings 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 or display engines are installed. Then import the settings into any Settings page that you customized on the source VR-Vantage machine.

3.5.2 Global Settings and Observer-Specific Settings

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

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

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



4. Managing Network Connections

This chapter provides details about how to configure network connections.

4.1. Managing Simulation Connections 84
4.2. Configuring Connection Settings 86

4.1. Managing Simulation Connections

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

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

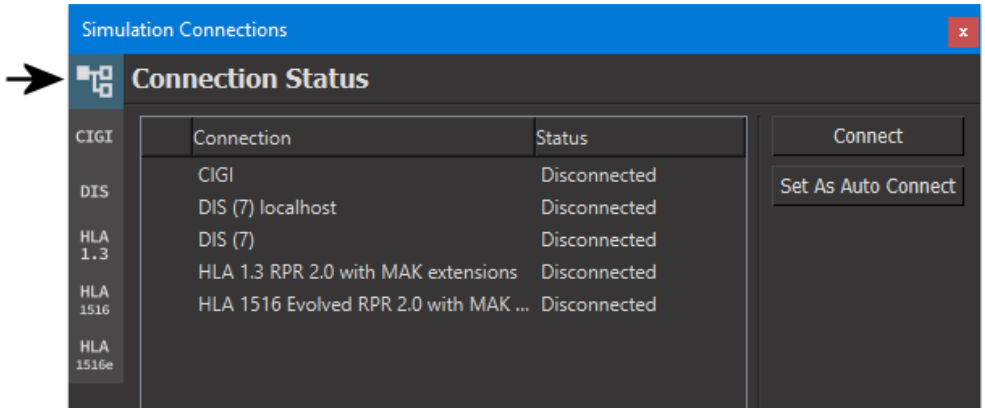
4.1.1 Displaying Connections

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

➤ **To view the list of connections:**

1. Choose **Settings > Connection**. The Simulation Connections dialog box opens.
2. Select the Connection Status page (Figure 20).

Figure 20. Simulation Connections dialog box, Connection Status page



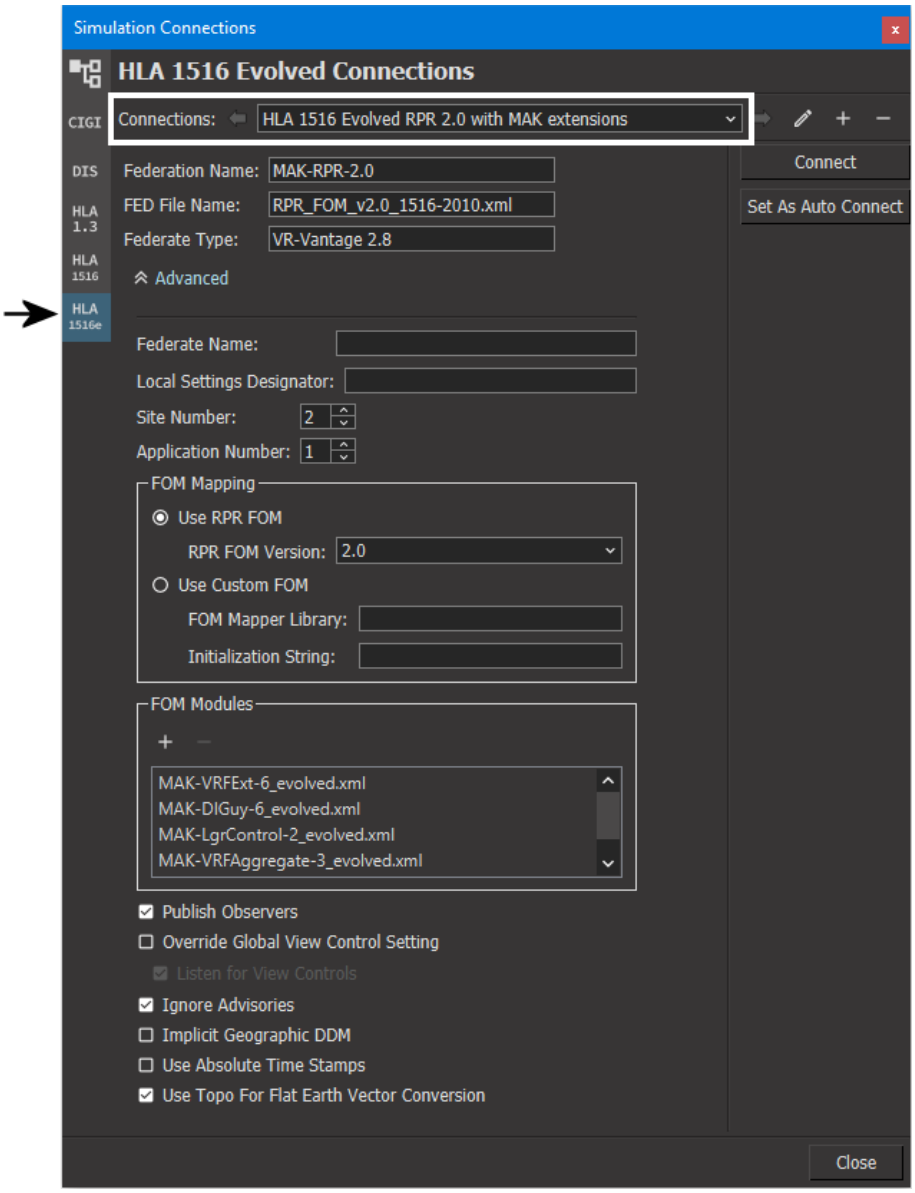
4.1.2 Adding a Simulation Connection

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

➤ **To add a simulation connection:**

1. Choose **Settings > Connection**. The Simulation Connections dialog box opens (Figure 20 on the previous page).
2. Select the page for the connection type you want to add (Figure 21).

Figure 21. Protocol-specific page



3. Click the Add button (+) to the right of the Connections list. A new connection is added to the list. (To change the name of the connection, follow the procedure in "4.1.3 Renaming a Simulation Connection" on the next page.)
4. Set the connection parameters to the desired values. (For details about connection parameters, please see "4.2. Configuring Connection Settings" on the next page.)

5. Optionally, click Set As Auto Connect to have VR-Vantage automatically connect using this connection when it starts up.
6. Click Close.

4.1.3 Renaming a Simulation Connection

➤ **To rename a simulation connection:**

1. Choose **Settings > Connection**. The Simulation Connections dialog box opens (Figure 20 on page 84).
2. Select the page for the connection type that you want to rename.
3. In the Connections list, select the connection that you want to rename.
4. Click the Rename button (). The Rename Connection dialog box opens.
5. Type a new name for the connection.
6. Click OK.

4.1.4 Deleting a Simulation Connection

➤ **To delete a simulation connection:**

1. Choose **Settings > Connection**. The Simulation Connections dialog box opens (Figure 20 on page 84).
2. Select the page for the connection type that you want to delete.
3. In the Connections list, select the connection that you want to delete.
4. Click the Delete button (). You are prompted to confirm the deletion.
5. Click Yes.

4.2. Configuring Connection Settings

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

HLA 1.3 and HLA Evolved share many of the same parameters; HLA Evolved has two additional 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, MAK'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 20 on page 84).
2. Select the page for the connection type that you want to configure.
3. In the Connections list, select the connection that you want to configure, or add a new connection, as described in "4.1.2 Adding a Simulation Connection" on page 84.
4. Click Advanced to display all of the parameters.
5. Specify values for connection parameters, as described in the following tables: Table 3 below, Table 4 on the next page, or Table 5 on page 90.

4.2.1 HLA Connection Settings

Table 3 describes the connection settings for HLA 1.3 and HLA 1516e.

Table 3. HLA connection settings

Parameter	Description
Federation Name	Specifies the federation execution name.
FED File Name	Specifies the FED file. Default: the federation name with *.fed* appended.
Federate Type	Federate Type can be used to distinguish different categories of federates, and its only practical use is in save-and-restore.
Advanced	
Federate Name	Specifies a unique name that can be assigned to the federate. No two federates within the same federation can have the same name. If no name is specified, the RTI will automatically assign a unique name for the federate. (HLA 1516e only)
Site Number	Specifies the site number for the observer. The Site ID and Application Number uniquely identify the observer.
Application Number	Specifies the application number for the observer.
Use RPR FOM	Specifies use of a version of the RPR FOM.
RPR FOM Version	Specifies the RPR FOM version. VR-Vantage has built-in support for RPR FOM versions 0.5, 0.7, 0.8, 1.0, 2.0006, 2.0014, 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.
Use Custom FOM	Specifies use of a FOM other than the RPR FOM.

Table 3. HLA connection settings (continued)

Parameter	Description
FOM Mapper Library	Specifies the name of a FOM Mapper library.
Initialize String	Specifies initialization data for the specified FOM Mapper, if required. It is your responsibility to know if your FOM Mapper needs initialization data.
FOM Modules	Lets you specify FOM Modules. Consult your RTI documentation for information about FOM Modules. (HLA 1516e Only)
Publish Observers	Specifies whether or not to publish an entity for the observer that is using this connection.
Override Global View Control Setting	Apply the setting in this connection to instead of the setting in the GUI. If this is used, the GUI setting is ignored.
Listen for View Controls	Specifies whether or not to respond to view control messages sent by other applications.
Ignore Advisories	Enables or disables use of HLA advisory messages.
Implicit Geographic DDM	Enables or disables use of implicit DDM. Valid only with the MAK RTI.
Use Absolute Time Stamps	Enables or disables use of absolute time stamps.

4.2.2 DIS Connection Settings

Table 4 describes the connections settings for DIS connections.

Table 4. DIS connection settings

Parameter	Description
Port	The DIS port to connect to.
Exercise ID	Specifies the exercise ID for VR-Vantage.
Site Number	Specifies the site number for VR-Vantage.
Application Number	VR-Vantage can send PDUs to the network to communicate the observer's position and orientation. By default, these PDUs are sent to the host machine's broadcast address. You may want to direct VR-Vantage data to a unicast address so it is received by only one application.
DIS Version	Specifies the DIS version (4, 5, or 6).

Table 4. DIS connection settings (continued)

Parameter	Description
Network Interface Address	On computers with multiple network cards, the address of the network card to use.
Advanced	
Destination Address	Specifies the destination address for outgoing PDUs. Default: the computer's broadcast address.
Multicast Addresses	Specifies one or more multicast groups to subscribe to. Separate multiple addresses with a semi-colon (;). For more information about multicast addresses, please see the note that follows this table.
Send Buffer Size	Increasing the send and receive buffer size can reduce dropped packets. If the parameters are set to 0, the system default setting is used.
Receive Buffer Size	Increasing the send and receive buffer size can reduce dropped packets. If the parameters are set to 0, the system default setting is used.
Multicast TTL	Specifies the number of routers that a message can pass through when PDUs are sent to multicast addresses.
Enable Timeout Processing	Enables or disables applying a timeout value to discovered objects.
Timeout Interval	The number of seconds to wait without receiving an updated before timing out an object.
Use Asynchronous IO	Enables or disables asynchronous IO. Use of asynchronous IO can reduce dropped packets.
Use Absolute Time Stamps	Enables or disables use of absolute time stamps.
Show Self Published Objects	Broadcast the location of objects that VR-Vantage creates - primarily the observer.
Publish Observers	Specifies whether or not to publish an entity for the observer that is using this connection.
Override Global View Control Setting	Apply the setting in this connection to instead of the setting in the GUI. If this is used, the GUI setting is ignored.
Listen for View Controls	Specifies whether or not to respond to view control messages sent by other applications.



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.

4.2.3 CIGI Connection Settings

Table 5 describes the connections settings for CIGI connections.

Table 5. 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 29. Mapping CIGI Models and Components" on page 437.
Driver Frequency	The frequency at which VR-Vantage should try to communicate with the host. There is no guarantee that this frequency can be maintained.
Transport Type	The network transport type to use: Best Effort, Reliable Client, or Reliable Server.
Host IP Address	The IP address of the CIGI host.
Network Device Address	The device address for the network card to be used.
Listen Port	The port on which to listen for CIGI messages
Send Port	The port on which to send CIGI messages.
Packet Buffer Size	Specifies the amount of space to allocate for packets.
CIGI Messages: Incoming CIGI Messages: Outgoing	The number and size of CIGI message buffers to maintain. Decreasing the number or size can slow down performance. Increasing the number or size can use up memory.



5. Optimizing Performance

This chapter explains how to monitor performance and improve performance.

5.1. Factors that Affect Performance 92
5.2. Displaying Performance Statistics 93
5.2.1 Displaying VR-Vantage Performance Statistics 94
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5.4. Clearing the Model Instancing Cache 96
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5.1. Factors that Affect Performance

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

- Processor speed.
- Video card. (Always use the latest drivers for your video card.)
- Available memory.
- Size of the terrain database.
- The number and complexity of models loaded and how well they have been optimized for performance. For information about optimizing models, see "Best Practices for Creating Models" in the *Adding Content to MAK ONE Applications Reference Manual*.
- Number of objects in the simulation and how active they are.
- Use of model instancing.

You can display statistics to help you evaluate VR-Vantage's performance. For details, please see "5.2. Displaying Performance Statistics" on the facing page.

The following display features can affect performance:

- Displaying performance statistics.
- Use of ground clamping.
- Displaying track histories.
- Displaying height-above-terrain lines.
- Enabling advanced lighting and various lighting effects.
- Enabling dynamic ocean effects. When you are using Plan View observer mode, enabling wakes, spray effects, and the buoyancy model can seriously degrade performance. These features are disabled by default. If you inadvertently enable them and experience this problem, switching to Stealth mode and back to Plan View mode restores performance.
- Sound effects. Disabling sound effects can improve performance.
- You can configure anti-aliasing settings and Horizon Based Ambient Occlusion (HBAO) to improve performance. For details, please see "5.7. Configuring Graphics Quality" on page 99 .

In addition to the sections in this chapter and in *Terrain Performance and Configuration* in the *Adding Content to MAK ONE Applications Reference Manual*, the following sections describe options for optimizing performance:

- "Configuring SpeedTree Trees" in the *Adding Content to MAK ONE Applications Reference Manual*.
- "5.4. Clearing the Model Instancing Cache" on page 96.
- "6.4.1 Setting the Clipping Planes" on page 122.
- "19.13. Filtering Simulation Objects Using Interest Management" on page 341.

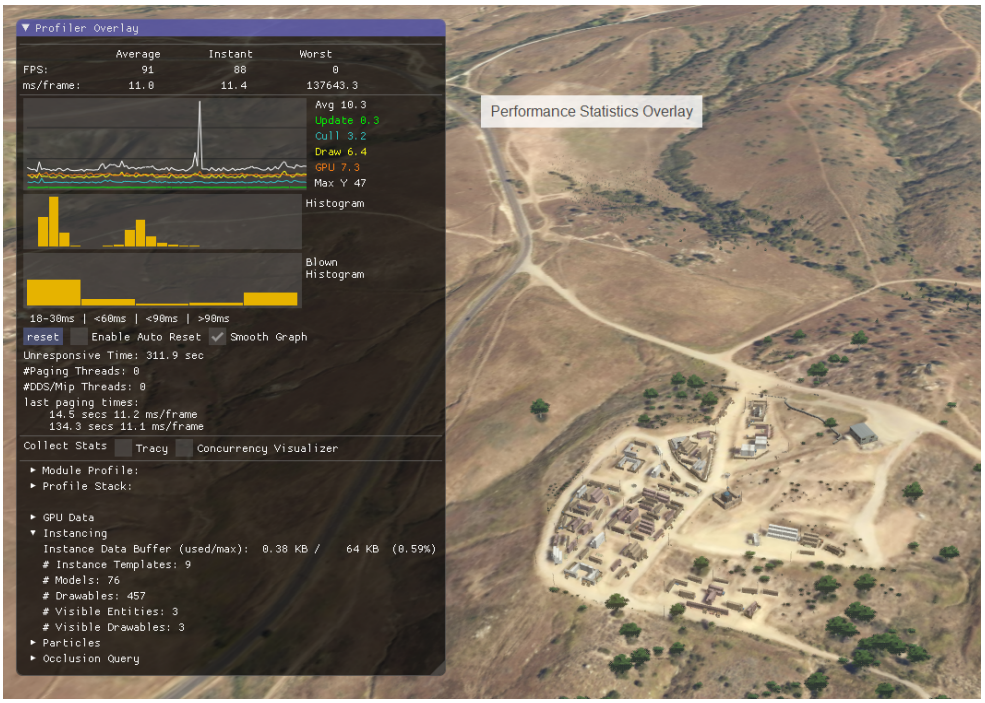
- "Setting the Ocean LOD Elevation" in the *Adding Content to MAK ONE Applications Reference Manual*.
- "Configuring the Ocean Height Map" in the *Adding Content to MAK ONE Applications Reference Manual*.
- "21.11. Displaying Wakes and Spray Effects" on page 374.
- "13.7. Configuring the Skybox Cube Map" on page 233.
- "16.1.9 Improving Performance when Attaching to Ground Objects" on page 292.
- "21.12. Enabling Buoyancy for Surface Entities" on page 375.
- "Chapter 13. Lighting Effects" on page 223.

Nahimic audio software can have a negative impact on performance. See "A.1. Performance and Display Issues" on page 560 to learn how to add the application to the *BlackApps.dat* file.

5.2. Displaying Performance Statistics

VR-Vantage can display VR-Vantage performance statistics and a function profiler (Figure 22).

Figure 22. VR-Vantage performance statistics and function profiler



Displaying performance statistics can affect performance.

5.2.1 Displaying VR-Vantage Performance Statistics

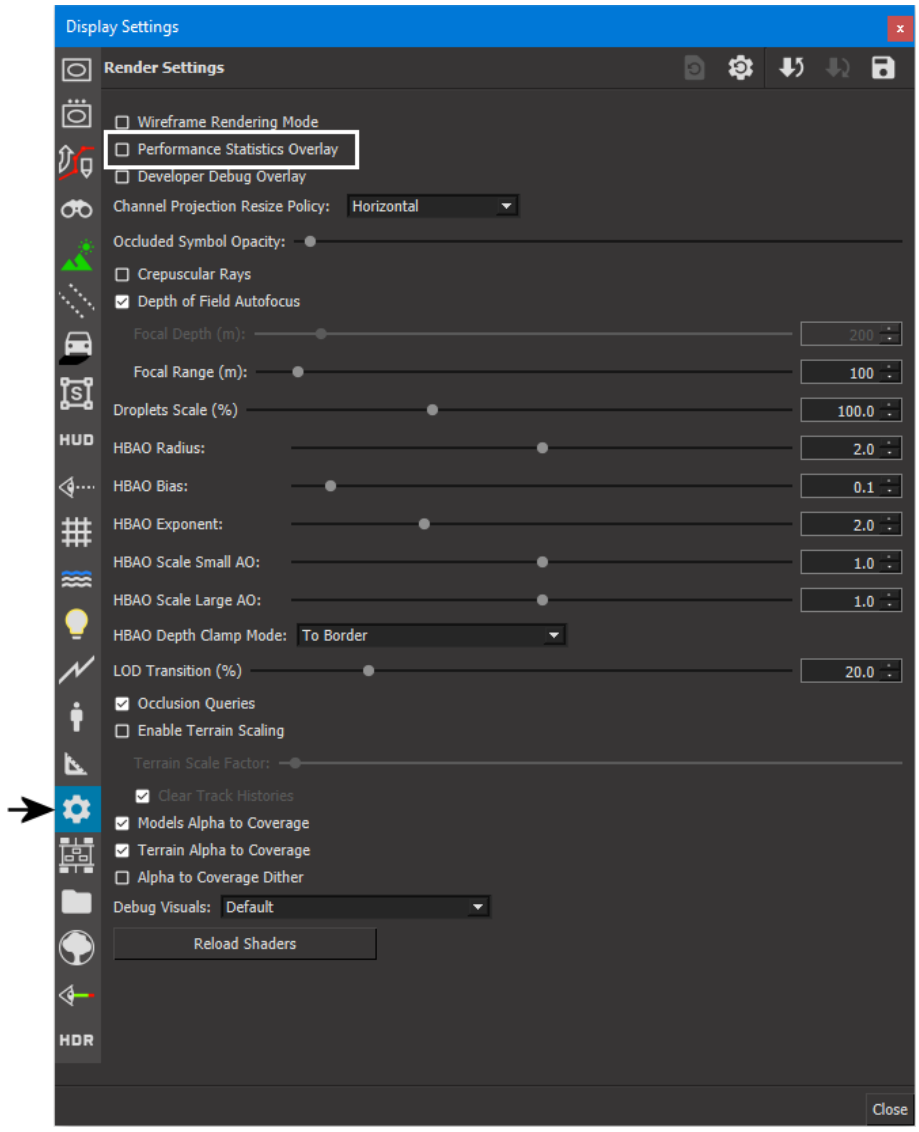
The VR-Vantage Performance Statistics shows information about the scene, while the Function Profiler is primarily for the use of developers who are debugging VR-Vantage applications. For information about how to integrate the profiler into your code, please see Chapter 11, *Using the Function Profiler*,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

For information about another debugging utility, please see "5.12. Using the Developer Debug Overlay" on page 106.

➤ **To display VR-Vantage performance statistics:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 23).

Figure 23. Render Settings page



3. Select the Performance Statistics Overlay check box. A statistics display is added to the window (Figure 22 on page 93).

5.2.2 Using the Tracy Client

VR-Vantage includes the Tracy Client, which you can use to evaluate performance or save a file to send to MAK Support to help debug performance issues. To learn more about using the Tracy Client, you can read the documentation at https://bitbucket.org/wolfpld/tracy/downloads.

➤ **To run the Tracy Client and save a file:**

1. Choose **Settings > Display**. Display Settings dialog box opens. Select the Render Settings page (Figure 23 on the previous page).
2. Select the Show Performance Statistics Overlay check box. A statistics display is added to the window (Figure 22 on page 93).
3. Next to Collect Stats, select the Tracy check box.
4. To run Tracy Client:
   - On Windows, from the Start menu, choose **MAK Technologies > Tracy Client**.
   - On Linux, run *../bin64/Tracy-release*.
5. Verify the client address and then click Connect. The Tracy Client displays the information from VR-Vantage.
6. To save the file, click Connection (). The Connection dialog opens.
7. Click Save Trace.
8. Save the file.

5.3. Preloading Models

When VR-Vantage discovers simulation objects on the network, it must load the visual models for these objects. This can affect performance. It is particularly noticeable when VR-Vantage first connects to an exercise, but can occur at other times if there is a sudden influx of new objects. You can reduce the likelihood of this problem by loading models before you connect to an exercise.

To preload models, you create a list of the models that you expect to need. VR-Vantage loads these models when it starts up. You can also load them immediately.

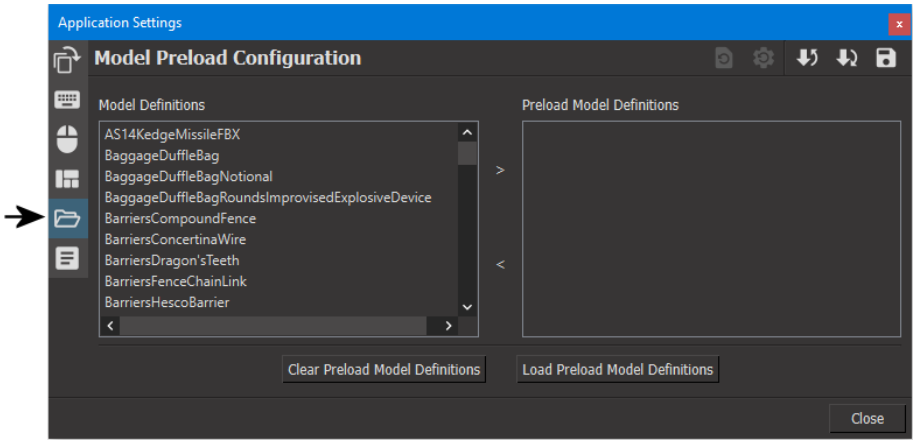
While VR-Vantage is participating in an exercise, you can capture a list of models that have not been preloaded. You can then add this list of models to the default preload list or specify the list in a command-line argument.

By default, the list of models to be loaded is saved to *./appData/settings/<application>/default_ModelPreload.mpsx*. You can export the list to a different file name. You can also import and merge lists.

➤ **To configure the list of models for preloading:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the Model Preload Configuration page (Figure 24).

Figure 24. Model Preload Configuration page



3. In the Model Definitions list, select the models that you want to preload. Use the standard methods of multiple object selection.
4. Click the right-facing arrow to move the models into the Preload Model Definitions list.
5. To load the models immediately, click Load Preload Model Definitions.

5.3.1 Command-Line Options for Preloading Models

By default, when VR-Vantage starts, it loads the models listed in *default_ModelPreload.mpsx*. You can specify that it load a different model list with the `--modelPreloadFileName` command-line option. The syntax is:

`--modelPreloadFileName` *`filename`*

where *`filename`* is the name of the file to load.

While VR-Vantage is participating in an exercise, it can capture a list of models that were not preloaded. You can then merge this list with the default preload file or specify it as an alternative to the default file on the command line. To capture a list of models, use the following command:

`--discoveredModelPreloadFileName` *`filename`*

where *`filename`* is the name of the file to save the list to.

5.4. Clearing the Model Instancing Cache

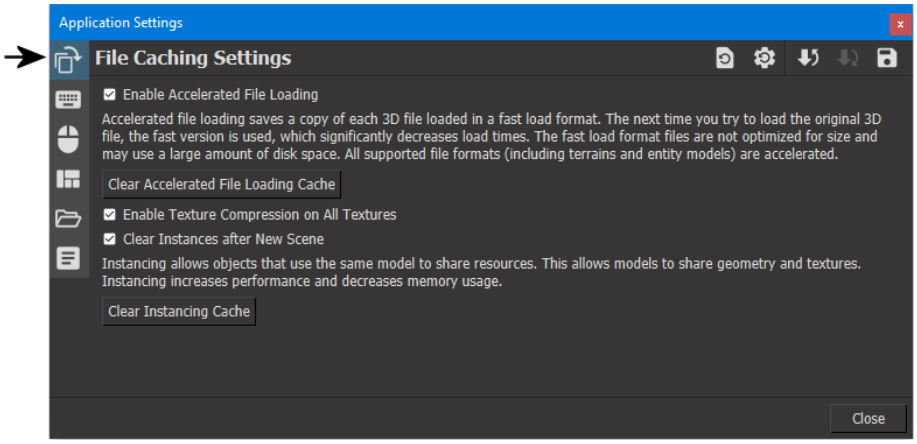
VR-Vantage has a feature called model instancing that lets models share resources, such as geometry and textures. These shared resources are stored in a cache. Use of model instance caching decreases memory use and improves performance.

You can clear the model instancing cache if you need the disk space. You can clear it automatically whenever you create a new scene, or you can clear it manually.

➤ **To clear the model instancing cache after each scene change:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the File Caching Settings page (Figure 25).

Figure 25. File Caching Settings page



3. Select the Clear Instances After New Scene check box.

➤ **To clear the model instancing cache manually:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the File Caching Settings page (Figure 25).
3. Click Clear Instancing Cache.

5.5. Configuring VSync

VSync (vertical synchronization) synchronizes VR-Vantage's frame rate with your monitor's refresh rate. This prevents a visual anomaly called tearing, in which parts of two frames of data can be visible at the same time, but it caps the maximum render frame rate based on the display. Typically this cap is 60 Hz.

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

By default, VSync is disabled. If you want to enable it, start up with the `--enableVSync` command-line option, or you can configure your video card to force it to be on.



For `--enableVSync` to work, your graphics card must be set to "Use application setting".

5.5.1 Managing 3D Settings and Multiscreen Performance

In a configuration with remote displays on different screens using the same host computer, you can encounter frame rate issues when vertical sync (VSync) is enabled.

If you see a very low frame rate or a frame rate that cycles between high and very low, first make sure that all monitors are using the same refresh rate (usually 60 Hz).

➤ **To check the refresh rate on a monitor:**

1. Open the NVIDIA Control Panel.
2. Choose the Change Resolution task.
3. Check the Refresh Rate.
4. If you made any changes, click Apply.

If that does not solve the problem, try changing the Vertical Sync setting in the NVIDIA Control Panel.

➤ **To edit the Vertical Sync settings:**

1. Open the NVIDIA Control Panel.
2. Choose the Manage 3D Settings task.
3. In the Global Settings tab, check the Vertical Sync setting. If Vertical Sync is set to On, try setting it to Use the 3D application setting or Off.
4. In the Program Settings tab, check whether vrvIG or vrvStealth are included in the list. If either is listed, try setting Vertical Sync to Use the 3D application setting or Off.
5. Click Apply.

5.6. Adaptive Tick Rate

The Adaptive Tick Rate check box in the Entity Display Settings controls whether the tick rate for entities adjusts based on their distance from the observer. You can enable adaptive tick rate to allow VR-Vantage to support a large number of entities that need to be updated in a scene. When adaptive tick rate is enabled, entities update their state (for example, position and orientation) less frequently when they are further from the observer.

Please note that there can be display issues with high speed objects, such as aircraft, when adaptive tick rate is enabled. It is intended for use when there are many human entities.



The distance used for adaptive tick rate has an inner radius and an outer radius. If an entity is farther than 1000 meters from the observer (inner radius), the updates are about once for every six frames. The update then decreases until 10,000 meters (outer radius), where the updates occur once every 30 frames. These distances are the default values.

➤ **To enable or disable adaptive tick rate:**

1. Choose **Settings > Display**.
2. Select or clear the Adaptive Tick Rate checkbox.

Figure 26. Adaptive Tick Rate in Entity Display Settings



5.7. Configuring Graphics Quality

VR-Vantage has command-line and display settings options that let you configure graphics quality. In particular, depending on the capabilities of your graphics card, you may need to adjust the default settings for anti-aliasing using `--antiAliasing` *level*. Anti-aliasing is a technique used to reduce the jagged edges of digital graphics. You can set the level to 0, 2, 4, 8, or 16. Default: 4. On older graphics cards, you may need to set anti-aliasing to 0 to improve performance.

You can also make adjustments to the horizon-based ambient occlusion. See "5.7.3 Configuring Ambient Occlusion" on page 102.

5.7.1 Alpha to Coverage

Alpha to coverage is a way of handling objects with transparency that improves rendering of objects that have a sharp transition between opaque and transparent. Grass, trees, and fences are a few examples of when alpha to coverage is a good option, as shown in Figure 27. In addition to improving visualization of some objects, there is a slight performance improvement when alpha to coverage is enabled.

Figure 27. Alpha to coverage



You can set alpha to coverage for models and terrains. For models, you can enable it globally or in specific model definitions. For terrains, you can enable it globally or for specific terrain patches.

By default, alpha to coverage is enabled globally for models and terrains.

If alpha to coverage is enabled, you can enable a dither shader that modifies the alpha with a noise pattern so that there are no hard edges between different alpha levels. The tradeoff for this setting is that it adds a small amount of noise as the object or camera moves.

VR-Vantage uses render bin 1 for the alpha to coverage render bin. You can change the render bin with the VRV_ALPHA_TO_COVERAGE_RENDERBIN environment variable. (Render bins are an OpenSceneGraph concept that affects the order in which scene objects are rendered. Do not set the render bin environment variable unless instructed to do so by a plug-in developer.)

Enabling Alpha to Coverage for Models

You can enable alpha to coverage globally for models and you can specify it for specific models. When you enable alpha to coverage globally, it affects all models that do not have it specified specifically in their model definition.

To enable or disable alpha to coverage for a specific model, add the alphaToCoverageEnabled parameter to the model definition and set it to true or false. For information about editing model definitions, see "Editing a Model Definition" in the *Adding Content to MAK ONE Applications Reference Manual*.

➤ **To enable or disable alpha to coverage globally for models:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 23 on page 94).
3. Select or clear the Models Alpha to Coverage check box.

Enabling Alpha to Coverage for Terrains

You can enable alpha to coverage globally for terrains or for specific terrain patches. The global setting affects all terrain patches that do not have an alpha to coverage option specified in their MTF file.

You enable alpha to coverage for a terrain patch when you add it. For details, see "Adding Elevation Data to a Terrain" in the *Adding Content to MAK ONE Applications Reference Manual*.

➤ **To enable or disable alpha to coverage globally for terrains:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 23 on page 94).
3. Select or clear the Terrain Alpha to Coverage check box.

Enabling the Dither Shader for Alpha to Coverage

If alpha to coverage is enabled, you can enable a dither shader that modifies the alpha with a noise pattern so that there are no hard edges between different alpha levels. The trade-off for this setting is that it adds a small amount of noise as the object or

camera moves.

➤ **To enable or disable the dither shader for alpha to coverage:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 23 on page 94).
3. Select or clear the Alpha to Coverage Dither check box.

5.7.2 Using the Ambient Occlusion Effect

Horizon-based ambient occlusion (HBAO) adds screen space ambient occlusion lighting effects to the scene. This improves the realism by approximating the amount of ambient light that impacts a scene, which provides more realistic lighting of three-dimensional objects.

HBAO is disabled in Figure 28 and enabled in Figure 29. The differences are subtle. Some differences you might notice are the light inside the building as seen through the window on the left side of that building, and the shadows on the wall of the building behind the fruit stand and grass.

Figure 28. HBAO disabled



Figure 29. HBAO enabled



➤ **To enable or disable HBAO:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page.
3. Select the observer mode for which you want to enable HBAO.
4. Select or clear the Ambient Occlusion (HBAO+) check box.

5.7.3 Configuring Ambient Occlusion

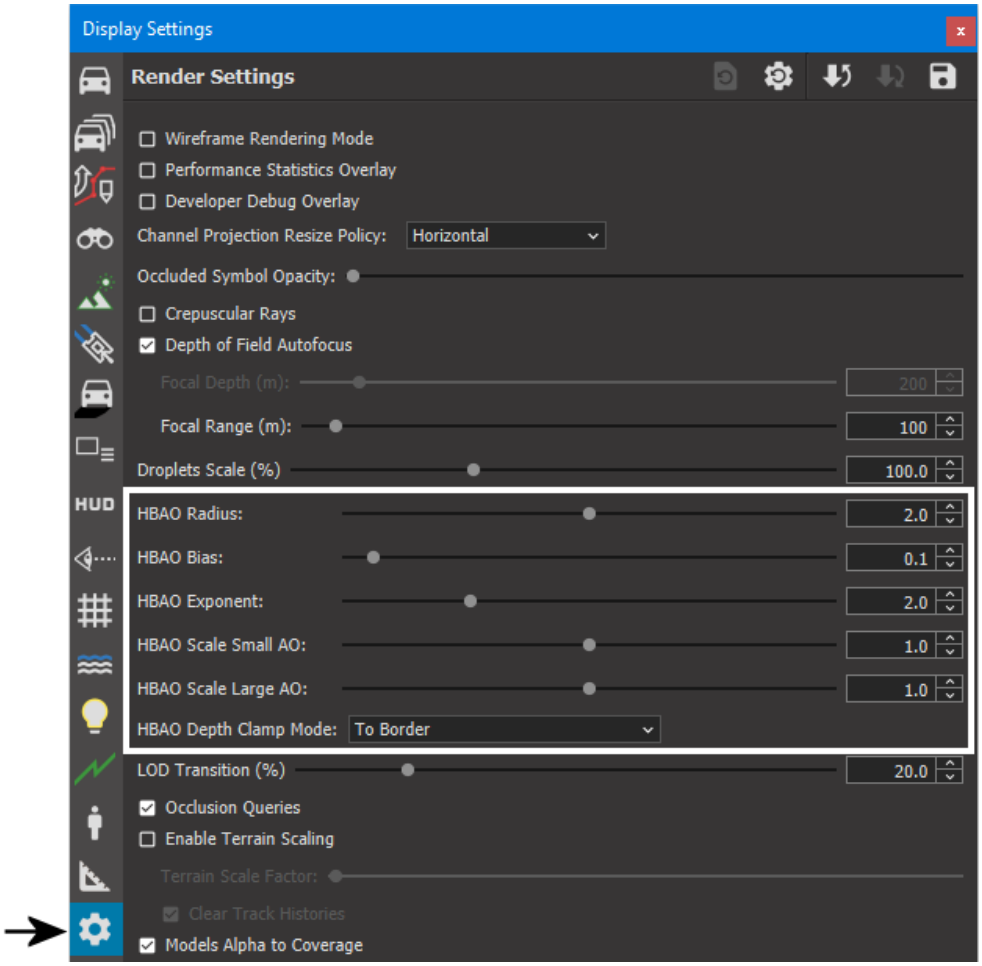
There are parameters that adjust how ambient occlusion appears.

- HBAO Radius. The distance from occluding objects where the HBAO effect is visible. Higher values cause the effect to extend further from occluding objects.
- HBAO Bias. The bias for thin items. At higher values, larger objects cause the most noticeable effect on surrounding objects. This can reduce polygon edge artifacts and artifacts caused by thin geometry.
- HBAO Exponent. The intensity of the HBAO effect. Higher values create a more intense effect.
- HBAO Scale Small AO. The intensity of the HBAO effect on objects that are close to each other. Higher values have a more intense effect on the small corner areas of objects and also objects that are close together.
- HBAO Scale Large AO. The intensity of the HBAO effect on objects that are at the edges of the specified HBAO Radius. Higher values make the area for objects that are around the HBAO radius distance from each other show a more intense effect.
- HBAO Depth Clamp Mode. The depth clamp mode to use. To Border uses a method that reduces the false occlusion of objects along the edge of the screen. To Edge uses a method that correctly applies the occlusion effect to objects along the edge of the screen.

➤ **To configure HBAO:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 30).
3. Adjust the HBAO settings as needed.

Figure 30. Render Settings page



5.8. Using Incremental Compiling with Streamed Data

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

Using OSG_ICO may cause LOD issues with other paged formats.

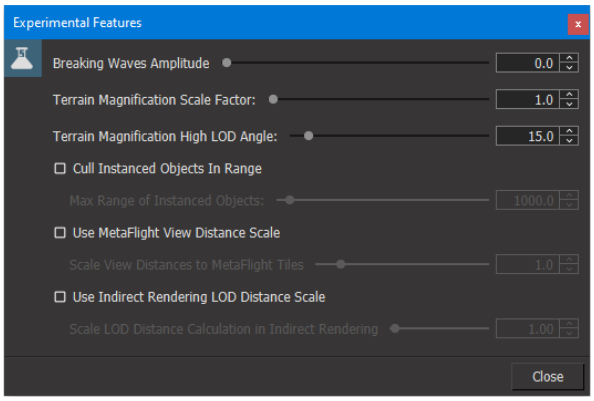
5.9. Culling Instanced Objects

You can specify a distance from the observer beyond which instanced objects do not get drawn. If you are not concerned about seeing distant objects, this can improve performance.

➤ **To cull objects based on their distance from the observer:**

1. Choose **Settings > Experimental Features**. The Experimental Features dialog box opens (Figure 31).

Figure 31. Experimental Features dialog box



2. Select the Cull Instanced Objects in Range check box. The Max Range of Instance Objects slider becomes available.
3. Set the slider to the distance beyond which you want to cull objects or specify a value in the box.
4. Click Close.

5.10. Coloring Draw Calls

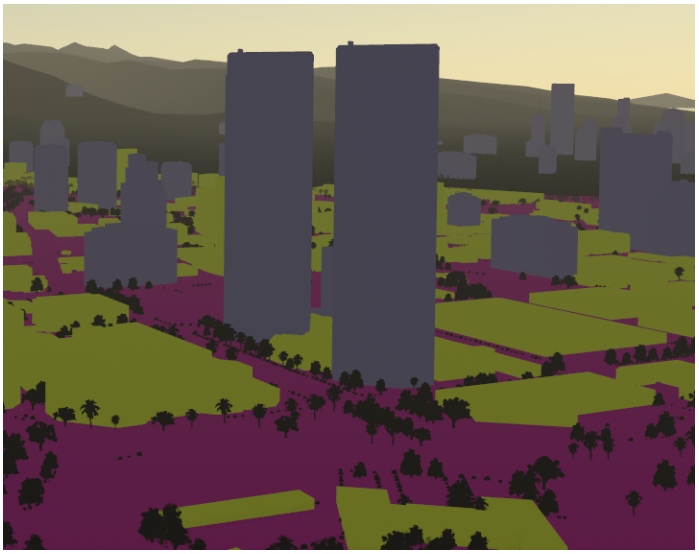
One of the factors that affects performance is the number of draw calls it takes to render a scene. VR-Vantage lets you color the draw calls in a scene so that you can see which objects could be creating performance problems.

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

Figure 32 illustrates a terrain with the feature tiles colorized.

Indirect geometry groups draw calls together to ensure that there are fewer draw calls. Indirect rendering for entities is enabled by default. To learn more, see "Indirect Rendering of Terrain" or "Indirect Rendering for Entities" in the *Adding Content to MAK ONE Applications Reference Manual*.

Figure 32. Colorized drawables on terrain



The colors do not update as new information comes into the scene. Therefore, you can refresh the colorization to see your changes by changing the Component Visualization setting to a different visual debug mode and then back to Debug Texture.

➤ **To visualize draw calls:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 23 on page 94).
3. In the Debug Visuals list, choose Colorize Drawables.

The colors may looked washed out if high dynamic range is enabled. See "13.9. Using High Dynamic Range Lighting" on page 234.

5.11. DI-Guy Performance Settings

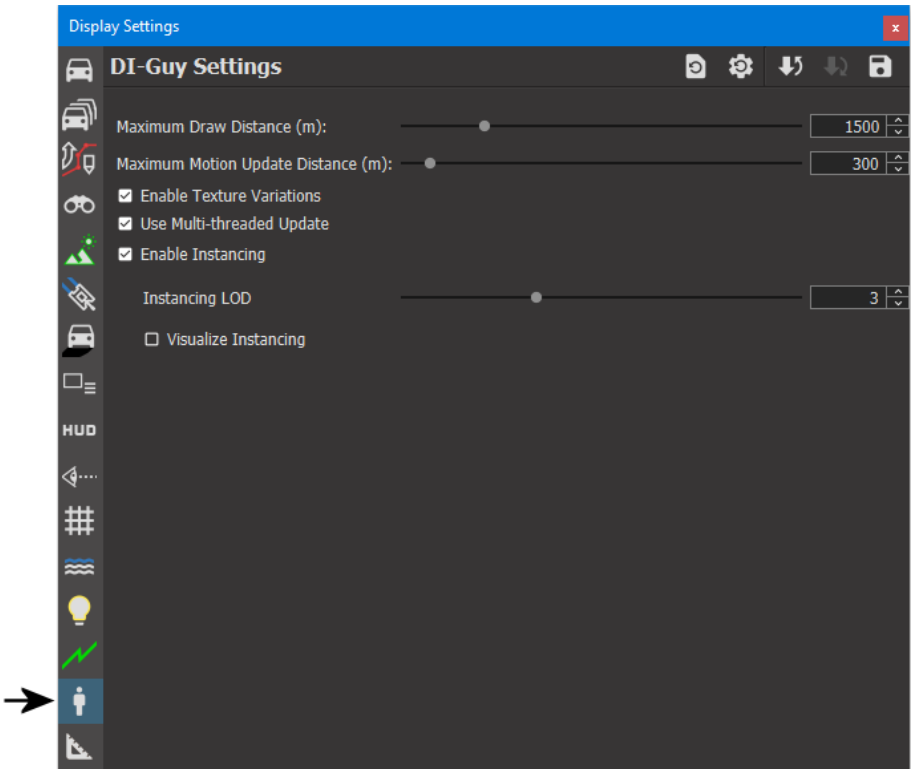
The following settings affect performance of DI-Guy human characters:

- Maximum draw distance. VR-Vantage will not render characters that are farther away from the observer than this distance.
- Maximum motion update distance. The distance at which VR-Vantage stops animating DI-Guys unless they are changing posture.
- Use multi-threaded update. Developers who are debugging DI-Guy may want to disable multi-threaded update to make it easier to debug.
- Enable instancing. Enabling instancing improves performance by reusing model data for similar characters. You can set the LOD beyond which instancing is used. You can visualize instanced characters.

➤ **To specify DI-Guy performance settings:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the DI-Guy Settings page (Figure 33).

Figure 33. DI-Guy Settings page

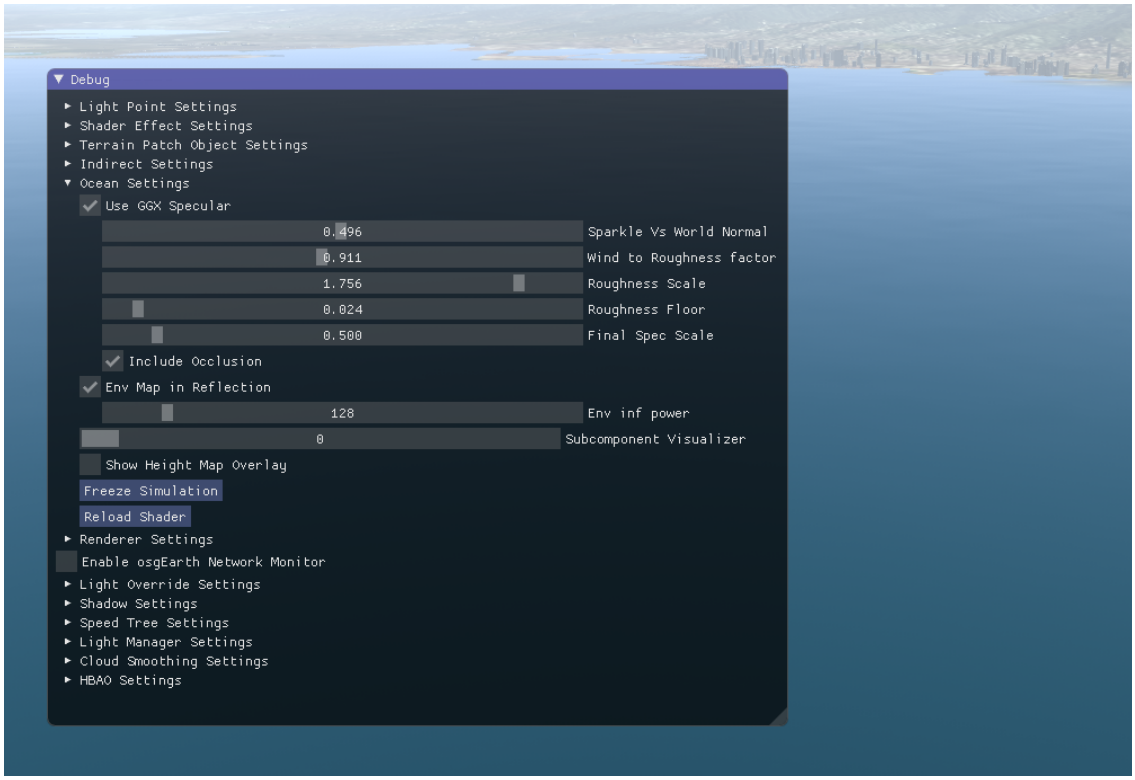


3. To set the maximum draw distance, adjust the Max Draw Distance slider or change the value in the box.
4. To change the distance at which DI-Guys stop animating, adjust the Maximum Motion Update Distance slider.
5. Optionally, select or clear the Use Multi-threaded Update check box.
6. Optionally, select or clear the Enable Instancing check box.
7. If instancing is enabled, adjust the Instancing LOD slider or change the value in the box.
8. Optionally, select or clear the Visualize Instancing check box.

5.12. Using the Developer Debug Overlay

VR-Vantage uses the ImGui API to create an overlay that developers can use to test changes to some of its visual features. VR-Vantage includes an overlay for testing ocean settings, shadow settings, and other visual features. It also includes an ImGui test user interface that demonstrates some of its features.

Figure 34. Developer debug overlay



This feature is provided “as is” for the use of interested developers. For complete information about how to use ImGui, please see documentation at https://github.com/ocornut/imgui and other web pages.

➤ **To enable the developer debug overlay:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 23 on page 94).
3. Select the Developer Debug Overlay check box. The Developer Debug Overlay opens. It has menus and options for Ocean Settings, SpeedTree Settings, osgEarth Network Monitor, and so on.
4. To view shadow settings:
    a. In the Display Settings dialog box, select the Shadow Settings page.
    b. Select the Enable Shadow check box.



II. Display Engine, Video Streaming, Head Mounted Displays

This section describes display engines, which render the visual data in VR-Vantage. It also covers video streaming and capabilities that involve special hardware.



6. Windows, Channels, and Display Engines

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

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6.1. The VR-Vantage Display Engine

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

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

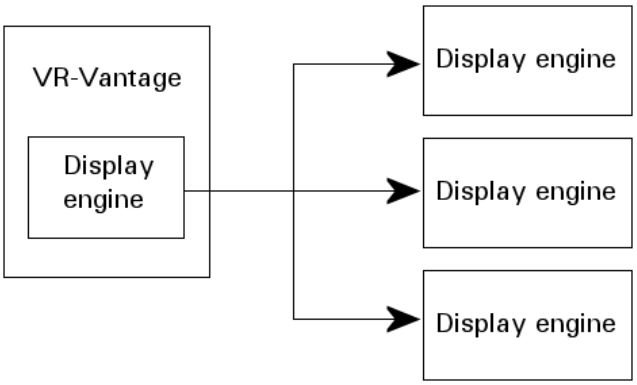
The master display engine can connect to multiple VR-Vantage Display Engines (typically running on other computers) and control what is displayed in their windows.



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

VR-Vantage drives all of the display engines it is connected to, as illustrated in Figure 35.

Figure 35. VR-Vantage and display engines





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

6.1.1 How VR-Vantage Responds to Display Engine Connections

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

6.1.2 The Display Engine's Connection States

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

6.1.3 Windows and Channels

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

6.1.4 Window Types

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

- Full screen. A full screen window uses the entire area of a monitor. It does not have any menus, panels, or other GUI controls.
- Resizable. A resizable window can be moved, resized, maximized, and minimized. It does not have any GUI controls. An inset view is an example of a resizable window. (For information about inset views, please see "17.1. Inset Views" on page 308.)
- Embedded. An embedded window is part of an application. The main display window in VR-Vantage is an embedded window. The application provides a variety of controls that affect the view in the window. You could, if you wanted to, change VR-Vantage's window to a different type, in which case it would no longer be embedded in the main application window.

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

6.2. Managing Display Engine Configurations

A VR-Vantage application has one display engine. You can add windows to the display engine and you can add channels to the windows. The windows and channels make up a display engine configuration. You can save a display engine configuration and load a

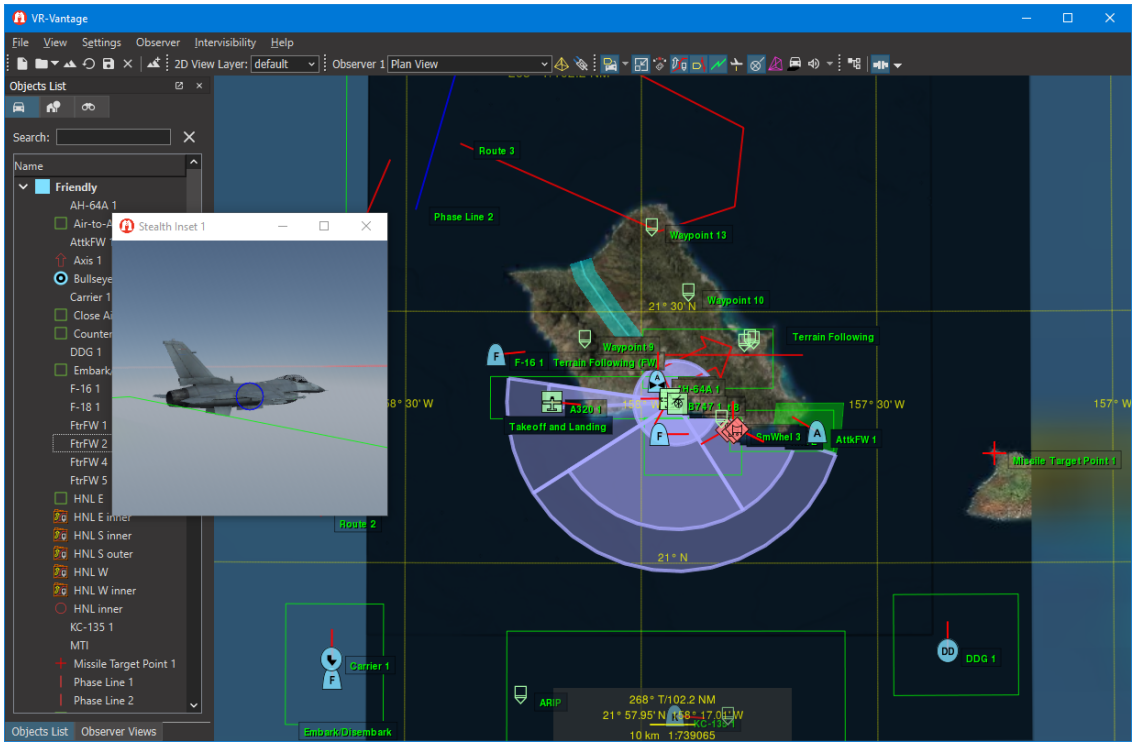
saved configuration. "7.1. Saving and Loading Display Engine Configurations" on page 142 shows how to edit a channel's attributes and how to save and load display engine configurations.

6.2.1 Adding a Window

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

➤ To add a window from the File menu, choose **File > New Stealth Window** (or **New Plan View Window**). (The new window commands that are available on the File menu depend on which VR-Vantage application you are running.) A new window opens (Figure 36).

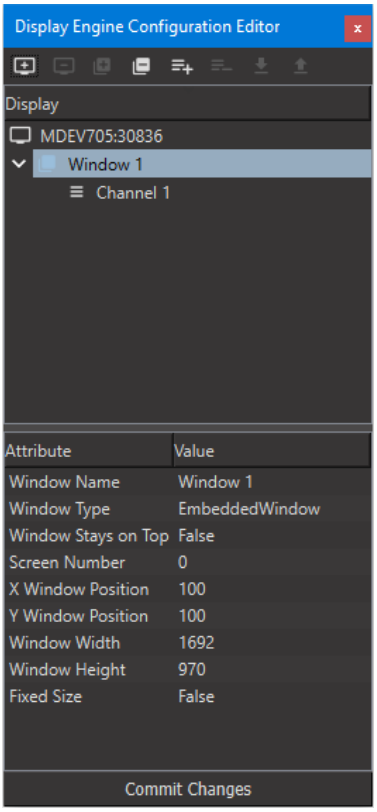
Figure 36. New window



➤ **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 37).

Figure 37. Display Engine Configuration Editor Panel



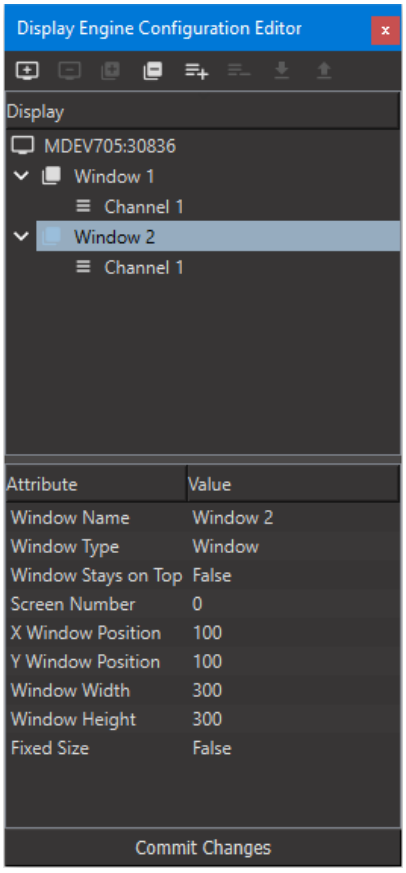


The Display Engine Configuration Editor Panel is available only in a VR-Vantage application, not on remote display engines.

2. Select the display engine at the top of the Display tree.

3. Click the Add a Window button (), or right-click the display engine name and choose **Add a Window** on the context-sensitive menu. A new window opens and is listed in the Display Engine Configuration Editor Panel (Figure 38).

Figure 38. New window



6.2.2 Adding a Channel to a Window

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

➤ **To add a channel to a window:**

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

> To see a difference between the channels, change the attributes of the new channel. For details about editing channel attributes, please see "6.4. Changing a Channel's Attributes" on page 120.

6.2.3 Removing a Window

➤ **To remove a window:**

1. In the Display Engine Configuration Editor Panel, select the window that you want to remove.

2. Click the Remove Window button (), or right-click the window name and choose **Remove Window** from the menu.

6.2.4 Removing a Channel

➤ **To remove a channel:**

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

6.2.5 Saving a Display Engine Configuration

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

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

➤ **To save a display engine configuration:**

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

6.2.6 Loading a Display Engine Configuration

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

➤ **To load a display engine configuration:**

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

3. Select the display engine configuration you want to load.
4. Click Open.



You can also drag-and-drop a *.DCX* file to the Display Engine Configuration Editor Panel to load it.

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 "6.7. Configuring Multichannel Displays" on page 132.) You can load these configurations (or any set of configurations) in the Display Engine Configuration Editor Panel, as described in "6.2.6 Loading a Display Engine Configuration" on the previous page. 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 ....
-W port@netAddress;remotedisplayConfigFileN
```

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

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

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

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

➤ **To load these three configurations:**

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

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

   On Linux use:

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

6.3. Changing a Window's Attributes

You can change the following attributes of a window:

- Window Name.
- Window Type (for details about window types, please see "6.1.4 Window Types" on page 114).
- Window Stays on Top.
- 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 37 on page 116).
2. Click the value of the attribute that you want to change.
3. To change a numeric value, type or select a value.
4. To change the Window Type or Fixed Size, select a value from the list.
5. To change the name, type a new name.
6. To indicate that the window should always display on top of other windows, set Window Stays on Top to True.
7. Click Commit Changes. The window is updated.



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

6.4. Changing a Channel's Attributes

You can change the following attributes of a channel:

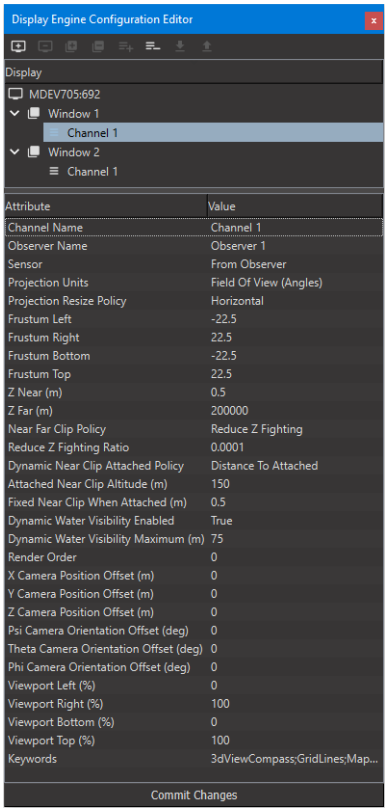
- Channel Name.
- Observer Name.

- Sensor. Use the sensor configured for the current observer, or override the observer and use one of the listed sensors.
- Projection Units – field of view, in angles, or database, in meters.
- Projection Resize Policy – fixed, vertical, or horizontal.
- Frustum (Left, Right, Bottom, and Top) (field of view).
- Z Near and Z Far (clipping planes).
- Near Far Clip Policy.
- Reduce Z Fighting Ratio.
- Dynamic Near Clip Attached Policy.
- Attached Near Clip Altitude.
- Fixed Near Clip When Attached.
- Dynamic Water Visibility Enabled.
- Dynamic Water Visibility Maximum.
- Render Order. Set the order in which channels are rendered in a particular window. For example, to display Channel 1 over Channel 2, set Channel 1 to render after Channel 2.
- Mirror Mode. Flips the channel horizontally.
- Camera Position Offset (X, Y, Z).
- Camera Orientation Offset (Psi (heading), Theta (pitch), Phi (roll)).
- Viewport (Left, Right, Bottom, Top).
- Keywords – keywords to associate with the channel, for example, "showCockpits". (For a list of channel keywords, see "6.4.7 Channel Keywords" on page 130.)

➤ **To change a channel's attributes:**

1. Choose **View > Display Engine Configuration Editor Panel**.
2. Select the channel in the Display Engine Configuration Editor Panel. A list of attributes is displayed at the bottom of the editor (Figure 39).

Figure 39. Channel attributes



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

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

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

6.4.1 Setting the Clipping Planes

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

Figure 40 illustrates the effect of changing the near clipping plane (the Z Near attribute). Figure 41 illustrates the effect of changing the far clipping plane (the Z Far attribute). To see the effect of changing the near and far clipping planes, you must set the Near Far Clip Policy to Fixed.

Figure 40. Near clipping

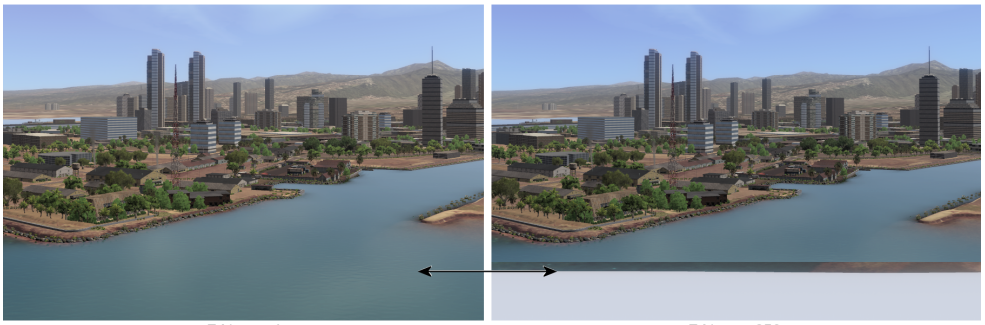
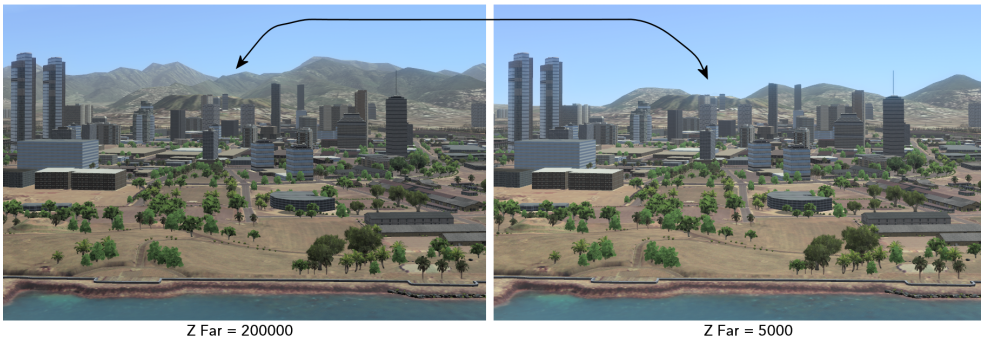


Figure 41. Far clipping



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

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

- Fixed. Clipping planes are set explicitly using the Z Near and Z Far attributes.
- Reduce Near Clip. Clipping planes are adjusted dynamically based on the observer's altitude. The near clipping plane is increased slightly as the observer rises to 20,000 meters, but stays under 1.5 meters. When the observer rises above 20,000 meters, the near and far clipping planes gradually increase. The Reduce Near Clip policy can be modified by the Dynamic Near Clip Attached Policy.
- Reduce Z Fighting. Clipping planes are set based on a ratio of the near clipping plane to the far clipping plane (the Reduce Z Fighting Ratio attribute). The near clipping plane can get as large as needed to maintain the ratio. This policy is the default clipping plane policy. The Reduce Z Fighting policy can be modified by the Dynamic Near Clip Attached Policy.
- Clamp Near Clip When Magnified. It is the same as Reduce Z Fighting, but adds an intersector to clamp the near clipping plane to prevent the near clip from going past objects or terrain in the scene when using view magnification. The

intersector is only used when view magnification is 2x or more (this value can be changed through the API by extending the channel and overriding the call that calculates the clamp). This is an expensive operation, so only enable it if you really need it.

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

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

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



- Reverse Z buffering is enabled by default to reduce Z fighting. It is not supported in 2D observer modes. The Oculus Rift HMD does not work with reverse Z buffering. To disable reverse Z buffering, start VR-Vantage with the `--disableReverseZBuffer` command-line option.
- When using Reverse Z Buffering in conjunction with Reduce Z Fighting Near Far Clip Policy (the default) and Triton dynamic ocean, significant performance slowdowns sometimes occur. Changing the Near Far Clip Policy to Fixed resolves the issue; when Reverse Z Buffering is enabled, the Reduce Z Fighting policy is not needed.

6.4.2 Specifying the Projection Resize Policy Attribute

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

- Fixed. Keep the aspect ratio the same regardless of how the window is resized.
- Horizontal. Change the horizontal field of view (FOV) to so that the ratio of the FOV angles matches the aspect ratio of the viewport.
- Vertical. Change the vertical FOV so that the ratio of the FOV angles matches the aspect ratio of the viewport.

Figure 42 illustrates the effect of different resize policies

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.

Figure 42. Effect of different projection resize policies



Initial View

Resized with Fixed resize policy

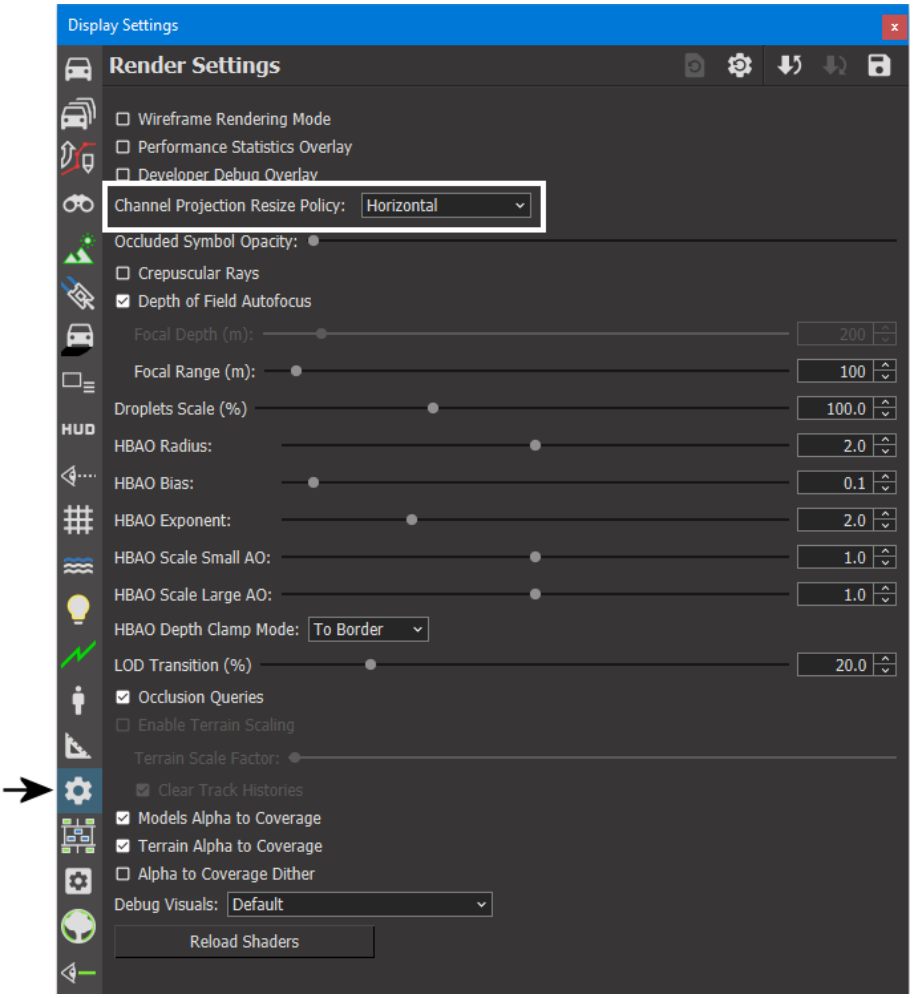
Resized with Horizontal resize policy

Resized with Vertical resize policy

➤ **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 43).

Figure 43. Display Settings, Render Settings page



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

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

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

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

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

Figure 44 illustrates different field of view settings taken from the same observer location. The view on the left has frustum values -22.5, 22.5, -22.5, 22.5. The view on the right has the frustum values -10, 10, -10, 10.

Figure 44. Field of view

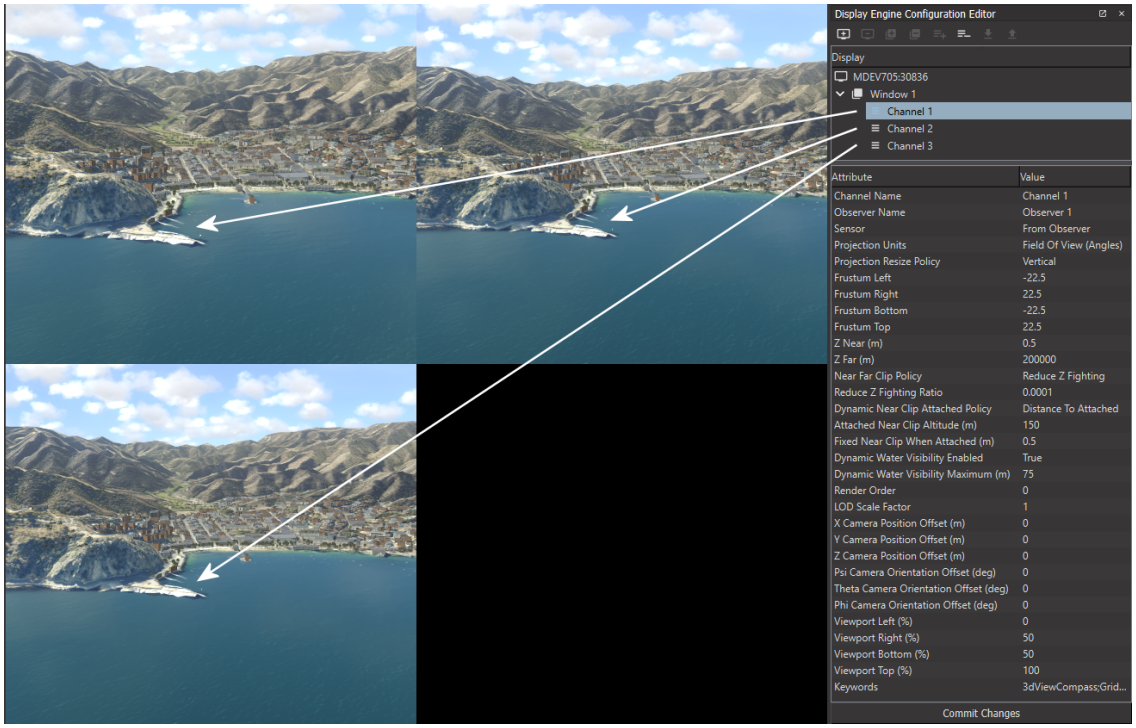


➤ To change a channel's field of view, edit the frustum values in its attributes list.

6.4.4 Changing the Viewport

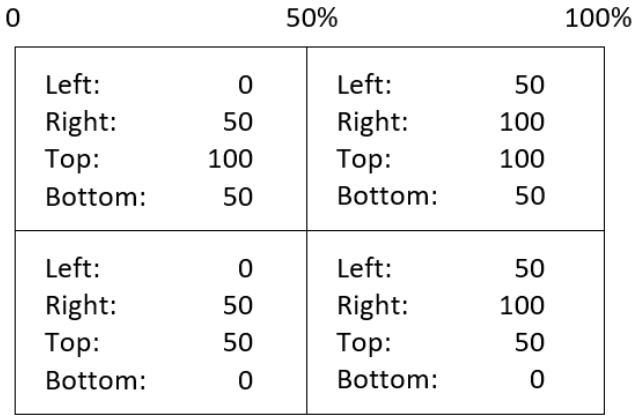
When you change the viewport of a channel, you change the portion of the window in which the channel is displayed. This does not change the extents of the scene. A narrow viewport compresses the scene width. A short viewport compresses the height. Figure 45 shows a window that has three channels, each 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 45. 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 46 shows the percentage allocation for the viewports in Figure 45 above.

Figure 46. Viewport configuration



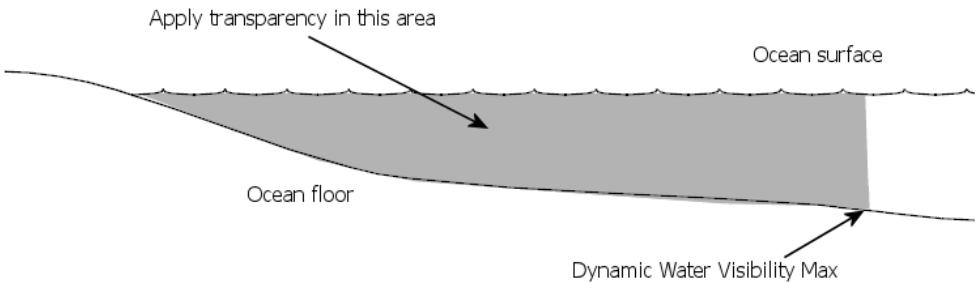
When you change viewports, the window might not completely refresh. To see the changes, resize the window.

6.4.5 Configuring Water Visibility

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

Adding transparency to the water reduces Z-fighting. The Dynamic Water Visibility Enabled attribute increases transparency automatically as the observer's altitude increases. Dynamic Water Visibility Maximum specifies the maximum depth to which transparency is added (Figure 47).

Figure 47. Dynamic water visibility



Dynamic water visibility is enabled by default. When Dynamic Water Visibility Enabled is True, VR-Vantage increases the water visibility depth from the value Surface Transparency setting (at 0 meters altitude), to the maximum value specified at the current Ocean LOD Elevation. The default depth is 75 meters. This value provides reasonable performance given the default Ocean LOD Elevation (5000

meters), the altitude above which VR-Vantage stops displaying dynamic ocean. If you change the Ocean LOD Elevation so that dynamic ocean is displayed when the observer is higher than 5000 meters, Z-fighting may increase and you may need to increase the Dynamic Water Visibility Maximum value. (For details about setting the ocean LOD Elevation, see "Setting the Ocean LOD Elevation" in the *Adding Content to MAK ONE Applications Reference Manual*.)

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

6.4.6 Configuring a Mirror Channel

You can enable the Mirror Mode for a channel to view it as a horizontal mirror of the scene. This is useful in situations where you want to include a view such as a rearview mirror. The following procedure describes how to do this when VR-Vantage is connected to a scenario that includes a ground vehicle.

➤ **To set up a channel as a mirror:**

1. In either the terrain or the Objects List, right-click on the vehicle and then choose an observer attach mode, for example, **Observer Attach > Attach Mimic**.
2. Choose **View > Display Engine Configuration Editor Panel**.
3. Select the window and then click Add a Channel (). The channel is added to the list under the window.
4. Modify the properties of your new channel:
    a. Change the Viewport settings to position the channel near the top of the window. For example: Left 20, Right 80, Bottom 75, and Top 90.
    b. Set the Observer Psi to 180. This points the camera behind the viewer.
    c. Set Mirror Mode to True.
    d. If there is a cockpit that you do not want to include, remove showCockpits from the Keywords list.
    e. Click Commit Changes.

Figure 48. Observer attached to a truck and displaying a rearview mirror



6.4.7 Channel Keywords

You can edit channel keywords in the Keywords attribute of each channel in the Display Engine Configuration Editor. VR-Vantage supports the following channel keywords:

- largeCompass. If the compass is enabled, this channel shows the large compass. Default: Included in configuration of all channels.
- smallCompass. If the compass is enabled, this channel shows the small compass. Default: Not included in the configuration of any channels.
- GridLines. If grid lines are enabled, this channel shows the grid lines. Default: Included in configuration of all channels.
- showRemoteGraphics. If remote graphics are received this channel displays them. Default: Included for all channels except inset views.
- showCockpits. If GL Studio cockpits are enabled, this channel shows them. Default: Included in configuration of all channels.
- NoExternalInput. This keyword disables all mouse/keyboard/touch events for the channel. Default: Only included in the configuration of Sensor Gimbal View channels (controlled by remote VR-Forces).
- cockpitOnly. If this keyword is true, the scene will not be rendered in the channel. Default: Included in the configuration of instrument panels only.
- cigiView1. CIGI provides for the definition of views and view groups, by integer ID. Subsequent CIGI view controls that address a given ID will only be applied to the channel or channels with the cigiViewX keyword, where X is the view ID. Default: cigiView1 is included for all channels except inset views.

6.5. Starting a VR-Vantage Display Engine

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

➤ To start a display engine, on the Windows Start menu, choose **MAK Technologies > VR-Vantage Display Engine.**

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

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

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

6.6. Connecting to a Display Engine

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

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



If you have trouble connecting to a remote display engine, make sure that your firewall is not blocking the port you are using to connect.

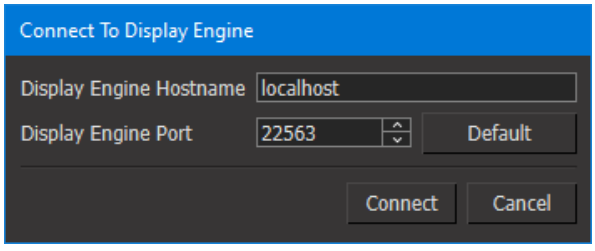


It is possible to run multiple display engines on the same machine with different ports. However, this is not a recommended configuration.

➤ **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 "6.5. Starting a VR-Vantage Display Engine" above.
3. On the master computer, choose **View > Display Engine Configuration Editor**. The Display Engine Configuration Editor Panel opens (Figure 37 on page 116).
4. In the Display Engine Configuration Editor Panel, click the Connect a Display Engine button (), or right-click the main display engine icon and choose **Connect a Display Engine** on the shortcut menu. The Connect To Display Engine dialog box opens (Figure 49).

Figure 49. Connect to Display Engine dialog box



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

6.6.1 Disconnecting from a Display Engine

➤ **To disconnect from a display engine:**

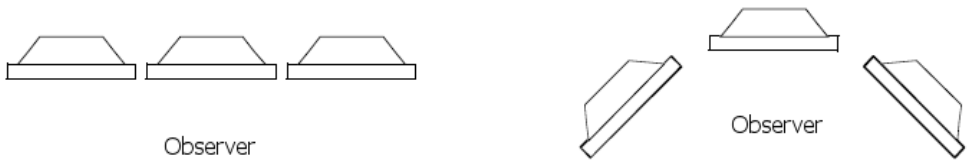
1. In the Display Engine Configuration Editor Panel, select the display engine that you want to disconnect.
2. Click the Disconnect a Display Engine button ( ), or right-click the display engine name and choose **Disconnect a Display Engine** on the menu.

You cannot disconnect the master display engine.

6.7. Configuring Multichannel Displays

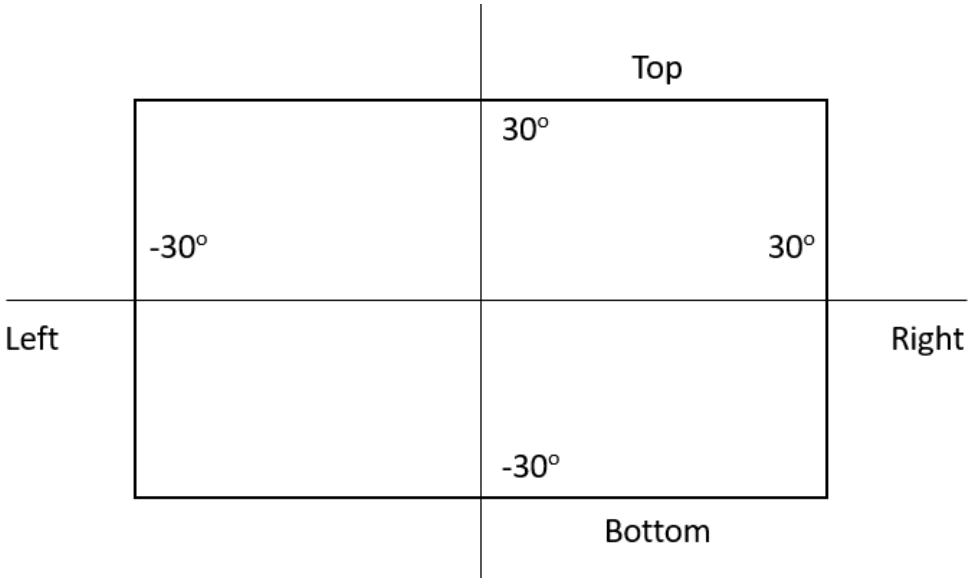
People running simulations often want to set up a multichannel configuration using multiple monitors (on one or more computers) to display exercises. Typical configurations are a horizontal alignment, which widens the view, and the angled alignment, which surrounds the observer to simulate an out-the-window view (Figure 50). 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 52, default window views). Therefore, for multiple views, you must configure the channels to calculate an offset from the master view.

Figure 50. Multi-channel displays (top-down view)



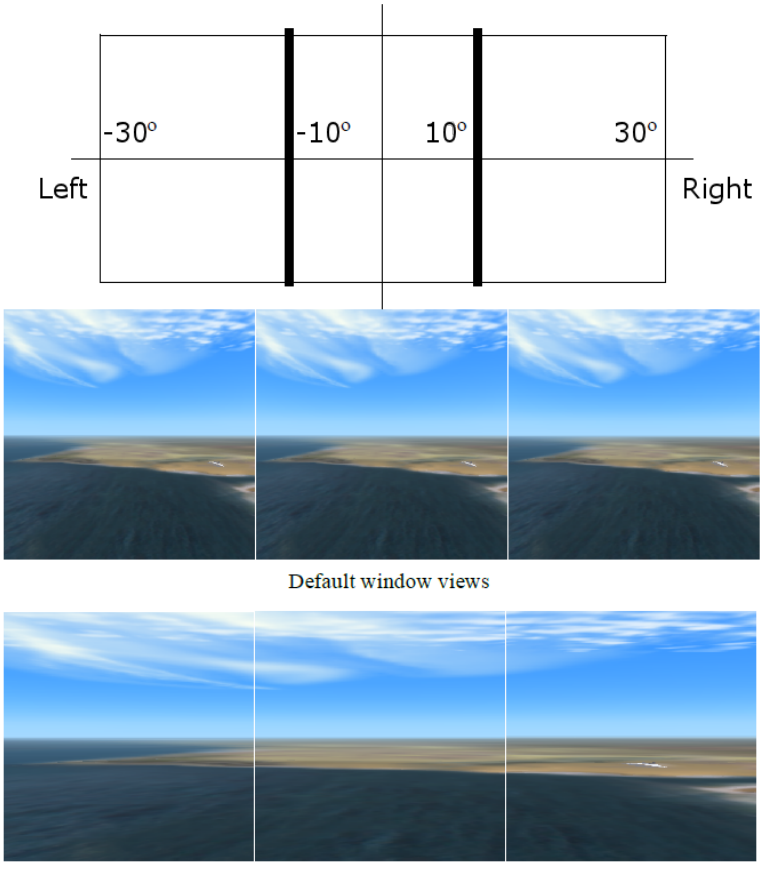
The distribution of the view across multiple channels is controlled by the frustum. Figure 51 illustrates the default frustum for Channel 1. It has a 60° field of view, from -30° to +30°.

Figure 51. Default frustum for Channel 1



If you wanted to split the view into, for example, three horizontal channels, you would edit the left and right frustum values for each channel, as shown in Figure 52. 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 52. Frustum values for three channels



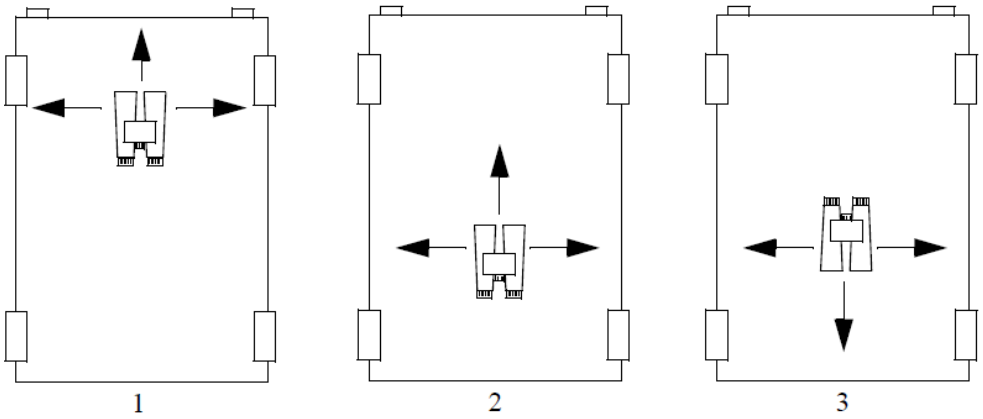
For a multi-monitor configuration to work correctly, use fixed size windows whose size matches the aspect ratio specified by the horizontal and vertical fields of view and set the projection resize policy to fixed. (For information about the projection resize policy, please see "6.4.2 Specifying the Projection Resize Policy Attribute" on page 124.)

6.7.1 Changing the Camera's Position and Orientation Offset

Changing the frustum affects how much of the database is in the view. Changing the camera's position and orientation affects the point from which you look at the view. For example, imagine you are simulating the view from a vehicle, as in vehicle 1 in Figure 53. (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 53. Position and orientation offsets



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

6.7.2 Creating a Multichannel Configuration

A multichannel configuration is a set of display engine configurations. You must save each configuration individually."7.1. Saving and Loading Display Engine Configurations" on page 142 shows how to create, save, and load a multichannel display engine configuration.

➤ **To save a multichannel configuration:**

1. Start VR-Vantage and one or more VR-Vantage Display Engines.
2. In the Display Engine Configuration Editor Panel, connect the display engines.
3. Configure the display engines with the windows and channels that you want them to have.
4. For each display engine in the Display Engine Configuration Editor Panel:

a. Select the display engine.

b. Click the Save Display Engine Configuration button ( ).

c. Type a name for the configuration.

d. Click Save.

6.7.3 Loading a Multichannel Configuration

You can load a multichannel configuration in the Display Engine Configuration Editor Panel or from the command line. If you load it in the editor, you must load each configuration individually. For details about loading multiple configurations from the command line, please see "Loading Multiple Display Engine Configurations from the Command Line" on page 119 .

➤ **To load a multichannel configuration:**

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

6.8. Stereoscopic Displays

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

- Active Stereo: In an active stereo setup, frames are alternated on the display for the left eye and the right eye, and a pair of shutter glasses blocks light to either the left or right eye in synchronization with the display. This method requires hardware support to synchronize the glasses to the display, along with a graphics card capable of quad buffering, and a display that can refresh at twice the desired frame rate. Active stereo should be possible with VR-Vantage, but has not been tested.
- Anaglyphic Stereo: Anaglyphic stereo is the cheapest and simplest method to use. A typical setup is a display showing a red channel and a cyan channel simultaneously, along with a pair of glasses with one red lens and one cyan lens for the viewer. This will work with no special hardware aside from the inexpensive glasses. It is also the simplest method to set up in VR-Vantage, requiring only that some OpenSceneGraph environment variables be set.

- Polarized Stereo: A polarized display shows the frames for both eyes simultaneously, but with their light polarized in different directions. The viewer wears glasses that have lenses polarized to match the two different frames, allowing each eye to see only the frame intended for it. Polarized stereoscopy requires some specialized equipment to display the images with the correct polarization. One simple method for producing this kind of display is to use two projectors with polarizing filters, projecting onto a rear projection screen. Monitors are available that can polarize the two frames. It is easy to configure a polarized display with VR-Vantage.

6.8.1 Configuring Anaglyphic Stereo

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

Table 6. 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 (interoccular distance).	0.06

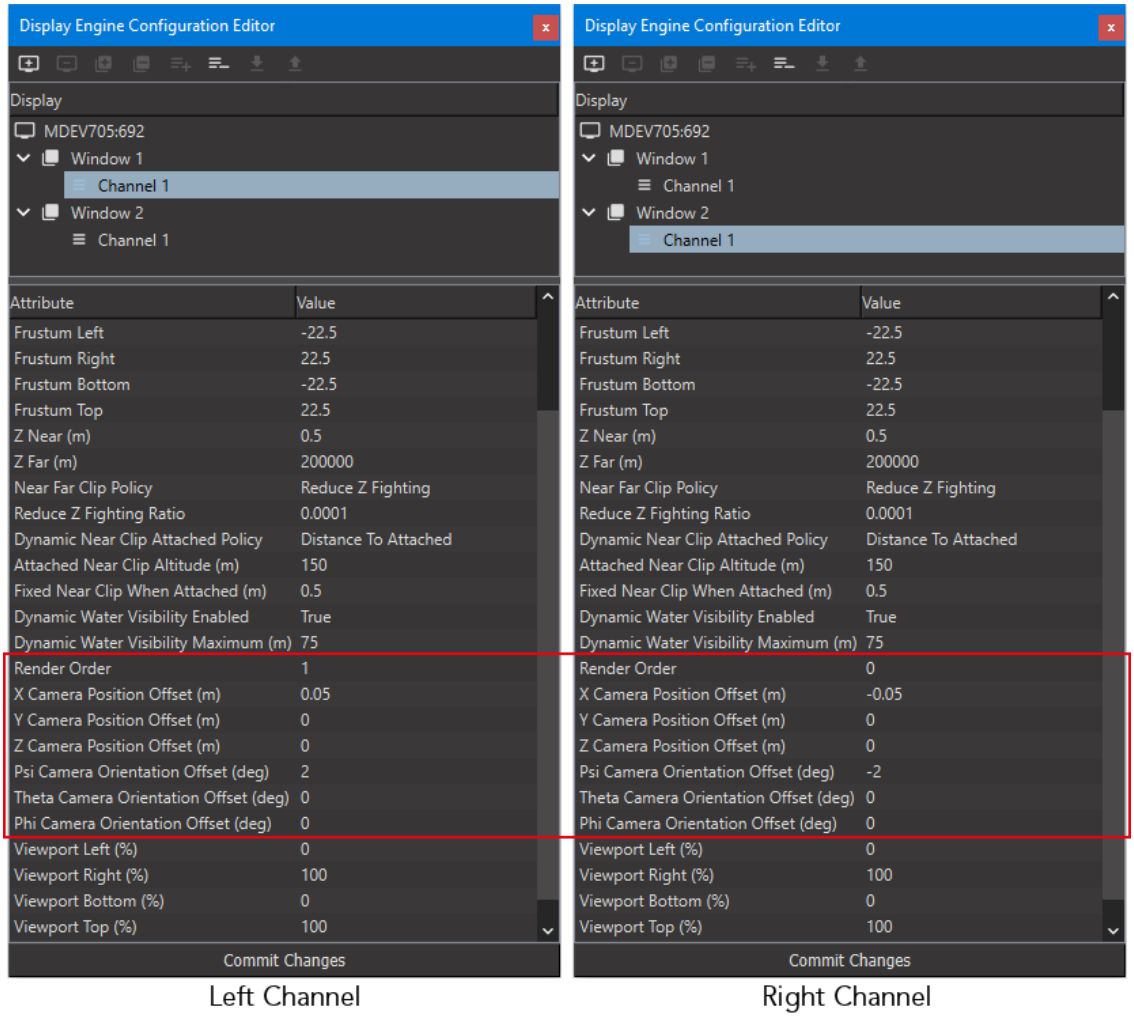
For more information, please see the OpenSceneGraph documentation at http://www.openscenegraph.org/index.php/documentation/guides/user-guides/62-stereo-settings.

6.8.2 Configuring Polarized Stereo

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

Varying the eye spacing and focal length can produce different effects, and the best values may depend on what the viewer is looking at. Figure 54 shows an example configuration.

Figure 54. 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[1].
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.

[1]"Variation and extrema of human interpupillary distance", N. A. Dodgson, Proc SPIE 5291. Select publications link and scroll to 2004 at http://www.cl.cam.ac.uk/~nad10/pubs/EI5291A-05.pdf.

6.9. Taking Screen Captures

You can take screen captures of the VR-Vantage window. None of the GUI controls or panels are saved.

By default, screen captures are saved to *./userData/screenshots*. You can change the default location. You can also change the key used for screen captures. For details about changing key mappings, see Chapter 37 on page 549.

➤ To take a screen capture, press **F5**.

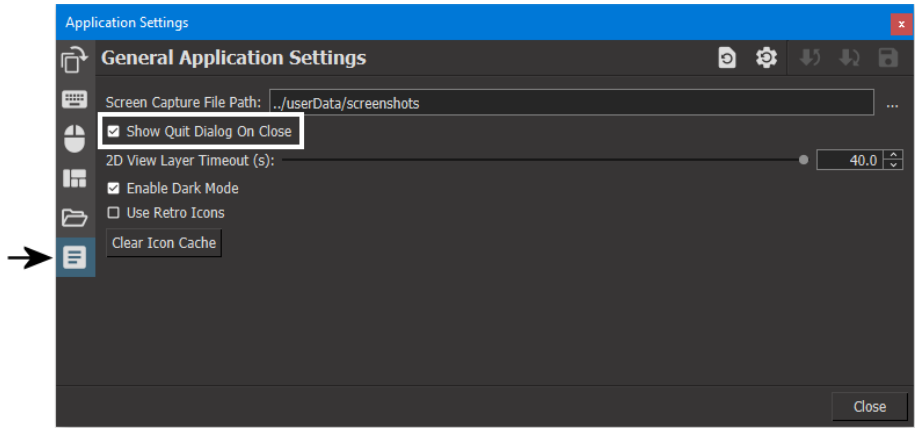
On Linux machines, the screen capture the screenshot is not adjusted for gamma corrected. It appears dark in the default image viewer on Linux but displays correctly in other applications.

6.9.1 Specifying the Location of Screen Captures

➤ **To specify the location where screen captures are saved:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the General Application Settings page (Figure 55).

Figure 55. General Application Settings page



3. In the Screen Capture File Path box, specify the location where you want to save screen captures.

6.10. Display Issues on Linux

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

The workarounds to support two screens include:

- Use the NVIDIA driver's TwinView mode. This behavior is identical to the Window multi-monitor behavior and VR-Vantage works correctly with this setting.
- Use Xinerama, which is an X extension that behaves similar to TwinView.
- Run VR-Vantage on one X Screen and run a Remote Display Engine on the other. Use the `--appCacheDir` command-line option to specify separate directories for each application's cache. For details, see "3.1.3 Command-Line Options" on page 64. (If you do not use the command-line option, you must run the applications from two separate installs to ensure that the *./appData* directories are not compromised.)



7. Display Engine Tutorials

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

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7.1. Saving and Loading Display Engine Configurations

This tutorial demonstrates how to:

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

7.1.1 Connect a VR-Vantage Display Engine

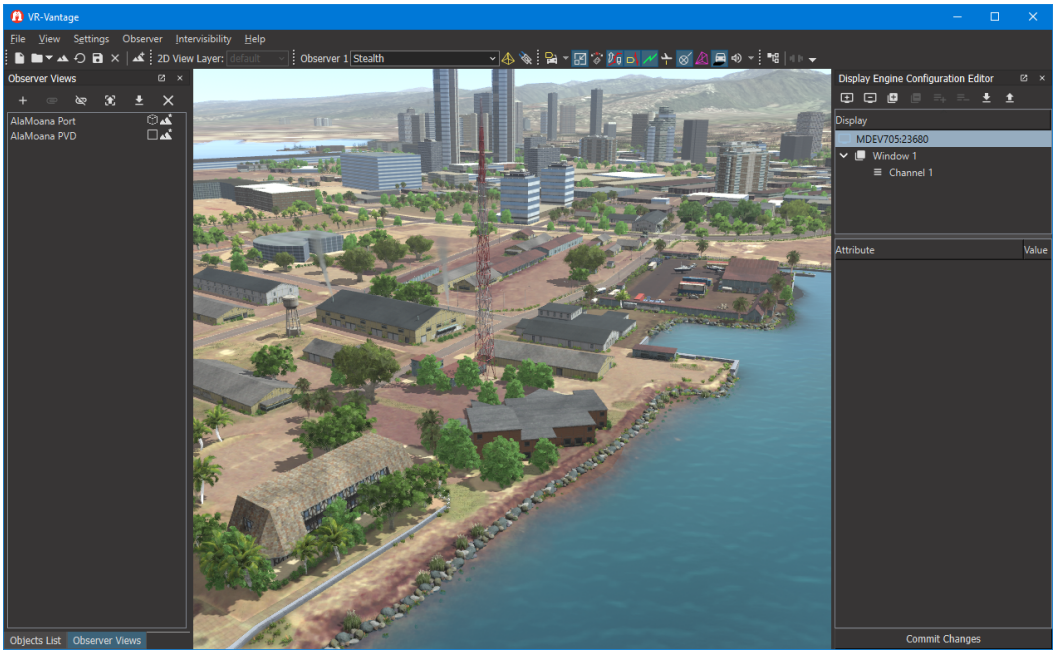


This tutorial assumes that you have two computers, one for your VR-Vantage application, and one for the remote display engine. You could run this tutorial on one computer if you have two monitors.

➤ **To create the display engine configurations:**

1. On computer 1, start VR-Vantage.
2. Load *Ala Moana.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 56).

Figure 56. Display Engine Configuration Editor Panel and default window



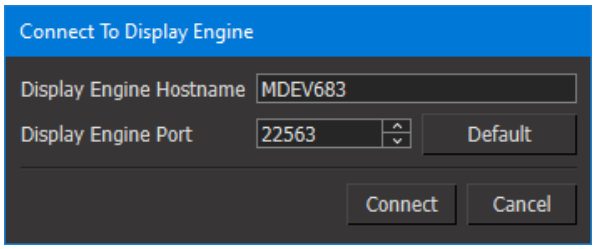
4. On computer 2:
   - On Windows, on the Start menu, choose **MAK Technologies > VR-Vantage Display Engine**.
   - On Linux, run:

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

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

   A VR-Vantage display engine opens. It does not show a default window.
5. On computer 1, in the Display Engine Configuration Editor Panel, click the Connect a Display Engine button ( ). The Connect to Display Engine dialog box opens.
6. In the Display Engine Hostname box, replace “localhost” with the name of computer 2. (If you are using one computer with two monitors, leave the text as localhost.)

Figure 57. Connect to Display Engine dialog box



7. Click Connect. An entry for the remote display engine is added to the Display Engine Configuration Editor Panel (Figure 58). The remote display engine now displays the MAK Earth terrain with the same view as the VR-Vantage application.

Figure 58. Remote display engine connected



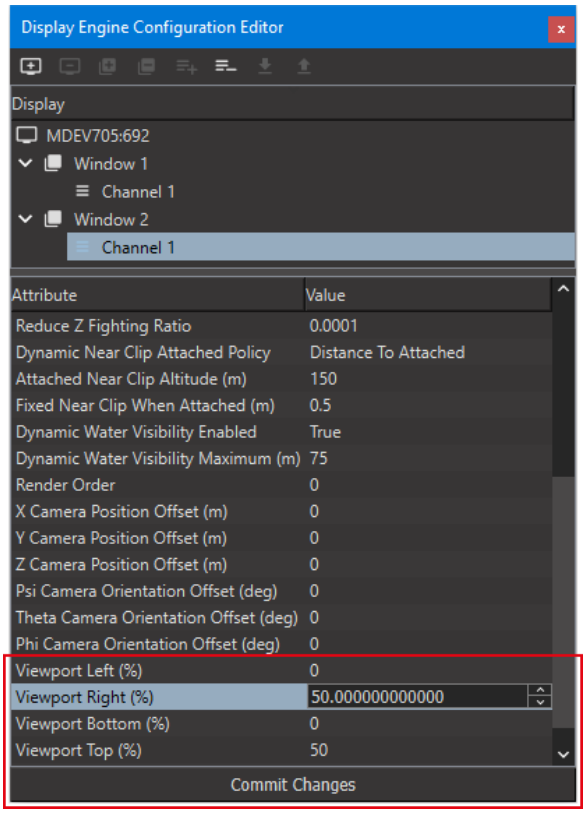
7.1.2 Save the Display Engine Configurations

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 59).

Figure 59. 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 60). (The full screen view of the terrain may also be visible until such time as the display engine refreshes.)

Figure 60. Remote display engine view after changing configuration



4. Select the display engine on the VR-Vantage application (in this example, MDEV705).
5. Click the Save Display Engine Configuration button (). A save dialog box opens.
6. Call this configuration *mainwindow.dcx*.
7. Click Save.
8. Select the display engine on the remote display engine (in this example, MDEV683).
9. Click the Save Display Configuration button. A save dialog box opens.
10. Call this configuration *remotedisplay.dcx*.
11. Click Save.

7.1.3 Load the Display Engine Configurations in the GUI

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

➤ **To load the display engine configurations in the GUI:**

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

7.1.4 Load the Display Engine Configurations from the Command Line

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

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

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

The syntax for Linux is:

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

In this tutorial, we use the default port (22563). The netaddress for the remote display engine is the computer name (Dev25). 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@Dev25;
../appData/-settings/vantageIG/remotedisplay.dcx
```

➤ **To load the tutorial configurations from the command line:**

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

   ```
   vrvIG.exe --dispSetting ../appData/settings/
   vantageIG/mainwindow.dcx -W 22563@Dev25;
   ../appData/settings/vantageIG/remotedisplay.dcx
   ```

On Linux, enter the command:

```
vrvIG.exe --dispSetting ../appData/settings/
vantageIG/mainwindow.dcx -W 22563@Dev25:
../appData/settings/vantageIG/remotedisplay.dcx
```

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

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



8. Using Streaming Video

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

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8.2. Starting a Video Stream 152
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8.4. Viewing Streaming Video 158
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8.1. Streaming Video

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

You can also stream video to a file. In other words, you can record the VR-Vantage display. To do so, use one of the file output video stream configurations, as described in "8.3. Configuring Video Streams" on page 154.

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

- Shared Memory. VR-Vantage compresses the video and places it in shared memory. We provide an example application that shows how to read the shared memory data for your application.
- TCP. VR-Vantage acts as a server and connected clients are able to connect over TCP and get raw or compressed images through the connection.
- Web socket. VR-Vantage acts as a server and web browsers can connect to it and display the video stream.
- GStreamer. GStreamer is a multimedia library that uses configuration files to build a video pipeline. Pipelines allow for different encoding, multiplexing, and transport options. This is how VR-Vantage encodes video with MPEG-2, H.264, and H.265 encoding schemes and transports them over a network with embedded metadata.

  GStreamer is a complex SDK. It works on all supported versions of Microsoft Windows. For Linux, it has been tested on Centos 7.3, Centos 7.4, RedHat 7.3, and RedHat 7.4. It requires GLib2 version 2.46 and Gtk3 version 3.14. If our implementation does not meet your needs for video streaming, please contact MAK support. We will work with you to help you achieve your goals.

  MPEG-2 video uses CPU, or software, encoding. The image from the graphics processing unit (GPU) on the video card is copied to memory and encoded by the CPU before being streamed to the network.

  H.264 and H.265 video supports GPU, or hardware, encoding. Encoding is done on the GPU directly. Hardware encoding increases the quality of the streamed video. Please check *VR-Vantage Release Notes* to be sure you have the proper video card driver to support hardware encoding.

> The first time you stream video using GStreamer, it generates a message indicating a critical error. This is a bug in GStreamer. There is no critical error. Subsequent uses of GStreamer do not generate this error.
>
> GStreamer as delivered does not work on some builds of Linux.

- Image Compression. VR-Vantage compresses the video frame using JPG or PNG compression. This is typically used with video sinks that use image frames such as the WebSocket, shared memory, and TCP video sinks.
- Transform. VR-Vantage transforms the video frame by scaling, flipping, or converting the bit depth of the image. This is typically used with video sinks that use image frames such as the WebSocket, shared memory, and TCP video sinks. GStreamer can also transform the image and you may get better results using GStreamer alone than using a Transform operation and a GStreamer operation.

> Streaming video can reduce performance.

8.1.1 Example Video Stream Configurations

The default configurations include the following:

- Compress and Shared Memory. This video stream configuration is an example of a pipeline that compresses and moves frames into a shared memory segment. To use this configuration you must provide an application that reads the frames from shared memory and displays them using whatever method it likes. The exampleReadVideoShm example shows how to access frames from shared memory.
- GLImagesink Test. This video stream configuration uses a GStreamer pipeline task to stream video directly to an OpenGL viewer. If this configuration is started, a new OpenGL window opens containing the video stream.
- H.264, H.265, and MPEG 2 configurations. H.264, H.265, and MPEG-2 configurations are described in "8.1.2 H.264, H.265, and MPEG-2 Configuration Naming Conventions" on the next page.
- WebSocket. The WebSocket video stream configuration streams capture frames to a web browser. When the video stream is started, it listens on the Connection Port specified for connections from a web browser. Specify the URL as `hostname:port` (use localhost if connecting from the same machine). Typical usage is to put an Image Compress task element prior to this task element to send compressed images to the connected web clients. For more information, see "8.4.2 Streaming Video to a Web Browser" on page 161.

- Some older versions of browsers may not support WebSockets.
- If you stream using WebSockets on Windows 10, you might need to disable the Windows firewall.
- VR-Vantage can send multiple GStreamer video streams. The number you can send depends on your video card and CPU. Sending multiple video streams will affect the frame rate.

8.1.2 H.264, H.265, and MPEG-2 Configuration Naming Conventions

VR-Vantage includes multiple configurations for streaming H.264, H.265, and MPEG-2 video. The naming convention for these configurations is as follows:

- Encoding format. H264, H265, or MPEG2.
- HW. Uses hardware encoding. (If not present uses software encoding.)
- Metadata. Includes metadata in the video stream.
- MPGTS. Uses a MPEG Transport Stream.
- FILE. These video stream configurations use a GStreamer pipeline task to output video to a file. The file that the video is written to is specified in the pipeline configuration, as a parameter to the `filesink` GStreamer element. If no path is included in the filename, the file is written to *./bin64*.
- UDP. The video stream is sent over UDP (User Datagram Protocol).

There are commercial and freeware video viewers, such as VLC, that can connect to and display streaming video from a UDP stream. VLC is a commonly used application to display network video streams. You can download VLC from http://www.videolan.org/vlc/index.html. For more information, please see "8.4.1 Viewing Streaming Video Using VLC" on page 158.

- RTP-UDP. The video stream is sent with Real-Time Transport Protocol over UDP.

These naming conventions are simply for the convenience of quickly understanding what each configuration does. The actual configuration is in the pipeline configuration.

8.2. Starting a Video Stream

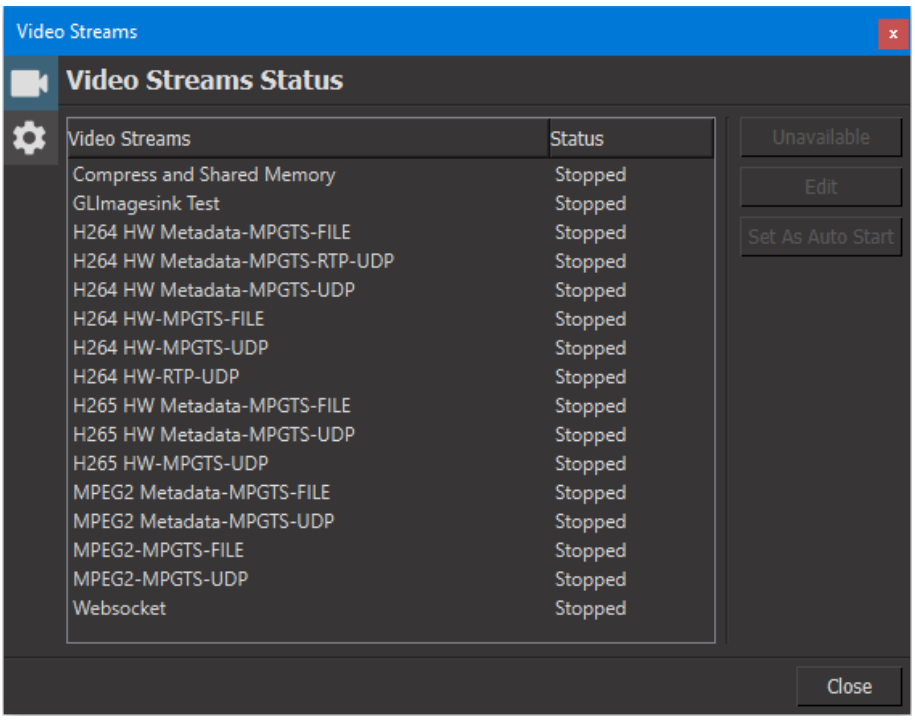
You can start a video stream manually or specify that a video stream start automatically when VR-Vantage starts up.

When streaming H.265 HW Metadata MPGTS to VLC, you must start listening on the network in VLC before starting the video stream in VR-Vantage.

➤ **To start a video stream:**

1. Choose **Settings > Video Streams**. The Video Streams dialog box opens. Select the Video Streams page (Figure 61).

Figure 61. Video Streams page



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

8.2.1 Setting Up Auto Start

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

➤ **To specify auto start:**

1. Choose **Settings > Video Streams**. The Video Streams dialog box opens. Select the Video Streams page (Figure 61 above).
2. Select the video stream that you want to start automatically.
3. Click Set As Auto Start. VR-Vantage displays a star next to the video stream name.

8.3. Configuring Video Streams

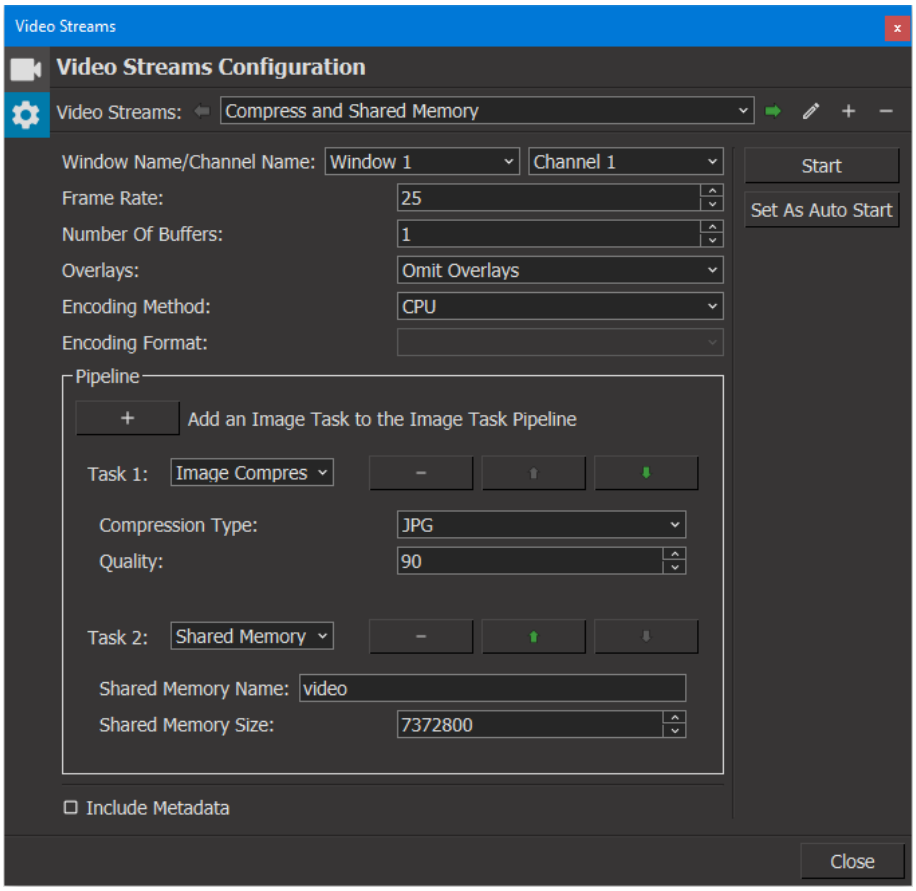
You can configure the different streaming video streams to work with your playback environment. A video stream configuration has:

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

➤ **To configure a video stream:**

1. Choose **Settings > Video Streams**. The Video Streams dialog box opens. Select the Video Streams Configuration page (Figure 62).

Figure 62. Video stream configuration page



2. In the Video Streams list, select the video stream that you want to configure or add a new video stream.
3. Specify values for the capture parameters. Table 7 describes the parameters.

Table 7. Video stream configuration capture parameters

Parameter	Description
Window Name	The window from which to stream video.
Channel Name	The channel, in the window specified by Window Name, from which to stream video.
Frame Rate	The frame rate at which to stream video.
Number of Buffers	The number of buffers affects how well VR-Vantage captures video from the rendering process. For details please see "8.3.3 Choosing the Number of Capture Buffers to Use for CPU Encoding" on page 157.
Overlays	Omit or include 2D overlays, including 2D icons, the compass, and tactical graphics. If you are using hardware encoding, select an overlay option that specifies hardware (HW). If you select hardware encoding, you must include a matching pipeline string. Please contact our support team for assistance (https://www.mak.com/mak-one/support/portal).
Encoding Method	Use the Encoding Method to specify whether to use CPU or GPU encoding.
Encoding Format	If you select GPU encoding, specify the Encoding Format: h264 or h265. Select the format that matches the GStreamer format.
Include Metadata	Encode metadata about the video image into the video stream following Motion Imagery Standards Board (MISB) metadata standards for UAV systems.

4. To add a task, in the Pipeline group box, click the Add button (+). A task is added to the group box.
5. For the new task or any existing tasks, select an image task in the Task drop-down list.
6. Select values for the parameters that are appropriate to the task. The supported tasks and their parameters are:
   - TCP. Send the video over TCP.
     - Port. The port to which the video stream should be sent.
   - Shared Memory.
     - Shared Memory Name. The name of the shared memory space.
     - Shared Memory Size. The amount of shared memory. This must be large enough to hold at least three frames of data as specified in the capture parameters.

- GStreamer.
  - Pipeline Configuration. This is a complex string that varies depending on what you want done with the video. It defines the GStreamer nodes that the video frames will be processed through. You can resize, transform, compress, and multiplex the video. Then you can send the results to disk as a file or to the network as a stream. VR-Vantage has examples that show how to encode video, multiplex in metadata about the video stream, save to file. and stream to a network. For information about GStreamer and how to build a configuration description, please go to http://gstreamer.freedesktop.org/.
- Image Compress.
  - Compression Type. Select an option from the list.
  - Quality. Specifies the level of compression as a percentage. The higher the percentage, the less the compression and therefore, the better the quality.
- Web Socket.
  - Connection Port. The port on which VR-Vantage will listen for a browser connection.
- Transform.
  - Flip Image. Optionally, flip the image.
  - Scale Image. Optionally, scale the image to the specified X, Y values.
  - Convert Bit Depth. Optionally, convert the image to the specified bit depth.
  - Rotate Image. Optionally rotate the image by a specified number of degrees.

7. Optionally, add additional image tasks.
8. Optionally, change the order of the tasks.
9. If you select Include Metadata, the dialog box expands. Specify a Publisher Name and an Observer Name. In the Published Name list, Minimum Metadata Set refers to the MISB Standard 0902.7: https://nsgreg.nga.mil/doc/view?i=4582. Local Metadata Set refers to the MISB Standard 0601.12: https://nsgreg.nga.mil/doc/view?i=4579.

8.3.1 Configuring H.264 and H.265 Video Streams

To create an H.264 or H.265 video stream, follow the procedure in "8.3. Configuring Video Streams" on page 154. H.264 and H.265 support software encoding and hardware encoding. If you want to include metadata in the stream, the pipeline configuration must specify MPEG Transport Stream. In addition to configuring the video stream, you must set up VR-Vantage and your PC as follows:

- Create a display engine configuration in which the window size dimensions are multiples of 16, for example, 1280x720 and set Fixed Size to true. For details about creating display engine configurations, please see "Chapter 6. Windows, Channels, and Display Engines" on page 111.
- If you are using Windows 10, you may need to disable the firewall or write new rules to send or receive data on the ports you are using. This applies to the receiving PC as well. On Linux you must disable the firewall.



The default H.264 and H.265 configurations included with VR-Vantage all use hardware encoding. If you want to use software encoding, you can copy the files in *./appData/videoStreams/LegacyVideoStream* to *./appData/videoStreams* and use them.

8.3.2 Configuring MPEG 2 Video Streams

You can configure MPEG 2 video output to to a file or over UDP, with or without metadata. Follow the procedure in "8.3. Configuring Video Streams" on page 154. MPEG 2 only supports software encoding. If you want to include metadata in the stream, the pipeline configuration must specify MPEG Transport Stream. Examine the default configurations provided with VR-Vantage to see the required pipelines. When sending MPEG 2 to file, the **location** parameter specifies the filename for output. For file out without metadata, the output has the extension *.mpg*. For file out with metadata, the extension is *.ts*.

8.3.3 Choosing the Number of Capture Buffers to Use for CPU Encoding

One of the parameters you can set for video streams is the number of capture buffers. If you use CPU encoding, when a frame is captured from the frame buffer in OpenGL, it is copied to an offscreen buffer on the GPU. Then the buffer is copied across the bus from the GPU to the CPU, where it can be pushed into the encoding system. With some video cards, this process can cause all rendering to stop until all the memory copying is completed between buffers and between GPU and system memory. Moving data across the bus can be a slow process. This is called stalling out the rendering pipeline and usually results in a significant drop in rendering performance.

(If you use hardware encoding, the buffer is not copied. It stays on the GPU.)

➤ **To see if the rendering pipeline is stalling:**

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

➤ **To see if the number of buffers affects performance:**

1. Start VR-Vantage Stealth from the command line with the `--showConsole` option.
2. Watch the timing values that are displayed in the console. If the readback and copy times are in the 10-15ms range, then the rendering pipeline is probably

stalling. If they are in the 0-2 ms time range, then they are not adversely affecting performance.

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

8.4. Viewing Streaming Video

The method used to view a video stream depends on its configuration. This section describes how to view video using VLC and how to view video in a web browser.

8.4.1 Viewing Streaming Video Using VLC

VLC is a free and open-source media player that works on multiple platforms. Some users experience latency when using VLC that is not commonly present in other products. For information about reducing latency in VLC, see "Reducing Latency in VLC" on the facing page.

➤ **To view video in VLC streamed from VR-Vantage:**

1. Start the UDP stream (MPEG/H264/H265).
2. Start VLC.
3. If you are viewing an RTP video stream:
   a. Choose **Media > Open File**.
   b. Select *./appData/videoStreams/<configuration>.sdp* where *<configuration>* matches the RTP video stream configuration you are viewing.
   c. Click Open.
4. Choose **Media > Open Network Stream**.
5. For the network URL, put "udp://@:5000" (if the parameter to udpsink is port=5000).

The current NVENC that VR-Vantage uses is version 8.1, which uses the NVIDIA encoding preset described at https://docs.nvidia.com/video-technologies/video-codec-sdk/nvenc-preset-migration-guide.

To learn more about the NVENCODE API, see https://developer.nvidia.com/nvidia-video-codec-sdk.

To learn about NVIDIA's GPU support for encoding and decoding, see https://developer.nvidia.com/video-encode-and-decode-gpu-support-matrix-new.

Reducing Latency in VLC

The default setting for viewing network streams in VLC includes a lot of buffering to make sure the video plays smoothly. This introduces a lot of latency on the receiving side. This section explains how to reduce that latency. It assumes you are using VLC 3.0.3 Vetinari.

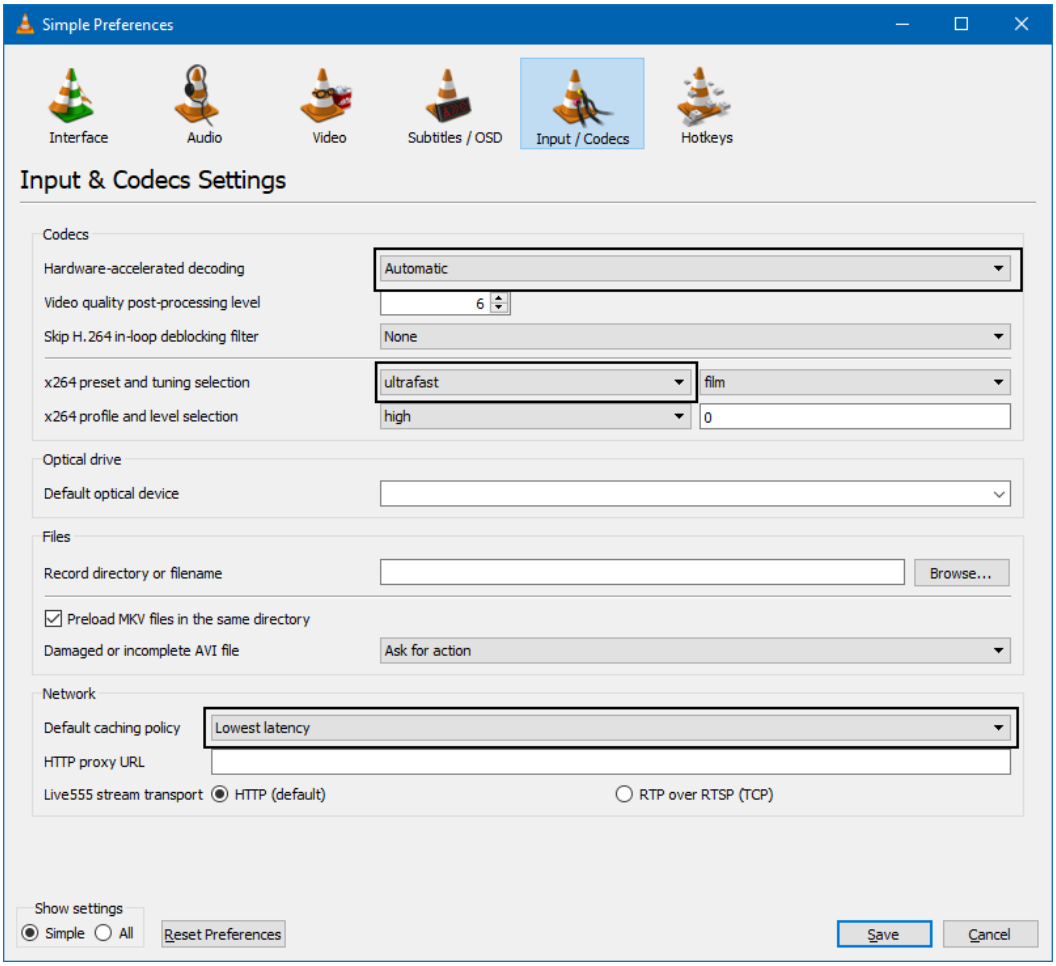


Reducing latency may lead to jitter. However, when working on a LAN, MAK engineers have rarely had problems.

➤ **To reduce latency when using VLC:**

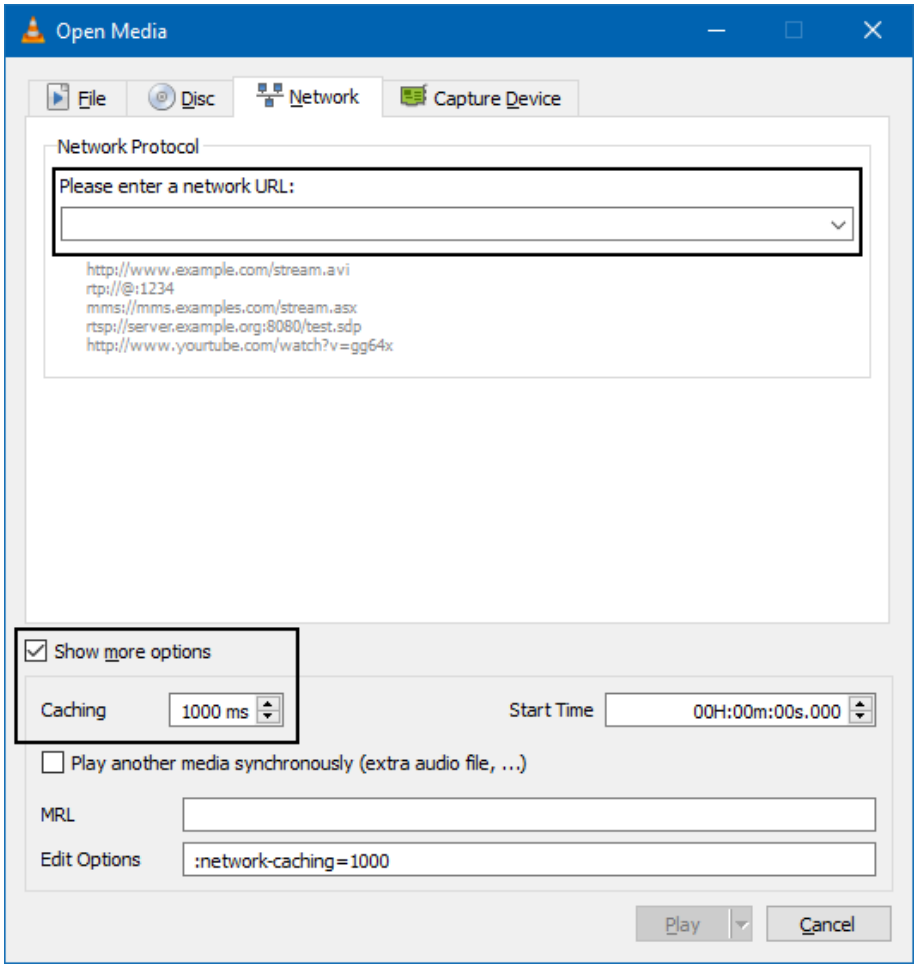
1. Start VLC.
2. Choose **Tools > Preferences**. The Preferences dialog box opens.
3. Select Input & Codecs (Figure 63).
4. In the Codecs group box, in the Hardware-accelerated Decoding list, select Automatic.
5. In the x264 Preset and Tuning Selection list, select ultrafast.
6. In the Network group box, in the Default Caching Policy list, select Lowest latency.
7. Click Save.

Figure 63. VLC Preferences, Inputs & Codecs



8. Choose **Media > Open Network Stream**. The Open Media dialog box opens.
9. Select the Network tab (Figure 64).
10. Enter the URL as udp://@:5000 (or whatever port you have your system set up for).
11. Select the Show More Options check box. The dialog box expands with more options.
12. Set Caching to 1ms. (Do not set caching to zero. VLC will crash.)

Figure 64. Open Media dialog box, Network tab

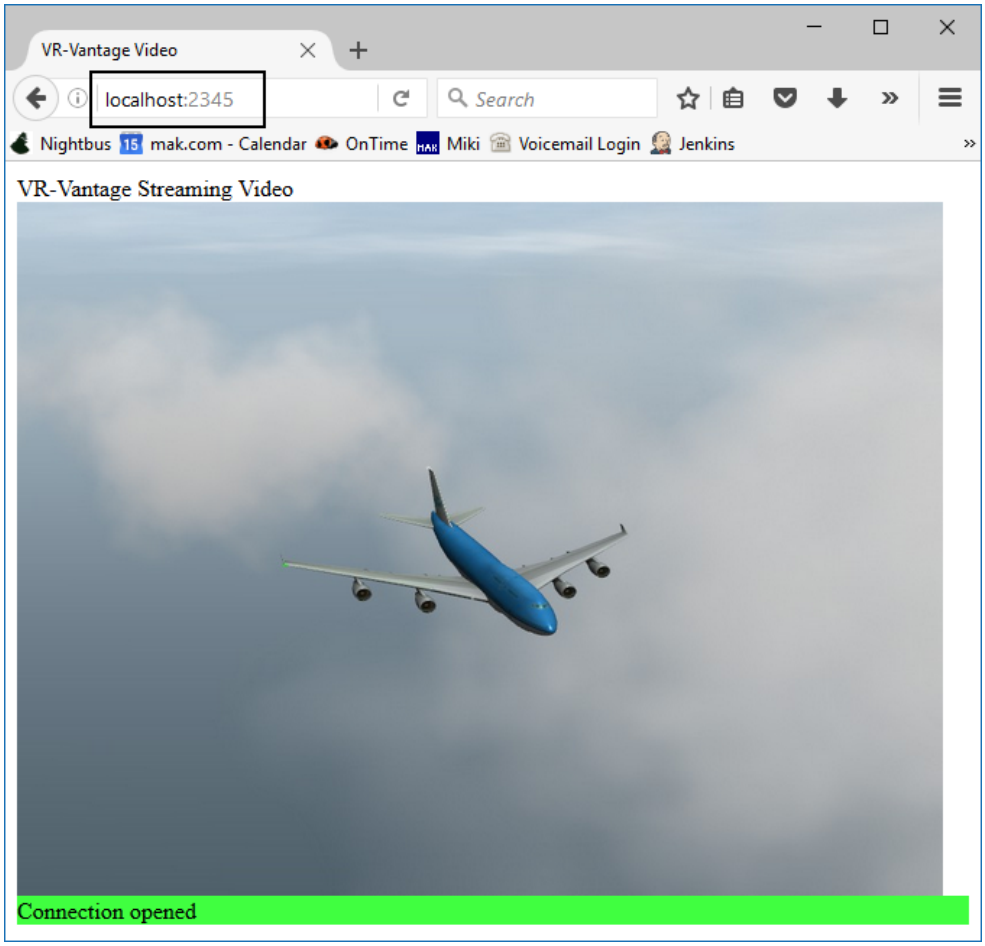


13. Click Play.

8.4.2 Streaming Video to a Web Browser

To stream video to a web browser, you just need to know the hostname of the computer on which you are running the browser. If you run a browser on the same machine as you are using to run VR-Vantage, you can specify the hostname as localhost (Figure 65).

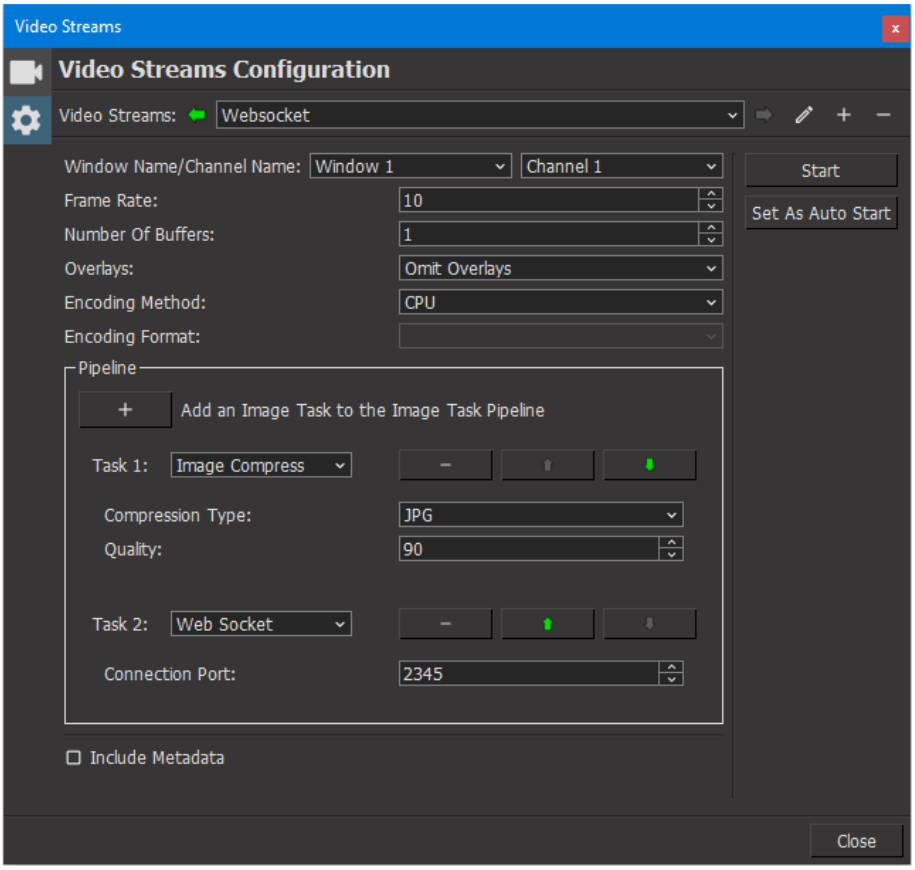
Figure 65. Streaming video to a browser



➤ **To stream video to your web browser:**

1. Start VR-Vantage.
2. Choose the **Settings > Video Streams**. The Video Streams dialog box opens.
3. Select the Video Streams Configuration page (Figure 62 on page 154).
4. In the Video Streams list, select Websocket (Figure 66).

Figure 66. Websocket configuration



5. In the Pipeline group box, accept the default value for the Connection Port (2345) or specify a different value.
6. On the Video Streams Configuration page, click Start.
7. If you are not already connected to an exercise, connect VR-Vantage to the exercise you want to view.
8. In your browser type the URL **localhost:2345**. (If you are not connecting to the same machine, use hostname:2345. If you specified a different port, use the port that you specified.) You will see the video stream.

8.5. Recording the VR-Vantage Display

VR-Vantage users often want to record the VR-Vantage display. You can do this with commercial video capture tools. You can also send a video stream to disk. The H264/H265/MPEG2 FILE video stream configurations provided with VR-Vantage sends the output to a file. The configurations are described in "8.4. Viewing Streaming Video" on page 158.

8.6. Configuring Streaming Video Metadata

This section lists the metadata that VR-Vantage publishes for streaming video. You can specify values for some metadata in the streaming video configuration files.

Table 8 lists the fields in the Motion Imagery Sensor (MISB) metadata set and indicates which ones are supported by VR-Vantage and which one you can configure in the streaming video configuration file.

Table 8. Motion Imagery Sensor Minimum Metadata Set

Fields	Supported	Configurable
1 Checksum	x	
2 Precision Time Stamp	x	
3 Mission ID	x	x
5 Platform Heading Angle	x	
6 Platform Pitch Angle (Short)	x	
7 Platform Roll Angle (Short)	x	
10 Platform Designation	x	x
11 Image Source Sensor	x	x
12 Image Coordinate System	x	
13 Sensor Latitude	x	
14 Sensor Longitude	x	
15 Sensor True Altitude (MSL)	x	
16 Sensor Horizontal FoV	x	
17 Sensor Vertical FoV	x	
18 Sensor Relative Azimuth Angle	x	
19 Sensor Relative Elevation Angle	x	
20 Sensor Relative Roll Angle	x	
21 Slant Range	x	
22 Target Width	x	
23 Frame Center Latitude	x	
24 Frame Center Longitude	x	
25 Frame Center Elevation (MSL)	x	
48 Security	x	x
65 UAS Local Set Version	x	
75 Sensor Ellipsoid Height (HAE)		
78 Frame Center Height Above Ellipsoid (HAE)		
90 Platform Pitch Angle (Full)		
91 Platform Roll Angle (Full)		
94 Motion Imagery Core Identifier	x	x
96 Target Width Extended		
104 Sensor Ellipsoid Height Extended (HAE)		

Table 9 lists the fields in the UAS Datalink Local metadata set and indicates which ones are supported by VR-Vantage and which one you can configure in the streaming video configuration file.

Table 9. UAS Datalink Local Metadata Set

Field	Supported	Configurable
1 Checksum	x	
2 Precision Time Stamp	x	
3 Mission ID	x	x
4 Platform Tail Number	x	x
5 Platform Heading Angle	x	
6 Platform Pitch Angle	x	
7 Platform Roll Angle	x	
8 Platform True Airspeed	x	
9 Platform Indicated Airspeed	x	
10 Platform Designation	x	x
11 Image Source Sensor	x	x
12 Image Coordinate System	x	
13 Sensor Latitude	x	
14 Sensor Longitude	x	
15 Sensor True Altitude	x	
16 Sensor Horizontal Field of View	x	
17 Sensor Vertical Field of View	x	
18 Sensor Relative Azimuth Angle	x	
19 Sensor Relative Elevation Angle	x	
20 Sensor Relative Roll Angle	x	
21 Slant Range	x	
22 Target Width	x	
23 Frame Center Latitude	x	
24 Frame Center Longitude	x	
25 Frame Center Elevation	x	
26 Offset Corner Latitude Point 1	x	
27 Offset Corner Longitude Point 1	x	
28 Offset Corner Latitude Point 2	x	
29 Offset Corner Longitude Point 2	x	
31 Offset Corner Longitude Point 3	x	
32 Offset Corner Latitude Point 4	x	

Table 9. UAS Datalink Local Metadata Set (continued)

Field	Supported	Configurable
34 Icing Detected	x	
35 Wind Direction	x	
36 Wind Speed	x	
37 Static Pressure	x	
38 Density Altitude	x	
39 Outside Air Temperature	x	
40 Target Location Latitude	x	
41 Target Location Longitude	x	
42 Target Location Elevation	x	
43 Target Track Gate Width	x	
44 Target Track Gate Height	x	
45 Target Error Estimate - CE90		
46 Target Error Estimate - LE90		
47 Generic Flag Data 01	x	
48 Security Local Set	x	x
49 Differential Pressure	x	
50 Platform Angle of Attack	x	
51 Platform Vertical Speed	x	
52 Platform Sideslip Angle	x	
53 Airfield Barometric Pressure	x	
54 Airfield Elevation	x	
55 Relative Humidity	x	
56 Platform Ground Speed	x	
57 Ground Range		
58 Platform Fuel Remaining	x	
59 Platform Call Sign	x	
60 Weapon Load		
61 Weapon Fired		
62 Laser PRF Code	x	
63 Sensor Field of View Name	x	
64 Platform Magnetic Heading	x	
65 UAS Datalink LS Version Number	x	
66 Target Location Covariance Matrix		

Table 9. UAS Datalink Local Metadata Set (continued)

Field	Supported	Configurable
67 Alternate Platform Latitude	x	
68 Alternate Platform Longitude	x	
69 Alternate Platform Altitude	x	
70 Alternate Platform Name	x	
71 Alternate Platform Heading	x	
72 Event Start Time - UTC		
73 RVT Local Set		
74 VMTI Local Set		
75 Sensor Ellipsoid Height	x	
76 Alternate Platform Ellipsoid Height	x	
77 Operational Mode	x	
78 Frame Center Height Above Ellipsoid	x	
79 Sensor North Velocity	x	
80 Sensor East Velocity	x	
81 Image Horizon Pixel Pack		
82 Corner Latitude Point 1 (Full)		
83 Corner Longitude Point 1 (Full)		
84 Corner Latitude Point 2 (Full)		
85 Corner Longitude Point 2 (Full)		
87 Corner Longitude Point 3 (Full)		
88 Corner Latitude Point 4 (Full)		
89 Corner Longitude Point 4 (Full)		
90 Platform Pitch Angle (Full)		
91 Platform Roll Angle (Full)		
92 Platform Angle of Attack (Full)		
93 Platform Sideslip Angle (Full)		
94 MIIS Core Identifier	x	x
95 SAR Motion Imagery Local Set		
96 Target Width Extended		
97 Range Image Local Set		
98 Geo-Registration Local Set		
99 Composite Imaging Local Set		
100 Segment Local Set		

Table 9. UAS Datalink Local Metadata Set (continued)

Field	Supported	Configurable
101 Amend Local Set		
102 SDCC-FLP		
103 Density Altitude Extended		
104 Sensor Ellipsoid Height Extended		
105 Alternate Platform Ellipsoid Height Extended		
106 Stream Designator		
107 Operational Base		
108 Broadcast Source		

8.6.1 Specifying Metadata in a Streaming Video Configuration File

You can configure some metadata values in the streaming video configuration files in *./appData/videoStreams*. Table 8 on page 164 and Table 9 on page 165 list the metadata fields that you can specify. The following code snippet is from *H264 HW Metadata-MPGTS-File.DtVideoStream*:

```
<myMetadataPublisherRecord class_id="1" tracking_level="0"
version="2">
    <myPublisherType>LocalMS</myPublisherType>
    <myObserverName>Observer 1</myObserverName>
    <DtNameValueLists class_id="2" tracking_level="0" version="1">
        ...
        <myParametersString class_id="6" tracking_level="0"
version="0">
            <count>18</count>
            <item_version>0</item_version>
            <item class_id="7" tracking_level="0" version="0">
                <first>ImageSourceSensor</first>
                <second>EO Nose</second>
            </item>
            <item>
                <first>MissionID</first>
                <second>12</second>
            </item>
            <item>
                <first>MotionImageryCoreIdentifier_MinorID</first>
                <second></second>
            </item>
            <item>
                <first>MotionImageryCoreIdentifier_PlatformID</first>
                <second>16B74341000841A0BE365B5AB96A3645</second>
            </item>
            <item>
```

```
                <first>MotionImageryCoreIdentifier_
PlatformType</first>
                <second>VIRTUAL</second>
            </item>
            <item>
                <first>MotionImageryCoreIdentifier_SensorID</first>
                <second>F592F02373364AF8AA9162C00F2EB2DA</second>
            </item>
            <item>
                <first>MotionImageryCoreIdentifier_SensorType</first>
                <second>PHYSICAL</second>
            </item>
            ...
        </myParametersString>
    </DtNameValueLists>
</myMetadataPublisherRecord>
```

The following list describes the parameters for the MISB metadata set that you can configure:

- MissionID. Sets the mission ID string that is sent in the stream every 10 seconds. Please see MISB Standard 0102.12: https://nsgreg.nga.mil/doc/view?i=4422.
- PlatformDesignation. Sets the Platform Designation text sent every 10 seconds. If not set in the DtVideoStream the text from VrvLink identification will be used if connected to an entity.
- ImageSourceSensor. Sets the Image Source Sensor string that is sent in the stream every 10 seconds.
- Motion Imagery Core Identifier (please see MISB Standard 1204.1: https://nsgreg.nga.mil/doc/view?i=4175).
  - MotionImageryCoreIdentifier_SensorID: UUID (32 char.) If SensorID is set, set MotionImageryCoreIdentifier_SensorType (PHYSICAL, VIRTUAL, MANAGED).
  - MotionImageryCoreIdentifier_PlatformID: UUID (32 char.) If PlatformID is set, set MotionImageryCoreIdentifier_PlatformType (PHYSICAL, VIRTUAL, MANAGED).
  - MotionImageryCoreIdentifier_WindowID: UUID (32 char.).
  - MotionImageryCoreIdentifier_MinorID: UUID (32 char.).
- Security (please see MISB Standard 0102.12: https://nsgreg.nga.mil/doc/view?i=4422).
  - SecurityClassification: UNCLASSIFIED, RESTRICTED, CONFIDENTIAL, SECRET, TOP SECRET.
  - SecurityCodingMethod: ISO_3166_TWO_LETTER, ISO_3166_THREE_LETTER, FIPS_10_4_TWO_LETTER, FIPS_10_4_FOUR_LETTER, ISO_3166_NUMERIC, 1059_TWO_LETTER, 1059_THREE_LETTER, FIPS_10_4_MIXED,

ISO_3166_MIXED, STANAG_1059_MIXED, GENC_TWO_LETTER, GENC_THREE_LETTER, GENC_NUMERIC, GENC_MIXED.

- SecurityClassifyingCountry : 2, 3 or more letters describing the country code (depends on the SecurityCodingMethod selected). Example: “USA” for “ISO_3166_THREE_LETTER”.
- SecurityInformation: See section 6.1.4 of Standard 0102.12.
- SecurityCaveats: See section 6.1.5 of Standard 0102.12.
- SecurityReleasingInstructions: See section 6.1.6 of Standard 0102.12.
- SecurityObjectCountryCodingMethod: ISO_3166_TWO_LETTER, ISO_3166_THREE_LETTER, FIPS_10_4_TWO_LETTER, FIPS_10_4_FOUR_LETTER, ISO_3166_NUMERIC, 1059_TWO_LETTER, 1059_THREE_LETTER, FIPS_10_4_MIXED, ISO_3166_MIXED, STANAG_1059_MIXED, GENC_TWO_LETTER, GENC_THREE_LETTER, GENC_NUMERIC, GENC_MIXED.
- SecurityObjectCountryCodes: 2, 3 or more letters describing the country code (depends on the SecurityObjectCountryCodingMethod selected). Example: “USA” for “ISO_3166_THREE_LETTER”.

The following list describes the parameters you can specify for the Local metadata set that you can configure:

- MissionID. Sets the mission ID string that is sent in the stream every 10 seconds. Please see MISB Standard 0102.12: https://nsgreg.nga.mil/doc/view?i=4422.
- PlatformTailNumber. Sets the tail number that is sent in the stream every 10 seconds.
- PlatformDesignation. Sets the Platform Designation text sent every 10 seconds. If not set in the DtVideoStream the text from VrvLink identification will be use if connect to an entity.
- ImageSourceSensor. Sets the Image Source Sensor string that is sent in the stream every 10 seconds.
- Motion Imagery Core Identifier (please see MISB Standard 1204.1: https://nsgreg.nga.mil/doc/view?i=4175).
  - MotionImageryCoreIdentifier_SensorID: UUID (32 char.).
  - If SensorID is set, set MotionImageryCoreIdentifier_SensorType (PHYSICAL, VIRTUAL, MANAGED).
  - MotionImageryCoreIdentifier_PlatformID: UUID (32 char.).
  - If PlatformID is set, set MotionImageryCoreIdentifier_PlatformType (PHYSICAL, VIRTUAL, MANAGED).
  - MotionImageryCoreIdentifier_WindowID: UUID (32 char.).
  - MotionImageryCoreIdentifier_MinorID: UUID (32 char.).
- Security (please see MISB Standard 0102.12: https://nsgreg.nga.mil/doc/view?i=4422).

- SecurityClassification: UNCLASSIFIED, RESTRICTED, CONFIDENTIAL, SECRET, TOP SECRET.
- SecurityCodingMethod: ISO_3166_TWO_LETTER, ISO_3166_THREE_LETTER, FIPS_10_4_TWO_LETTER, FIPS_10_4_FOUR_LETTER, ISO_3166_NUMERIC, 1059_TWO_LETTER, 1059_THREE_LETTER, FIPS_10_4_MIXED, ISO_3166_MIXED, STANAG_1059_MIXED, GENC_TWO_LETTER, GENC_THREE_LETTER, GENC_NUMERIC, GENC_MIXED.
- SecurityClassifyingCountry : 2, 3 or more letters describing the country code (depends on the SecurityCodingMethod selected). Example: “USA” for “ISO_3166_THREE_LETTER”.
- SecurityInformation: See section 6.1.4 of Standard 0102.12.
- SecurityCaveats: See section 6.1.5 of Standard 0102.12.
- SecurityReleasingInstructions: See section 6.1.6 of Standard 0102.12.
- SecurityObjectCountryCodingMethod: ISO_3166_TWO_LETTER, ISO_3166_THREE_LETTER, FIPS_10_4_TWO_LETTER, FIPS_10_4_FOUR_LETTER, ISO_3166_NUMERIC, 1059_TWO_LETTER, 1059_THREE_LETTER, FIPS_10_4_MIXED, ISO_3166_MIXED, STANAG_1059_MIXED, GENC_TWO_LETTER, GENC_THREE_LETTER, GENC_NUMERIC, GENC_MIXED.
- SecurityObjectCountryCodes: 2, 3 or more letters describing the country code (depends on the SecurityObjectCountryCodingMethod selected). Example: “USA” for “ISO_3166_THREE_LETTER”.

8.6.2 Streaming Video and Metadata from a UAV Gimbaled Sensor

When you want to stream the video and metadata of a gimbaled sensor, you must create a view for the gimbaled sensor and set it to transmit the information you want to stream.

Out of the box, only certain UAVs included with MAK products support this method for streaming video with metadata:

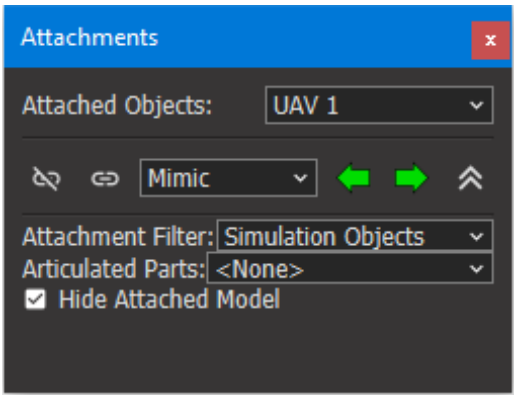
- MQ-1 Predator
- MQ-8B Fire Scout
- MQ-9 Reaper UAV
- RQ-11 Raven UAV

➤ **To stream video and metadata from a gimbaled sensor:**

1. Optionally, open the terrain used in the simulation.
2. Connect to your simulation. See "3.4. Connecting to a Simulation Network" on page 75 for details.
3. Right-click on the entity with the gimbaled sensor and choose **Observer Attach > Attach Mimic**.
4. Right-click on the entity again and choose **Create Sensor View >** *sensor* (typically **Gimbaled Sensor** or **Sensor 1**). This creates a new window and a new observer named Observer 2.

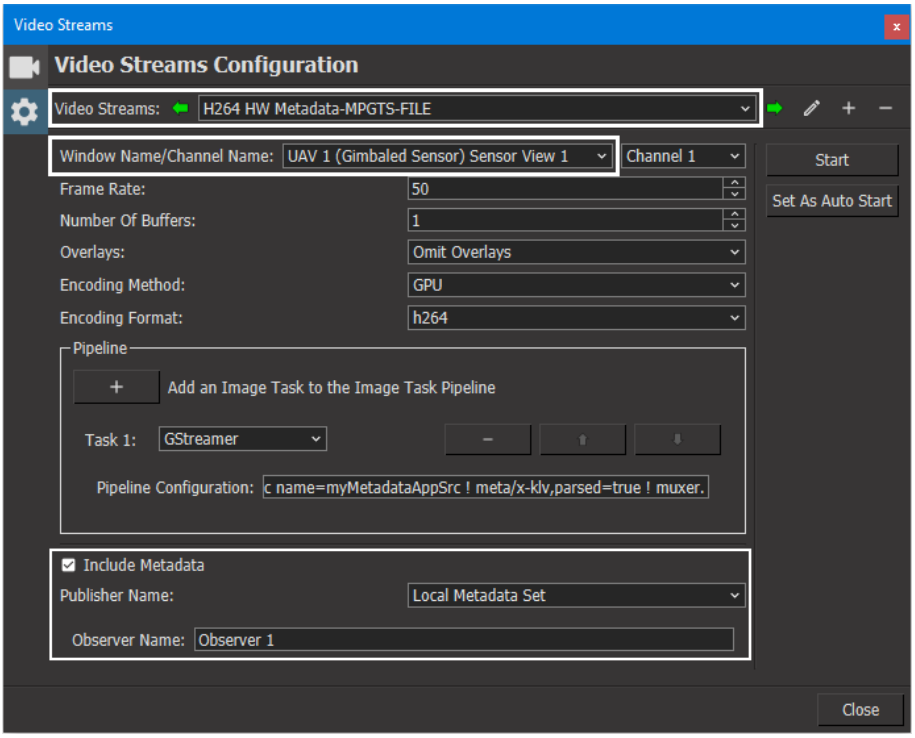
5. If the Attachments Panel is not open, choose **View > Attachments Panel** (Figure 67).
6. Make sure that the UAV is shown in the Attached Objects box. If not, double-click it in the Objects List and then select the sensor view window.
7. Click the down arrow to expand the Attachments Panel.
8. In the Articulated Parts list, select an articulated part.

Figure 67. Attachments Panel



9. Choose **Settings > Video Streams**. The Video Streams dialog box opens.
10. Select the Video Streams Configuration page (Figure 68).
11. In the Video Streams list, select the desired stream type that includes the word "Metadata".
12. In the Window Name list, select the gimbaled sensor's window.
13. If it is not selected, select the Include Metadata check box.
14. From the Publisher Name drop-down box, select Local Metadata Set to stream all of the metadata.
15. Click in the Observer Name box. The Set Observer Name dialog box opens.
16. Enter Observer 2 and then click OK.

Figure 68. Video Streams Configuration



17. When you are ready to begin streaming, click Start in the Video Streams dialog box.
18. When you are finished streaming, click Stop.



9. Using Head Mounted Displays for Virtual and Mixed Reality

This chapter explains how to use a head mounted display (HMD) with VR-Vantage.

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9.2. Running VR-Vantage with an HMD 178
9.3. Measuring Performance 179
9.4. Configuration Options for Virtual and Mixed Reality 180

9.1. Introduction to Head-Mounted Displays

VR-Vantage is integrated with several virtual reality head-mounted displays (HMDs). VR-Vantage can render stereo views, which are presented inside the HMD. The head position and orientation tracking of the HMD are reflected in the observer as the wearer of the HMD moves their head.

VR-Vantage uses the OpenVR, Oculus SDK, Varjo SDK, and VRgineers libraries to integrate with virtual reality systems. Any system that is capable of using OpenVR should work with VR-Vantage.

VR-Vantage is tested with the following systems:

- Oculus Rift and Rift S
- HTC Vive and HTC Vive Pro
- Valve Index
- Varjo XR-1, XR-3, VR-2, and VR-3
- VRgineers XTAL 2 and XTAL 3
- Windows Mixed Reality headsets

9.1.1 Prerequisites for Using an HMD

To use an HMD, you need specific software and VR-Vantage setup:

- SteamVR. Required for the Vive and other OpenCR headsets. It is installed through the Steam digital distribution platform (http://store.steampowered.com).
- The Oculus Rift requires that you install the Oculus Runtime.
- For a Varjo headset, you must install Varjo Base. The Varjo XR-range devices support mixed reality, which requires that you also install Thunderbolt 3. For information on Varjo system requirements, see https://varjo.com/use-center/getting-started/system-requirements.
- XTAL headsets require the VRgineers software.
- If you are using Microsoft Mixed Reality devices, the "Windows Mixed Reality for SteamVR" add-on must be installed through Steam.



When using an HMD, ambient occlusion (HBAO+) is disabled by default.

9.1.2 Resetting the Tracking Sensor

For user comfort, you can reset the origin of the positional tracking performed by the HMD. This allows you to restart the head tracking once you have put on the HMD and assumed a comfortable position. You can reset the sensor at any time by pressing the **F8** key.

You can change the keyboard assignment by changing the “Reset Virtual Reality HMD” action in the VR-Vantage Key Mapping Editor. (This action is available only when you run VR-Vantage with the virtual reality plug-in.) To learn how to change the key mapping, see "37. Creating and Editing Key Mappings" on page 549.

9.1.3 Calibrating the Eye Tracking for Varjo

Varjo devices allow applications that use eye tracking can start multi-dot calibration for more accurate eye tracking data. You can access the Varjo's eye tracking calibration by pressing **F9**.

9.1.4 Configuration for Mixed Reality

Some headsets natively support Mixed Reality mode, such as the Varjo XR range and VRgineers XTAL 3. Mixed reality in VR-Vantage requires a mask mesh, which is drawn into the scene and indicates the areas that should display the real world video stream. For headsets that support it, you can enable mixed reality mode using the Virtual Reality Configuration dialog box. See "9.4. Configuration Options for Virtual and Mixed Reality" on page 180.

Once you enable the mask mesh, you can select a mixed reality definition file. This is an XML file that describes a model as well as some transform offsets and depth range information. You can use any mesh file format supported by VR-Vantage.

The mesh and transform units are in the same units as the database, which are typically meters. Table 10 lists the fields that are in the XML file.

Table 10. Mask mesh file fields

Field	Description
`<Model>`	The path to the mesh file used as your mask. If you do not define a model, a default unit cube is created.
`<UseAttachmentPosition>`	By default the mask anchors itself to and follows the observer. If `UseAttachmentPosition` is set to true, the mask anchors to whatever entity the observer is attached to. This is important because the anchor point becomes the mesh file's origin. For example, if you created a mask mesh of an aircraft's cockpit, sharing the same origin as the original aircraft model you would need to set `UseAttachmentPosition` to true so the mask anchors to the aircraft.
`<Translate>`	An XYZ translation for the mesh.
`<Rotate>`	A Pitch/Yaw/Roll rotation in degrees for the mesh.
`<Scale>`	An XYZ scale for the for the mesh.
`<DepthRange>`	Near and Far depth range used for real-world depth testing on Varjo XR headsets.

9.2. Running VR-Vantage with an HMD

To use an HMD, you must load the virtual reality plug-in when you start VR-Vantage. VR-Vantage includes a batch file with the startup commands to load the plugins. This batch file is also included in the start menu. If you want to enable Virtual Reality every time you start VR-Vantage, copy *vrvVirtualRealityPlugin.dll* and *vrvVirtualRealityQtPlugin.dll* from *./bin64* to *,/plugins64/release*.

➤ **To use an HMD with VR-Vantage:**

1. Start the HMD's software and ensure the headset is functioning correctly:
   - SteamVR for OpenVR headsets. SteamVR Home must be visible in the HMD.
   - Oculus App for Oculus headsets
   - Varjo Base for Varjo headsets
   - VR Tool for VRgineers headsets

   For headsets that support a native SDK as well as OpenVR (such as the Varjo), be sure that their native software is open before starting VR-Vantage. If you do not, VR-Vantage selects OpenVR as the runtime and that might not support all of the headset's features.
2. Start VR-Vantage using the **VR-Vantage with Virtual Reality** shortcut on the Start menu.
3. Load a terrain.
4. Connect to a simulation.
5. Position the observer using the mouse and keyboard or attach to an entity in Mimic mode.
6. Disable cockpit displays (Display Settings dialog box, Cockpit Displays page).
7. Position the observer to the location of the eyes of the entity or operator of the vehicle.
8. Put on the HMD.
9. When you are comfortable, reset the tracking sensor as described in "9.1.2 Resetting the Tracking Sensor" on page 176.

9.2.1 Enabling and Disabling Virtual Reality Rendering

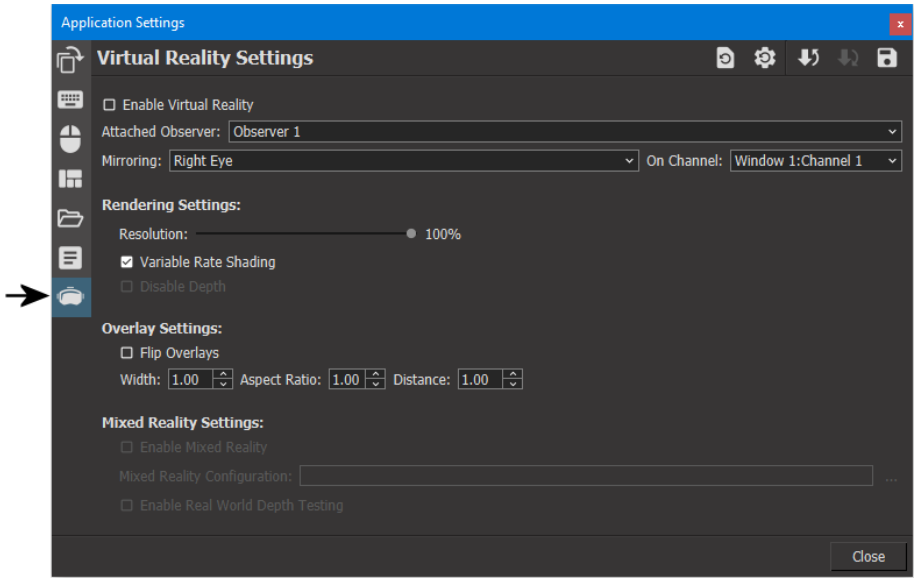
By default, when you start VR-Vantage with Virtual Reality, rendering to the HMD is enabled at startup. You can enable and disable rendering to the HMD at runtime.

➤ **To enable or disable virtual reality rendering:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the Virtual Reality Settings page (Figure 69).

The Virtual Reality Settings page is available only if the virtual reality plug-in is loaded and an HMD is detected.

Figure 69. Virtual Reality Settings page



3. Select or clear the Enable Virtual Reality check box.

You can also enable or disable virtual reality by choosing **Settings > Enable Virtual Reality**, or clicking the Virtual Reality button on the Display Settings toolbar.

9.3. Measuring Performance

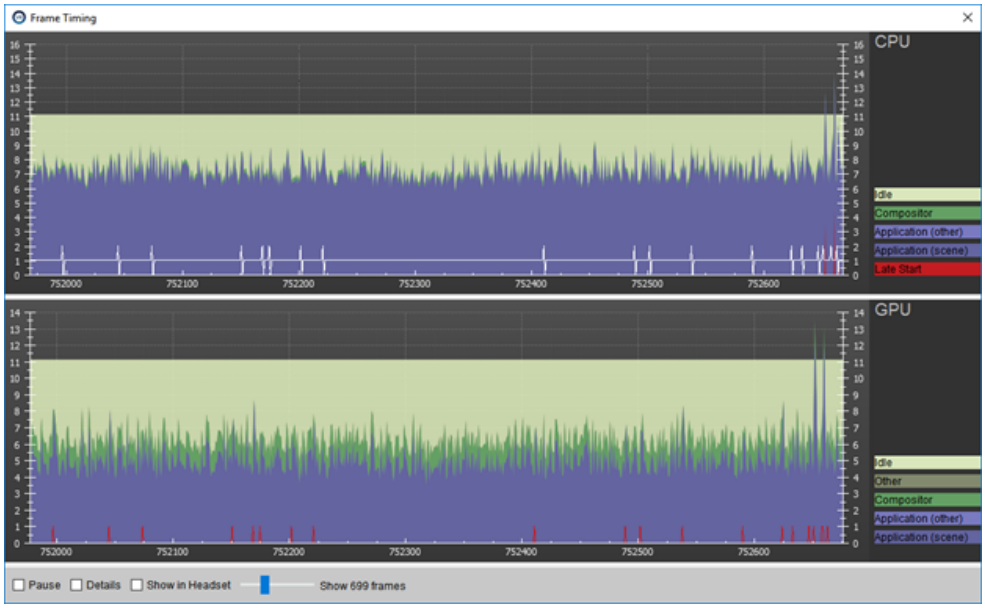
Virtual reality requires a high frame rate for a comfortable experience. 90hz is the recommended frame rate. Lower frame rates can cause discomfort and nausea in some individuals. Using the frame rate statistics in VR-Vantage can help you tune VR-Vantage for optimal performance. You can also see frame rate statistics in the SteamVR Performance Settings dialog box.

Some devices also provide statistics in their software. Refer to the device's documentation for details.

- For OpenVR-compatible headsets, you can use the SteamVR Performance Settings dialog box.
- Varjo headsets allow you to use the Varjo Base Analytics window.

Figure 70 illustrates SteamVR performance statistics.

Figure 70. SteamVR performance statistics



9.4. Configuration Options for Virtual and Mixed Reality

You can set the following configuration options for virtual and mixed reality:

- Attached Observer. This is the observer that the HMD will attach to and render the perspective from. The default is to attach to Observer 1.
- Mirroring. This copies the image rendered for a given eye to the selected channel in the main display. The default is to render the right eye to the main channel. Mirroring disables the normal render pass of the attached channel to help with performance.

  If mirroring is enabled and the HMD is attached to the observer that is driving a displayed channel, then the main view will be rendered from the HMD perspective. This affects performance, because the scene will be rendered a third time.

- Rendering Resolution. The slider bar allows you to dynamically adjust the resolution. Overlays remain at their native resolution.
- Variable Rate Shading. Improves performance in VR by lowering the precision and accuracy of GPU fragment operations in certain areas of the frame.
- Disable Depth. Some headsets support depth-based warping, which is a way of making image appear smooth with lower frame rates. Currently, this applies to Varjo headsets and the Oculus Rift. When you select Disable Depth, you disable the depth-based warp (VR-Vantage does not pass the depth buffer to the headset SDKs). If the depth warp is causing cockpit windows to display artifacts and otherwise look incorrect, selecting Disable Depth can help.

- Flip Overlays. Currently this applies only to the HTC Vive. Enabling this option flips the overlays vertically. Select this check box when overlays display upside down.
- Enable Mixed Reality. This applies only to headsets that support mixed reality. Select or clear this check box to enable or disable mixed reality.

  When this is selected, you can specify the XML configuration file that defines the 3D mesh, position, rotation, and scale of that mesh. You can also define the chroma key configuration. Using the XML file, the device positions the model with the offsets and rotation from either the Observer's position or the object that the Observer is attached to. See "9.1.4 Configuration for Mixed Reality" on page 177 for an overview of the mesh file.
- Enable Real World Depth Testing. You can enable or disable real world depth testing separately from mixed reality mode. Disabling depth estimation can improve performance. When you enable Real World Depth Testing, VR-Vantage reads settings from the specified mask file. The Depth Range entry defines what the Real World Depth testing sees.

➤ **To set virtual reality configuration settings:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the Virtual Reality Settings page (Figure 69 on page 179).

   The Virtual Reality Settings page is available only when the virtual reality plug-in is loaded.
3. Change the settings as desired.



10. Using Multiple Projectors with VR-Vantage

This chapter describes how to set up two PCs and two projectors to project a large, seamless, edge blended display of VR-Vantage.

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10.2. Hardware Requirements 184
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10.1. Using Multiple Projectors

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

This chapter covers the integration of SDM with VR-Vantage.

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

10.2. Hardware Requirements

The procedure in this chapter assumes you have two computers, two projectors, and a camera. The Scalable Display Manager software requires a camera. It must be one of the following cameras:

- Logitech C910, C920.
- Canon Rebel XSi, T1i, T2i, T3, T3i.

Set up the two computers with graphics cards that will be synchronized together. One computer is the master; the other computer is the client.

Set up the camera with its correct drivers on the master computer.

Set up the projector displays so that they overlap at least 15%.

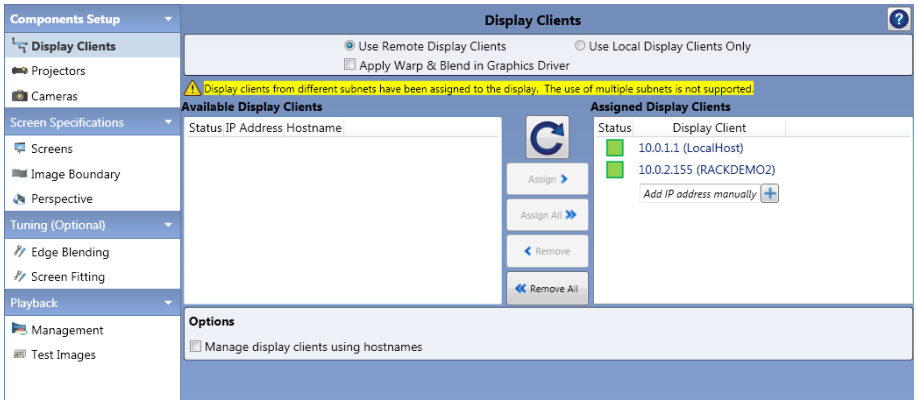
10.3. Installing the Scalable Display Manager

1. Download the Scalable Display Manager (SDM) and associated documentation. Make sure to also download the User Manual.
2. Run the Scalable Display client on the client computer. The client software will run in the background (no GUI will be seen).
3. On the master computer, right-click the Scalable Display Manager installer and choose **run as admin**. The Scalable Display Manager is installed.
4. Request a license from Scalable Display Technologies.

10.3.1 Configuring the Master Computer

1. Open the Scalable Display Manager.
2. In the Components Setup Panel, select Display Clients. Make sure you have the master and display clients in the Assigned Display Clients list (Figure 71).

Figure 71. Display Clients list



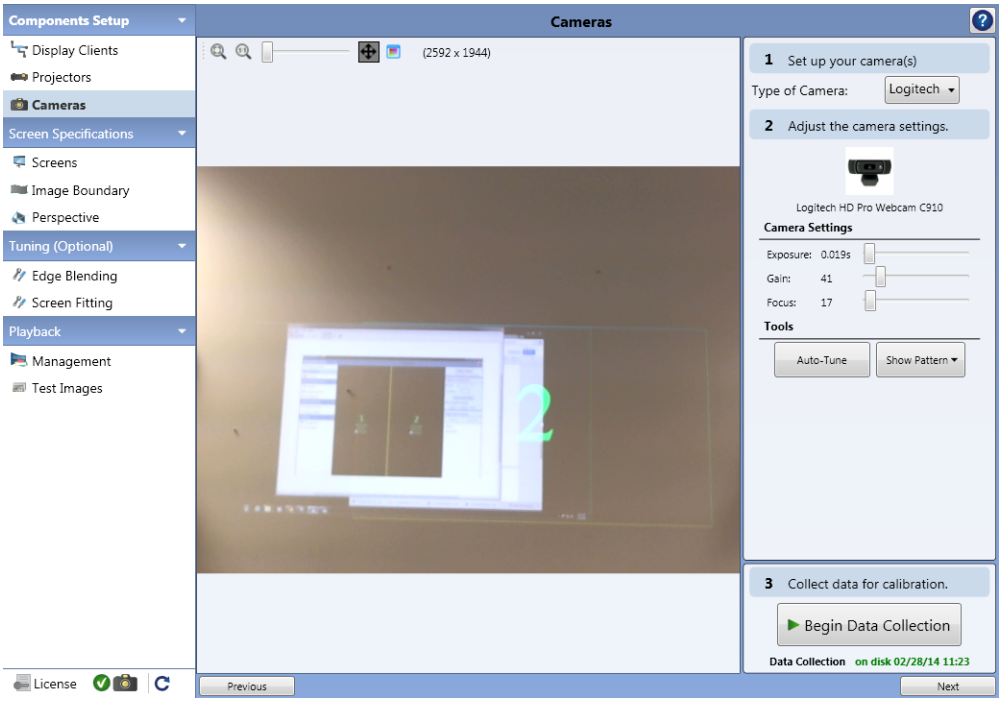
3. In the Components Setup Panel, select Projectors.
4. Specify the arrangement of the projectors (Figure 72).

Figure 72. Projectors



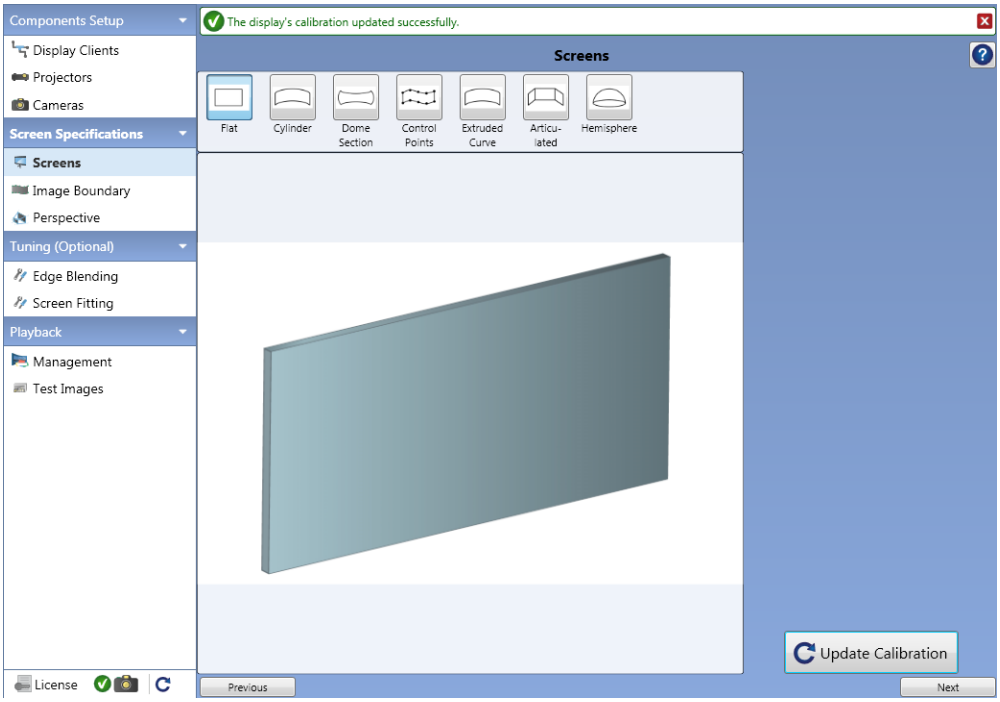
5. In the Components Setup Panel, select Cameras (Figure 73).

Figure 73. Cameras



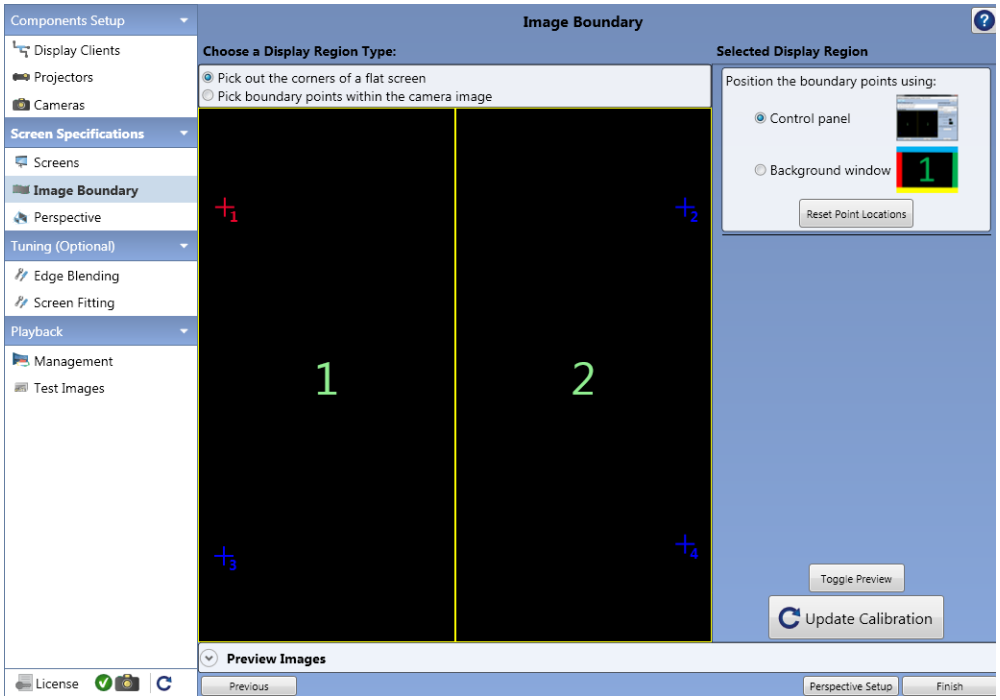
6. In the Type of Camera list, select your camera.
7. Click the Auto-Tune button to have it configure the right camera parameters.
8. Click Begin Data Collection.
9. On the Screen Specification Panel, select Screens (Figure 74).

Figure 74. Screens



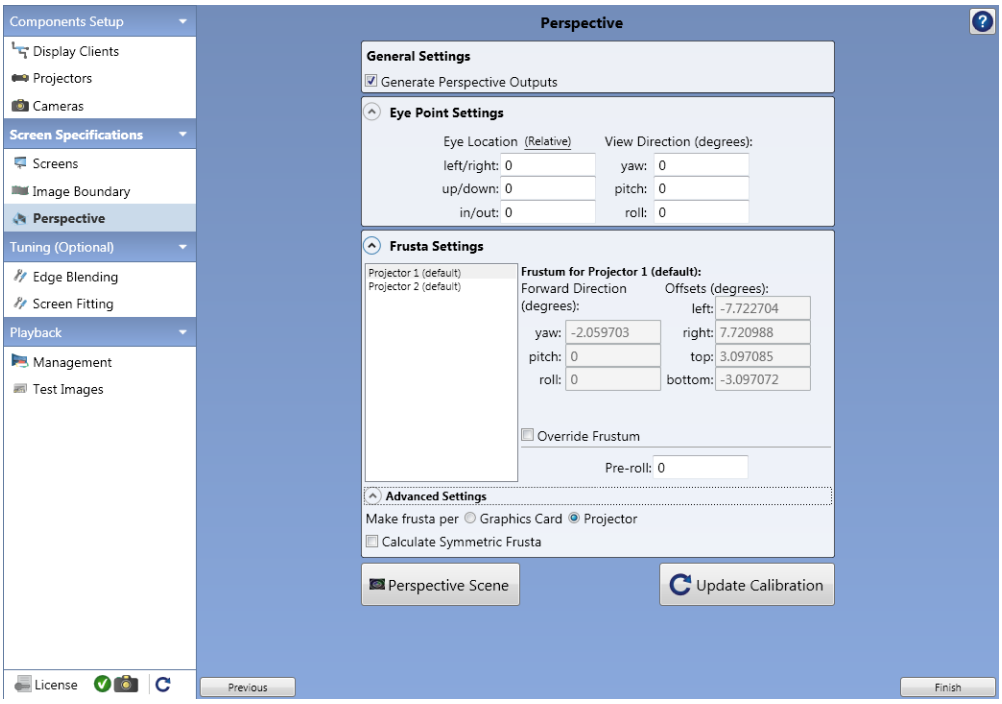
10. Select Flat. (This assumes you are projecting on a wall. If not, select the screen you are setting up. This procedure sets up flat screens.)
11. Click the Update Calibration button.
12. On the Screen Specification Panel, select Image Boundary (Figure 75).

Figure 75. Image Boundary



13. Move the four corners to make a rectangle on the display wall.
14. Click Update Calibration.
15. On the Screen Specification Panel, select Perspective (Figure 76).

Figure 76. Perspective



16. Click the Perspective Scene button. Spherical cones are displayed on the perspective grid on the wall. You should see circles and not ovals. If you see ovals, you have to do the following:

    a. On the Scalable menu, choose **Support > Advanced Options**.

    b. Specify the following values (in meters):

        — FlatScreenWidth, double

        — FlatScreenHeight, double

        This defines the width and height of a flat screen for SDK programs. The default is 1.0, 1.0, which will probably stretch the image horizontally because screens rarely have a 1 to 1 aspect ratio. It is used in conjunction with the standard option "Flat Screen Distance" (FlatScreenZ).

    c. Set Flat Screen Distance (FlatScreenZ). This is usually measured as the distance from the wall or screen and the eyepoint. When computing the perspective calibration data for the EasyBlend SDK, this is the distance away from (0,0,0), down the -Z axis, of the screen. It is measured as a multiplier of the width of the screen, and defaults to 1 width away. Decreasing this value will increase the perspective field-of-view generated for the SDK. Increasing this value will shrink the perspective field-of-view. This value should always be positive.

        For example, if the camera is 114" from the wall, the chosen eye point is at 80 inches and the display is 95 inches wide (W) by 29 inches high (H) the following values can be converted to meters: FlatScreenWidth, FlatScreenHeight and eye point distance are (2.4 (W), 0.74 (H) and 2.0 (eye point to screen distance) respectively). With these values the FlatScreenZ can be calculated:

        ```
        FlatScreenZ = EyePointDistance/FlatScreenWidth = 2.0/2.4 =
        0.83 meters.
        ```

    d. Click Finish.

    e. Shut down the SDM.

    f. Restart the SDM.

    g. On the Screen Specification Panel, select Perspective (Figure 76).

    h. Click Update Calibration. If you see circles on the wall, you are finished.

17. Click Finish. The mesh will be written out to *C:\Program Files\Scalable Display\DEI\LocalCalibration\ScalableData.ol*. This is the default that the plug-in looks for. Use the environment variable MAK_SCALABLEDATA if you want to use a different mesh. If you move the projectors you must reconfigure the mesh.

10.4. Running VR-Vantage with the Scalable Plug-in

1. Turn on the projectors.

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

   ```
   vrvStealth --plugin vrvScalableDisplayPlugin.dll
   ```

2. On the master computer, run the *stealthScalableDisplay.bat*.
3. On the client computer, run the *displayEngineScalableDisplay.bat*.
4. On the master, choose **View > Display Engine Configuration Editor**.
5. Click the Add Display Engine button.
6. Use the computer's name as the display engine hostname. You will not have to configure any channel or window parameters.
7. On the master, load a terrain (such as VR-Village). When it is loaded, press **Ctrl**+**Enter** to go into Fullscreen mode. You should now see a big, edge blended display! The picture will look distorted unless viewed from somewhere near the camera (unless you configured it to be viewed from some other point).



III. Scenes and Environmental Effects

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



11. Scenes and Environmental Effects

This chapter describes scenes and environment conditions.

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11.1. Working with Scenes

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

11.1.1 Creating a Scene

➤ **To create a scene:**

1. Optionally, choose **File > New Scene**. 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, see "3.3. Opening a Terrain" on page 73 and "26.1. Terrain Agility and Composability" on page 416.
3. Optionally, set the date and time of day.
4. Optionally, specify environment settings, as described in this chapter.

11.1.2 Saving a Scene

➤ **To save a scene:**

1. Choose **File > Save Scene**. The Save Scene dialog box opens. If you did not load a terrain when you created the scene, or if you built a terrain but did not save it, VR-Vantage prompts you to specify a terrain for the scene.
2. Type a name for the scene.
3. Click Save.

11.1.3 Opening a Scene

➤ **To open a scene:**

1. Choose **File > Open Scene**. The Open Scene dialog box opens.
2. Select the scene you want to open.
3. Click Open.

11.2. Setting the Date and Time of Day

VR-Vantage changes the ambient, diffuse, and specular light based on the simulated time of day and the date. Figure 77 illustrates different time of day settings.

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

Figure 77. Time of Day - dawn and midday

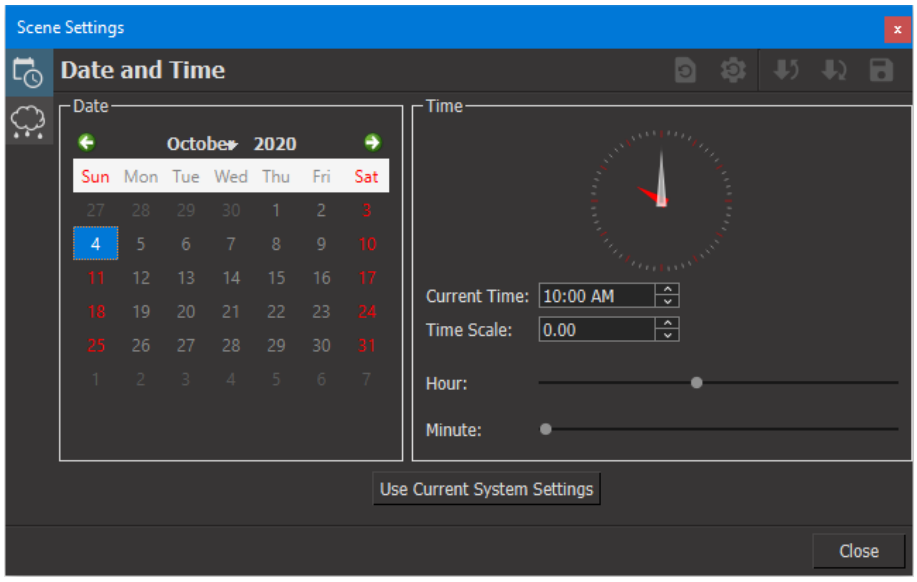


You can synchronize the time of day with VR-Forces. For details, see "11.7. Displaying Remote Environment Settings" on page 214.

➤ **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 78).

Figure 78. Date and Time page



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



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

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

11.2.1 Setting the Time Scale

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

➤ **To set the time scale:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Date and Time page (Figure 78 on the previous page).
3. In the Time group box, type or select a value in the Time Scale box.

11.3. Specifying the Environment Conditions

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

- Weather:
  - Wind speed and direction.
  - Visibility.
  - Primary obscurant (for example, haze, dust or smoke).
  - Cloud type and sky cover.
  - Precipitation type and intensity.
  - Snow depth on the ground and roads and starting elevation for accumulation.
  - Rain depth on the ground.
  - Fog height and color.
- Marine:
  - Sea swell.
  - Sea state.
  - Surface transparency.

- Underwater visibility.
- Choppiness.
- Surge depth.

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

You can save and import environment settings. When you save a scene, environment settings are saved as part of the scene. Environment settings support the standard VR-Vantage settings behaviors, as described in "3.5. Managing VR-Vantage Settings" on page 79.

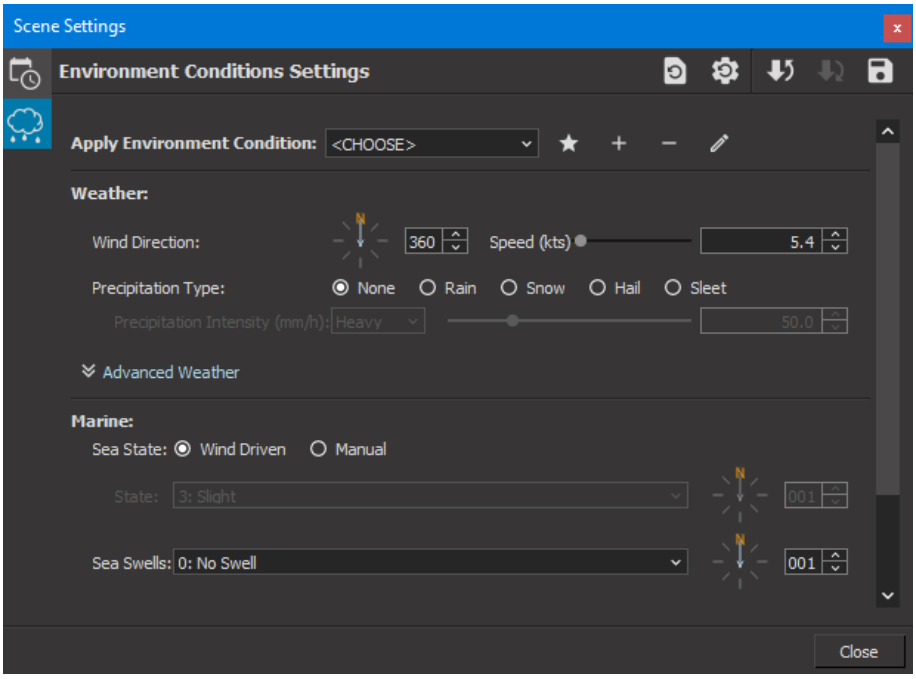
You can add your own environment conditions. You can also set an environment condition as the default condition to use when VR-Vantage starts up. If you do not set a default condition, VR-Vantage saves the settings that were in effect when you last closed it.

> The settings on the Environment Conditions Settings page always reflect the current settings for environment conditions. They do not necessarily match any of the preconfigured environment conditions as listed in the Apply Environment Conditions list except immediately after a preconfigured environment condition is applied. In other words, the Apply Environment Conditions list lets you apply environment conditions, but is not intended to summarize the status of the current environment conditions.

➤ **To specify an environment condition:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 79).

Figure 79. Environment Conditions Settings page



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

> After you select a preconfigured environment condition, the list does not show the option you selected. It applies the conditions and the settings in the rest of the page change to reflect those conditions.

11.3.1 Setting the Default Environment Condition

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

➤ **To set the default environment condition:**

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

11.3.2 Adding an Environment Condition

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

➤ **To add an environment condition:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 79 on the previous page).
3. Change the weather settings to the ones you want for the new condition.
4. Click the Add button ( ). The Name an Environment Condition dialog box opens.
5. Type a name for the new condition.
6. Click OK.

11.3.3 Editing an Environment Condition

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

➤ **To edit an environment condition:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 79 on the previous page).
3. Optionally, in the Apply Environment Condition list, select a condition you want to use as your starting point.
4. Change whatever conditions you want.
5. Click the Edit button ( ). The Select an Environment Condition dialog box opens.
6. In the Select Name list, select the condition you want to overwrite.
7. Click OK.

11.3.4 Deleting an Environment Condition

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

➤ **To delete an environment condition:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 79 on the previous page).
3. Click the Delete button ( ). The Select an Environment Condition dialog box opens.
4. In the Select Name list, select the condition you want to delete.
5. Click OK.

11.4. Configuring the Weather

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

11.4.1 Setting the Wind Direction, Speed, and Visibility

You can set atmospheric conditions, including wind speed and direction, visibility, obscurant (such as fog, smoke, or dust), cloud types, and sky coverage. If you do not specify the sea state manually, it is set based on the wind conditions. (The maximum wind speed that you can set is 360 km/h.) The wind direction affects the angle at which precipitation falls. Wind speed and direction also affect SpeedTrees, grass, and particle systems (dust clouds, smoke, and so on).



The arrow in the dial indicating the wind direction points in the direction that the wind is moving. For example, if the wind direction is set to 180 degrees, the arrow points up to show that the wind is moving from the south to the north.

In the Advanced Weather settings, you can specify cloud types and sky coverage at various altitudes. You can create up to ten levels of atmospheric configurations. In addition, you can specify wind direction, wind speed, visibility, and primary obscurant for all elevations by editing the base elevational configuration (0 feet).

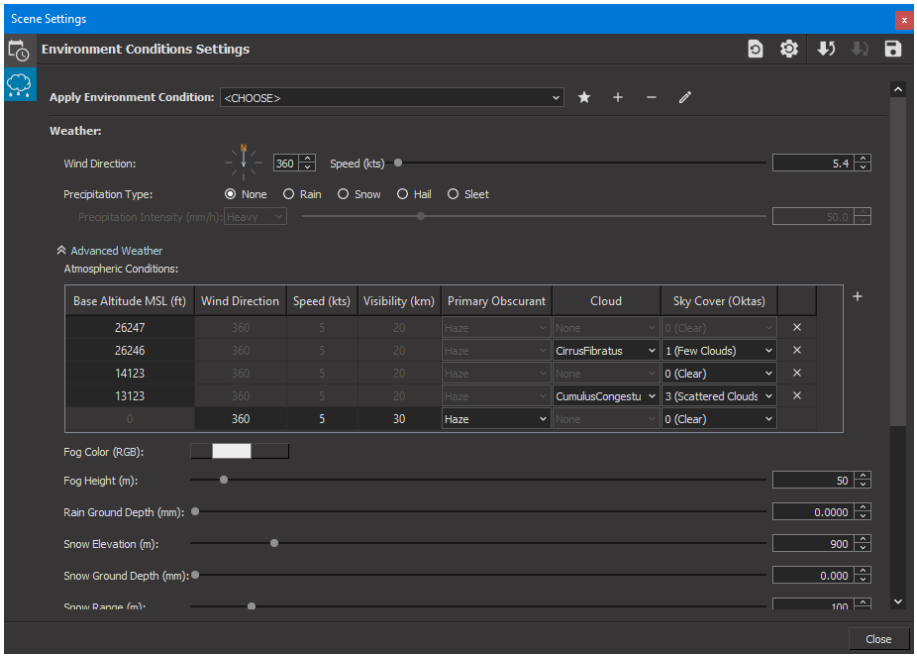
The highest elevation in the Atmospheric Conditions table (under Advanced Weather) is automatically configured with a Sky Cover value of 0 and no clouds. This elevation's Base Altitude MSL value provides an effective ceiling for the clouds at the elevation immediately underneath it.

If you set Visibility to a large value, you might need to adjust the value of the channel's Z far attribute (also known as the far clipping plane). If the Z far attribute is set to a value smaller than the Visibility value, objects beyond the Z far distance are not visible in the channel. For details, see "6.4.1 Setting the Clipping Planes" on page 122.

➤ **To set wind, visibility, and other elevation-based atmospheric conditions:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 80).

Figure 80. Environment Conditions Settings page



3. Click Advanced Weather to expose the Atmospheric Conditions table.
4. Set the atmospheric conditions for one or more levels of elevation:
    a. Select an environment condition from the Apply Environment Conditions list, or click the Add button (+) to create a new environment condition.

       The lowest elevational configuration in the Atmospheric Conditions table begins at 0 feet above mean sea level (MSL). You can specify the base of each subsequent elevation.

    b. Choose a row and set the Sky Cover.
    c. If you set Sky Cover to a nonzero value, you activate the Cloud column. Choose a cloud type.
    d. To add a new elevational configuration, click the Add button (+) and specify the values for that elevation.
5. Set wind direction and speed using the tools under the Weather heading:
    a. Use the Wind Direction dial to set a heading between 001 and 360 degrees.
    b. Drag the Speed slider to set the wind's speed.

       The wind heading and speed you entered appear in the Atmospheric Conditions table. Note that you can set only one wind direction and one wind speed; you cannot set values for individual elevation rows in the table.
6. Set visibility for all elevation levels in the bottom (altitude 0) row of the Atmospheric Conditions table:

a. Enter a Visibility distance.

b. If visibility is limited, choose the Primary Obscurant.

c. If you set Visibility to a high value, you might need to change the channel's Z far attribute value — it must be higher than the Visibility value. Z far defaults to 200 kilometers. For details on changing Z far, see "6.4.1 Setting the Clipping Planes" on page 122.

11.4.2 Setting Visibility

The visibility setting determines the denseness of obscurants in the atmosphere (fog, smoke, or dust, for example), which determines how far you can see. You set visibility and primary obscurant for all elevations in the top row of the Atmospheric Conditions table.

➤ **To set visibility:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 80 on the previous page).
3. In the Atmospheric Conditions table, change the value in the Visibility column.
4. If visibility is limited, choose a Primary Obscurant.
5. If you set Visibility to a large value, you might need to adjust the value of the channel's Z far attribute (also known as the far clipping plane). If the Z far attribute is set to a value smaller than the Visibility value, objects beyond the Z far distance are not visible in the channel. For details, see "6.4.1 Setting the Clipping Planes" on page 122.
6. To change visibility at a different elevation, click the Add button (+) and then specify the values for that elevation.

11.4.3 Specifying Precipitation Type and Intensity

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

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

➤ **To specify the precipitation type and intensity:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 80 on the previous page).
3. Select a Precipitation Type. Once you select a type other than none, the Precipitation Intensity setting becomes editable.
4. Adjust the Precipitation Intensity slider or enter a value in the box. The range is 0 through 200 mm per hour. The intensities list updates based on the rate you specify. You can also choose one of the preset intensities from the list:

- Light – 1.2 mm per hour.
- Moderate – 6.2 mm per hour.
- Heavy – 30 mm per hour.
- Extreme – 125 mm per hour.

11.4.4 Setting Rain Accumulation

You can specify the accumulation of rain on the terrain. When you have rain accumulation, the terrain appears slightly shinier and specular.

You can also specify that puddles should appear in areas of the terrain. If it is raining, ripples appear in the puddles. To define where puddles should accumulate, use a Rain Texture map. See "Using Shader-based Effect Maps" in *Adding Content to MAK ONE Applications Reference Manual*.

➤ **To set the rain accumulation:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 80 on page 201).
3. Click Advanced Weather.
4. Adjust the Rain Ground Depth slider or enter a value in the box. This specifies the depth of rain on the ground and other terrain features. The depth specifies the level of specular reflection on the ground and the appearance of puddles.

11.4.5 Setting Snow Depth and Elevation

You can specify the depth of snow on the ground and roads, and you can also specify the elevation for the snow line. Snow can also display on the roofs of buildings.

If appropriate, you can mask out the snow for certain parts of the terrain using a Snow Texture map. You can also use the SNO effect texture or the snow mask effect map layer to have snow drift across the roads when the wind is blowing. See "Using Shader-based Effect Maps" in *Adding Content to MAK ONE Applications Reference Manual*.

➤ **To set the snow depth and minimum elevation:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 80 on page 201).
3. Click Advanced Weather.
4. Adjust the Snow Ground Depth slider or enter a value in the box. This specifies the depth of the snow on the ground and other terrain features. The range is 0.000 through 10,000.000 millimeters.
5. Adjust the Snow Road Depth slider or enter a value in the box. This specifies the depth of the snow on roads. The range is 0.000 through 10,000.000 millimeters. (At this time, this is only configured for the California (online) terrain.)

6. Adjust the Snow Elevation slider or enter a value in the box. This specifies the minimum elevation (in meters) where the snow cover appears.
7. If desired, use the Snow Range slider and box to specify the range in elevation at which the snow transitions from no snow to the defined snow depth. Adjust the slider or enter a value.

   For example, if the Snow Elevation is set to 100m and the range is set to 50m, there will be no snow at 100m, half the current snow coverage at 125m, and full coverage at 150m.
8. Click Close.

11.5. Configuring Marine Conditions

VR-Vantage supports a variety of dynamic ocean effects (Figure 81), including:

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

Figure 81. Ocean effects



Enabling dynamic ocean effects can affect performance.

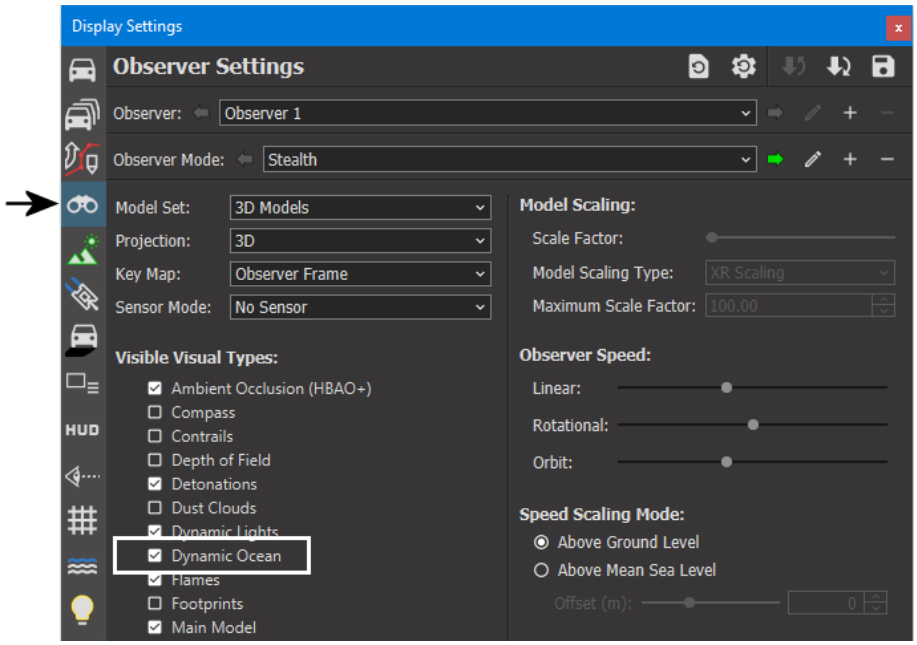
11.5.1 Enabling Marine Effects

Marine effects can reduce performance.

➤ **To enable marine effects (dynamic ocean):**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 82).

Figure 82. Observer Settings page



3. Select or clear the Dynamic Ocean check box.

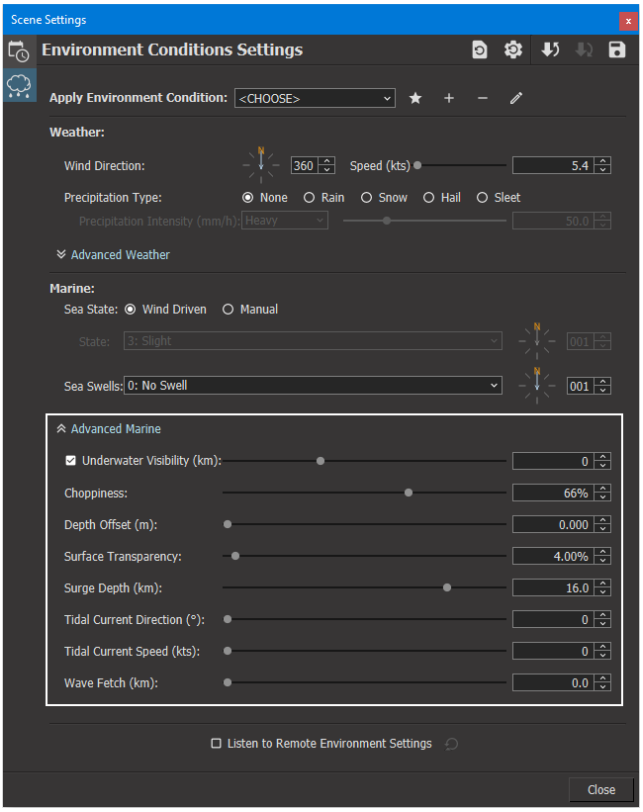
11.5.2 Configuring Marine Conditions

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

➤ **To configure marine effects:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Conditions Settings page (Figure 83).

Figure 83. Marine Settings



3. If the Marine section is not expanded, click Advanced Marine. The dialog box expands to show additional configuration options.
4. Change settings as desired. Table 11 describes the marine settings.

Table 11. Advanced marine settings

Parameter	Description
Sea Swells	The amount of rise and fall of waves independent of wind. Choose from 10 fixed swell states. You can also set the compass direction from which swells originate.
Sea State	Determined by the wind direction and speed or set manually. If manual, one of the swell states for the Douglas sea state scale. You can also set the compass direction from which sea state originates.
Advanced parameters	
Underwater visibility	The distance you can see underwater if the observer is underwater.

Table 11. Advanced marine settings (continued)

Parameter	Description
Surface Transparency	The depth at which VR-Vantage begins to apply transparency to the water surface if the terrain has bathymetry or underwater polygons. This setting helps reduce Z-fighting along the shoreline. It does not mean that you can see some distance into the water when the observer is over deep water. The maximum value represents transparency to 500 meters.
Choppiness	The percentage of turbulence on the water.
Surge depth	When bathymetry data is present, this is the depth of the water at which full storm effects take place. As the water gets shallower, it gets calmer.
Tidal Current Speed	The speed of the tidal current. This affects the display of tidal wakes on buoys and beacons. Default: 0.
Tidal Current Direction	The direction of the tidal current flow. This affects the display of tidal wakes on buoys and beacons.

11.5.3 Enabling Tidal Stream Wakes

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

Tidal stream wakes are disabled by default.

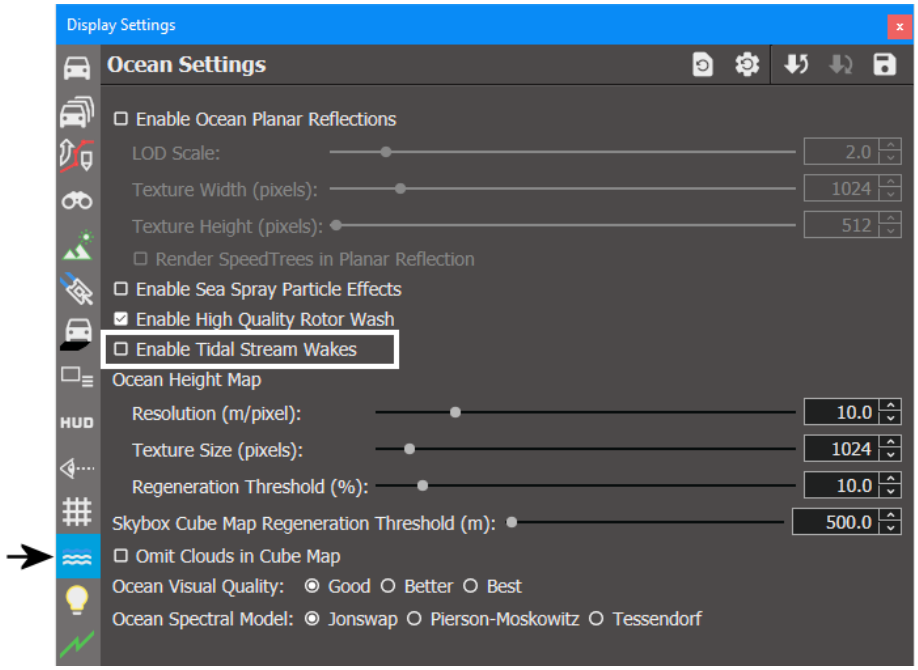


Even if tidal stream wakes are enabled, you will not see any wakes unless you also specify a tidal current, which is 0 by default. For details about setting tidal current, please see "11.5. Configuring Marine Conditions" on page 204.

➤ **To enable or disable tidal stream wakes:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 84).

Figure 84. Ocean Settings



3. Select or clear Enable Tidal Stream Wakes.

11.5.4 Setting Ocean Quality

You can adjust the overall quality of visualization of the ocean. Increasing ocean quality decreases performance. Best quality may affect overall performance of your computer. We suggest using this setting primarily for demonstrations rather than large scenarios.

➤ **To set ocean quality:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 84 above).
3. Select one of the Ocean Visual Quality options.

11.5.5 Specifying an Ocean Wave Spectrum

In Ocean Settings, you can specify the wave spectrum to use for the ocean: JONSWAP, Pierson-Moskowitz, or Tessendorf. These are part of the Triton Ocean SDK. JONSWAP is the default spectrum.

The JONSWAP (Joint North Sea Wave Project) wave spectrum model is useful for maritime training applications and buoyancy in simulations where you require realistic ship motion. It is an extension of the Pierson-Moskowitz model, therefore using JONSWAP can have slower performance than Pierson-Moskowitz. Tessendorf is the least physically accurate, but it offers improved performance. For more information on each of these models, consult Sundog Software's documentation on the Triton Ocean SDK.

➤ **To set the ocean spectrum model:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 84 on the previous page).
3. Select one of the Ocean Spectral Model options.

11.5.6 Configuring Breaking Waves

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

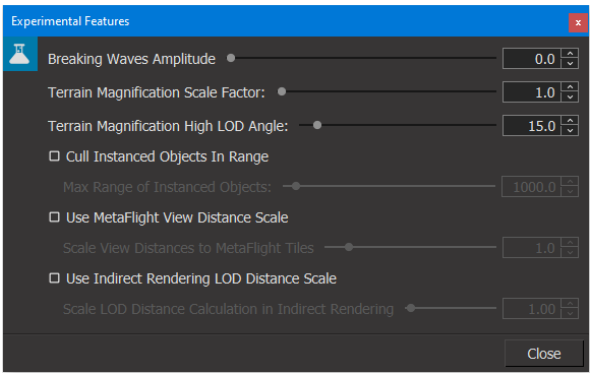
You can set the amplitude of breaking waves. By default, the amplitude is 0.

This is considered an experimental feature. It may be useful, but may affect performance.

➤ **To configure breaking waves:**

1. Choose **Settings > Experimental Features**. The Experimental Features dialog box opens (Figure 85).

Figure 85. Experimental Features dialog box



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

11.6. Displaying Water Droplets and Splash Effects

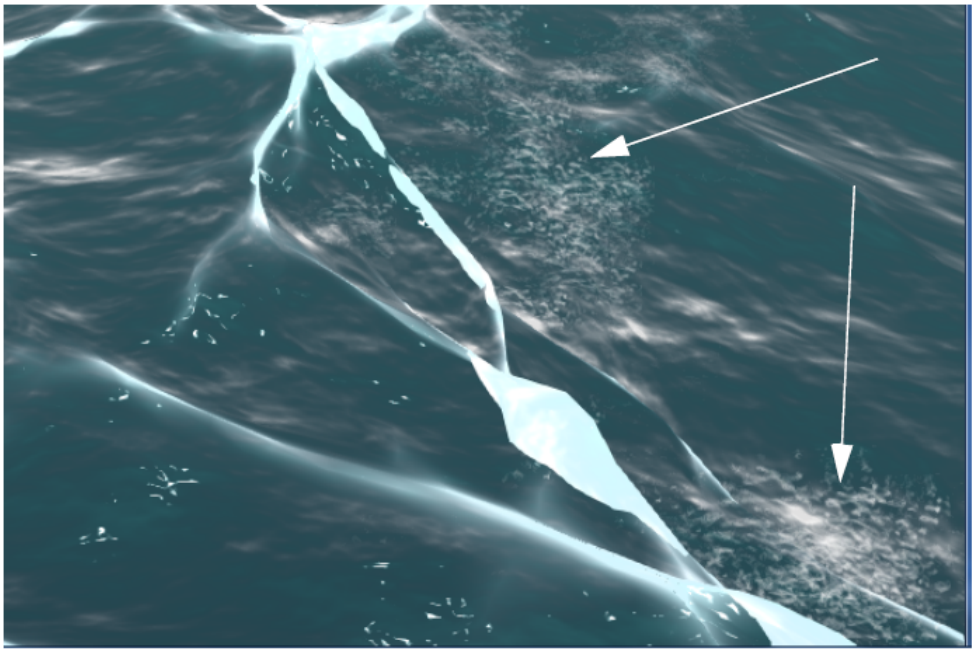
When it is raining, VR-Vantage can simulate raindrops hitting the observer's camera lens (Figure 86). If the observer is close to the surface of the ocean (as if a periscope were being raised or lowered), VR-Vantage can simulate the effect of waves and water droplets splashing on the observer's camera.

Figure 86. Rain effect



When dynamic ocean is enabled, VR-Vantage can simulate sea spray (most visible in high seas) (Figure 87). It can also display rotor wash for hovering helicopters. You can display rotor wash at two levels of quality.

Figure 87. Sea spray effects

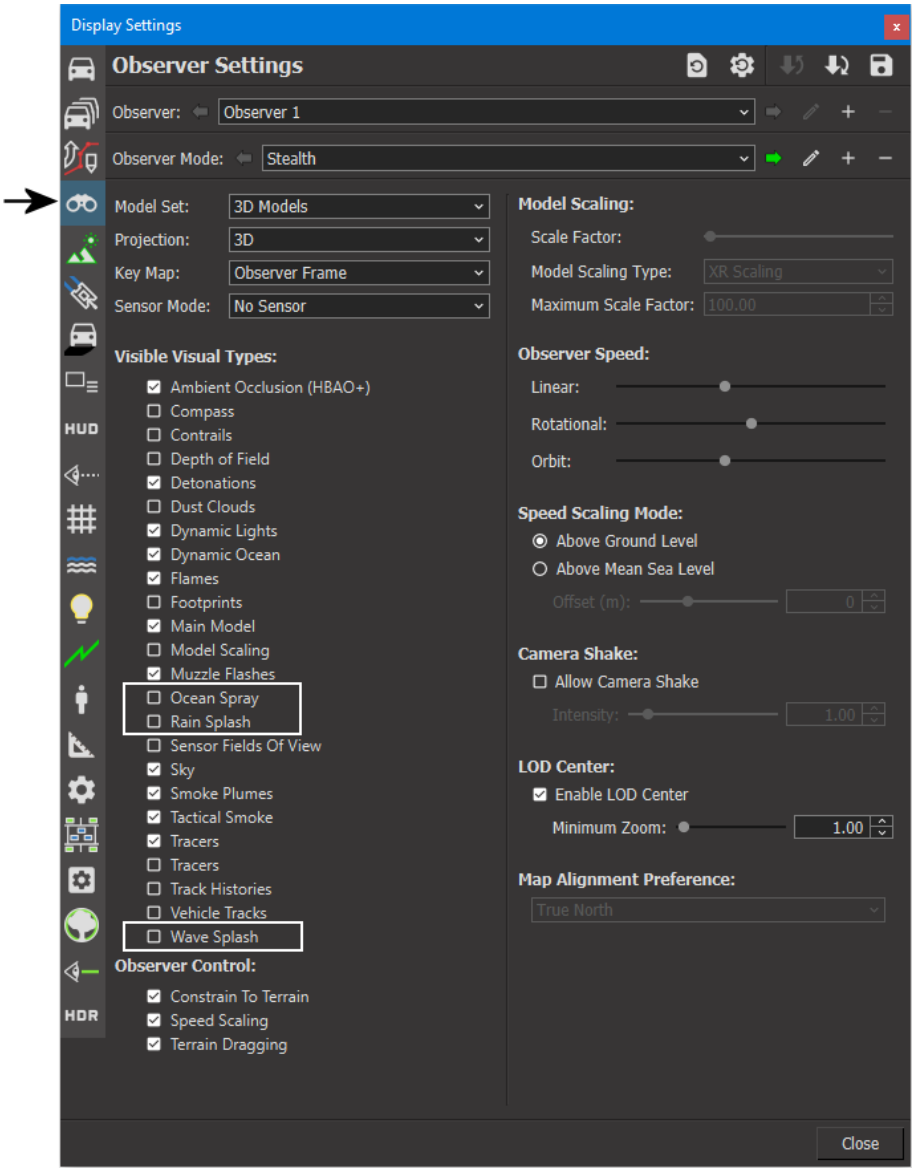


You can change the size of the water droplets for splash effects and sea spray. For details, please see "11.6.2 Setting the Size of Water Droplets" on the next page.

➤ **To enable or disable splash effects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 88).

Figure 88. Observer Settings page



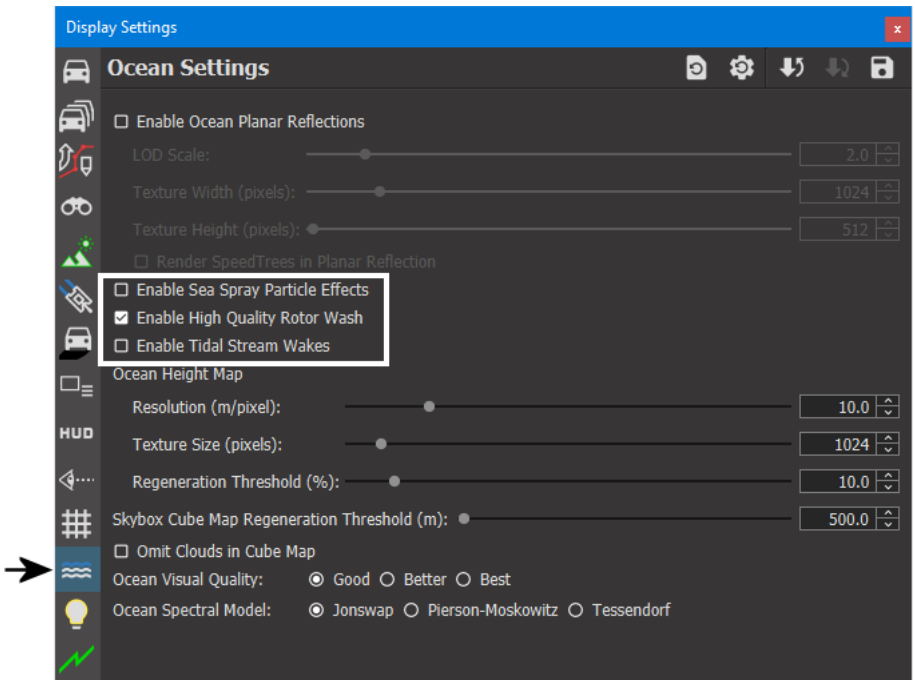
3. Select or clear the Ocean Spray, Rain Splash, or Wave Splash visible visual type check boxes.

11.6.1 Enabling Sea Spray

➤ **To enable sea spray effects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 89).

Figure 89. Ocean Settings page



3. Select Enable Sea Spray Particle Effects.

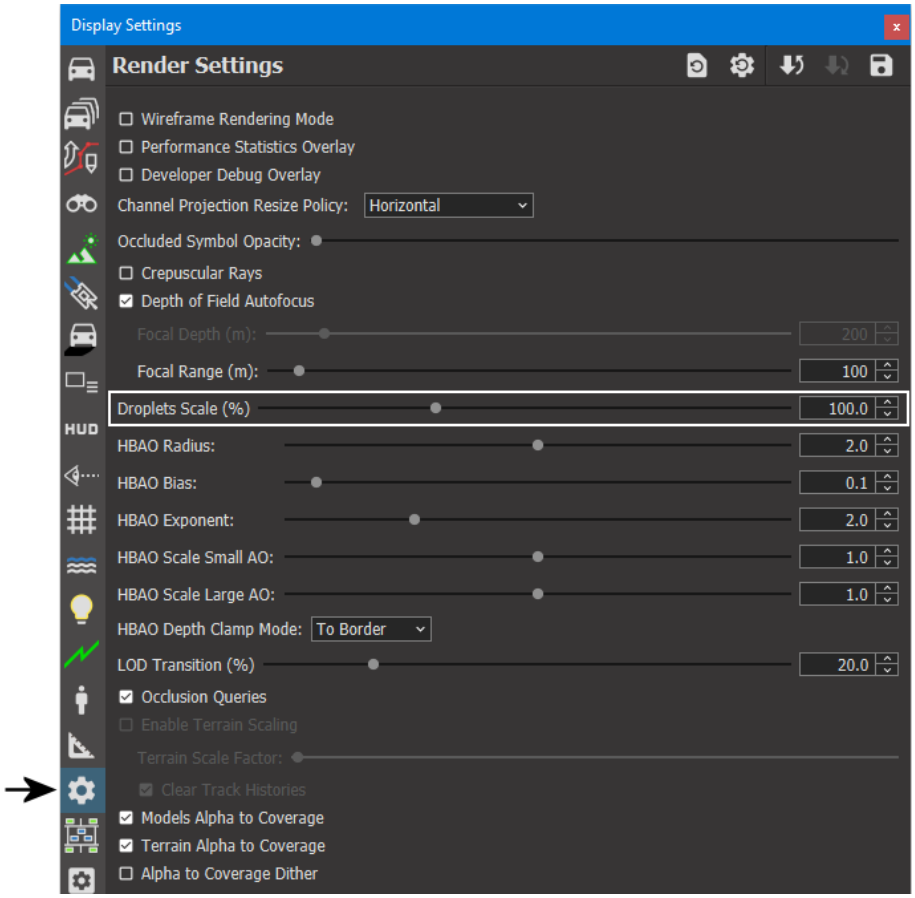
11.6.2 Setting the Size of Water Droplets

You can change the size of water droplets for splash effects and sea spray.

➤ **To change the size of water droplets:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 90).

Figure 90. Render Settings page



3. Adjust the Droplets Scale slider or enter a value in the box.

11.6.3 Enabling and Disabling Rotor Wash

If dynamic ocean is enabled, VR-Vantage can display rotor wash over the water for rotary-wing entities. VR-Vantage can also display rotor wash over land for some soil types. You can enable or disable rotor wash globally.

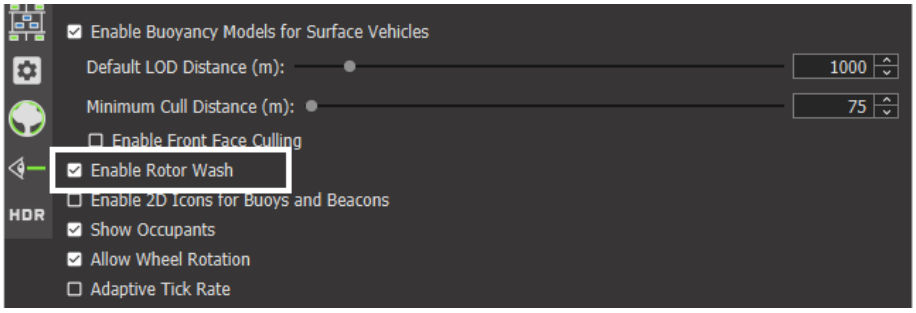
Rotor wash is a particle system. You can edit rotor wash particle systems in the Particle System Editor. For details, see *Special Effects (Particle Systems)* in the *Adding Content to MAK ONE Applications Reference Manual*.

> VR-Vantage displays rotor wash only for helicopters that are simulated by VR-Forces. There is no DIS or HLA standard for rotor wash. VR-Forces sends special messages to enable its display.

➤ **To enable or disable rotor wash:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 91).

Figure 91. Rotor wash settings



3. Select or clear the Enable Rotor Wash check box.

11.6.4 Enabling High Quality Rotor Wash

➤ **To enable high quality rotor wash:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 89 on page 212).
3. Select Enable High Quality Rotor Wash.

11.7. Displaying Remote Environment Settings

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

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

Listening to remote environment conditions also synchronizes date and time of day with VR-Forces.

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

➤ **To enable remote weather effects:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the Environment Condition Settings page (Figure 80 on page 201).
3. Select the Listen to Remote Environment Settings check box.
4. Click the Refresh button (↻).

11.8. Disabling Lighting and Clouds

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

➤ To enable or disable lighting and clouds, choose **Observer > Sky**.



12. Using Sensors

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

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12.2. Enabling Sensors 218
12.3. Configuring Sensors 219
12.4. Adding New Sensors 221

12.1. Using Sensors

VR-Vantage can simulate the way that the 3D scene would look if an observer were using visual sensor devices such as night vision goggles or viewing the infrared spectrum (Figure 92). This is an observer-specific setting. You can adjust the contrast, blur, and noise of the view.

VR-Vantage includes one sensor module: CameraFX, which uses the SenSim libraries from JRM Technologies. The sensors do not take into account the materials of the objects that you are viewing. They simply filter the view to produce the desired effect. CameraFX supports only one "ActiveRegion" per entity based on the power plant status. If you want physics-based sensor effects, you can purchase the SensorFX Plug-in for VR-Vantage, developed by JRM. For details, please contact your MAK salesperson.

Figure 92. CameraFX



No sensor (6 A.M.) IR Sensor

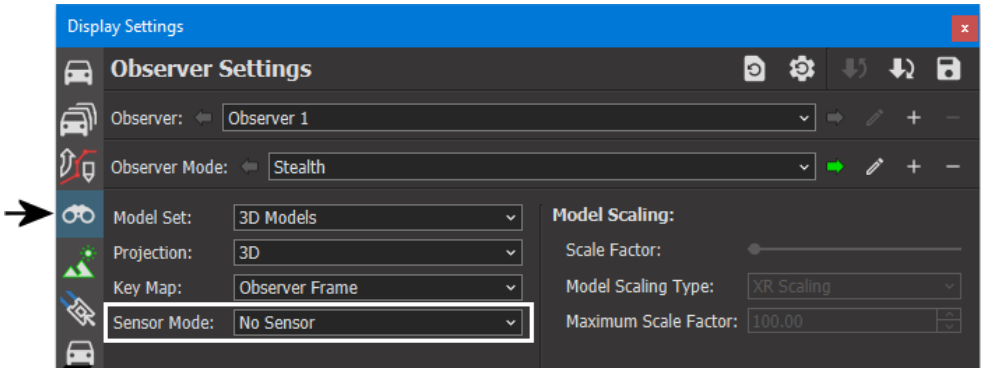
The sensors described in this chapter are strictly visual effects. They have no relationship to the sensor systems used by simulation objects.

12.2. Enabling Sensors

Sensors are observer-specific (Figure 93). VR-Vantage includes observer modes that have sensors enabled. The names of the observer modes match the sensor modes that they enable.

- NVG (CameraFX) (night vision goggles).
- IR (CameraFX) (infrared).
- IR BlackHot (CameraFX).
- Camera (CameraFX). This mode uses the Visual Camera sensor mode.

Figure 93. Sensor setting for observer mode



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

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

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

➤ **To enable sensors, do one of the following:**

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

For details about creating and editing observer modes, see "14.4. Creating and Editing Observer Modes" on page 245. For details about editing channel attributes, see "6.4. Changing a Channel's Attributes" on page 120.

12.3. Configuring Sensors

You can configure the following aspects of sensors:

- Blur. The sharpness of the image.
- Noise. The graininess of the image.
- Gain. The contrast and brightness of the image. (IR only)
- Lighting overrides. You can adjust the amount of ambient and diffuse light and the intensity of light emitted by DI-Guys and other entities.
- Sensor texture. VR-Vantage supports a shader-based effects map called a Sensor Texture map. This is a three-channel texture that adds the red, green, or blue channels as appropriate when the observer is in an NVG CameraFX or IR mode.

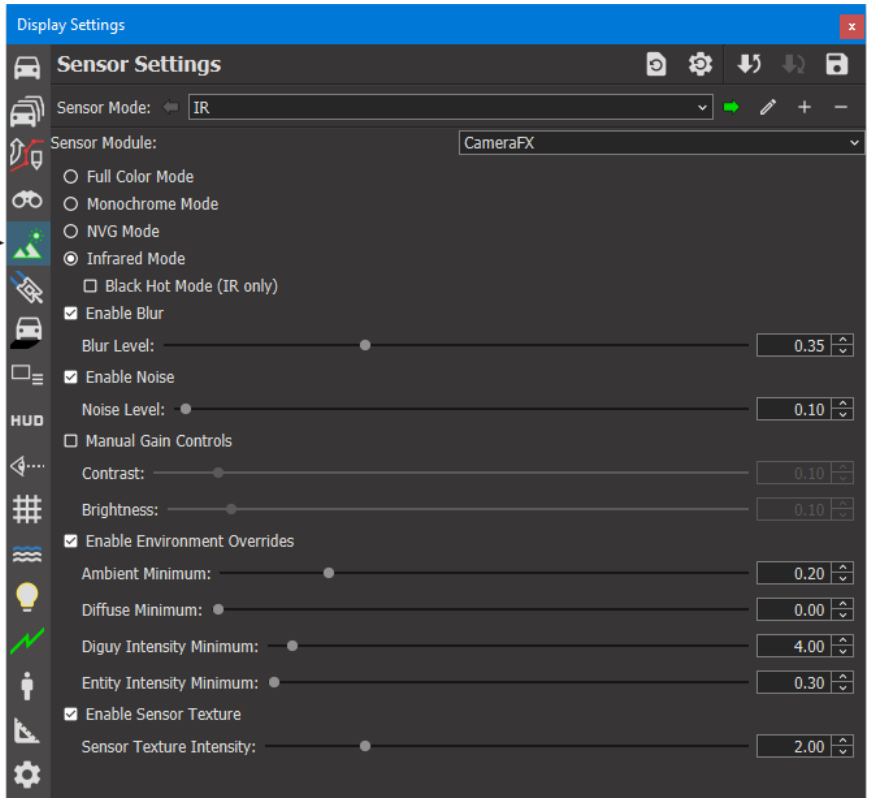
You can enable and disable use of these textures and specify their intensity. For more information about shader-based effects maps, see "Using Shader-based Effect Maps" in the *Adding Content to MAK ONE Applications Reference Manual*.

You can configure a separate set of settings for each sensor type. VR-Vantage remembers the settings. When you change the settings for a sensor type, they affect the display only if that sensor type is in use. For example, if you select NVG in the sensor list on the Observer Settings page, and select IR in the Sensors list on the Sensor Settings page, the changes you make to the IR configuration do not affect the NVG display you are looking at. If you then switch to IR in the VR-Vantage window, the new IR settings take effect.

➤ **To configure sensors:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Sensor Settings page (Figure 94).

Figure 94. Sensor Settings page



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

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

6. For each setting you want to change, select the controlling check box and adjust the sliders.

12.4. Adding New Sensors

You can add, rename, and delete sensors.

➤ **To add a sensor:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Sensor Settings page (Figure 94 on the previous page).
3. On the Sensor Mode line, click the Add button (+). A new sensor called sensor_*number* is added. There are no configuration options on the page. (To rename the sensor, click the Rename button (✎) and enter a new name.)
4. In the Sensor Module list, select CameraFX. The available configuration options are added to the page.
5. Select the type of sensor that you want this to be (Full Color, Monochrome, Infrared, or NVG).
6. Set the Blur, Noise, and Gain levels.



13. Lighting Effects

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

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13.1. Displaying Lighting Effects

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

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

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

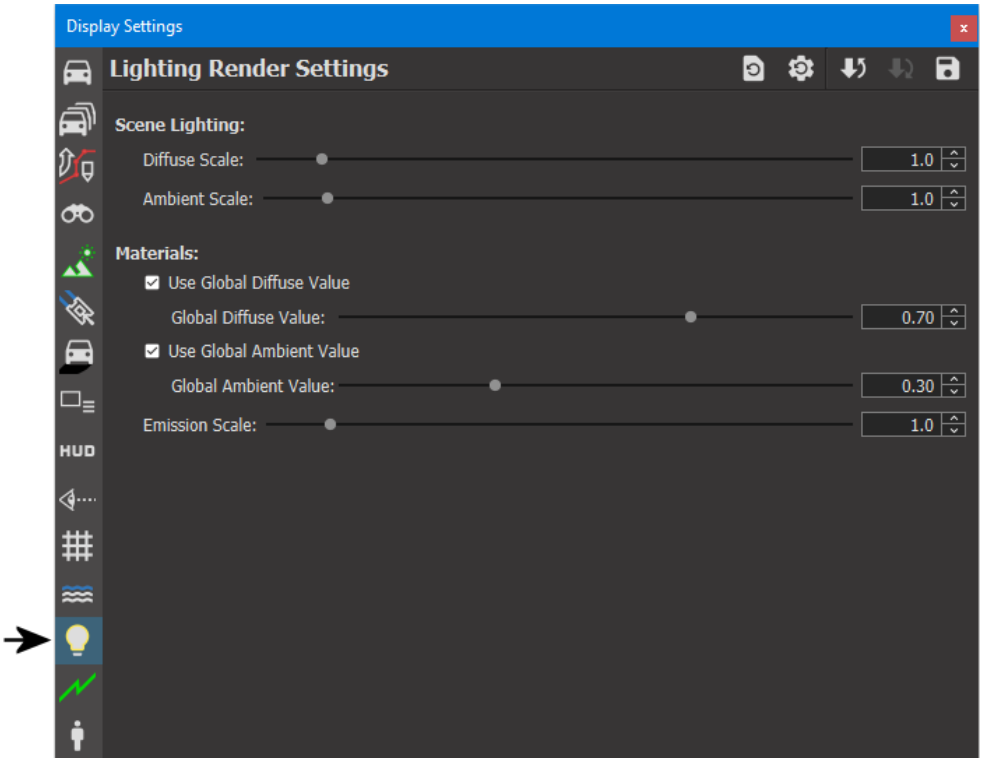
13.2. Advanced Lighting Settings

VR-Vantage allows you to adjust the lighting for the scene and materials.

➤ **To access the lighting render settings:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 95).

Figure 95. Lighting Render Settings



13.2.1 Configuring Ambient and Diffuse Lighting

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

Configuring the Ambient and Diffuse Scale Values for Scene Lighting

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

➤ **To specify the ambient and diffuse lighting scale values:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 95 on the previous page).
3. Adjust the Diffuse Scale slider or change the value in the box.
4. Adjust the Ambient Scale slider or change the value in the box.

Configuring the Material Ambient and Diffuse Values for Materials

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

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

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

➤ **To configure the material ambient value:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 95 on the previous page).
3. To use the ambient values specified by objects, clear the Use Global Ambient Value check box. To have VR-Vantage use a global value, select the Use Global Ambient Value check box.
4. If you selected the Use Global Ambient Value check box, optionally, adjust the Global Ambient Value slider or change the value in the box.

➤ **To configure the material diffuse value:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 95 on page 224).
3. To use the diffuse values specified by objects, clear the Use Global Diffuse Value check box. To have VR-Vantage use a global value, select the Use Global Diffuse Value check box.
4. If you selected the Use Global Diffuse Value check box, optionally, adjust the Global Diffuse Value slider or change the value in the box.

13.2.2 Specifying the Emissive Lighting Scale

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

➤ **To specify the emissive lighting scale value:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Lighting Render Settings page (Figure 95 on page 224).
3. Adjust the Emission Scale slider or change the value in the box.

13.3. Displaying Dynamic Lighting

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

Dynamic lights are either part of the terrain or part of an entity model. If they are part of an entity model, they can be set permanently on or they can be turned on and off by the appearance bit. VR-Vantage entities that have lights can enable them using the Set Appearance set data request.

Figure 96 shows a night-time scene with dynamic lighting enabled. The HMMWV's taillights cast light to the rear. The headlights cast light forward. Street lamps and windows are also casting light.

Figure 96. Dynamic Lighting enabled



- Light points can be configured to automatically turn on at dusk and turn off at dawn. For details, see "13.3.1 Daylight Control of Lights" on the next page.
- Emissive lights are always on, day or night. The headlights on vehicles shipped with MAK products are configured with Dynamic Lights and Emissive Textures which are controlled by the Appearance State “Head Lights On”. When the headlights are on and dynamic lights are enabled, the emissive textures are visible.

You cannot change these lighting settings.

➤ **To enable dynamic lighting:**

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

You can also enable or disable dynamic lighting by choosing **Observer > Dynamic Lights**.

13.3.1 Daylight Control of Lights

Lights that have a light point type specified can be placed under daylight control.

- Light points that do not have a light point type defined are not automatically placed under daylight control.
- Light points in an OpenFlight file that are loaded as an articulated model use the **daylightControlledLights** model definition parameter.
- Light points with a type defined use the Daylight Controlled parameter for their type in *./appData/importConfig/Lights_DefaultValues_3_2.csv*.

For more information about configuring light points, see "Configuring Light Points" in the *Adding Content to MAK ONE Applications Reference Manual*.

Light sources (lights that cast light onto other objects) are discovered on the cull pass of the scene graph. Sources found under the terrain root or props root of the scene graph are automatically put under daylight control.

13.4. Displaying Ocean Planar Reflections

VR-Vantage can show the reflection of terrain and objects on water (Figure 97). To see planar reflections, dynamic ocean must be enabled. (For details about enabling dynamic ocean, please see "11.5.1 Enabling Marine Effects" on page 205.)

Displaying ocean planar reflections degrades performance.

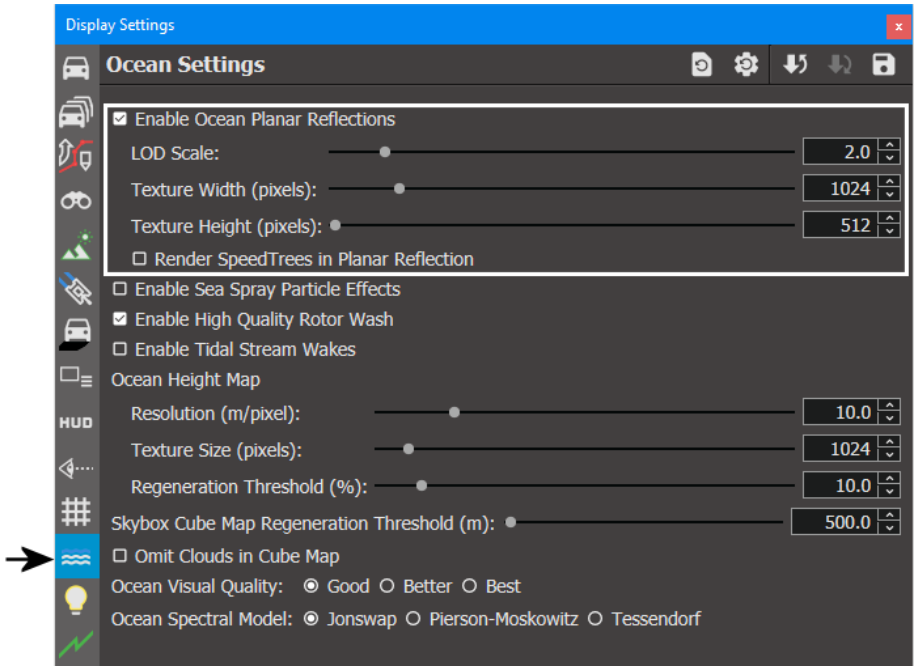
Figure 97. Ocean planar reflection



➤ **To enable or disable planar reflections:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 98).

Figure 98. Ocean Settings



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

13.4.1 Configuring Ocean Planar Reflections

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

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

You can also enable and disable display of SpeedTrees as planar reflections.

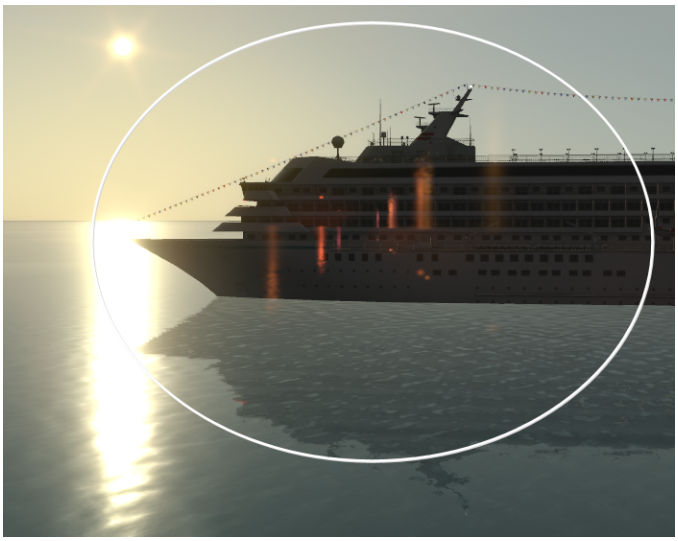
➤ **To configure ocean planar reflections:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 98 above).
3. To change the ocean planar reflection LOD scale, adjust the LOD Scale slider under Enable Ocean Planar Reflections, or change the value in the box.
4. To change the width or height of the ocean planar reflection texture, adjust the Texture Width or Texture Height slider under Enable Ocean Planar Reflections, or change the values in the boxes.
5. To include SpeedTrees in ocean planar reflections, select the Render SpeedTrees in Planar Reflections check box.

13.5. Lens Flare

Lens flare is a visual artifact often seen when looking at light sources such as the sun through a camera lens (Figure 99). VR-Vantage can simulate lens flare when the observer looks towards the sun.

Figure 99. Lens flare

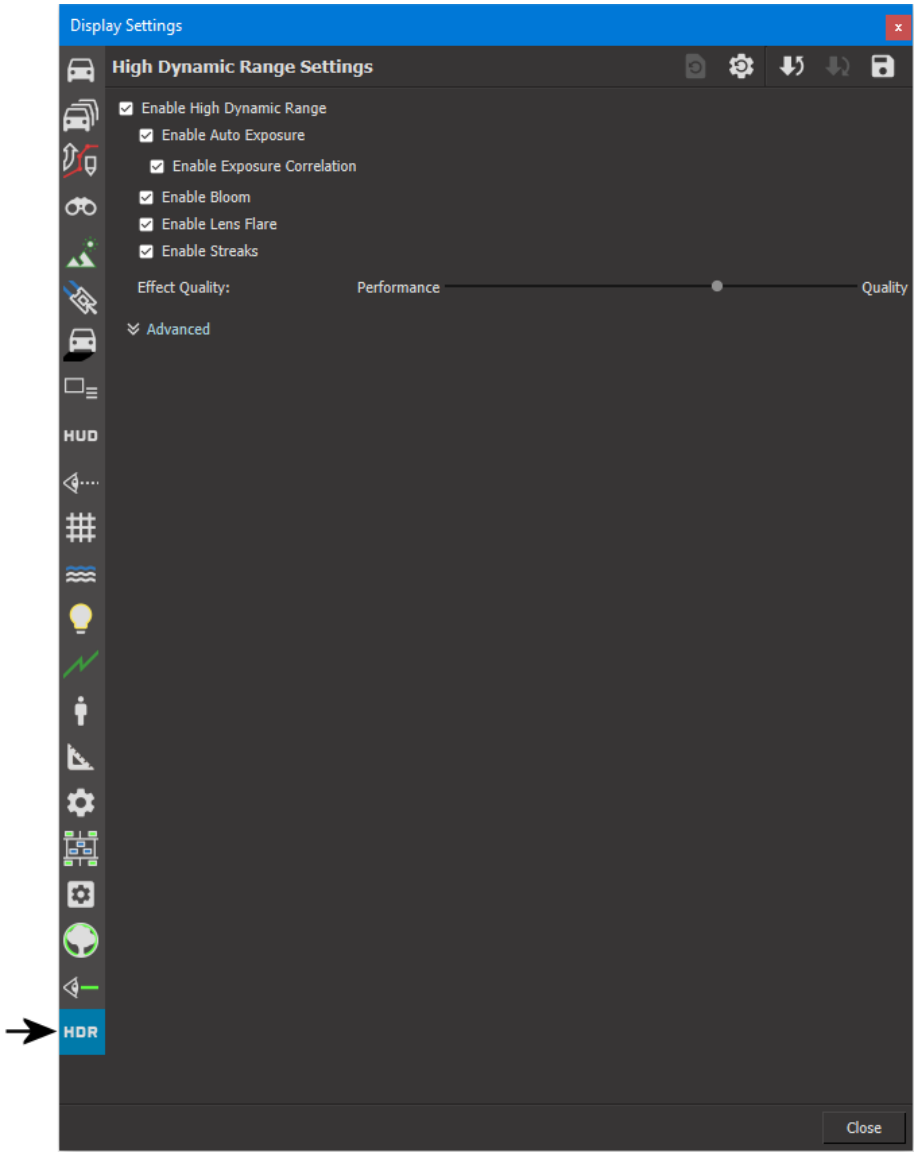


Lens flare is supported only when high dynamic range lighting is enabled. You can also enable this in the High Dynamic Range Settings page.

➤ **To enable or disable lens flare:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the High Dynamic Range Settings page (Figure 100).

Figure 100. High Dynamic Range Settings page

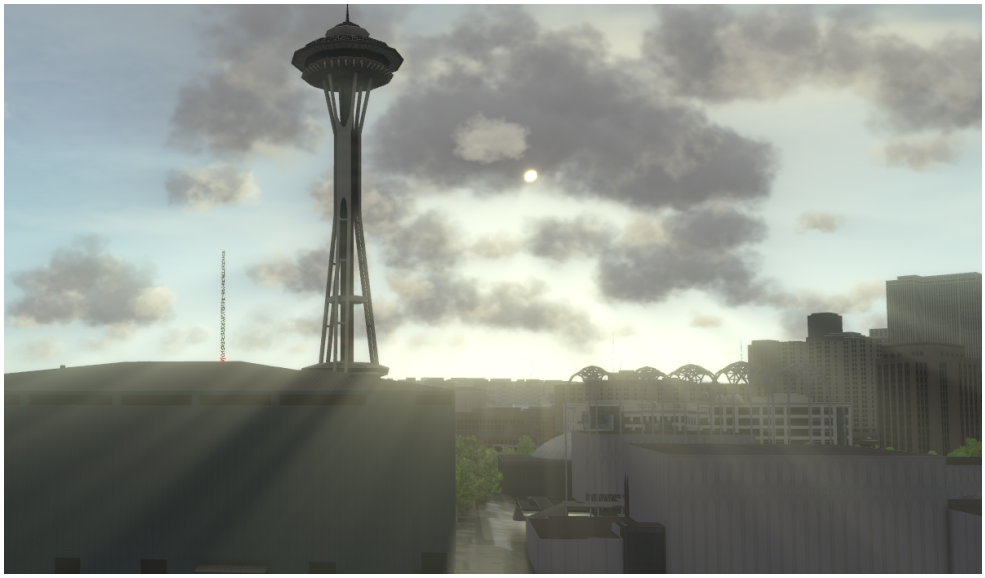


3. Select or clear the Enable Lens Flare check box.

13.6. Displaying Crepuscular (Sun) Rays

VR-Vantage can simulate the effect of crepuscular rays (sunbeams) beaming through clouds (Figure 101).

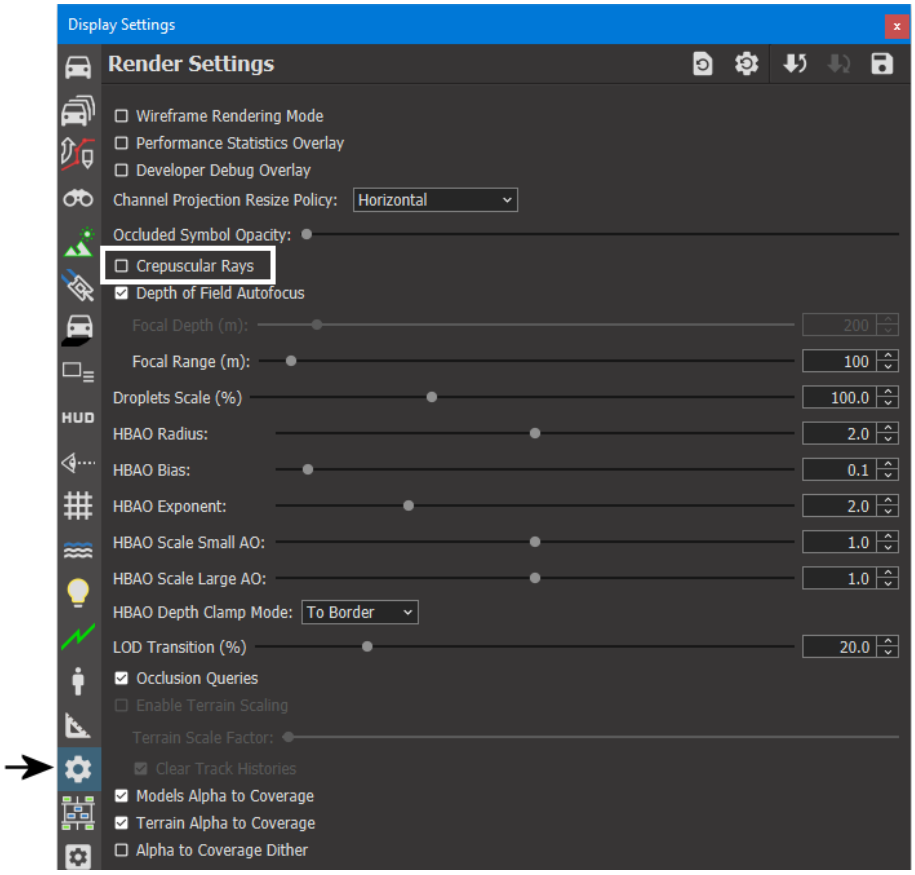
Figure 101. Crepuscular rays



➤ **To enable or disable crepuscular (sun) rays:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 102).

Figure 102. Render Settings page



3. Select or clear the Crepuscular Rays check box.

13.7. Configuring the Skybox Cube Map

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

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

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

➤ **To configure the skybox cube map:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Ocean Settings page (Figure 98 on page 229).
3. Adjust the Skybox Cube Map Regeneration Threshold slider or enter a value in the box.
4. Optionally, select the Omit Clouds in Cube Map check box.

13.8. Flashlight Mode

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

Figure 103. Flashlight mode



➤ To turn flashlight mode on or off, press **F**.

➤ To move the flashlight beam, hold down **Alt** and the right mouse button, then move the mouse.

➤ To change the size of the flashlight beam, hold down **Alt** and move the mouse scroll wheel forward or back.

13.9. Using High Dynamic Range Lighting

High dynamic range (HDR) lighting makes scenes look more realistic. They look particularly good on HDR monitors. HDR is enabled by default.

➤ **To configure HDR lighting:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the High Dynamic Range Settings page (Figure 100 on page 231).
3. To enable or disable HDR lighting, select or clear the Enable High Dynamic Range check box.
4. Enable other settings as desired.
5. For those settings that are enabled, adjust their parameters. Table 12 describes the HDR settings.

Table 12. HDR settings

Setting	Description
Enable High Dynamic Range	Turns High Dynamic Range (HDR) on and off. When HDR is turned on, the scene is rendered in 16-bits per color floating point and then tone mapped to 8-bits per color before being sent to the display. Additionally, there are post process effects applied to objects that are greater than the display range.
Enable Auto Exposure	Turns auto exposure on and off, which is a post process that scales the intensity of the rendered image based on the intensity of the screen. When auto exposure is turned off, the global lighting values are used to scale the intensity to a reasonable value.
Enable Exposure Correlation	When auto exposure is enabled, this controls whether all the channels share the same auto exposure adjustment. When enabled, all channels use the exposure for the main luminance. If if it disabled, each channel across master or slave computes its own luminance.
Enable Bloom	Turns the bloom post process effect on and off. This effect is a blurring of high intensity objects in the scene which gives a glow around bright objects like light points.
Enable Lens Flare	Turns the lens flare post process effect on and off. This effect creates a lens flare effect for high intensity objects.
Enable Streaks	Turns the streak post process effect on and off. This effect creates a star effect by streaking the high intensity objects in all directions.
Advanced Settings	
Dynamic Light Scale	When HDR is turned on, the intensity of dynamic lights are scaled by this setting.
Emissive Texture Scale	When HDR is turned on, the intensity of the emissive textures is scaled by this setting.
Light Point Scale	When HDR is turned on, light point intensity is scaled by this setting.
Shininess Scale	When HDR is turned on the lighting shininess component is scaled by this setting. Exposure adjustments are all related to how the intensity of the scene is scaled before being tone mapped. These values are in order based on when they are applied to the scalar.
Specular Scale	When HDR is turned on the lighting specular component is scaled by this setting.
Rate Scale	When Auto Exposure is enabled, this scales the time it takes for the auto exposure to adjust to changes in the scene. Increase this value to reduce the time it takes for the auto exposure to adjust.

Table 12. HDR settings (continued)

Setting	Description
Pre Scale	When Auto Exposure is enabled, this scales the calculated intensity for the scene. Increase this value to reduce the overall intensity of the final image.
Min Difference	When Auto Exposure is enabled, this clamps the minimum value of the calculated intensity to a portion of the global lighting value. This is used to prevent the auto exposure from going too low compared to the global lighting value.
Max Difference	When Auto Exposure is enabled, this clamps the maximum value of the calculated intensity to a portion of the global lighting value. This is used to prevent the auto exposure from going too high compared to the global lighting value.
Post Scale	Scales the scalar after all Auto Exposure calculations have been done. This also affects the global lighting value when Auto Exposure is turned off. Increase this value to reduce the overall intensity of the final image.
Final Clamp Min	The minimum value for the final value that will be used to scale the intensity prior to tone mapping.
Final Clamp Max	The maximum value for the final value that will be used to scale the intensity prior to tone mapping.
Bloom Scale	Scales the bloom before it is applied to the scene. Increase this value to increase the intensity of the bloom effect on high intensity objects.
Lens Flare Scale	Scales the lens flare effect before it is applied to the scene. Increase this value to increase the intensity of the lens flare effect.
Streak Intensity Scale	Scales the streaks before they are applied to the scene. Increase this value to increase the intensity of the streak effect on high intensity objects.
Number of Streaks	Number of streaks that the streak effect will create for each high intensity object. Maximum of 8 streaks.
Streak Length Scale	Scales the length of the streak effect. Increase this value to increase the length of the streak effect.
Streak Rotation Offset	Rotates the streak effect so that it changes the direction that the streaks point.
Gamma	Final color correction used to adjust the image based on the display. Change this value based on the characteristics of the display being used.

13.10. Displaying Shadows (3D Only)

VR-Vantage can display shadows for entities, props, clouds, and terrain features (Figure 104). It can also display shadows on the ocean.

Figure 104. Shadows



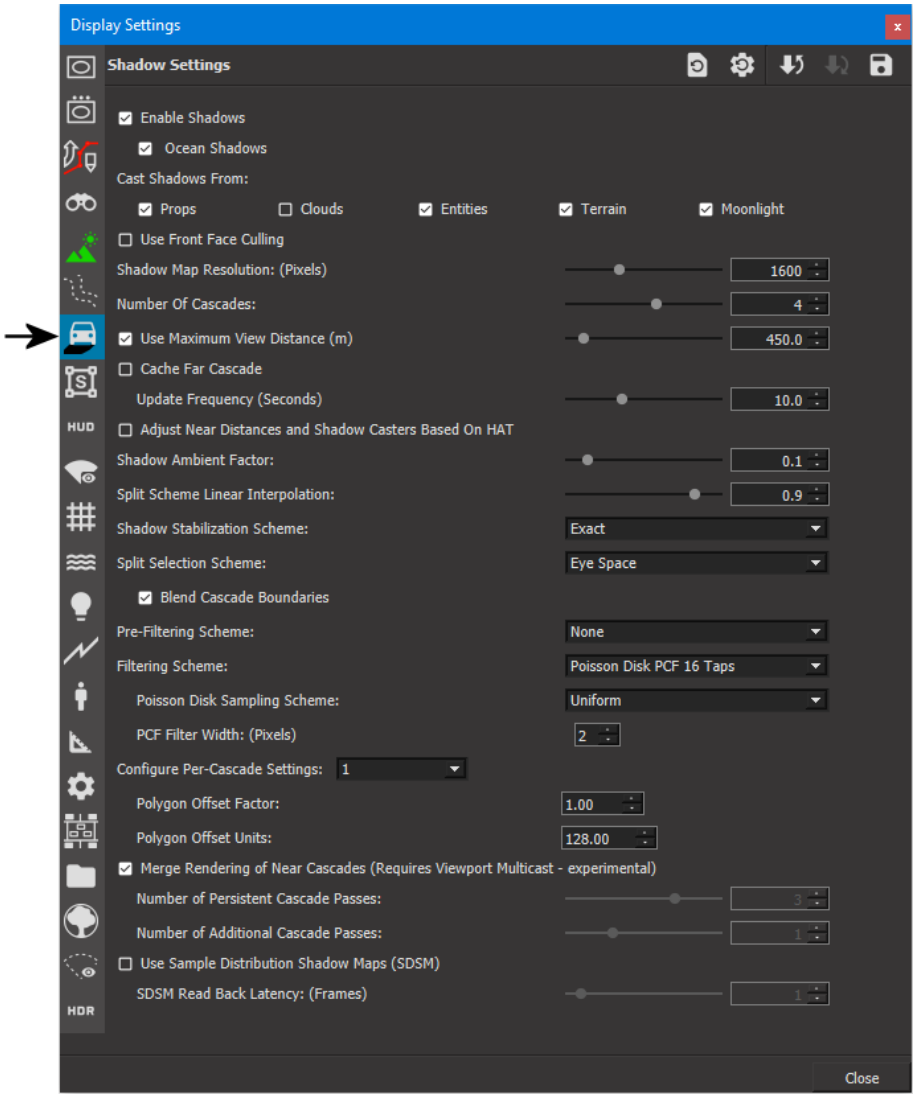
You can enable and disable shadows, and you can also configure shadow quality.

Enabling shadows can affect performance.

➤ **To enable and disable shadows globally:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Shadow Settings page (Figure 105).

Figure 105. Display Settings, Shadow Settings page



3. Select or clear the Enable Shadows check box to controls shadows on the terrain.
4. Select or clear the Ocean Shadows check box to control shadows on only the dynamic ocean.
5. To enable or disable shadows for specific object types, select or clear the check boxes under Cast Shadows From.

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

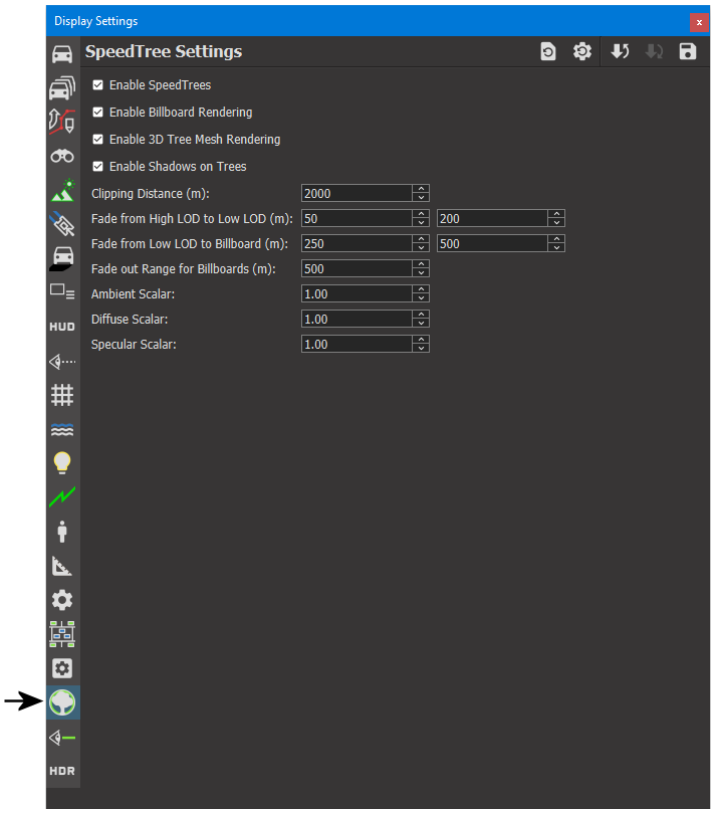
13.10.1 Enabling Shadows on Trees

You can enable and disable casting of shadows on SpeedTree trees.

➤ **To enable or disable casting shadows on SpeedTree trees:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the SpeedTree Settings page (Figure 106).

Figure 106. SpeedTree Settings page



3. Select or clear the Enable Shadows on Trees check box.

13.10.2 Configuring Shadows

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

Shadows are drawn based on a shadow map. A shadow map determines what parts of a scene are in shadow relative to a light source. Then the scene is drawn showing the shadows that would be visible from the viewpoint of the observer.

Scenes are split into sections, called cascades. The cascades that are closest to the camera show the highest resolution shadows. Many of the settings control the size of cascades and how they merge together.

For an in-depth understanding of how shadows are rendered in 3D scenes, please see the many articles available on the world wide web.

➤ **To configure how shadows are rendered:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Shadow Settings page (Figure 105 on the previous page).

3. Change the parameters as desired. Table 13 briefly describes them.

Table 13. Shadow settings

Setting	Description
Use Front Face Culling	Use of face front culling is a choice between more shadow acne (an effect similar to z-fighting) and more light bleeding artifacts.
Shadow Map Resolution	Increasing shadow map resolution provides more detail at the cost of performance and increased memory use.
Number of Cascades	The more cascades there are, the more detail is rendered, at the expense of memory usage and performance.
Use Maximum View Distance	If enabled, specifies how far away shadows are displayed. The smaller the area in which shadows are displayed, the more quickly they get displayed and the higher the quality. If disabled, uses the scene values.
Cache Far Cascade	Caches the farthest cascade and updates it less frequently than the near cascade, which increases performance.
Adjust Near Distances and Shadow Casters Based On HAT	As the observer moves higher above the terrain, the near cascade shrinks and only entities are rendered to them. The far cascade becomes responsible for the terrain shadows.
Shadow Ambient Factor	Fades out shadows. It determines how much light gets through.
Split Scheme Linear Interpolation	Adjusts how cascades are distributed between a logarithmic approach and a linear approach.
Shadow Stabilization Scheme	A list of different ways to reduce the shimmer that is common in shadow maps.
Split Selection Scheme	A list of different ways to choose which cascade a piece of geometry is in.
Pre-Filtering Scheme	A list of different shadow casing techniques to try to smooth shadows.
Filtering Scheme	Affects how blurred the shadow map is.
Configure Per-Cascade Settings	Lets you configure the polygon offset for cascades.
Merge Rendering of Near Cascades	Lets you draw cascades all at once instead of individually. This improves performance. It is available on supported video cards (NVIDIA 980 or newer). If disabled, you can configure the number of cascades passes to draw shadows.
Use Sample Distribution Shadow Map (SDSM)	Adjusts quality based on the depth complexity of an area of the scene.



IV. The Observer

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

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

- "Chapter 14. The Observer and Observer Modes" on page 243
- "Chapter 15. Moving the Observer" on page 255
- "Chapter 16. Attaching the Observer to Objects" on page 287
- "19.12. Displaying Models for Remote Observers" on page 340



14. 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 15. Moving the Observer" on page 255. For details about attaching the observer to entities and props, please see "Chapter 16. Attaching the Observer to Objects" on page 287.

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14.1. Switching Between the 2D and 3D Projections

VR-Vantage 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 "14.3. Changing the Observer Mode" on the facing page.) 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).

14.2. Observer Modes

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

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

VR-Vantage includes the following observer modes:

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

The observer modes all support the three model sets: 3D models, 3D colorized models, and 2D icons. You can edit observer modes and add new ones. For details, please see "14.4. Creating and Editing Observer Modes" on the facing page.

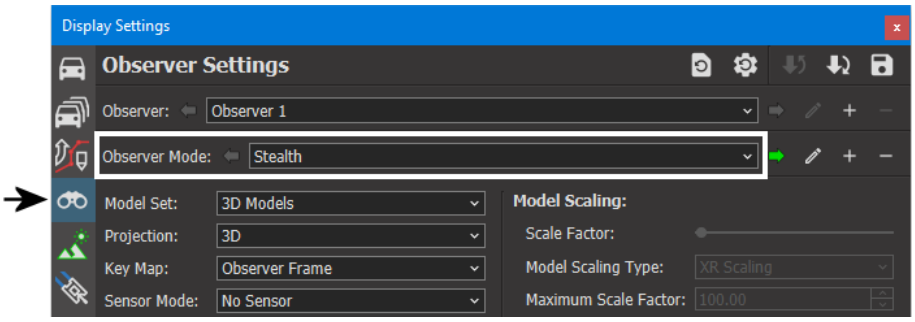
14.3. Changing the Observer Mode

When you change the observer mode, terrain may be displayed differently and the model sets used to display simulation objects may change. For descriptions of the observer modes, please see "14.2. Observer Modes" on the previous page.

➤ **To change the observer mode:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 107).

Figure 107. Observer Settings page



3. Select an option in the Observer Mode list.

You can also change the observer mode by choosing **Observer > Set Observer Mode >** *mode*, or on the Observer Settings Toolbar, choose an option from the Observer Mode list.

14.4. Creating and Editing Observer Modes

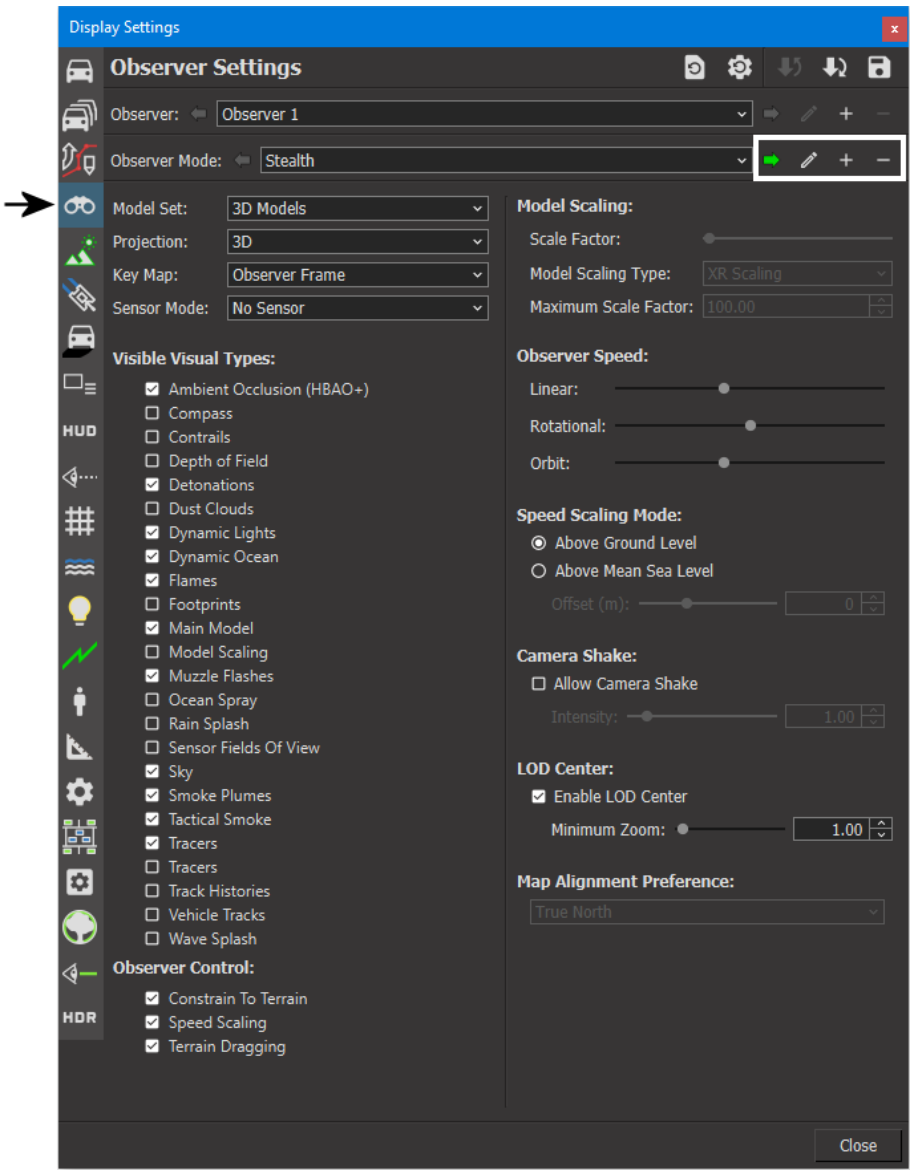
VR-Vantage comes with 3D and 2D observer modes. (Table 14 on page 261 lists the observer modes available for each VR-Vantage application.) They are configured with the display settings, key mappings, and model sets that users most commonly want to use. However, if they do not meet your needs, you can easily edit them or create new observer modes.

14.4.1 Creating an Observer Mode

➤ **To create an observer mode:**

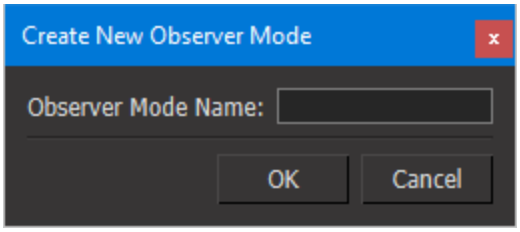
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108).

Figure 108. Observer Settings page



3. Click the Add button (+) to the right of the Observer Mode list. The Create New Observer Mode dialog box opens (Figure 109).

Figure 109. Create New Observer Mode dialog box



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

14.4.2 Deleting an Observer Mode

➤ **To delete an observer mode:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on the previous page).
3. In the Observer Mode list, select the observer mode that you want to delete.
4. Click the Delete button ( ).

14.4.3 Editing an Observer Mode

➤ **To edit an observer mode:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on the previous page).
3. In the Observer Mode list, select the observer mode that you want to edit.
4. Edit the attributes of the observer mode as desired.

14.4.4 Renaming an Observer Mode

➤ **To rename an observer mode:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on the previous page).
3. In the Observer Mode list, select the observer mode that you want to rename.

4. Click the Rename button (). The Rename Observer Mode dialog box opens.
5. Type the new name.
6. Click OK.

14.5. Adding an Observer

You can add and remove observers. Having multiple observers lets you assign different observers to different windows or channels. Changing the position and orientation of the observer in one channel does not affect the view of a different observer in a different channel. (For information about windows and channels, see "Chapter 6. Windows, Channels, and Display Engines" on page 111.)



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

You can add observers in the Display Engine Configuration Editor Panel or on the Observer Settings page. (For information about the Display Configuration Editor Panel, see "Chapter 6. Windows, Channels, and Display Engines" on page 111.)

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.)

14.5.1 Adding an Observer on the Observer Settings Page

➤ **To add an observer on the Observer Settings page:**

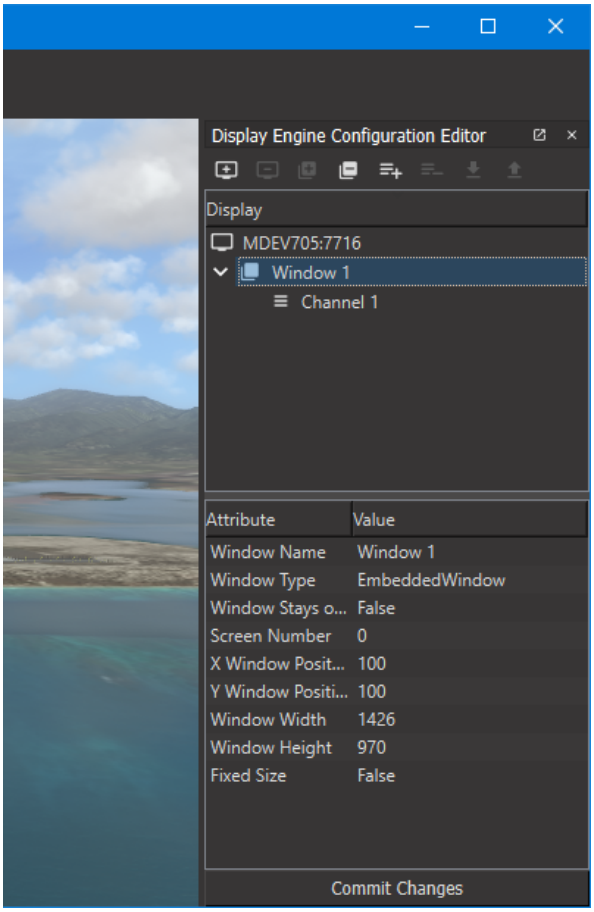
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on page 246).
3. Click the Add button (+) to the right of the Observer list. The Create New Observer dialog box opens.
4. Type a name for the new observer.
5. Click OK. The new observer is added to the list.
6. To save the observer, save the display configuration. (Saving the observer settings does not save observers. For information saving a display configuration, please see "6.2.5 Saving a Display Engine Configuration" on page 118.)

14.5.2 Adding an Observer in the Display Engine Configuration Editor

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

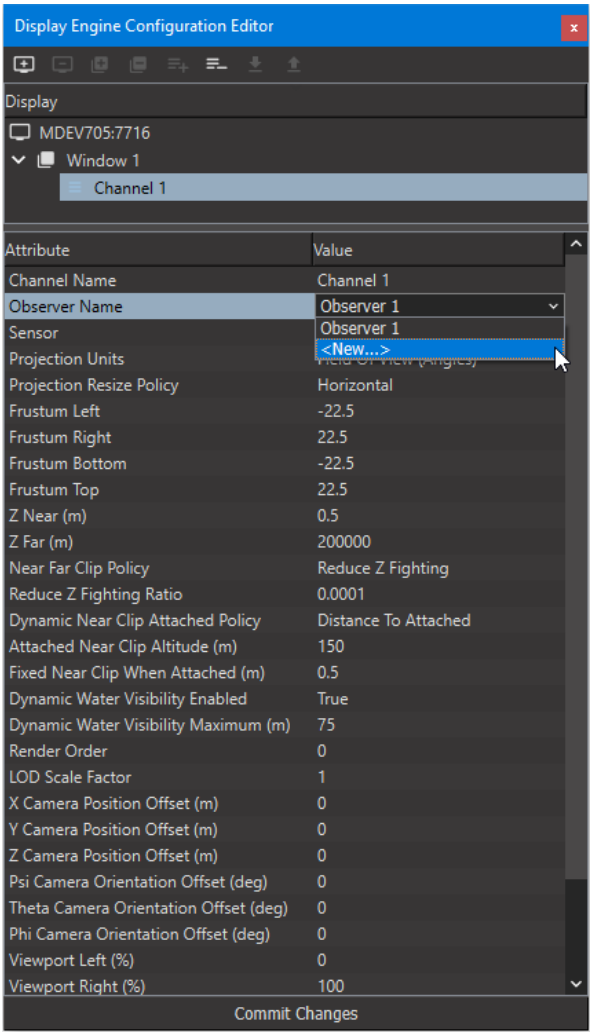
1. Choose **View > Display Engine Configuration Editor Panel**. The Display Engine Configuration Editor Panel opens (Figure 110).

Figure 110. Display Engine Configuration Editor Panel



2. Select the channel on which you want to add an observer.
3. Click the Value field for the Observer Name attribute to make it editable.
4. In the list, select New (Figure 111).

Figure 111. Observer Name attribute



5. Click Commit Changes. The Add Observer dialog box opens.
6. Type a name for the new observer.
7. Click OK. The new observer becomes the selected observer on the Observer Settings Toolbar, and is listed in the Observer Name attribute. (You may need to refresh the channel attributes before the observer name is listed.)
8. To save the observer, save the display configuration. (For information about saving a display configuration, please see "6.2.5 Saving a Display Engine Configuration" on page 118.)

14.6. Removing an Observer

When you close VR-Vantage, all observers are 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 108 on page 246).
3. In the Observer list, select the observer that you want to remove.
4. Click the Delete button ( ). The observer is removed.
5. If the observer was saved as part of a display configuration, save the updated display configuration.

14.7. Communicating Information About the Observer

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

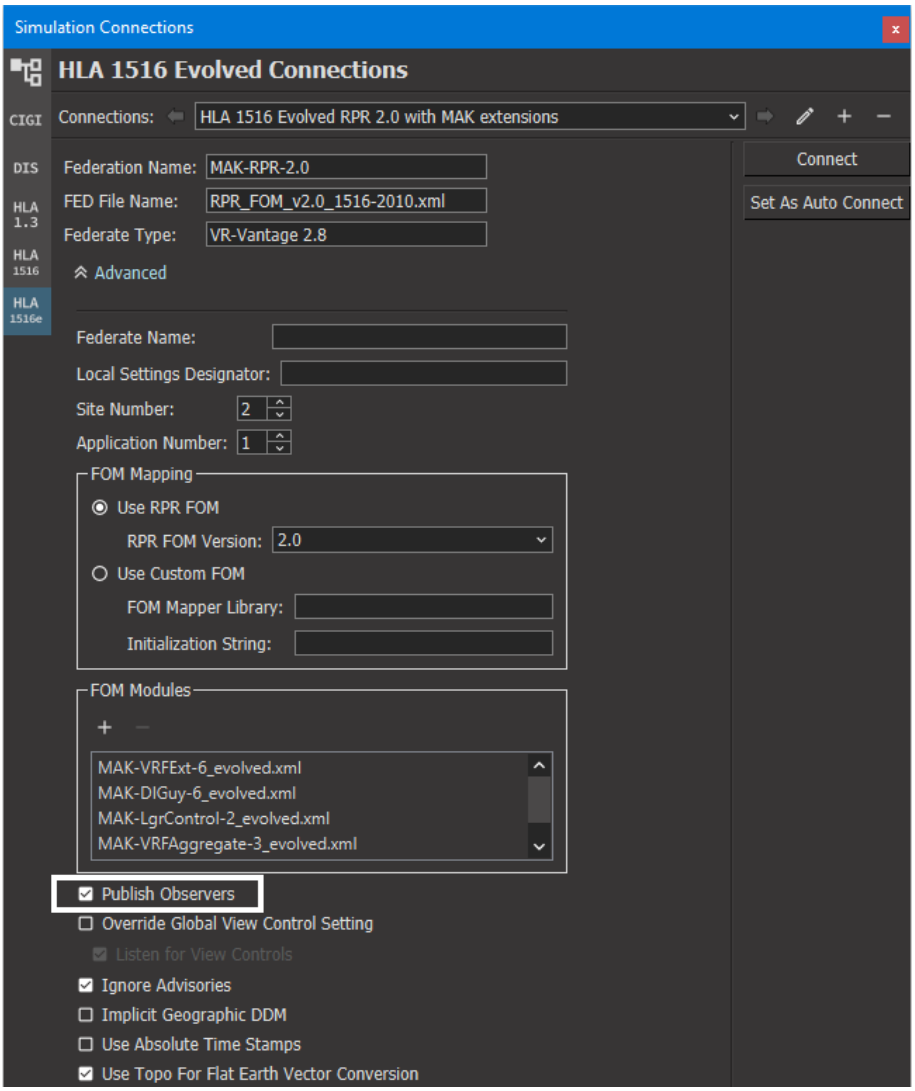
14.7.1 Making the Observer Visible to Other Applications

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

➤ **To enable or disable broadcasting of observer information:**

1. Choose **Settings > Connection**. The Simulation Connections dialog box opens (Figure 112).

Figure 112. HLA 1516 Evolved 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.

14.7.2 Viewing and Attaching to Other Observers

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

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

For related information, see "19.12. Displaying Models for Remote Observers" on page 340.



15. Moving the Observer

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

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15.1. Moving the Observer

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

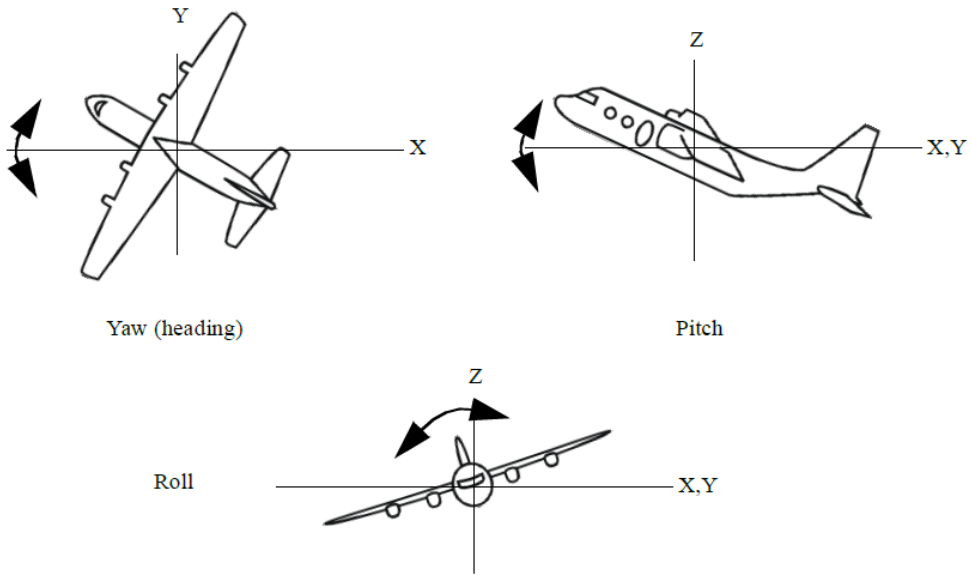
- You can move it independently of any scene element. This is called absolute, or free-fly mode.
- You can attach the observer to a simulation object, in which case it moves with the object. (You can also attach the observer to a prop. For details about attaching the observer to a simulation object or prop, see "16. Attaching the Observer to Objects" on page 287.

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 113).

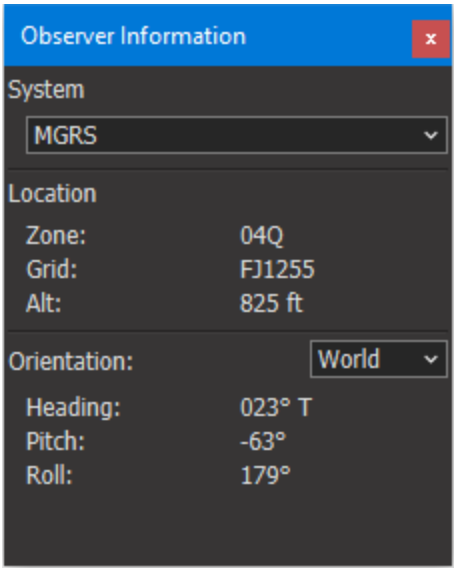
In the 2D projection, the Z coordinate is fixed. You can change the X and Y coordinates. You can change the observer's yaw, but pitch and roll are fixed.

Figure 113. Orientation



The Observer Information Panel (Figure 114) displays the location and orientation of the observer in whichever coordinate system you select.

Figure 114. Observer Information Panel



15.1.1 Using the Compass to View the Observer's Heading

VR-Vantage can display a compass that always shows the heading of the observer. The compass is an observer mode setting. In Figure 116, the observer's heading is east.

In the 2D view, the compass has two needles. The straight needle indicates true north and the arrow needle indicates magnetic north. Depending on where the observer is in the world, the needles may be close together or wide apart.

Figure 115. 2D Compass



In the 3D projection, the compass is horizontal and shows the direction where the observer is looking. This uses either true or magnetic north, based on the Heading specified in the Display Units Settings. You can also specify whether the 3D compass should use degrees or NATO-MIL. See "36.6. Specifying Display Units" on page 544.

Figure 116. 3D Compass



➤ **To enable or disable the compass:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on page 246).
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**.

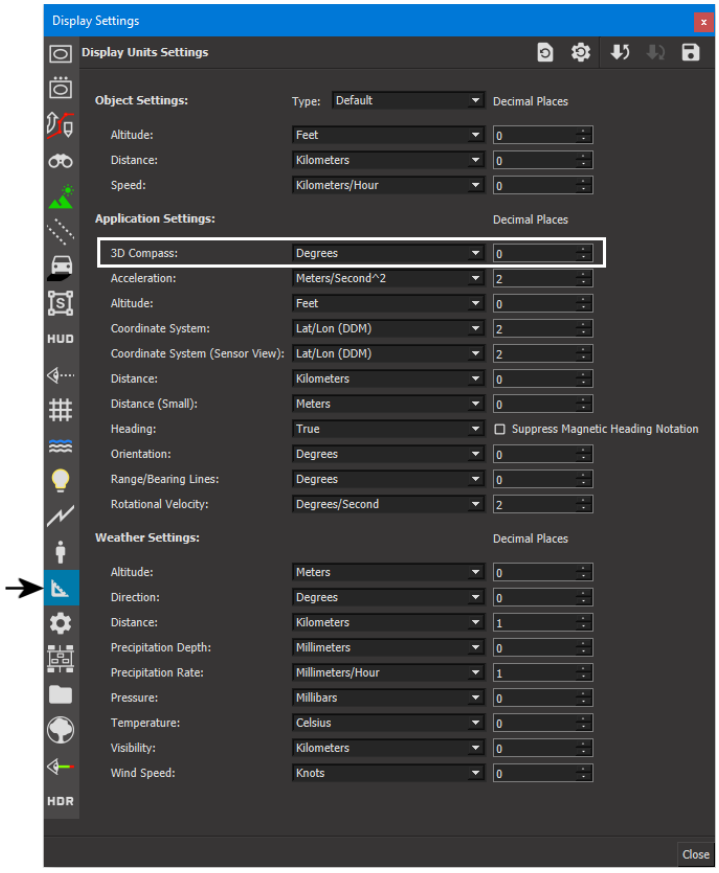
15.1.2 Setting the Compass to Degrees or MILs

In the Display Units Settings, you can specify the measurement units for the 3D compass: degrees or NATO-MIL.

➤ **To specify the measurement units for the 3D compass:**

1. Choose **Settings > Display**.
2. Select the Display Unit Settings page.
3. From the 3D Compass list, choose the measurement you want to use.

Figure 117. 3D Compass Settings



When you use the 3D compass, the default behavior is for it to show the cardinal and intercardinal direction indicators (N, NE, S, SW, and so on). You can change the definition such that they do not display as the current heading. (They continue to display on other parts of the compass.)

If you want to change the setting, edit the 3dViewCompass model definition (in the Channel3dViewCompass schema) and set the parameter isExactHeadingAlwaysShown to true. For more information, see the *Model Definitions* chapter of the *Adding Content to MAK ONE Applications Reference Manual*.

15.1.3 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, see "Creating and Editing Schemas" in the *Adding Content to MAK ONE Applications Reference Manual*. For details about editing model definitions, see "Creating and Editing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)

By default, all channels have the largeCompass keyword. To change the style of compass used for a channel, change the keyword in the Keywords attribute for the channel. To completely remove the compass, delete the keyword. For details about setting channel attributes, please see "6.4. Changing a Channel's Attributes" on page 120.

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

You can change the color of the compass by editing the darkTickColor and lightTickColor 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.

15.2. 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 "15.2.1 3D Observer Movement Coordinate Systems" below.)

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, see "Chapter 37. Creating and Editing Key Mappings" on page 549.) This section describes how observer movement can vary based on the observer coordinate system and the attach mode.

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

Table 14. Observer modes

Observer Mode	Projection	Key Map
Stealth	3D	Observer Frame
CameraFX modes	3D	Observer Frame
XR	3D	Observer Frame
Plan View	2D	2D Level Observer Frame

15.2.1 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.

15.2.2 2D Observer Coordinate System

When you use the 2D projection in VR-Vantage, 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.

15.2.3 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 MAK'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 118 and Figure 119 illustrate the differences between moving the observer in an attached context and without an attached context.

Figure 118 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 118. Observer movement in entity level body frame coordinates

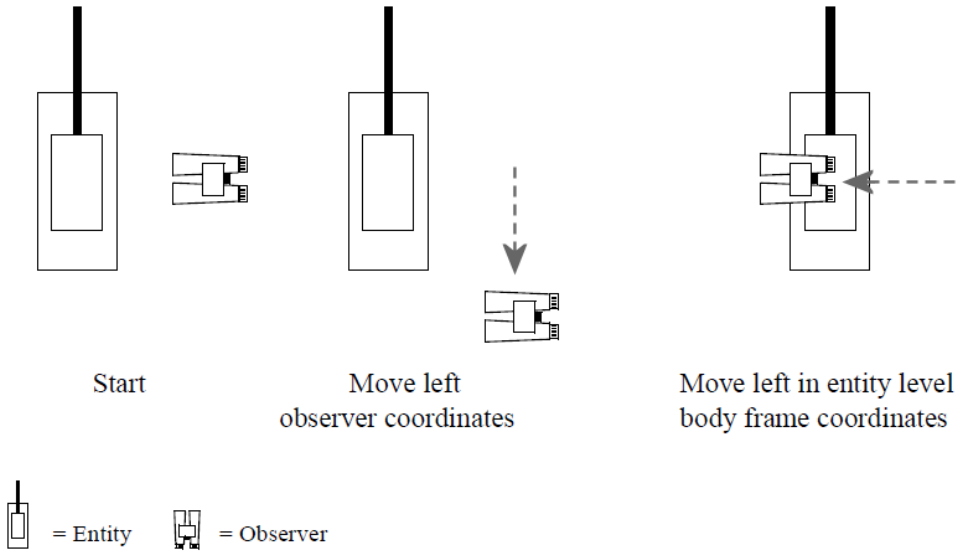
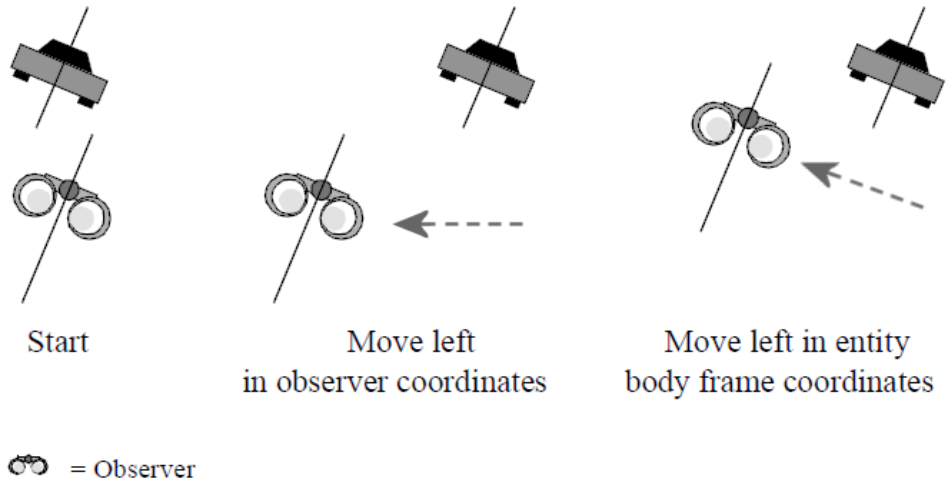


Figure 119 illustrates movement in entity body frame (Mimic mode). The Move Observer Left function moves the observer to the left in observer coordinates, that is left relative to the observer's heading, but ignoring pitch and roll. The Move Attached Context Left function moves the observer left in the attached context. In entity body frame, this means the observer moves left relative to the entity's heading and its pitch and roll.

Figure 119. Movement in entity body frame coordinates



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

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

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

As described in "15.1. Moving the Observer" on page 257, 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.

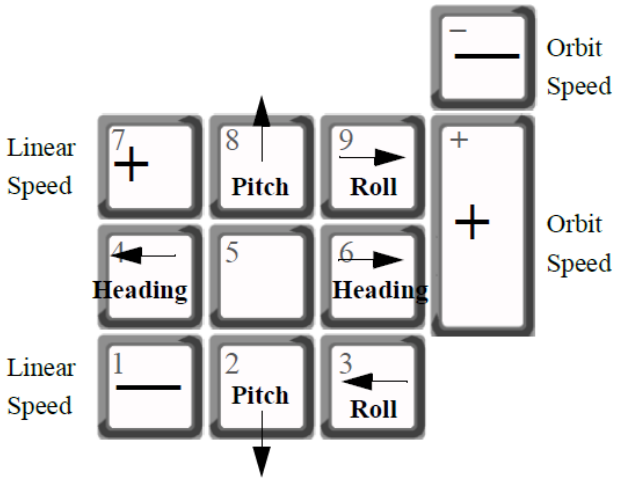
Figure 120 illustrates the positional movement keys. Figure 121 illustrates the keypad layout for changing orientation and movement speed. For a complete list of movement functions and their keyboard and mouse mappings, please see "VR-Vantage Quick Reference Card" on page 607 or the Key Mapping Editor.

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

Figure 120. Primary movement keys, observer coordinates (3D)



Figure 121. 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.

15.3.1 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" on page 607. You can:

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

For details about orbiting, see "15.3.2 Orbiting" below. For details about moving the camera, see "15.3.3 Moving the Camera" on the facing page.



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

15.3.2 Orbiting

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

➤ **To orbit around an object:**

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

➤ **To orbit around a point:**

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

15.3.3 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.

15.4. 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 Settings 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)

15.4.1 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

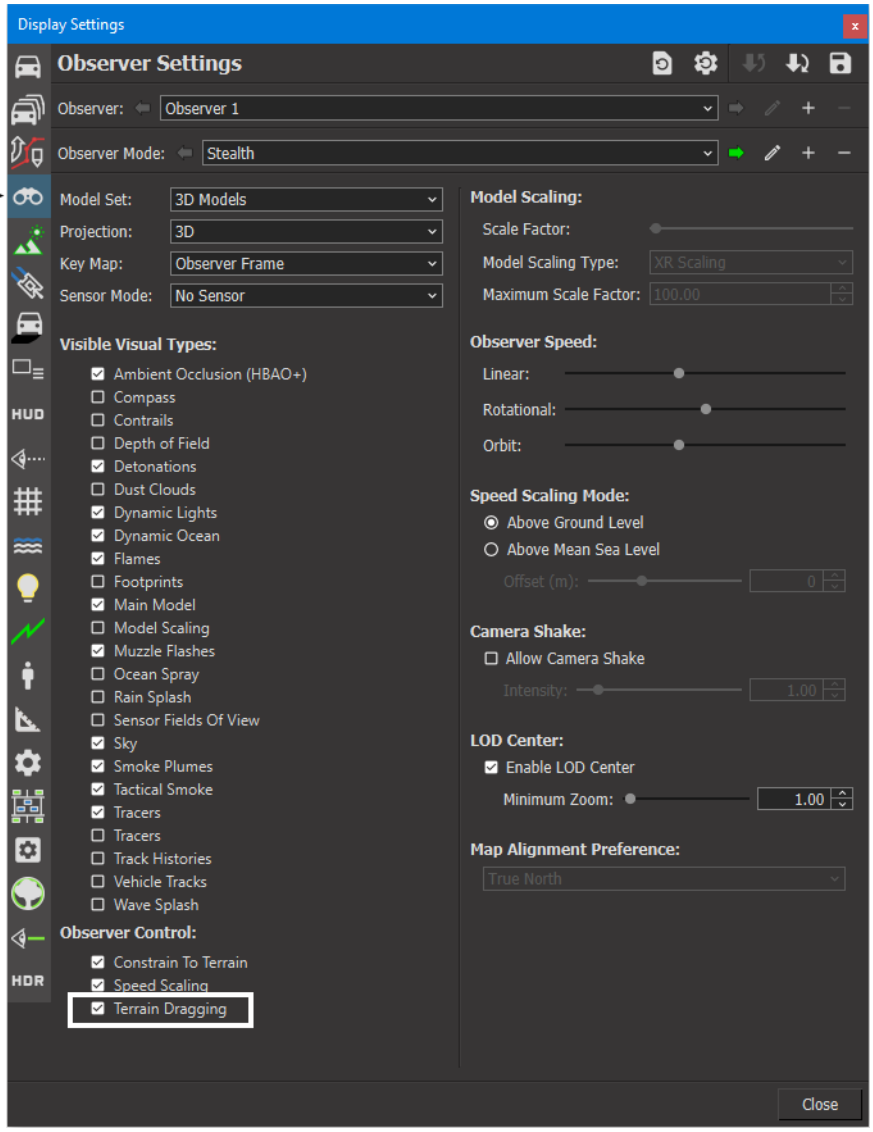
There may be times when you want to disable terrain dragging. This may be particularly useful when you are creating simulation objects or objects or editing them and do not want to inadvertently drag the terrain when you are trying to move

objects.

➤ **To enable or disable terrain dragging:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 122).

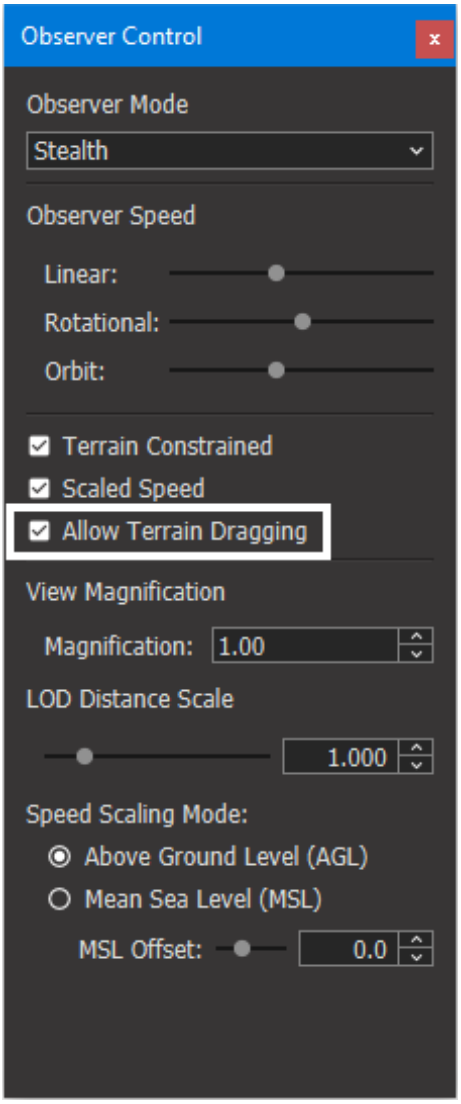
Figure 122. Observer Settings page



3. Select or clear the Terrain Dragging check box.

> You can also enable or disable terrain dragging by clearing the Allow Terrain Dragging check box on the Observer Control Panel (Figure 123).

Figure 123. Observer Control Panel



15.4.2 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.

15.4.3 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.

15.4.4 Orbiting the Terrain with the Mouse

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

15.4.5 Teleporting the Observer

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

➤ **To teleport the observer:**

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

  If you **Shift**+click on a filled area, the observer attaches to the area; it does not teleport. If you want to teleport to the terrain under an area, hide the area first. You can hide an area by hiding all tactical graphics or hiding the overlay on which the area is located.

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

15.5. 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 "15.8. Forcing Orientation North (Plan View Mode Only)" on page 276.

15.5.1 Moving the Observer from the Keyboard in the 2D Projection

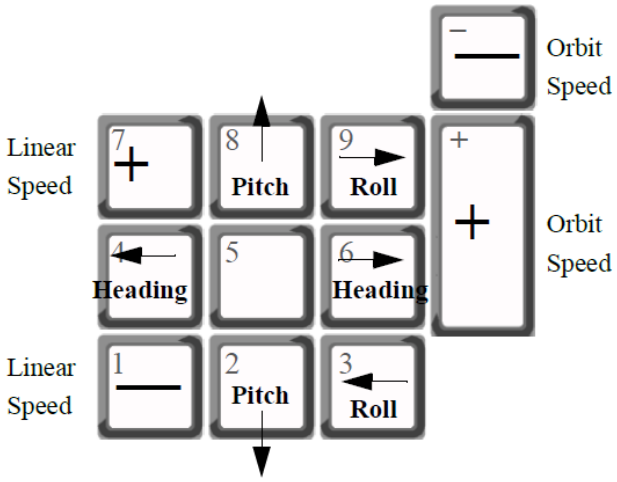
Figure 124 illustrates the positional movement keys for the 2D projection. Figure 125 illustrates the keypad layout for changing heading and movement speed. For a complete list of movement functions and their keyboard and mouse mappings, see "VR-Vantage Quick Reference Card" on page 607.

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

Figure 124. Primary movement keys, observer coordinates (2D)



Figure 125. Keypad layout, heading, pitch, and roll (2D)



15.5.2 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 "15.4.1 Dragging the Terrain" on page 267. You can change heading by orbiting, as described in the next section. (To see the full list of mouse mappings, view the Mouse Settings 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 "15.8. Forcing Orientation North (Plan View Mode Only)" on page 276.

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

15.6. Zooming the Observer

You can zoom the observer in the 3D and 2D projections. Although the apparent effect is similar for top-down views, they are conceptually and behaviorally different. In addition to a straight "in-and-out" zoom, you can zoom the view to the extents of a

simulation object or group of simulation objects.

15.6.1 Zooming the Observer in the 3D Projection

If you want to see something at a higher level of detail (LOD) without moving the observer, you can adjust the view magnification (zoom) of the observer view. Zooming the observer magnifies objects in the view, increasing the LOD to match the level of zoom. The magnification level is saved in saved views. 3D zoom has these characteristics:

- When you zoom the observer view, its movement and mouse look speeds decrease as the magnification increases, to allow for increased control.
- The channel's (window's) field of view establishes the baseline 1X zoom level. Changing the field of view does not change the effective magnification (that is, it does not change the LOD).
- When you switch from 3D to 2D (Stealth only), VR-Vantage calculates a 2D zoom level to match the 3D view. If you then switch back to 3D, it remembers the observer location and zoom level.
- If you zoom in from a very high altitude there may be scene corruption due to insufficient precision in the z-buffer. This can be limited by moving the observer closer to the subject before zooming in. This issue is typically only encountered above 10,000 meters.
- When you zoom, VR-Vantage respects the environmental conditions at the observer's location. For example, if the observer is above the cloud layer, zooming does not let you see below the clouds. Or, if it is raining at the observer's location, the visibility will not improve as you zoom in on a distant object.
- After zooming in, when you zoom out, you can only zoom out to magnification level 1. That is, you can only zoom out back to the observer's location. To see more of the terrain, move the observer away from the terrain.

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

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



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

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

15.6.2 Zooming the Observer in the 2D Projection

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

➤ To zoom in, press **E**, or to step the zoom, press the **=** key.

➤ To zoom out, press **Q**, or to step the zoom, press the **-** (dash) key.

➤ To zoom with the mouse wheel, scroll forward to zoom in on the spot under the mouse cursor, or backward to zoom out. Hold down the **Alt** key and scroll forward to zoom in on the spot at the center of the screen.

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

15.6.3 Setting the Scale Factor for Terrain

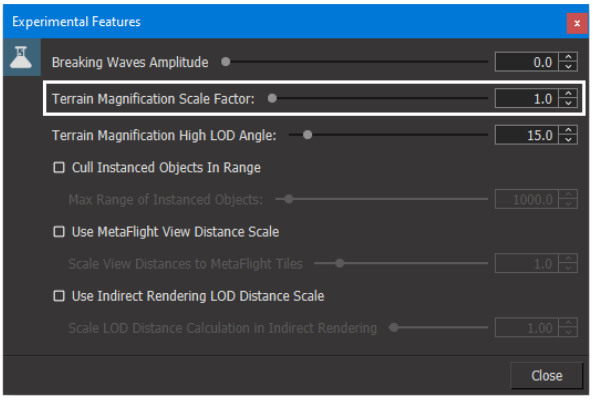
When you zoom the view, all distances used for determining LODs (including terrain) are scaled by the view magnification. In some cases, this is more aggressive than desired for the terrain. To remedy this problem, you can change the amount by which the terrain distance is scaled relative to the view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

Some 3D terrains are not designed to be viewed at higher magnification. Performance may decrease if magnification increases the level of detail of large areas of the terrain. For example, suppose you are looking down a row of trees that is in the center of the view. At normal magnification, there are a certain number of trees at each quality level, say 10 high, 20 medium, and 100 low (for a total of 130 trees in the row). Suppose also that performance will be acceptable only when visualizing 15 or fewer high quality trees. If you magnify the scene 2x, you may now see 20 high, 40 medium, and 70 low quality trees. You see the same number of trees, but performance will decrease because you are visualizing more high quality models.

➤ **To set the scale factor for terrain:**

1. Choose **Settings > Experimental Features**. The Experimental Features dialog box opens (Figure 126).
2. Adjust the Terrain Magnification Scale Factor slider.

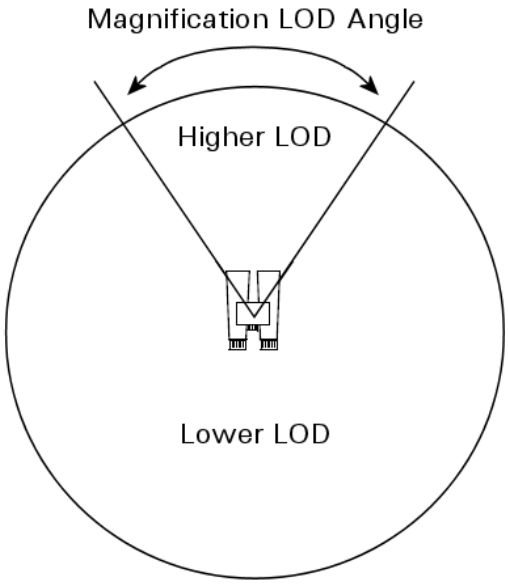
Figure 126. Experimental Features



15.6.4 Setting the Magnification LOD Angle for Terrains

When the observer zooms in, VR-Vantage pages in higher LOD tiles for the terrain. This increases memory usage. You can tune performance by restricting high LOD tiles to the areas you are interested in and using lower LOD tiles for the rest of the terrain. The Terrain Magnification High LOD Angle setting lets you adjust the angle within which higher LOD tiles are used (Figure 127).

Figure 127. Terrain magnification LOD angle



If you want the observer to be able to quickly scan a wide angle of terrain, you should increase the magnification LOD angle or you may have to wait for high LOD tiles to page in as you move the observer.

On some terrains, when high LOD tiles are adjacent to low LOD tiles, there can be cracks in the terrain along the boundaries. If you experience this problem, increase the magnification LOD angle.

This feature has a purpose similar to that of LOD centering (described in "15.6.6 Configuring the LOD Center in the Observer Mode" on the facing page). This feature is best used for ground vehicles. We recommend LOD centering for use with aircraft.

This setting is saved when you close VR-Vantage.

➤ **To set the magnification LOD angle for terrain:**

1. Choose **Settings > Experimental Features**. The Experimental Features dialog box opens (Figure 126 on the previous page).
2. Adjust the Terrain Magnification High LOD Angle slider.

15.6.5 Zooming In to the Ocean Over Long Distances

If you zoom in to the ocean over very long distances, the ocean might not be rendered at the correct altitude and ships may be hidden (beneath the rendered ocean). If you

experience this problem, edit *./data/Environment/Ocean/Triton.config* and set **use-mesh = no**. If after making this change you see performance decrease, adjust these settings in the file to improve performance:

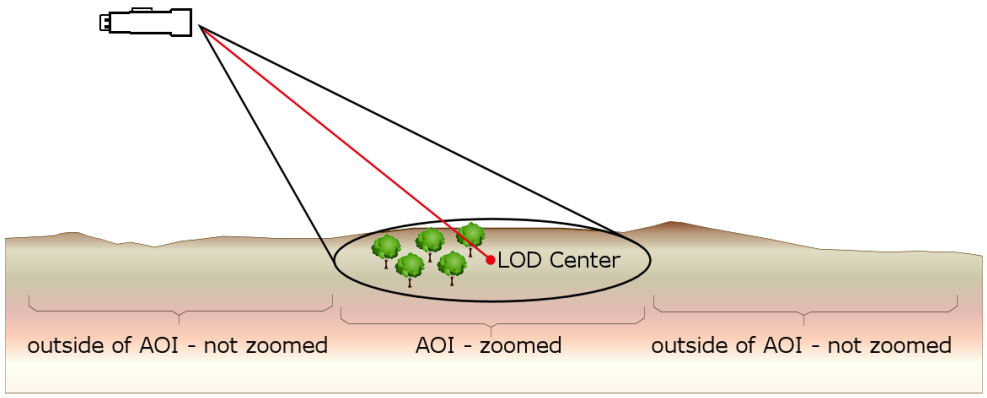
```
prop-wash-default-fade-time = 60.0
wake-wash-length = 1000
wake-wave-generation-distance = 1.0
wake-kelvin-wave-min-amplitude = 0.1
```

15.6.6 Configuring the LOD Center in the Observer Mode

When the magnification is greater than one, the default behavior is to perform a screen intersection on the area the observer is looking at and improve the LOD at that area and not in other areas. Some areas of the terrain between the observer and the point you have zoomed in on will have a lower LOD, so you might want to change the behavior.

Enabling the LOD center in the observer mode adjusts the LODs for the areas away from the area of interest (AOI) to be lower, which avoids paging or rendering higher LOD models that are not visible in the view. The LOD center uses an intersection with the view vector and the terrain to determine where the AOI is, as shown in (Figure 128).

Figure 128. LOD centering creates an area of interest where the view intersects the terrain



This feature has a purpose similar to that of changing the LOD angle (described in "15.6.4 Setting the Magnification LOD Angle for Terrains" on the previous page). This feature is best used with aircraft. We recommend changing the LOD angle for use with ground vehicles.

➤ **To configure the LOD center in the observer mode:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on page 246).
3. Select or clear the Enable LOD Center check box.
4. To use the LOD center starting at a specific zoom magnification, adjust the Minimum Zoom slider or enter a value in the box.
5. Click Close.

15.7. Simulating Camera Jitter

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

➤ **To simulate camera jitter:**

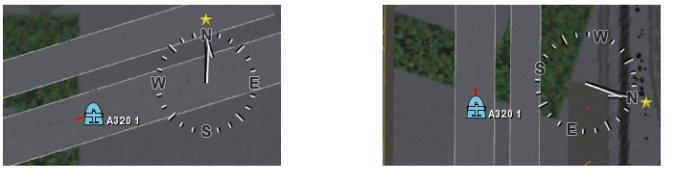
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on page 246).
3. In the Camera Shake section, select Allow Camera Shake.
4. Optionally, adjust the Intensity slider or change the value in the box.

15.8. Forcing Orientation North (Plan View Mode Only)

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

Figure 129 illustrates the view when the observer is attached to an entity with orientation forced to North or matched to that of the entity.

Figure 129. Forcing orientation North



Orient north Orient to entity heading

➤ **To enable or disable a northward orientation:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on page 246).
3. In the Observer Mode list, select Plan View.
4. In the list of observer settings, select or clear Orient North.
5. Optionally, you can define whether north is true or magnetic. See "15.8.1 Specifying True, Magnetic, or Grid North" below.

You can also enable or disable northward orientation by choosing **Observer > Orient North**.

15.8.1 Specifying True, Magnetic, or Grid North

When the observer is set to Orient North, you can specify which north to use for the plan view (2D). True north, also known as geodetic north, is the direction pointing to the geographic location of the North Pole. Magnetic north, on the other hand, is the

point where the magnetic field points down. In VR-Vantage, it is determined by the World Magnetic Model (WMM). The current parameters are good until 2025. To learn more about the WMM, visit https://www.ngdc.noaa.gov/geomag/WMM. Lastly, grid north is the direction indicated by the vertical grid lines on ordnance survey maps.

➤ **To specify the type of north:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on page 246).
3. In the Observer Mode list, select Plan View.
4. In the Map Alignment Preference list, select True North, Magnetic North, or Grid North.

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

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



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

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

- Press **/** (forward slash).
- Choose **Observer > Constrain to Terrain**.
- On the Observer Control Panel (Figure 123 on page 269), select or clear the Terrain Constrained check box.

15.10. Controlling Navigation Speed

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

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

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

15.10.1 Enabling or Disabling Speed Scaling

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

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

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

- On the Observer Control Panel (Figure 123 on page 269), select or clear the Scaled Speed check box.
- Choose **Observer > Speed Scaling**.
- Press the multiply key (*) (not the asterisk key).

Setting the Speed Scaling Mode

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

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

- On the Observer Control Panel (Figure 123 on page 269), set the Speed Scaling Mode to Above Ground Level (AGL) or Above Mean Sea Level (MSL)
- On the Display Settings dialog box, Observer Settings page, set the Speed Scaling Mode to Above Ground Level (AGL) or Above Mean Sea Level (MSL)

15.10.2 Changing the Observer's Movement Speed

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

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

- Adjust one of the Observer Speed sliders on the Observer Control Panel (Figure 123 on page 269) 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.

15.11. Saving and Recalling Views

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

VR-Vantage supports the following use cases for saving observer views:

- Associate views with a terrain. Save one or more absolute observer mode views and associate them with a terrain. The views are loaded automatically when the terrain loads. You can specify a default view that the observer jumps to immediately.
- Save a mix of absolute mode and attached mode views to a file. This use case is best when you want to associate a set of views with a particular simulation or simulation recording for analysis and demonstration purposes.

Nothing prevents you from including observer views that are attached to a simulation object in a terrain's saved views file, but they will not work unless the specific simulation object is available in the simulation.

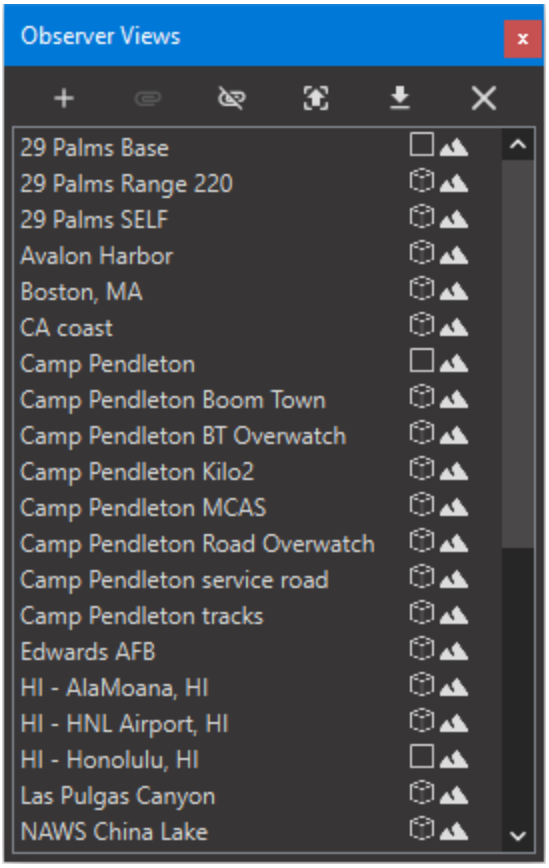
If the observer is not attached to a simulation object, its view is its position and orientation in the simulated environment. If the observer is attached to a simulation object, a view saves the following information:

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

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

Saved views are managed in the Observer Views Panel (Figure 130).

Figure 130. Observer Views Panel



Its buttons have the following meanings:

- Save the current view.
- Associate the views with the terrain.
- Dissociate views from the terrain.
- Save the views to a file.
- Load a saved views file and append it to the list.
- Clear the list.

The icons in the observer views list have the following meanings:

- 3D view, such as Stealth, XR, or Out-the-Window.
- 2D view, such as Plan View.
- View is associated with the terrain.
- Default view for the terrain.

Saved views are keyed to the marking text of the object to which the observer is attached.

➤ **To save the current view:**

1. Choose **Views > Observer Views Panel**. The Observer Views Panel opens (Figure 130).
2. Click the Add button (+). The current view is added to the list.

Views are remembered only while VR-Vantage remains running. To save a view for future use, you must save it to a file, associate with a terrain, or both. Please see "15.11.4 Saving Views to a File" on the next page.

15.11.1 Recalling a View

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

Animating Transitions Between Observer Views

Normally, when you select an observer view, the observer jumps immediately to the new view. However, VR-Vantage can smoothly transition from the current observer view to a saved view.

➤ To transition between observer views, hold down the **Ctrl** key and click the view in the Observer Views Panel that you want the observer to move to.

15.11.2 Deleting Views

➤ **To delete a view:**

1. In the Observer Views Panel, select the view you want to delete.
2. On the shortcut menu, select **Delete Observer View**.

Clearing the View List

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

15.11.3 Loading Views Automatically When You Load a Terrain

You can associate a saved views file with a terrain so that it loads automatically when the terrain loads. You can also specify that one of the views be the default view. When you associate views with a terrain, VR-Vantage saves a file to the *./SharedData/16/latest/TerrainData/TerrainConfiguration* directory. The file has the same name as the terrain and the extension *.osrx*.

> The file used for associating views with a terrain is different from the file that is created when you manually save views to a file, as described in "15.11.4 Saving Views to a File" below.

➤ To associate views with a terrain, click the Associate Views button ( ). VR-Vantage adds an icon ( ) next to each view to show that it is associated.

Specifying a Default Observer View

If you associate views with a terrain, you can specify that one of the views be the default view to use. A star is added to the association icon for default views ( ).

You can specify a default 3D view and a default 2D view. When you load a terrain, if there are two default views and the current observer mode is a 3D mode, it uses the 3D default view. If the current observer mode is a 2D mode, it uses the 2D default view.

➤ **To specify a default observer view:**

1. Right-click the observer view that you want to be the default.
2. On the shortcut menu, choose **Set As Default View**.

Unsetting a Default View

➤ **To unset a default observer view:**

1. Right-click the default observer view.
2. On the shortcut menu, choose **Unset Default View**.

15.11.4 Saving Views to a File

You can save views to a file and load them at a later time. The default location for saved views is *./appData/settings/application*, where *application* is the name of the VR-Vantage application. When you create a 2D view for a terrain that includes 2D View Layers, that view includes the currently specified layer.

Saving views to a file is not the same thing as associating views with a terrain. When you associate views with a terrain, they get loaded automatically and you can specify a default view to use immediately. When you save views to a file, you need to load them manually, or from the command line. You cannot specify a default view.

Associating views with a terrain is most beneficial for saving a set of Absolute mode observer views that you always want to be available to the terrain, regardless of the simulation that you are connected to. Saving views to a file manually is most beneficial for saving views when the observer is attached to simulation objects in a simulation or for simulation-specific Absolute mode views.

➤ **To save all views to a file:**

1. In the Observer Views Panel, click the Export Views button ( ). The Save Observer Views dialog box opens.

2. Select the file to which you want to save the views, or type the name of a new file.
3. Click OK.

Saving an Individual View to a File

You can save a single view to a file.

➤ **To save an individual view to a file:**

1. Right-click the view that you want to save.
2. On the menu, choose **Save Observer View**. The Save Observer View File dialog box opens.
3. Type a name for the file.
4. Click Save.

15.11.5 Loading Views

You can load saved views and append them to the list in the Observer Views Panel.



To load a view, you can also drag and drop the *.osrx* file onto the Observer Views Panel and then select it.

➤ **To load views and append them to the list of views:**

1. In the Observer Views Panel (Figure 130 on page 280), click the Load Views and Append button (). The Open Observer Views dialog box opens.
2. Select the saved views file that you want to load.
3. Click OK.

15.12. Using the Go To Location Panel

The Go To Location panel allows you to move the current observer to the specified address, latitude and longitude, or MGRS coordinates.

➤ **To go to a location:**

1. Open the Go To Location panel (**View > Go To Location**).
2. Select the method you want to use and then enter the appropriate information:
   - To go to an address, select Go to Address and then enter the complete address. This requires an internet connection. If VR-Vantage cannot find some address to match, it displays an alert icon. Hover the mouse over it for more information.

     You can also enter the code for an airport and use that to go to the airport's location.
   - To go to a latitude and longitude, select that option and then enter the degrees, minutes, and seconds.

— To go to the MGRS coordinates, select that option and then enter the Grid Zone, Map Sheet, and the Easting and Northing numerical location (no spaces).

3. Click Go. The Go button becomes active when you have entered the required information.

   If you entered an address but the current observer did not jump to the address you specified, there was an error. An icon displays next to the address field. Hover the mouse over the icon to read the error message.

15.13. Controlling the Observer from Other Applications

VR-Vantage can respond to view control messages sent by applications such as the MAK Logger and from VR-Forces plans. You can also write VR-Link-based applications to send view control messages to VR-Vantage using the classes in the VR-Vantage Control Toolkit. You can use view control messages to:

- Specify the attach mode and simulation object.
- Set the observer's position and orientation.

Acceptance of view control messages is a global setting. You can set it per connection.

The view control PDUs are experimental, and are not an official part of DIS. They are of PDU kind 202.

Some legacy applications were created with the Stealth Control Toolkit. The Stealth Control Toolkit is no longer distributed with VR-Vantage. It has been replaced with the VR-Vantage Control Toolkit. VR-Vantage responds to move, absolute, tether, mimic, track, tether track, mimic track, follow, orbit, and compass Stealth Control PDUs. It does not support the other PDUs in the Stealth Control Toolkit.

15.13.1 Enabling the Processing of View Control Messages

➤ To enable or disable the processing of view control messages, choose **Settings > View Controls**.

You can specify view control settings when you connect to an exercise that override the setting in the GUI.

15.13.2 Overriding the Global View Control Settings

Processing of view control messages is a global setting. It is either on or off for all observers. However, you can override the setting on a per-connection basis (DIS and HLA only). You might want to do this if you are running VR-Vantage with several connections and want to enable or disable view controls coming from some connections, but not others.

If you override the global view control setting, you will not be able to change the view control setting in the GUI.

➤ **To override the global view control setting:**

1. On the Simulation Connection page for the protocol for which you want to override the global view control setting, click Advanced.
2. Select Override Global View Control Settings.
3. Select or clear the Listen for View Control Settings check box depending on whether you want to enable view controls or disable them.
4. Set any other connection parameters desired.
5. Click Connect.



16. Attaching the Observer to Objects

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

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16.1. Attaching the Observer to a Simulation Object or Prop

You can attach the observer to a simulation object and follow it as it moves through the simulation. You can also attach the observer to props and to other observers.

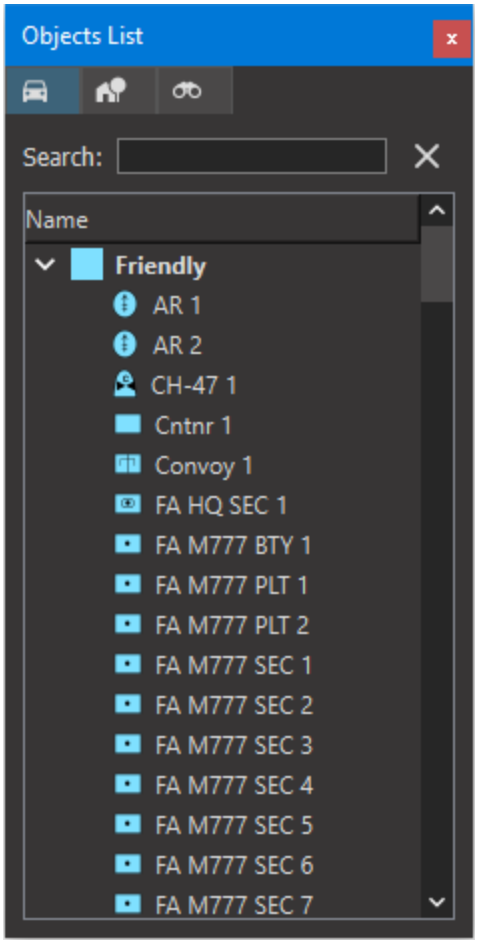


This procedure applies to Follow, Tether, Track, Mimic, and Space Follow modes. To attach in Tether Track or Mimic Track mode, see "16.1.3 Attaching the Observer in Mimic Track or Tether Track Mode" on page 291. To attach in Tether Location Track or Mimic Location Track mode, please see "16.1.4 Attaching the Observer in Mimic Location Track or Tether Location Track Mode" on page 291.

➤ **To attach the observer to a simulation object or prop, do one of the following:**

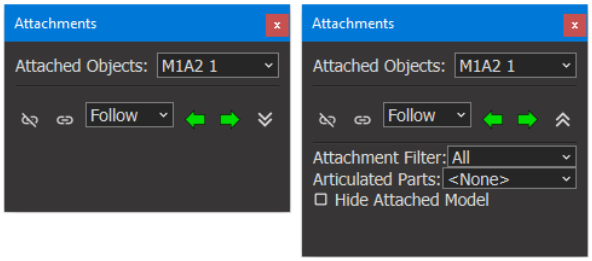
- Right-click an object in the Objects List Panel (Figure 131) or on the terrain and select **Observer Attach > Attach** *mode*, where *mode* is one of the supported attach modes. (For details about attach modes, see "16.2. Attach Modes in the 3D Projection" on page 292 and "16.3. Attach Modes in the 2D Projection" on page 299.)

Figure 131. Objects List Panel



- Select a simulation object or prop. (For details about selecting simulation objects and props, please see "19.1. Selecting Simulation Objects" on page 326 and "Selecting Props" in the *Adding Content to MAK ONE Applications Reference Manual*.) On the Attachments Panel (Figure 132), click the Attach button ( ) to attach with the current attachment mode.

Figure 132. Attachments Panel



- On the Attachments Panel, click the next or previous arrows to attach to the next (or previous) object in the object list.
- **Shift**+click the object you want to attach to.
- Press greater than (**>**) to attach to the next simulation object or prop in the Objects List without regard to the attachment filter. Press less than (**<**) to attach to the previous object. (For details about the attachment filter, see "16.1.5 Filtering the Object Attachment List" on the facing page.)
- Press period (**.**) to attach to the next simulation object or prop allowed by the attachment filter. Press comma (**,**) to attach to the previous object.

- When you select the next or previous object, VR-Vantage chooses next and previous based on the order in which the objects were discovered. This might 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. For example, if you moved the observer so that it is not looking at the attached object, when you attach to the next simulation object, the observer will not be looking at this object. It will be in the same relative position to the object that you previously established. To quickly return to the default offset for the attachment mode, press **Spacebar**.

16.1.1 Attaching the Observer to Another Observer

You can attach observers to other observers if you have more than one window open.

➤ **To attach an observer to another observer:**

1. Filter the Objects List to show All objects or to show observers.
2. Select the window whose observer you want to attach to another observer.

3. In the Objects List, select the observer you want to attach to.
4. Right-click and select **Observer Attach > Attach** *mode*, where *mode* is one of the supported attach modes.

16.1.2 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 "16.1. Attaching the Observer to a Simulation Object or Prop" on page 288.
2. On the Attachments Panel (Figure 132 on the previous page), 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.

16.1.3 Attaching the Observer in Mimic Track or Tether Track Mode

To attach the observer in Tether Track and Mimic Track modes, you must specify a primary simulation object and a secondary simulation object (the tracked simulation object).

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

1. Right-click the primary simulation object in the Objects List Panel or in the window. A shortcut menu displays.
2. Choose **Observer Attach > Attach Mimic Track** (or **Attach Tether Track**). The cursor changes to show an arrow and a Plus sign.
3. Click the secondary simulation object in the Objects List or in the window.

16.1.4 Attaching the Observer in Mimic Location Track or Tether Location Track Mode

To attach the observer in Tether Location Track and Mimic Location Track modes, you must specify a primary simulation object and a location.

➤ **To attach the observer in Mimic Location Track mode or Tether Location Track mode:**

1. Right-click the primary simulation object in the Objects List Panel or in the window. A shortcut menu displays.
2. Choose **Observer Attach > Attach Mimic Location Track** (or **Attach Tether Location Track**). The cursor changes to show an arrow and a Plus sign.
3. Click a location in the display window.

16.1.5 Filtering the Object Attachment List

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

> The filter for buoys and beacons applies to S-57 feature data, not buoys that are simulation objects, such as sonobuoys.

➤ **To filter the attachment list:**

1. On the Attachments Panel (Figure 132 on page 289), click the down arrow. The Attachments Panel expands.
2. In the Attachment Filter list, select the type of scene element that you want to attach to.

16.1.6 Detaching from a Simulation Object

➤ To detach the observer from the simulation object to which it is attached, click the Detach button () on the Attachments Panel (Figure 132 on page 289), or press **Z**.

16.1.7 Hiding the Attached Model (3D Projection Only)

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

➤ **To hide the attached model:**

1. On the Attachments Panel (Figure 132 on page 289), click the down arrow. The Attachments Panel expands.
2. Select the Hide Attached Model check box.

16.1.8 Attaching to Props

Since props do not move, attaching the observer to a prop does not result in any observer movement. The principal benefit of attaching to a prop is to let you quickly refocus the observer on a particular location in the scene. If you attach in Track mode, using the keyboard movement keys allows you to orbit around the prop.

16.1.9 Improving Performance when Attaching to Ground Objects

When the observer is attached to air entities, Z-fighting can affect visual quality. To prevent this problem, VR-Vantage needs to calculate the entity's height above the terrain. However, the calculation can affect performance. Unfortunately, when this calculation is enabled (the default), it must be applied to all entity types. If you know that you will want to attach the observer to ground simulation objects, but not air simulation objects (or if you do not care about Z-fighting), you can disable the height

above terrain calculation, which may improve performance when the observer is attached to simulation objects. To disable the height above terrain calculation, start VR-Vantage with the `-S | --suppressHatIntersectOnAttach` command line option.

16.2. Attach Modes in the 3D Projection

Attach modes are combinations of position and orientation models and constraints that produce a useful behavior for the observer. Except for Absolute mode, attach modes describe how movement of the simulation object to which the observer is attached affects the position and orientation of the observer.

VR-Vantagesupports the following attach modes:

- Absolute: The observer is not attached to a simulation object; it moves in space independently of all simulation objects.
- Follow: The observer position and heading changes with the simulation object's position and heading.
- Mimic: The observer position and orientation changes with the simulation object's position and orientation.
- Mimic Track: The observer's position changes with the simulation object's position while its orientation is focused on a second entity.
- Mimic Location Track: The observer's position changes with the simulation object's position while its orientation is focused on a location.
- Space Follow: The observer is a fixed distance from the simulation object and the simulation object model is scaled to be observable from a great distance.
- Tether: The observer's position changes with the simulation object's position.
- Tether Track: The observer's position changes with the simulation object's position while its heading is focused on a second simulation object.
- Tether Location Track: The observer's position changes with the simulation object's position while its heading is focused on a location.
- Track: The observer's heading changes to track the simulation object's position and heading.

The attach modes are described in detail in the following sections. For details about how to attach the observer to a simulation object, see "16.1. Attaching the Observer to a Simulation Object or Prop" on page 288.

16.2.1 Absolute Mode

In Absolute, or free-fly mode, the observer is not attached to a simulation object. Movement of simulation objects does not affect the observer in any way.

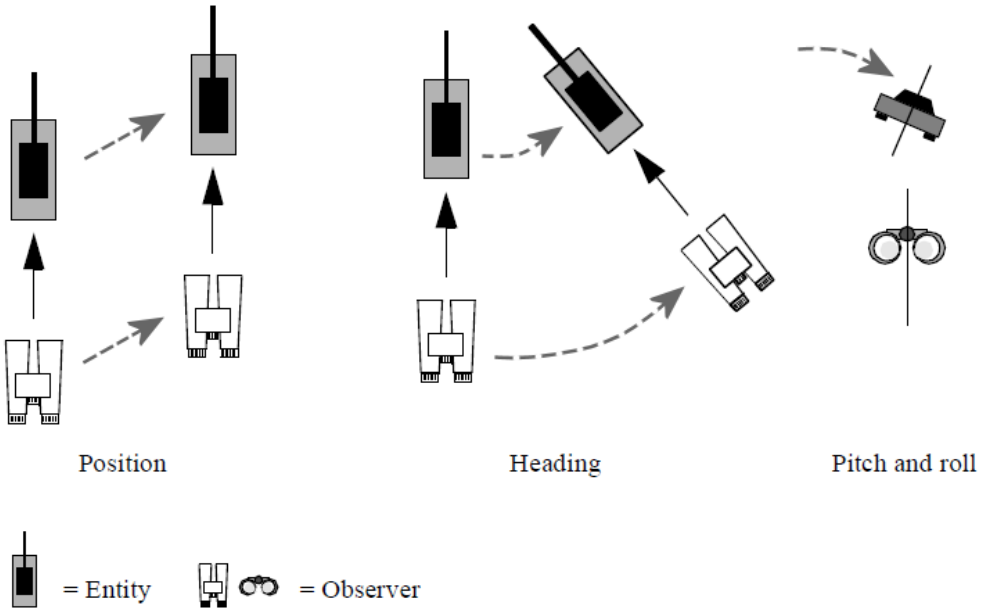
16.2.2 Follow Mode

In Follow mode, the observer maintains its relationship to the simulation object as follows:

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

Figure 133 illustrates the characteristics of Follow mode.

Figure 133. Follow mode



16.2.3 Mimic Mode

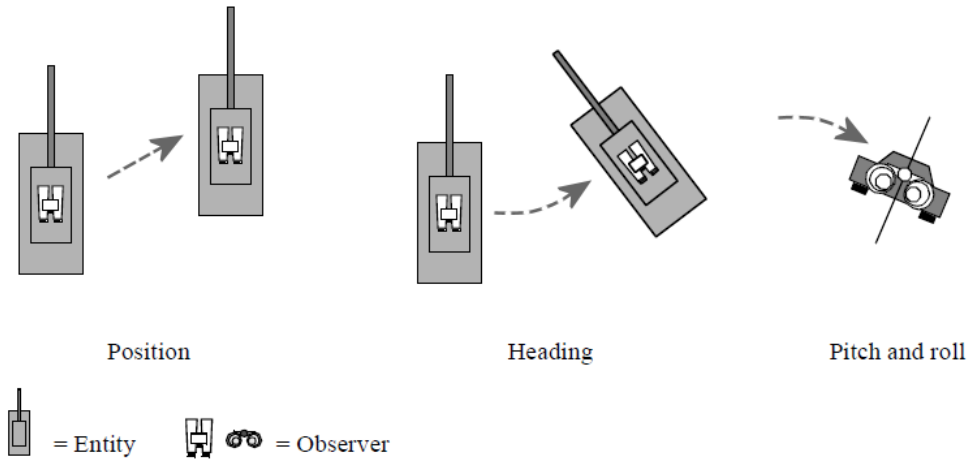
In Mimic mode, the observer behaves as though it is rigidly connected to the entity. Use Mimic mode to create the effect of riding in a vehicle cockpit, or of following a vehicle from an external location while connected to it by a solid, invisible rod. The observer maintains its relationship to the simulation object is as follows:

- When the simulation object's position changes, the observer's position changes to maintain its offset.
- When the simulation object's heading changes, the observer's heading and position change to maintain the offset.
- When the simulation object's pitch or roll change, the observer's pitch and roll change and the observer's position changes to maintain its offset.

When cockpit displays are enabled, you cannot change the position or orientation of the observer relative to the entity.

Figure 134 illustrates the characteristics of Mimic mode.

Figure 134. Mimic mode



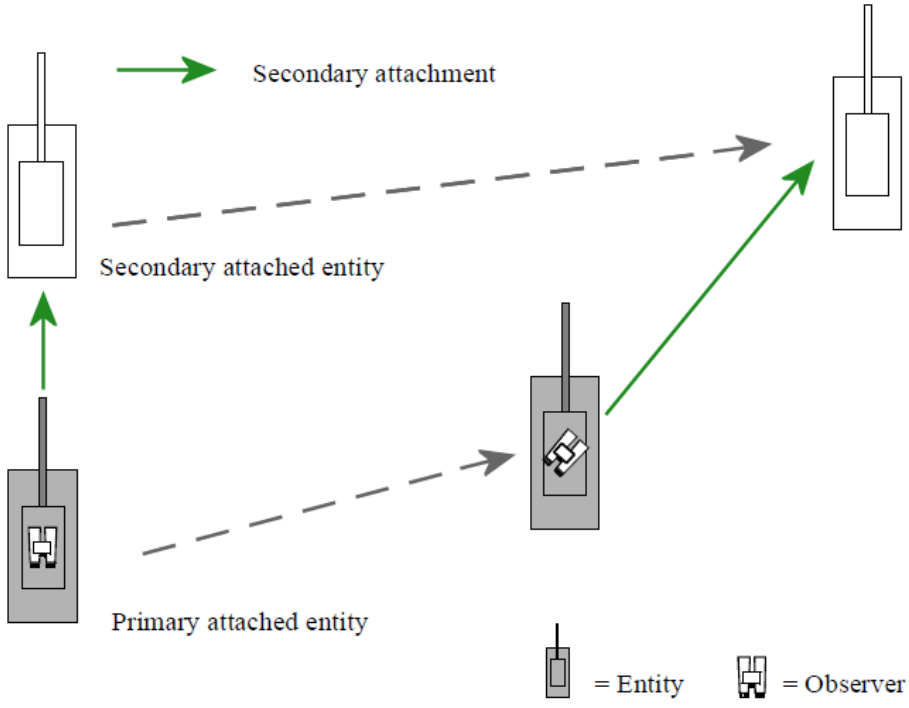
16.2.4 Mimic Track Mode

Mimic Track mode combines Mimic mode and Track mode. The observer's position changes with that of the entity to which it is attached, as in Mimic mode, while its orientation changes to remain focused on a secondary, tracked entity.

Orientation controls are disabled.

Figure 135 illustrates the characteristics of Mimic Track mode.

Figure 135. Mimic Track mode



16.2.5 Mimic Location Track Mode

Mimic Location Track mode works like Mimic Track mode except it tracks a location on the ground rather than an entity.

16.2.6 Space Follow Mode

Space Follow mode attaches the observer above an entity, looking down at it. Although it can be used with any entity, its primary purpose is for attaching to space objects such as satellites. You can also usefully use it with fixed-wing and rotary-wing entities.

The observer is attached at a fixed distance, determined by the near clipping plane for the object. For a satellite, this distance is approximately 500,000 meters. Since it is not possible to see regular models at that distance, the attached object is scaled to be visible. (You cannot change the scaling of the attached object.) Other objects are not scaled (except to the extent that model scaling might be enabled).

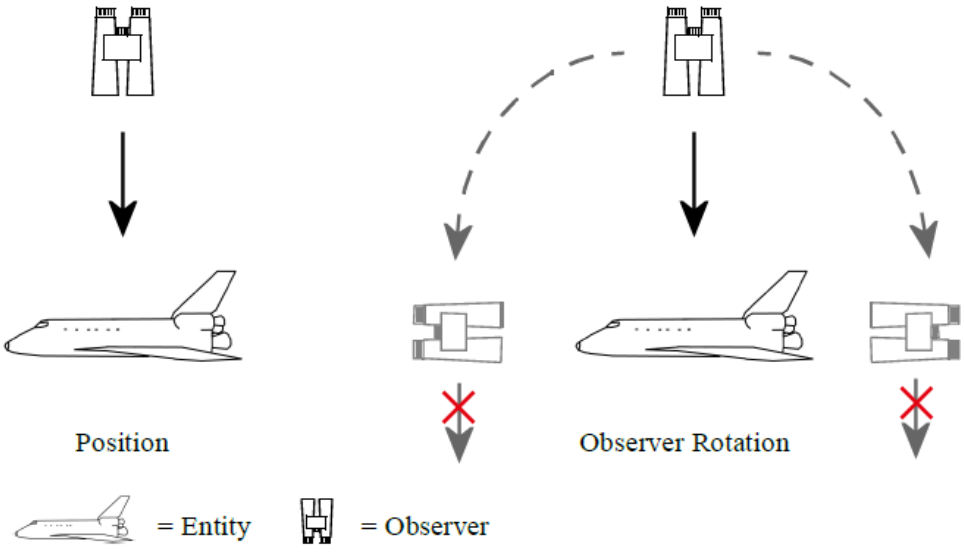
The observer maintains its relationship to the simulation object as follows:

- When the simulation object's position changes, the observer's position changes to maintain its offset.
- When the simulation object's heading changes, the observer's heading changes.
- When the simulation object's pitch or roll changes, the observer's pitch or roll does not change.

You cannot move the observer towards or away from the simulation object. You can rotate the observer around the entity, but you cannot go below the horizontal plane of the entity.

Figure 136 illustrates the characteristics of Space Follow mode.

Figure 136. Space Follow mode



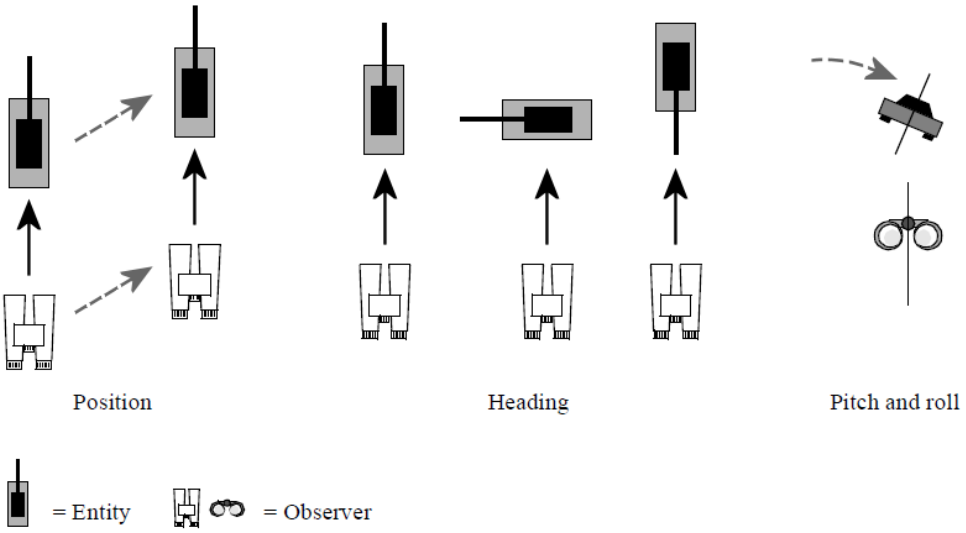
16.2.7 Tether Mode

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

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

Figure 137 illustrates the characteristics of Tether mode.

Figure 137. Tether mode



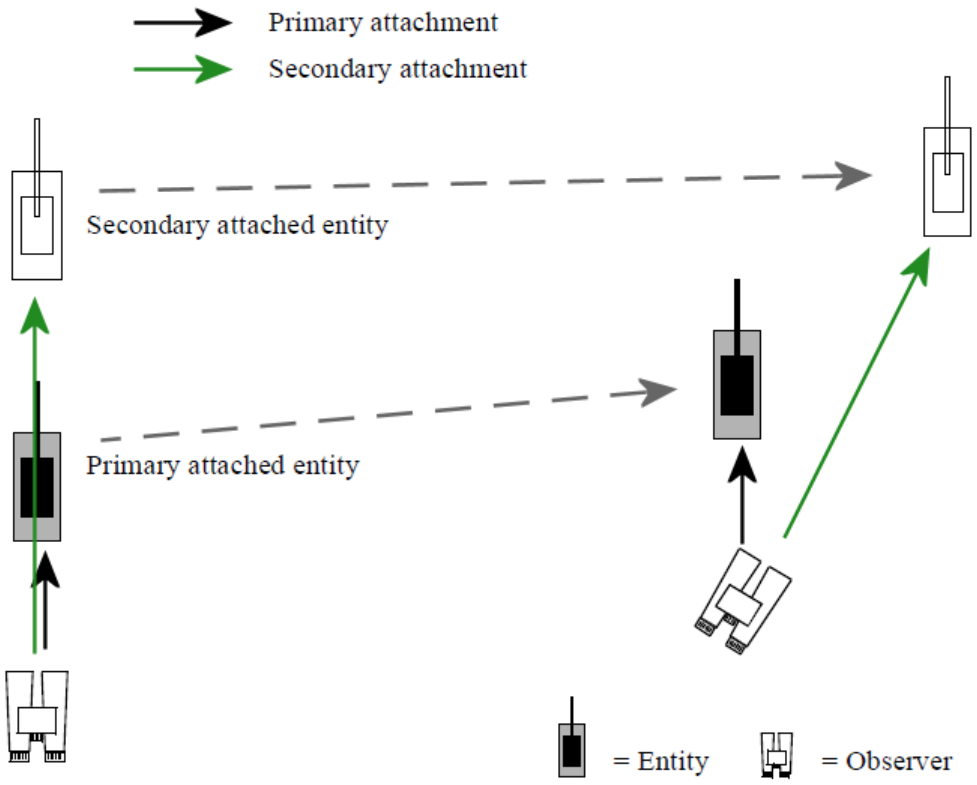
16.2.8 Tether Track Mode

Tether Track mode combines Tether mode and Track mode. The observer's position changes with that of the entity to which it is attached, as in Tether mode, while its orientation changes to remain focused on a secondary, tracked entity.

Orientation controls are disabled.

Figure 138 illustrates the characteristics of Tether Track mode.

Figure 138. Tether Track mode



16.2.9 Tether Location Track Mode

Tether Location Track mode works like Tether Track mode, except that it tracks a location on the ground instead of an entity.

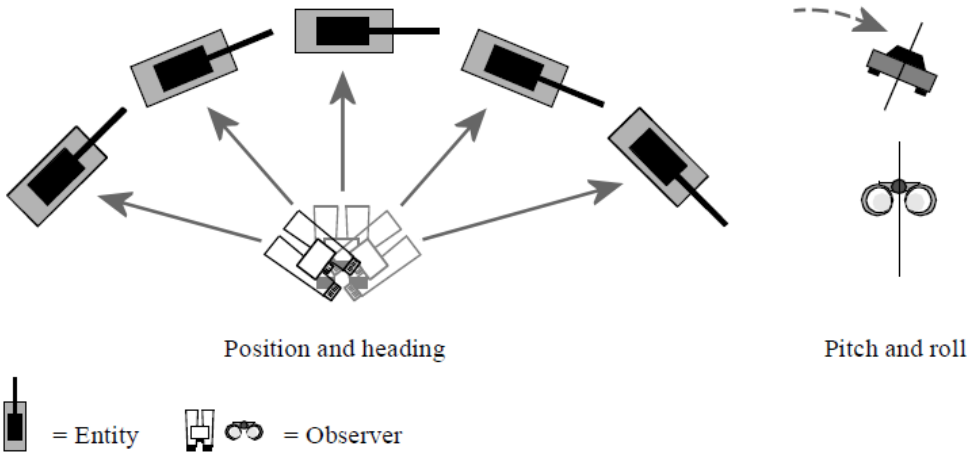
16.2.10 Track Mode

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

- When the simulation object's position changes, the observer's heading changes to keep the entity centered in the observer's view; the observer's position does not change.
- When the simulation object's heading changes, the observer's heading does not change.
- When the simulation object's pitch or roll change, the observer's pitch and roll do not change.

Figure 139 illustrates the characteristics of Track mode.

Figure 139. Track mode



16.3. Attach Modes in the 2D Projection

The 2D projection supports Follow mode and Tether mode. In Follow mode, the heading of the observer changes with the entity (if Orient North is disabled); in Tether mode, it does not. You can use the standard movement keys (**W**, **A**, **S**, **D**) to offset the observer with respect to the simulation object's position. You can use the orbit keys (left arrow, right arrow) to offset the observer's orientation with respect to the entity's orientation (in Follow mode) or the terrain.

If the observer is attached to an entity in the 3D projection and you switch to the 2D projection, the attach mode maps to either Follow or Tether modes, as shown in Table 15. If you then switch back to the 3D projection, the original attach mode is restored.

Table 15. 3D to 2D attachment mode mapping

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

16.4. 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 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.

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.

If `--bindObservers` specifies Observer 1 or defaults to it and the terrain you are loading has a default terrain view, the view specified by `--bindObservers` overrides the default terrain view. If `--bindObservers` specifies a different observer, Observer 1 uses the default terrain view.

➤ **To start VR-Vantage with the observer bound to an entity:**

1. Run a live or recorded simulation.
2. Attach the observer to the entity that you want it to be attached to when you start VR-Vantage. If you have multiple observers, create a saved view for each observer that you want to attach automatically.
3. Save the views.
4. If you have multiple observers, save the display engine configuration.
5. Start VR-Vantage with the `--bindObservers` command-line option and use your saved views file as the argument to `--bindObservers`. If you need to specify more than one observer, use `--dispSetting` to specify the display engine configuration file that defines the observers. You must also specify the terrain file to load:

   ```
   vrvIG --bindObservers "observer1,...,
    observern,../appData/settings/vantageIG/
    saved_views.osrx" --dispSetting displayconfig.dcx
    terrain_file.mtf
   ```

   If the simulation is running, VR-Vantage attaches the observer to the entity in the saved view. If the simulation is not running, VR-Vantage attaches the observer when the entity is next discovered.

16.4.1 Observer Attachment Tutorial

This tutorial implements the procedure described in the previous section using files provided with VR-Vantage and MAK Data Logger. It attaches the observer to one of the aircraft in the *Raid2021-DIS.lgr* recording.

➤ **To attach the observer to an entity at startup:**

1. Start VR-Vantage.
2. Load the *Ala Moana.mtf* terrain.

3. Start MAK Data Logger (DIS).
4. Load *Raid2021-DIS.lgr*.
5. Connect VR-Vantage to the simulation network.
6. Run the *Raid2021-DIS.lgr* recording.
7. Attach the observer in Mimic mode to UAV-Predat1.
8. If the Observer Views Panel is not open, choose **View > Observer Views Panel**.
9. On the Observer Views Panel, click the Add button (+). The view is listed in the panel window.
10. Save the view to a file, for example *UAV-Predat1.osrx*.
11. Shut down VR-Vantage.
12. Start VR-Vantage with the following command line:

```
vrvStealth --bindObservers "Observer 1,
  ../appData/settings/stealth/UAV-Predat1.osrx"
  "../../SharedData/16/latest/TerrainData/TerrainConfiguration/
  Ala Moana.mtf"
```

13. Connect to the simulation network.



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:

```
vrvStealth --bindObservers "Observer 1,Observer A,
  ../appData/settings/stealth/UAV-Predat1.osrx"
  --dispSetting displayConfig.dcx "../../SharedData/
  16/latest/TerrainData/TerrainConfiguration/
  Ala Moana.mtf"
```

You could also do this:

```
vrvStealth --bindObservers "Observer A,Observer 1,
  ../appData/settings/stealth/UAV-Predat1.osrx"
  --dispSetting displayConfig.dcx "../../SharedData/
  16/latest/TerrainData/TerrainConfiguration/
  Ala Moana.mtf"
```

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

VR-Vantage includes an example saved view, *./appData/settings/stealth/UAV-Predat1.osrx*, that you can use to try out this example.

16.4.2 Binding Multiple Observers Tutorial

This tutorial shows how to bind multiple observer views to multiple windows. The tutorial does the following:

- Creates three windows.
- Saves the display engine configuration.
- Saves different views for each window.
- Loads the terrain, saved views, and display engine configuration from the command line.

VR-Vantage loads the terrain, opens the three windows in the display engine configuration, and assigns a saved view to each window.

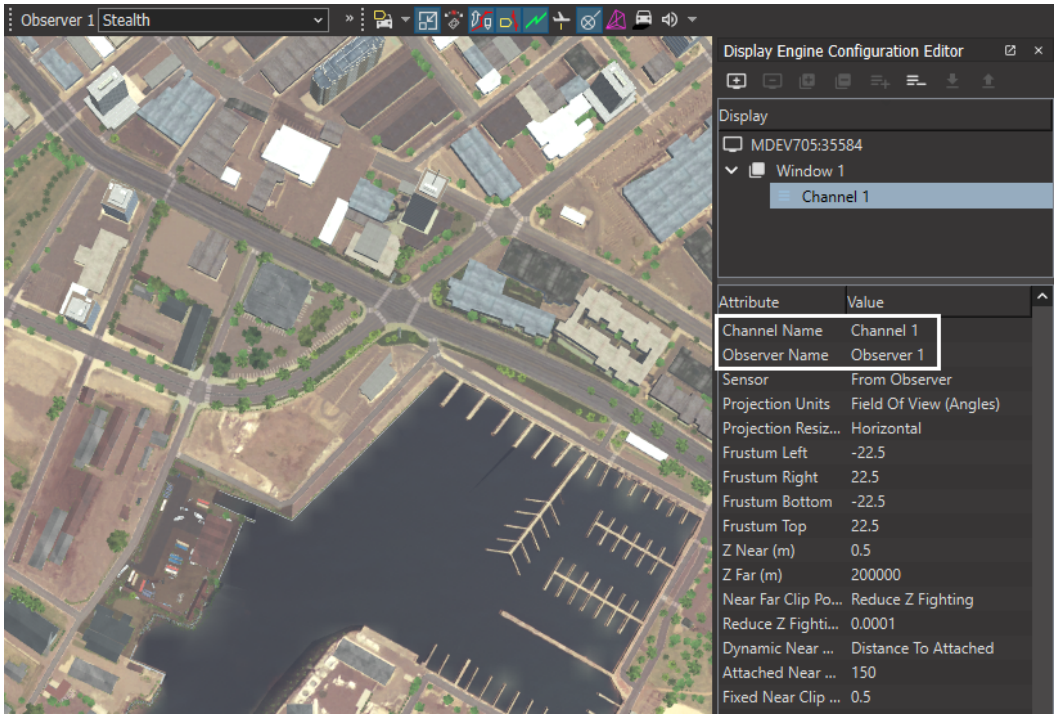
The tutorial uses VR-Vantage and both 2D and 3D windows.

Create the Windows

➤ **To bind multiple observer views to multiple windows:**

1. Start VR-Vantage.
2. Load *Ala Moana.mtf*.
3. In the toolbar, change Observer 1 to Stealth.
4. 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 140).

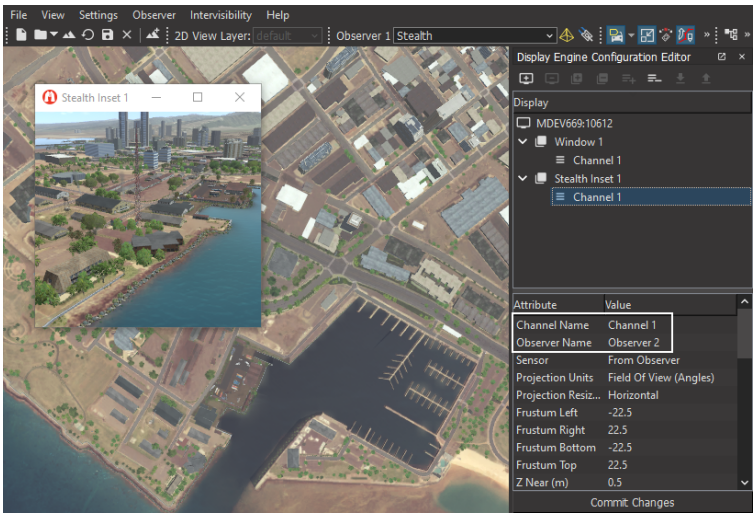
Figure 140. Observer 1



5. Choose **File > New Stealth Window**. A window titled Stealth Inset 1 opens. It shows the same view as the main window. A window called Stealth Inset 1 is added to the display engine configuration. The channel properties show that the window

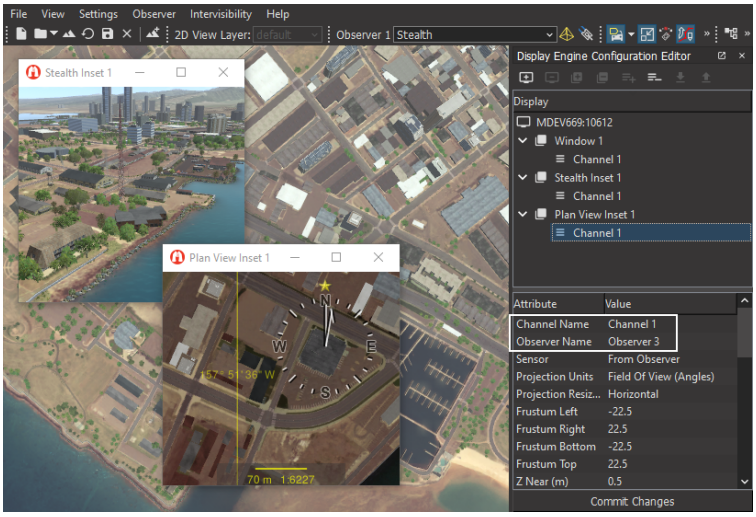
uses Observer 2 (Figure 141).

Figure 141. Observer 2



6. Choose **File > New Plan View Window**. A window titled Plan View Inset 1 opens. It shows a portion of the view in the main window. A window called Plan View Inset 1 is added to the display engine configuration. The channel properties show that the window uses Observer 3 (Figure 142).

Figure 142. Observer 3



Save the Display Engine Configuration

➤ **To save the display engine configuration:**

1. In the Display Configuration Editor Panel, select the display engine (the top line).

2. Click the Save Display Engine Configuration button (). The Save Display Engine Configuration dialog box opens.

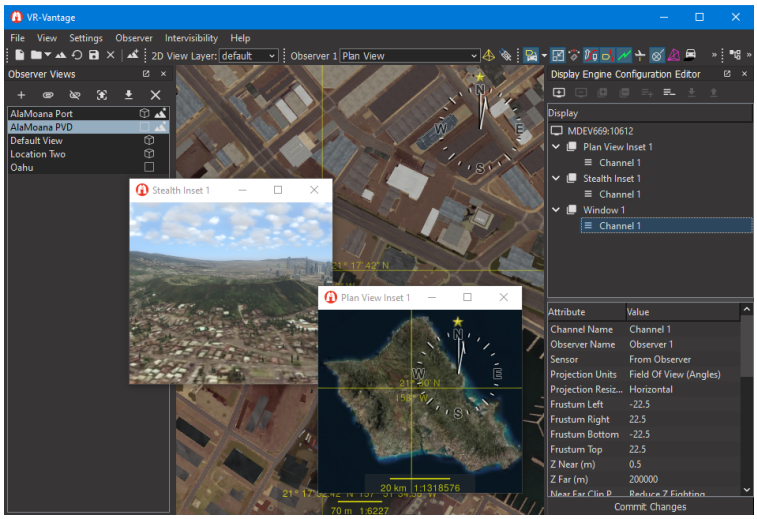
3. Type a name for the configuration, for example, *BindObserversTutorial.dcx*.
4. Click Save.

Create and Save the Views

➤ **To create observer views for each observer and save them:**

1. If the Observer Views Panel is not open, choose **View > Observer Views Panel**.
2. Click in the main window to give Observer 1 focus. Confirm this by looking at the observer name displayed on the Observer Settings Toolbar.
3. On the Observer Views Panel, click the Add button (+). A view called 3 - Absolute is added.
4. Double-click the name of the view to make it editable. Change the name to Default View. (This view will actually be identical to the AlaMoana Port view that is associated with the terrain.)
5. Click in Stealth Inset 1. Make sure that the Observer Settings Toolbar shows that the active observer is Observer 2.
6. Drag the view of the terrain to show a different location, such as the Diamondhead crater.
7. Add a new view to the Observer Views Panel.
8. Change the name of the view to Location Two.
9. Click in Plan View Inset 1. Make sure that the Observer Settings Toolbar shows that the active observer is Observer 3.
10. Zoom out to see all of the island of Oahu. The various windows should now look something like Figure 143.

Figure 143. VR-Vantage with saved views assigned



11. Add a new view to the Observer Views Panel.
12. Change the name of the view to Oahu.

13. Click the Export All Views to a File button (⬆). The Save Observer Views List prompt opens.
14. Click Save As. The Save Observer Views File dialog box opens.
15. Type a name for the saved views, for example, *BindObserversTutorialViews.osrx*.
16. Click Save.
17. Shut down VR-Vantage.

Start VR-Vantage with the Views and Display Engine Configuration

➤ To load the display engine configuration and bind observers to the saved views, start VR-Vantage with the following command:

```
C:\MAK\vrvantage3.0.3\bin64\vrvStealth.exe
--dispSetting ..\appData\settings\stealth\BindObserversTutorial.dcx
--bindObservers "Observer 1,Observer 2,Observer 3,
..\appData\settings\stealth\BindObserversTutorialViews.osrx""C:\MAK\Sha
redData\16\latest\TerrainData\TerrainConfiguration\Ala Moana.mtf"
```

VR-Vantage starts, loads the display engine configuration, opens the windows, and assigns the saved views to the windows (Figure 143).



17. Inset Views, Sensor FOV, and HUDs

This chapter describes special types of inset windows – inset views, instrument panels, and sensor fields of view, and head up displays.

17.1. Inset Views 308
17.2. Displaying Cockpit Displays 309
17.3. Displaying Instrument Panels 310
17.3.1 Configuring Entities to Use Instrument Panels 311
17.4. Displaying Sensor Views 312
17.4.1 Displaying a Sensor Field of View Cone 312

17.1. Inset Views

You can display inset views of individual simulation objects. Figure 144 shows a helicopter hovering over the Ala Moana area in the *MAK Earth (online).mtf* terrain with an inset view of a car driving through the town.

Figure 144. Inset view





By default, when you create an inset view, the observer in the inset view is attached to the simulation object in Mimic mode. This has the side effect of causing the 3D model in the main window to disappear. (The reverse occurs if you attach the observer in the main window to the simulation object in Mimic mode.) To make the model reappear, select the inset view and change the attach mode or detach the observer.

You can change the observer position and orientation in an inset view using keyboard controls. You can also edit window and channel properties for the window in the Display Engine Configuration Editor. (For information about the Display Engine Configuration Editor, see "Chapter 6. Windows, Channels, and Display Engines" on page 111.)

When you create an inset view, the title bar contains the simulation object's name. However, the window is not actually tied to the simulation object and you can change the view in the inset view and view other simulation objects. The title bar will continue to display the name of the simulation object for which the window was created.

➤ **To open an inset view:**

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

17.2. Displaying Cockpit Displays

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, see "Adding New Cockpit Display Models" in the *Adding Content to MAK ONE Applications Reference Manual*.

VR-Vantage supports 2D cockpits (Figure 145) and 3D cockpits (Figure 146). A 2D cockpit is fixed to the center of the screen and you cannot zoom in or out on the instrument panel. A 3D cockpit is aligned with the front of the vehicle. If you move the eyepoint, the instrument panel moves in or out of view as you would expect. You can zoom in and out on the instruments.

Figure 145. 2D cockpit



Figure 146. 3D cockpit

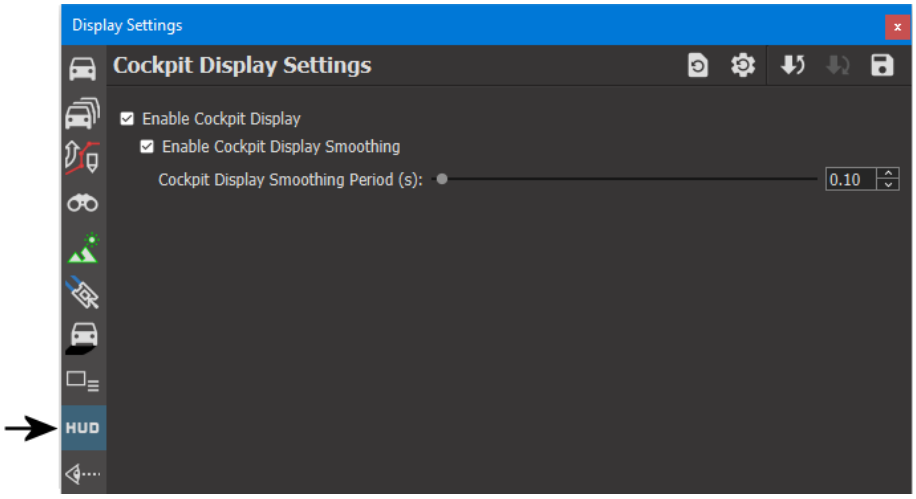


- Cockpits are displayed only when the observer is attached to an entity in Mimic mode.
- VR-Vantage includes one 3D cockpit, for the F-16 fighter jet.
- Cockpits are not supported on Linux.

➤ **To display cockpits:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Cockpit Display Settings page (Figure 147).

Figure 147. Cockpit display settings



3. Select or clear the Enable Cockpit Display check box.
4. Optionally, select the Enable Cockpit Display Smoothing check box. This smooths the display in the dynamic widgets, such as orientation or velocity, so they show a smoothed value rather than instantaneous changes.
5. Attach the observer to an entity in Mimic mode.

You can also enable and disable cockpit displays by choosing **Settings > Cockpit Displays**.

17.3. Displaying Instrument Panels

Instrument panels are inset windows that display a vehicle instrument such as an altimeter or artificial horizon. Unlike a cockpit display, which is a fixed display that operates in Mimic mode, an instrument panel is an independent window (like an inset view) that you can place anywhere on the screen (Figure 148). It does not affect the observer mode. You can organize multiple instrument panels to create your own virtual cockpit.

Figure 148. Instrument panels



When you create an instrument panel, the title bar of the window lists the entity for which you created it.

- Instrument panels are GL Studio controls.
- Instrument panels are not supported on Linux.
- If the source of the instrument panel is removed from the exercise, for example when a Logger recording rewinds, the instrument panels are removed from the inset windows. To see them again you must open new instrument panels. Because the relationship between an instrument panel window and an entity is not persistent across multiple runs of an exercise, you cannot save an instrument panel layout for an entity. (You could save the layout of the windows to a display configuration, but they would not display instrument panels when you loaded the configuration.)
- If you want to put multiple instrument panels in one window, like the six-pack panel provided with VR-Vantage, you must use GL Studio.

➤ **To open an instrument panel:**

1. Select the entity for which you want to display an instrument panel.
2. On its shortcut menu, choose **Create Instrument Panel >** *panel*.

17.3.1 Configuring Entities to Use Instrument Panels

VR-Vantage includes a set of instrument panels for fixed-wing aircraft, although many of them may be appropriate for rotary-wing aircraft, and even for ground vehicles. (For example, you might want to show a compass for a ground vehicle to get its heading or an altimeter to show its height above sea level.) The availability of instrument panels to an entity is determined by the **instrumentPanelCategory** parameter in its model definition.

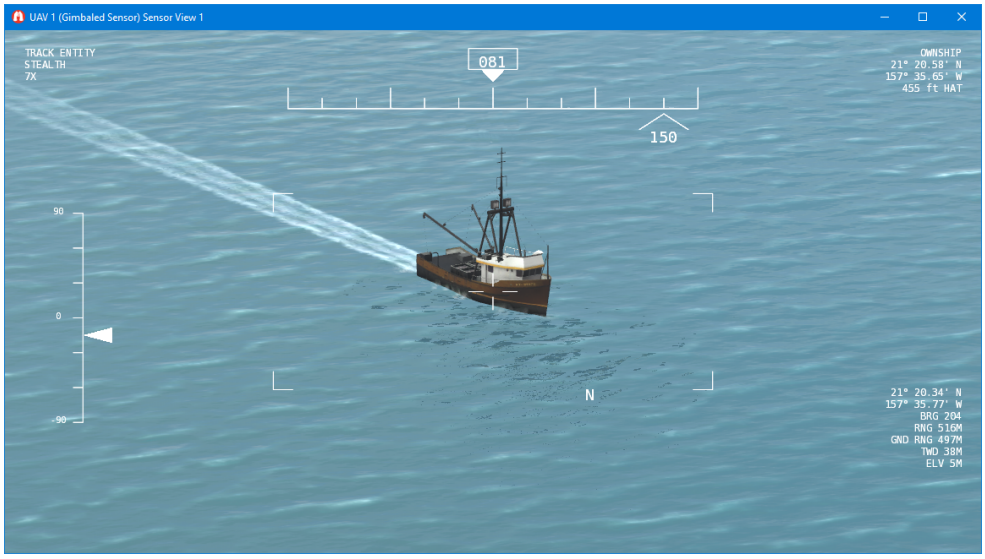
The instrument panels provided with VR-Vantage have the **instrumentPanelCategory** set to FixedWing. All fixed-wing entities have this parameter set in their model definition. None of the other entities do. If you want other entities to display instrument panels provided with VR-Vantage, you can add this parameter to their model definitions. (You could also copy an instrument panel model definition and change the category to some other value if you want to. Regardless, to use an instrument panel, an entity's model definition must include the **instrumentPanelCategory** parameter and set it to a valid value.)

If you create new instrument panels, you must add instrument panel model definitions for them and specify a value for the **instrumentPanelCategory** parameter. Then you can add the parameter to the appropriate entity model definitions.

17.4. Displaying Sensor Views

VR-Vantage can display the view from gimbaled visual sensors simulated by VR-Forces, such as a camera on a UAV (3D only). The view is displayed in an inset window that has information about the observer mode and area being viewed (Figure 149). The window has its own observer and you can change the observer mode in the view.

Figure 149. Sensor View



➤ **To display a sensor view:**

1. Select an entity that has a gimbaled sensor.
2. Right-click the entity and on the right-click menu choose **Create Sensor View > *sensor***, where *sensor* is one of the sensors on the entity.

17.4.1 Displaying a Sensor Field of View Cone

You can display translucent cones that show the area on the terrain that a gimbaled sensor is observing. Each cone is a different color. Figure 150 shows two sensor field of view cones. One is focused on an entity and is zoomed in for a tight focus. The other is focused on a point on the terrain.

Figure 150. Sensor field of view cones



➤ **To display sensor field of view cones:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 108 on page 246).
3. In the list of settings, select the Sensor Fields of View check box.

You can also enable and disable sensor field of view cones by choosing **Observer > Sensor Fields of View** or by clicking the Sensor Fields of View button ( ) on the Observer Settings Toolbar.



18. Exaggerating Models and Terrain

This chapter describes terrain scaling and model scaling – features primarily used in XR observer mode.

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18.2. Exaggerating the Terrain Scale 319
18.2.1 Scaling the Terrain 320
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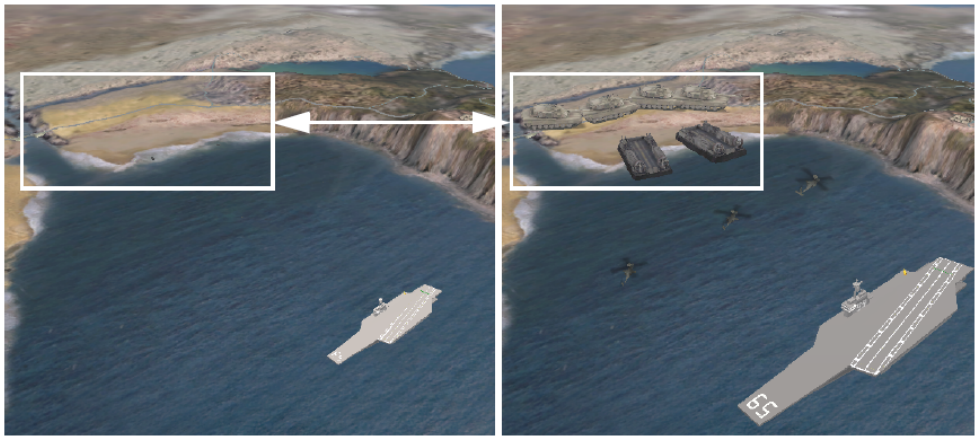
18.1. Exaggerating the Scale of 3D Entity Models

If you view the terrain in Stealth observer mode, beyond a certain distance most 3D entity models are too small to see. Model scaling lets you exaggerate the scale of entity models to see them at a great distance. Figure 151 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.

VR-Vantage supports the following types of model scaling:

- XR scaling. XR scaling tries to give all entities approximately equal visibility. It does not preserve size relationships between entities. The visual effect of model scaling depends on an entity's size and the observer's distance from the entity. When the observer is close to an entity, scaling models may not make any noticeable difference in its size.
- Linear scaling. Linear scaling scales all entities by the current model scale factor. The distance from the observer is not taken into account. A model scale factor of 10 scales all entities to be 10 times normal size.

Figure 151. Model scaling off and on (Stealth observer mode)



Another way to quickly change the visibility of entities is to switch to XR observer mode. In XR mode, entities are immediately scaled and are represented by colorized 3D models to enhance their visibility.

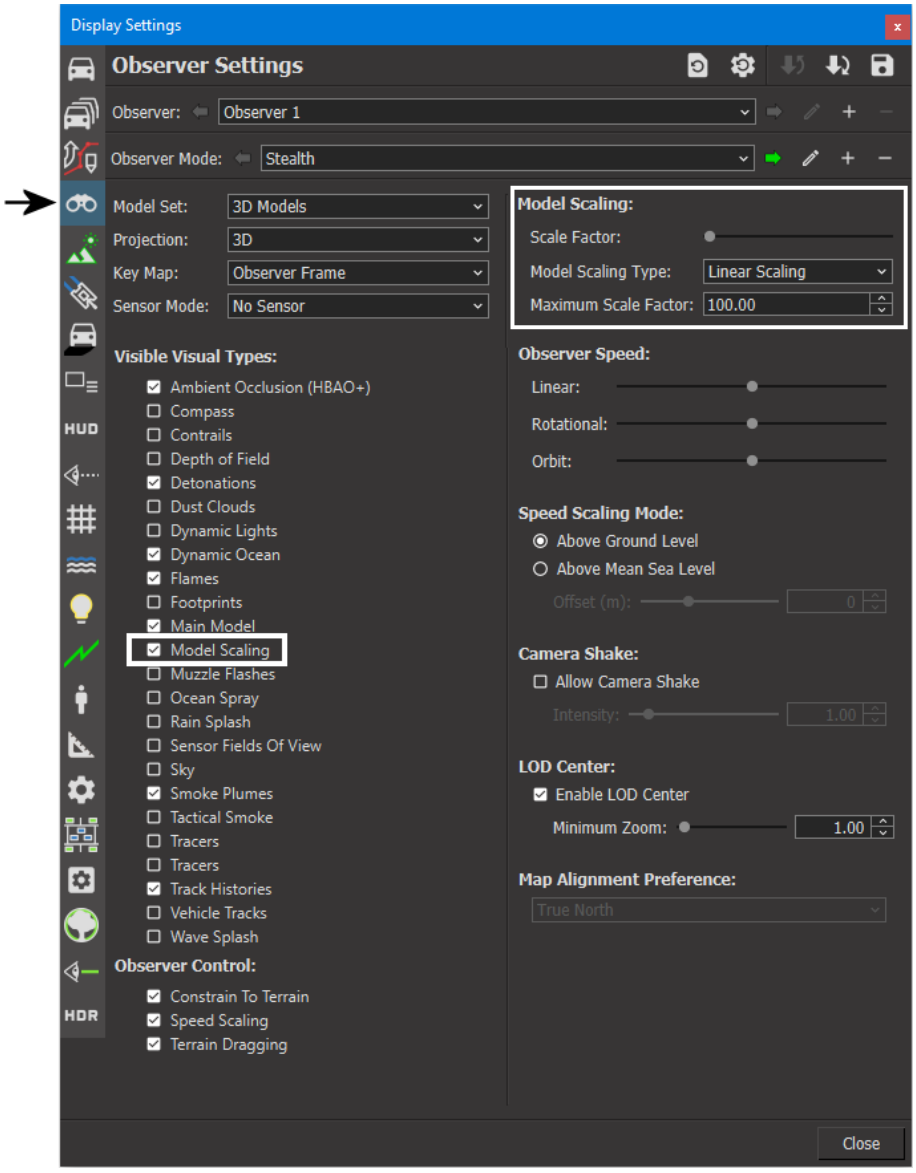
Figure 152. XR mode



➤ **To scale entity models:**

1. Choose **Observer > Advanced Settings.** The Display Settings dialog box opens to the Observer Settings page (Figure 153).

Figure 153. Observer Settings page



2. In the list of observer attributes, select Model Scaling.
3. In the Model Scaling Type list, select the type of scaling you want to use: XR or linear.

> If you want to use XR scaling, you must change the Observer Mode to XR.

4. Optionally, change the Maximum Scale Factor.
5. Adjust the Scale Factor slider to the amount of scaling that you want.

18.2. Exaggerating the Terrain Scale

You can exaggerate the terrain scale to improve your sense of line-of-sight issues and other terrain factors that can affect an exercise. Figure 154 and Figure 155 illustrate terrain from the same observer location with and without terrain scaling. Notice how much easier it is to understand the relationship of the aircraft to the ground in the scaled view.

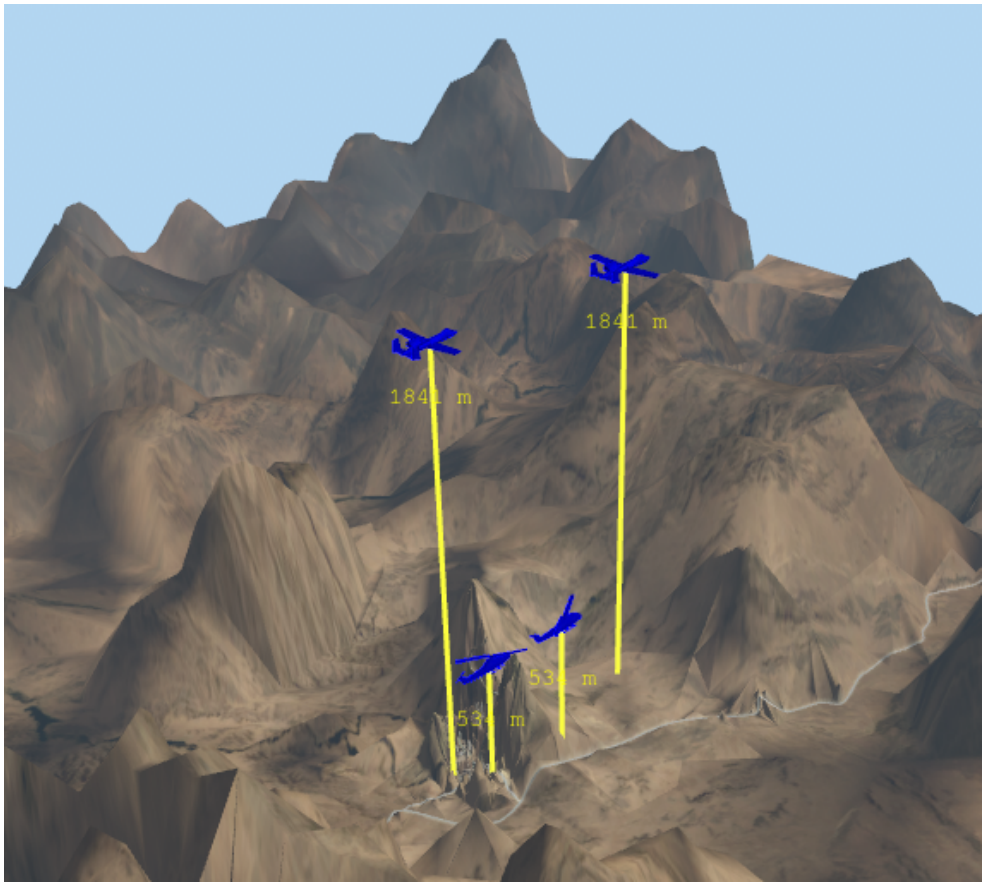


Terrain scaling is not supported on geocentric terrains.

Figure 154. No terrain scaling



Figure 155. Terrain scaling



When you scale the terrain, terrain, props, and SpeedTrees are all scaled. Simulation objects and entity labels are positioned so that they are in the correct position relative to the scaled terrain. However, the text on entity labels and other information panels displays their correct, unscaled location.

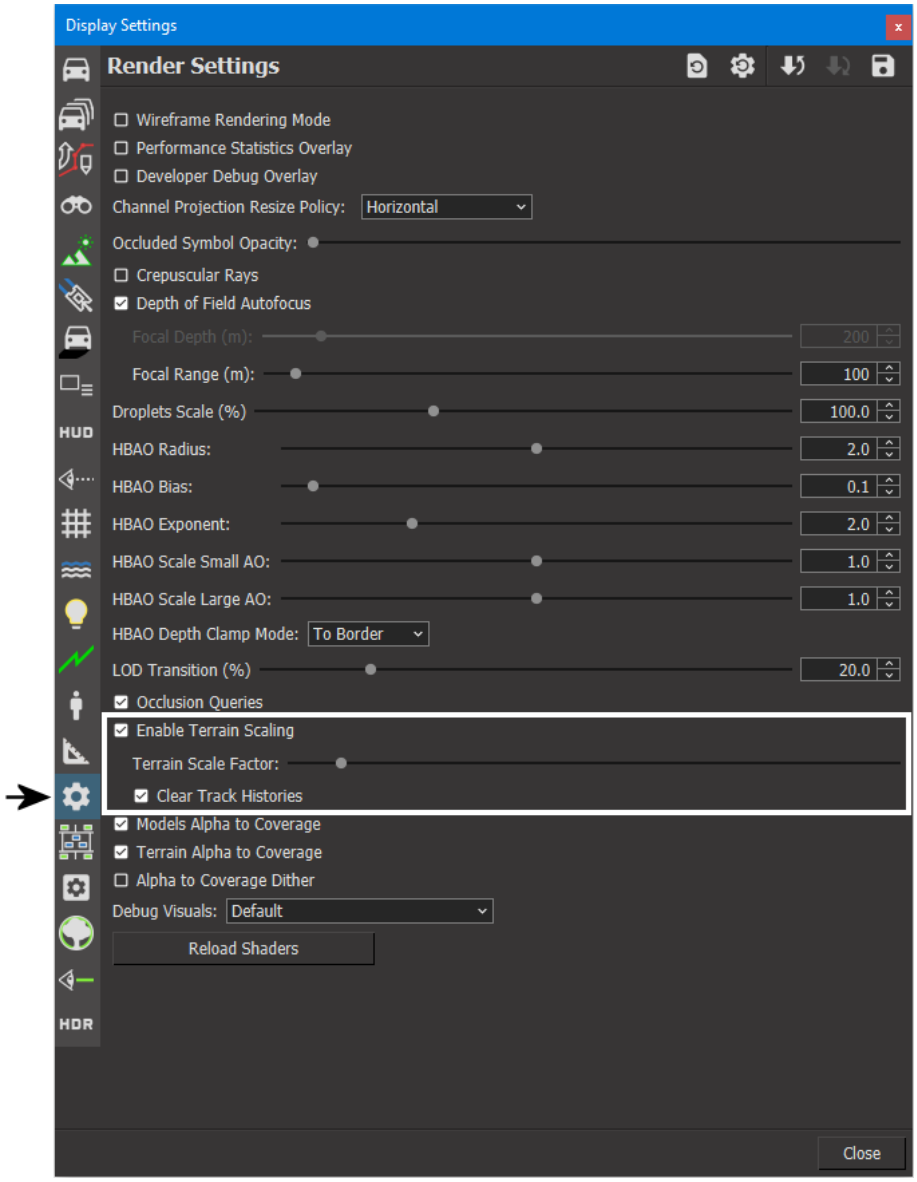
When you enable or disable terrain scaling or change the scale factor, track histories are cleared. You can specify that track histories not be cleared when you scale the terrain. See "18.2.2 Track Histories and Terrain Scaling" on the facing page.

18.2.1 Scaling the Terrain

➤ **To scale the terrain on a nongeocentric terrain:**

1. Choose **Settings > Display**.
2. Select the Render Settings page.
3. Select the Enable Terrain Scaling check box.
4. Adjust the Terrain Scale Factor slider (Figure 156).

Figure 156. Render Settings page



18.2.2 Track Histories and Terrain Scaling

By default, when you enable or disable terrain scaling or change the scale factor on a non-geocentric terrain, track histories are cleared and restarted. This is because track histories are not scaled and they would probably misrepresent the simulation object's track after the terrain was scaled. However, you can specify that track histories not be cleared when you scale the terrain.

➤ **To specify whether or not track histories are cleared when the terrain is scaled:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 156).
3. Select or clear the Clear Track Histories check box.



V. Viewing Simulation Objects

The chapters in this section explain how to manage the display of simulation objects (entities and units) and the information about them that is available.



19. Viewing Simulation Objects

This chapter describes how to select entities and units, and manage how they are viewed.

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19.1. Selecting Simulation Objects

Many procedures require you to select one or more simulation objects. When a 3D model is selected, a box is drawn around it (Figure 157). When a 2D icon is selected, it is highlighted. In either case, the simulation object is highlighted in the Objects List Panel.

Figure 157. Selected 3D model



➤ To select a simulation object, click it in the window, or select it in the Objects List Panel.

For multiple selection, standard conventions for **Shift**+click and **Ctrl**+click apply.

19.2. Displaying Entity Labels

For 3D models, VR-Vantage displays labels that help you locate and identify entities (Figure 158). The label consists of a locator circle, which is always visible when labels are enabled, and a text label that displays 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 — by default, these colors are blue for friendly, red for opposing, and green for neutral.

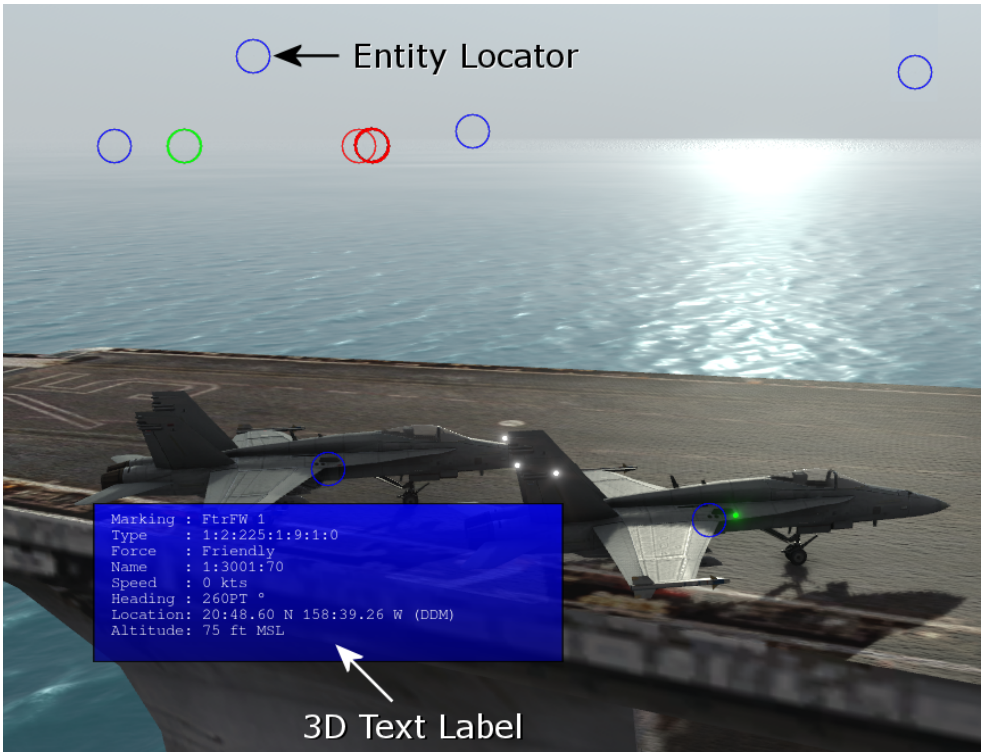
A 3D text label displays the entity's:

- Marking text
- Entity type enumeration

- Force
- Name
- Speed
- Heading
- Latitude and longitude
- Altitude

You can configure the attributes of the entity label, such as font size, and the height and width of the background by editing the entityInfo model definition in the Visual Models Editor. For details about editing model definitions, see "Creating and Editing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.

Figure 158. Entity labels for 3D models

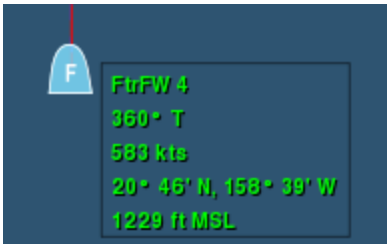


For 2D icons (VR-Vantage in Plan View), labels are a set of individually enabled text labels called symbol decorations (Figure 159). Entity labels for 2D icons are supported both in the 2D view and the 3D view. If you resize 2D icons, the labels are also resized. 2D icons can display the simulation object's:

- Acceleration
- Altitude above mean sea level – This displays only for aircraft, space, ground vehicle, subsurface, and life form entities (not surface entities).

- Altitude above ground level – This displays only for aircraft, space, and life form entities.
- Heading and Heading indicator
- Location
- Name
- Orientation
- Speed

Figure 159. Label for a 2D icon



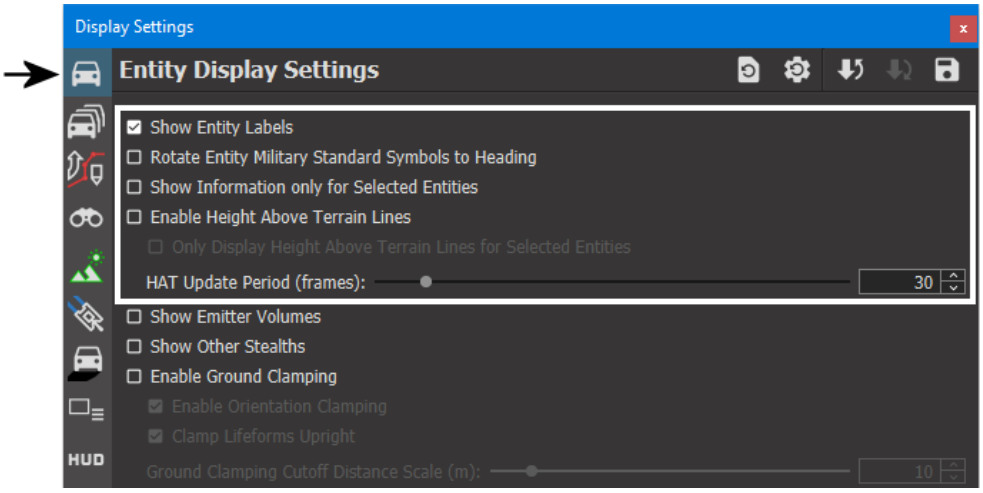
You can specify the order of symbol decorations in the 2D view. See exampleSymbolDecoration in the *VR-Vantage Developers Guide* to learn how to do this.

19.2.1 Displaying Text Labels for 3D Models

➤ **To view a 3D text label, use one of the following methods:**

- Move the cursor over the circle that represents the entity.
- On the Display Settings dialog box, Entity Display Settings page, select Show Information Only For Selected Entities (Figure 160). Then select the entity whose label you want to see.

Figure 160. Display Settings, Entity Display Settings page



19.2.2 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 160 on the previous page).
3. Select or clear the Show Entity Labels check box.

> You can also enable and disable entity labels by choosing **Settings > Entity Labels**, pressing **L**, or by clicking the Entity Labels button ( ) on the Display Settings Toolbar.

19.2.3 Pinning Text Labels and Symbol Decorations to the Window

You can pin 3D text labels and 2D symbol decorations to the window, making them stay visible after you move the cursor away from the entity. The pin applies to both the 2D and 3D views. The pin icon indicates the state of each entity's label:

- (sideways). The label for each selected entity is not pinned.
- (upright). The label for each selected entity is pinned.
- (angled). Multiple entities are selected and only some of their labels are pinned.

➤ **To pin or hide a text label or symbol decoration in the window:**

1. Right-click an entity's locator circle or the entity name in the Objects List. A menu displays.
2. Choose **Toggle Pinned Label**.

Displaying Multiple Text Labels or Symbol Decorations

You can display multiple text labels or symbol decorations at one time.

➤ **To display multiple labels or decorations, use either of the following methods:**

- Right-click and choose **Toggle Pinned Label** for each entity whose label or decoration you want to see.
- For 3D text labels only, on the Display Settings dialog box, Entity Display Settings page, select Show Information Only For Selected Entities (Figure 160 on the previous page). Then, in the Objects List Panel or the window, multi-select the entities whose labels you want to see.

The 3D text labels display for pinned entities and selected entities. This does not pin or unpin labels. You cannot pin or unpin labels while Show Information Only For Selected Entities is selected.

19.2.4 2D Icon Labels (Symbol Decorations)

You can enable and disable the display of symbol decorations for 2D icons by label type. This allows you to control how much screen space is taken up by the labels. You can control the display of labels in the Display Settings dialog box or on the Display Settings Toolbar.

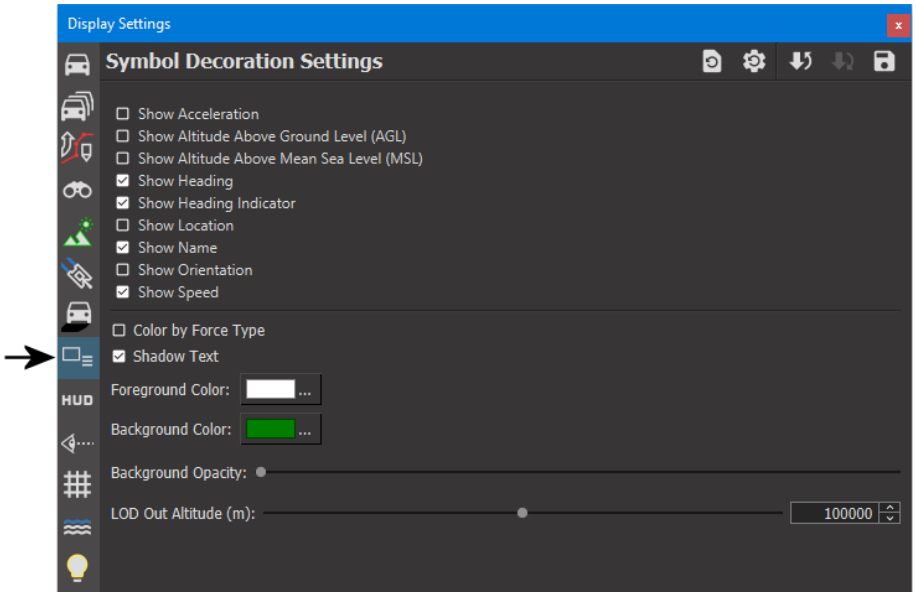
> By default, the symbol decorations for unselected entities are hidden when the observer is a certain distance away from them. To adjust that distance, see "Adjusting Display of Symbol Decorations by Altitude" on the facing page.

Displaying Symbol Decorations for 2D Icons

➤ **To enable and disable display of 2D icon labels in Display Settings dialog box:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 161).

Figure 161. 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.

Changing the Color for 2D Labels

The labels for 2D icons use the color specified by the Foreground Color setting on the Symbol Decoration Settings page. You can also specify that labels use the force color.

➤ **To change the color of 2D labels:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 161).

3. To set the color to any color:
    a. Click the Foreground Color color swatch. A color picker dialog box opens.
    b. Select the color you want to use.
    c. Click OK.
4. To use the force color for labels, select the Color by Force Type check box. This setting overrides the Foreground Color setting.

Adjusting Display of Symbol Decorations by Altitude

Symbol decorations are hidden when the observer rises to a specified altitude. The default is 100,000 meters, but you can change it. If you hover the mouse over or select a simulation object, the symbol decorations display regardless of the observer's altitude. This does not affect heading indicators.

➤ **To adjust the altitude at which symbol decorations are hidden:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 161 on the previous page).
3. Use the slider or the text box to adjust the LOD Out Altitude.



2D icons can also be resized based on the observer's altitude. See "Scaling 2D Icons by Altitude" on page 336.

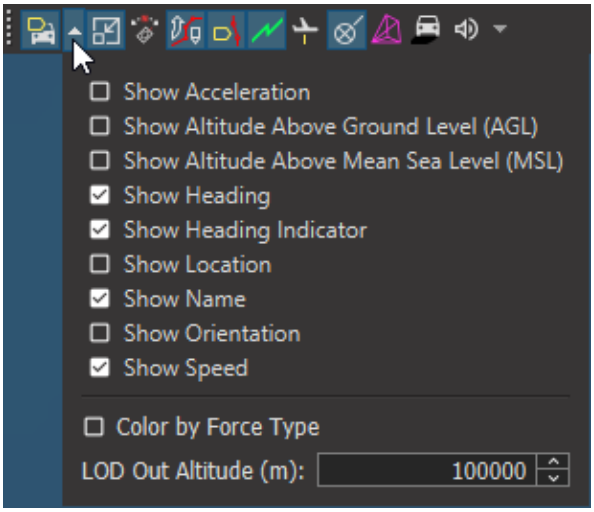
Enabling 2D Labels on the Display Settings Toolbar

The Entity Labels button on the Display Settings Toolbar lets you open a panel that lists the symbol decorations that you can show or hide. It also lets you color labels by force type.

➤ **To enable or disable 2D labels on the Display Settings Toolbar:**

1. Click the arrow on the Entity Labels button  . A small panel displays. It is a persistent window.

Figure 162. Symbol Decoration Panel



2. Select the symbol decorations that you want to display. Clear the ones you want to hide.
3. To hide the Symbol Decorations Panel, click the arrow on the Entity Labels button.

19.2.5 Configuring Shadowing and Background Color for 2D Labels

2D labels are drawn on a background that, by default, is transparent. However, you can increase the opacity of the background to make it visible and can change the background color.

You can add shadowing to the text of 2D labels. This may improve visibility when simulation objects are on light colored terrain.

Figure 163. 2D label with background



➤ **To set the color and opacity of the 2D label background:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 161 on page 330).
3. To change the opacity of the background, adjust the Background Opacity slider.
4. To change the color of the background:
    a. Click the Background Color color swatch. A color picker opens.
    b. Select the color you want to use for the background.
    c. Click OK.

➤ **To configure shadows for 2D labels:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Symbol Decoration Settings page (Figure 161 on page 330).
3. Select or clear the Shadow Text check box.

19.3. Changing Force Colors

By default, labels, detonation lines, and other force-related simulation object graphics (including the 3D Colorized Model model set in VR-Vantage Stealth) are displayed using primary colors (red, blue, and green). You can change the force coloring to use MIL-STD 2525B colors (light blue, light green, and pink (light red)).

➤ **To change force coloring:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. For entities and entity graphics, select the Entity Display Settings page (Figure 160 on page 328).

    For units, select the Unit Display Settings page (Figure 176 on page 349).
3. Select the Force Coloring Settings option that you want.

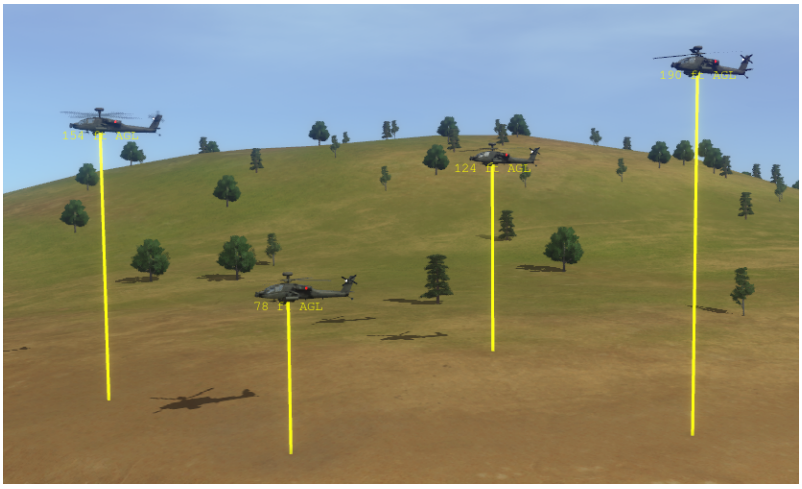
19.4. Displaying HAT Lines for Entities (3D Only)

Height-above-terrain (HAT) lines are vertical lines that run from an entity to the ground and display the altitude of the entity (using whatever units are configured on the Display Units Settings page) (Figure 164). They help you understand the relationship of the entity to the terrain.

HAT lines are shown only for entities that could be above or below the ground, such as fixed and rotary-wing vehicles. You can show and hide these lines globally and you can specify that they be shown only for the selected entities.

When you create or edit an entity, VR-Vantage displays HAT lines even if they are otherwise disabled.

Figure 164. 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 160 on page 328).
3. To display lines, select the Enable Height Above Terrain Lines check box.
4. To display lines only for selected entities, select the Only Display Height Above Terrain Lines For Selected Entities check box.

In VR-Vantage, you can also enable and disable entity HAT lines by choosing **Settings > Entity Height Above Terrain Lines** or by clicking the Entity Height Above Terrain Lines button ( ) on the Display Settings Toolbar.

19.5. Changing the Model Set

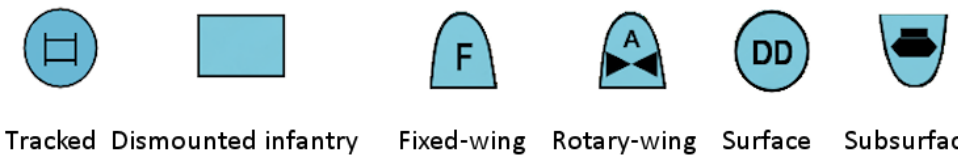
Each observer mode specifies a model set. You can change the model set associated with an observer mode by editing it (for details, see "14.4.3 Editing an Observer Mode" on page 247), but you can also dynamically change the model set being used.

➤ To change the model set, choose **Observer > Set Model Set >** *model_set*, where *model_set* is one of the options on the menu.

19.6. Simulation Object Icons

The 2D Icons model set uses MIL-STD 2525B icons. Figure 165 illustrates basic icon shapes for friendly forces.

Figure 165. MILSTD-2525B icons



The color and shape code for 2D simulation object icons is:

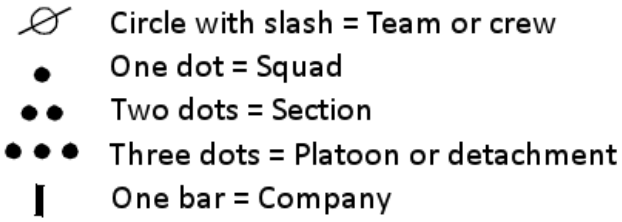
- Light blue – friendly.
- Pink (light red) – hostile.
- Light green – neutral.

Symbols have a black border except as follows:

- If there is no border on the top, the entity domain is subsurface, for example, submarines.
- Selected simulation objects have a white border.

Symbols that represent units have unit identifiers above the symbol, as illustrated in Figure 166.

Figure 166. Unit echelon indicators



19.6.1 Changing the Size of 2D Icons

The Plan View observer mode uses the 2D Icons model set for simulation objects.

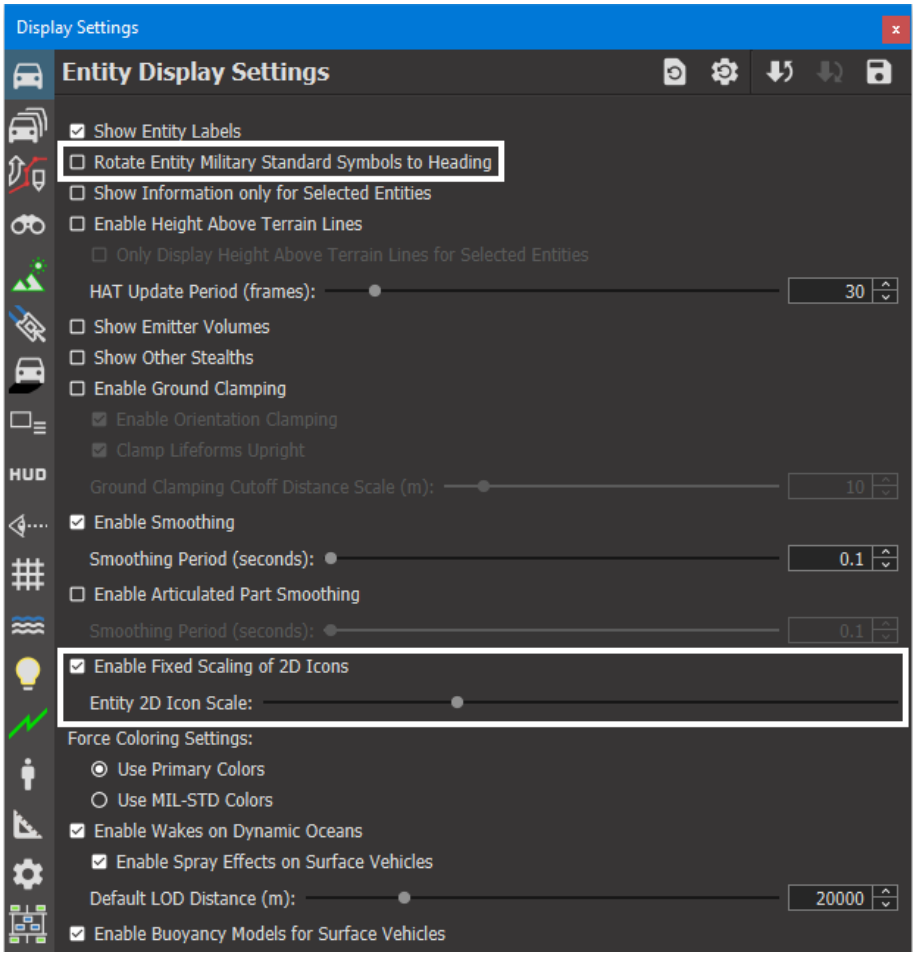
Manually Changing Icon Scale

You can change the size of 2D icons. When many simulation objects are close together, reducing the size of the icons can reduce overlap.

➤ **To change the size of simulation object icons:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 167).

Figure 167. Entity Display Settings page



3. Select the Enable Fixed Scaling of 2D Icons check box.
4. Adjust the Entity 2D Icon Scale slider.

Scaling 2D Icons by Altitude

Additionally, the 2D icons scale based on the observer's altitude, appearing smaller from greater heights. As with symbol decorations, the 2D icons display at full size when you hover over or select a simulation object.

➤ **To enable the resizing of icons based on altitude:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page.
3. Clear the Enable Fixed Scaling of 2D icons check box.

You can also enable or disable the resizing of icons based on altitude using the Display Settings Toolbar.

➤ To enable or disable the resizing of icons, click the Dynamically Scale Icons button  .

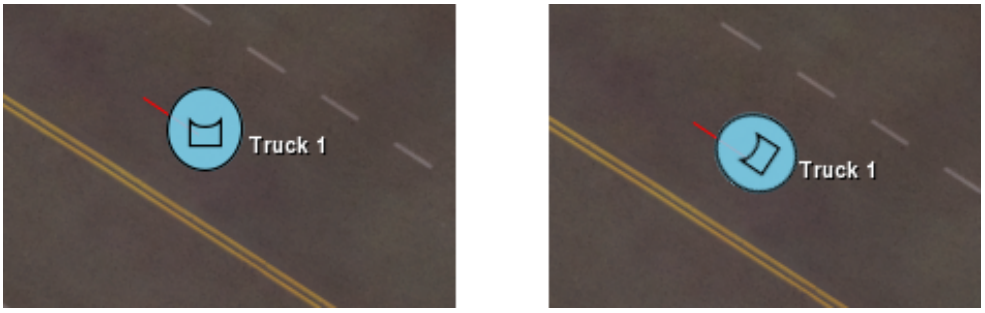
Additionally, symbol decorations can be hidden based on the observer's altitude. See "Adjusting Display of Symbol Decorations by Altitude" on page 331.

19.6.2 Rotating 2D Icons to a Simulation Object's Heading

By default, when a simulation object's heading changes, the heading indicator points to the new heading, but the icon remains oriented towards zero degrees (North). You can specify that icons rotate to the heading of the simulation object.

- Rotating 2D icons to match an entity's heading works only when Orient North is enabled. If Orient North is disabled, the rotated 2D icons may not match the object's heading. See "15.8. Forcing Orientation North (Plan View Mode Only)" on page 276 for details about controlling the observer's heading.
- The Rotate Entity Military Standard Symbols to Heading setting affects all entities. If you want to override it for specific entities, edit the Entity Definition and set the rotateicontoheading attribute for the Military Symbology Icon definition. See the chapter on *Element Definitions* in the *Adding Content to MAK ONE Applications Reference Manual*.

Figure 168. 2D icon rotated to heading



➤ **To rotate icons to a simulation object's heading:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 167).
3. Select the Rotate Entity Military Standard Symbols to Heading check box.

You can also click the Rotate 2D MIL STD Symbols button ( )in the Display Settings Toolbar.

19.7. Viewing Occluded 2D Icons

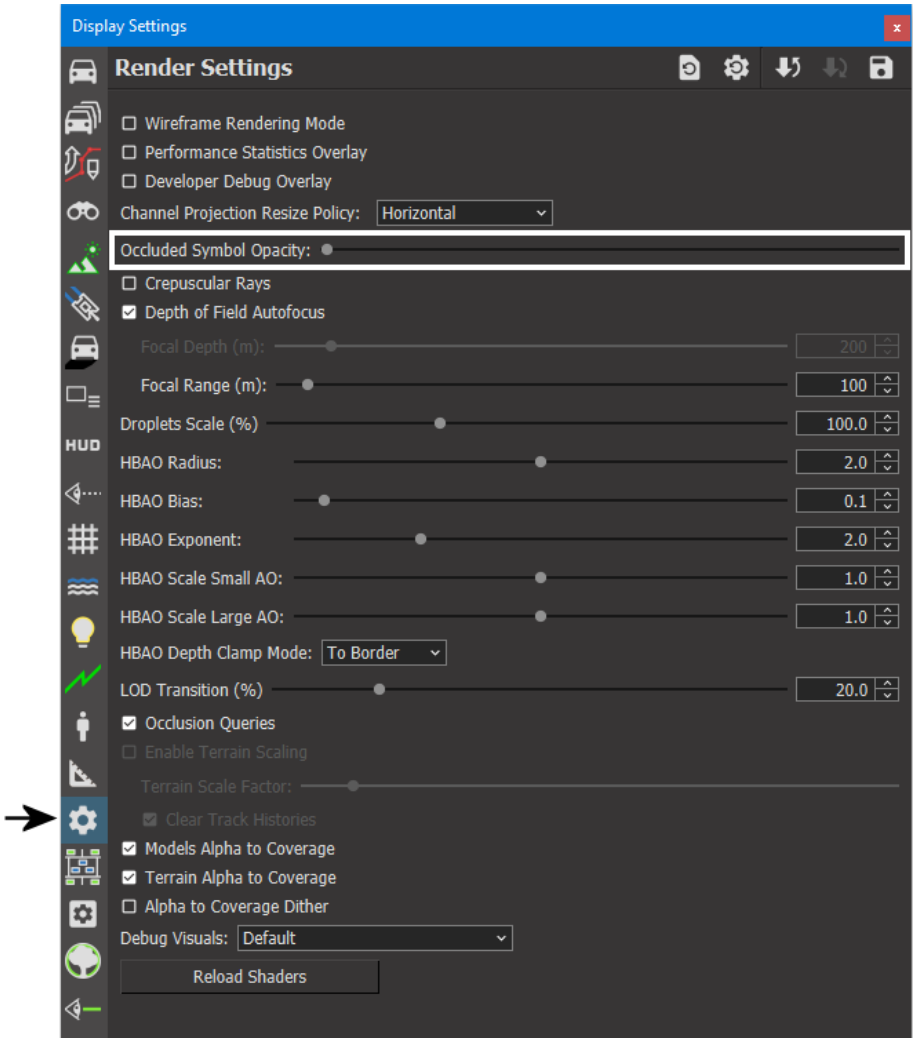
If you are using VR-TheWorld or a similar terrain in the 2D projection, it is possible that simulation objects are being simulated on the opposite side of the world from the observer (they are occluded from view by the earth). Since 2D icons are displayed on a layer above the terrain, they are not hidden from view by the terrain. VR-Vantage

allows you to configure the visibility of occluded entity icons. By default, occluded icons are displayed as 100% transparent. You can vary transparency from 100% transparent to 100% opaque.

➤ **To set the transparency of occluded 2D icons:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 169).

Figure 169. Render Settings page



3. Adjust the Occluded Symbol Opacity slider.

19.8. Hiding 3D Models

You can hide 3D models and 3D colorized models.

➤ **To hide 3D models:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 153 on page 318).

3. In the list of observer settings, clear the Main Model check box.

19.9. Display of Embarked Entities

When VR-Vantage renders a scenario generated by VR-Forces, the scenario may include embarked simulation objects. In the 3D projection, embarked entities are displayed just like any other object. In the 2D projection, VR-Vantage does not display icons for embarked entities. However, they are still listed in the Objects List Panel.

19.10. Displaying DI-Guys in Vehicles

If a vehicle has interior geometry, you can configure it to display DI-Guy characters inside the vehicle. If a vehicle is configured to display a DI-Guy, the model is added automatically. You can enable and disable display of DI-Guys. This is a global setting.

The characters displayed in vehicles are for display purposes only in VR-Vantage. They do not exist as entities in the simulation that VR-Vantage is rendering.

➤ **To enable or disable display of DI-Guys in vehicles:**

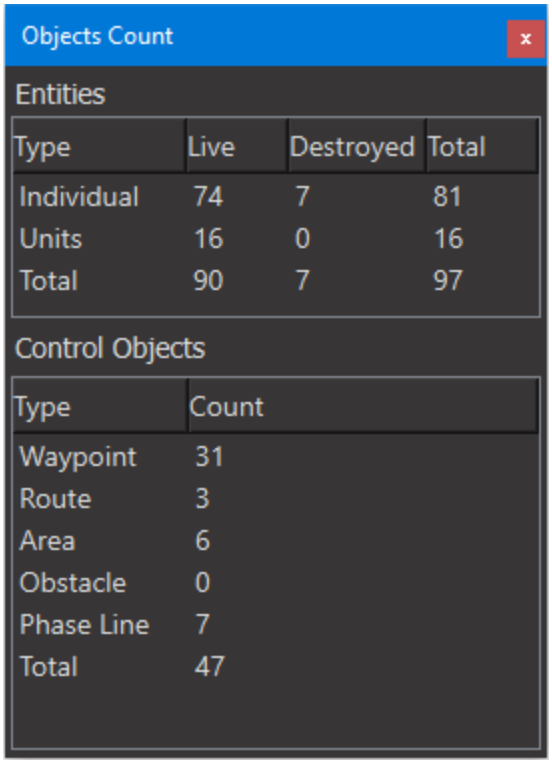
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page.
3. Select or clear the Show Occupants check box.

19.11. Viewing Object Counts

You can display the number of live and destroyed simulation objects in the simulation you are viewing and the number of VR-Forces control objects, by type.

➤ To display the object counts, choose **View > Objects Count Panel**. The Objects Count Panel is added to the display (Figure 170).

Figure 170. Objects Count Panel



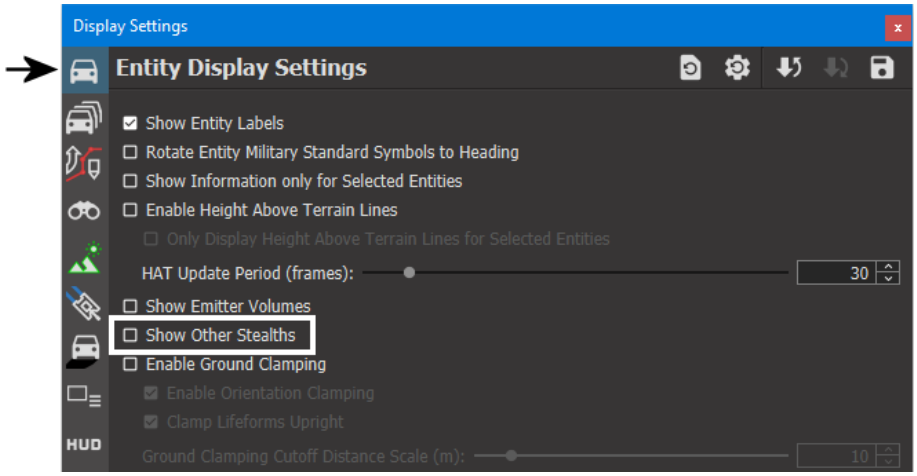
19.12. Displaying Models for Remote Observers

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 171).

Figure 171. Display Settings, Entity Display Settings page



3. Select the Show Other Stealths check box.

19.13. Filtering Simulation Objects Using Interest Management

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

19.13.1 Enabling Interest Management

To use interest management:

- You must use HLA (DIS does not support interest management).
- If you are using the MAK RTI, you must use MAK RTI 3.4a or later.
- You must configure your RTI to support DDM. (If you are using the MAK 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 use interest management:

➤ **To enable interest management:**

1. Choose **Settings > Connection**. The Connection Settings dialog box opens.
2. Select the HLA connections page for the version of HLA that you are using.
3. Click Advanced to show all connection parameters.
4. Select the Implicit Geographic DDM check box.
5. Specify any other information required for the simulation.
6. Click Connect.

19.13.2 Configuring Interest Management

Interest management works by filtering out all simulation objects beyond a specified distance from the observer. You can configure this distance (DDM region size) and you can configure the threshold for observer movement (region update threshold) before VR-Vantage recalculates which simulation objects should be displayed.

VR-Vantage uses a geographic DDM scheme. The earth is divided into two dimensional regions, with X pointing north and Y pointing east. When you specify a DDM region size, you specify the length of one side of a region.

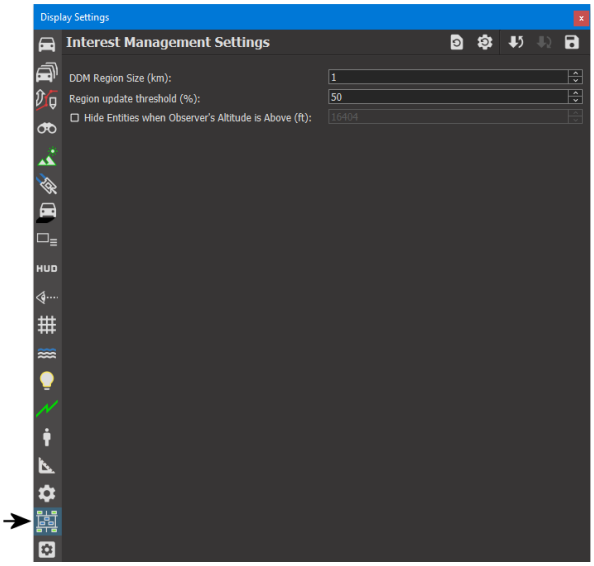
The region update threshold is a percentage of the distance from the center of the region to a side. When the observer moves beyond the threshold, the region is recalculated. For example, if the region size is 1000 meters, the distance from the center to a side is 500 meters. If the region update threshold is 50%, when the observer moves more than 250 meters from the center of the region, VR-Vantage recalculates the display region.

DDM regions use a two-dimensional grid, so the altitude of the observer is not considered when filtering simulation objects. However, in 3D observer modes, you usually cannot see entity models once the observer is a certain distance above the terrain (although you can see labels). Therefore, you may want to filter out simulation objects based on the observer's altitude, thereby increasing performance.

➤ **To configure interest management:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Interest Management Settings page (Figure 172).

Figure 172. Interest Management Settings page



3. In the DDM Region Size box, type a value for the region size.
4. In the Region Update Threshold box, type a value, as a percentage, for the update threshold.
5. Optionally, filter simulation objects based on the observer's altitude, as follows:

a. Select the Hide Entities When Observer's Altitude is Above check box.

b. Specify the observer altitude at which to hide simulation objects.

6. Click OK.



20. Displaying Units

If you are using a VR-Vantage application to view a simulation generated by VR-Forces, MAK's computer generated forces application, you can manipulate the display of the units that are in the simulation.

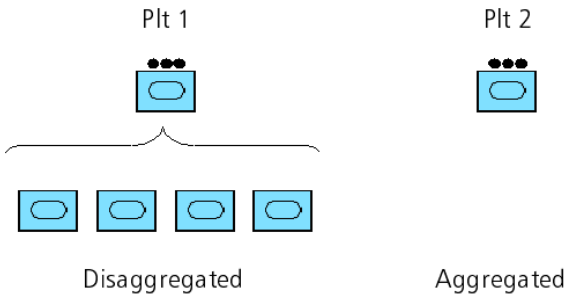
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20.1. Introduction to Units

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

- Disaggregated: Subordinates are simulated and published as individual entities (Figure 173). Members of the unit are displayed using individual models or icons.
- Aggregated: Subordinates are not simulated separately. The unit is represented by one icon.

Figure 173. Disaggregated and aggregated entities



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

Since aggregated units are sent over the network as one logical entity, VR-Vantage always represents them with one icon.

By default, the Objects List is filtered to just show entities. Therefore, if VR-Vantage is receiving units, there will be unit icons in the display, but no corresponding entry in the Objects List. To see units in the Objects List, change the filter to Units or All.

The rest of this chapter explains how to manage these different display options.

20.2. Expanding and Collapsing Units

You can display units in expanded or collapsed mode.

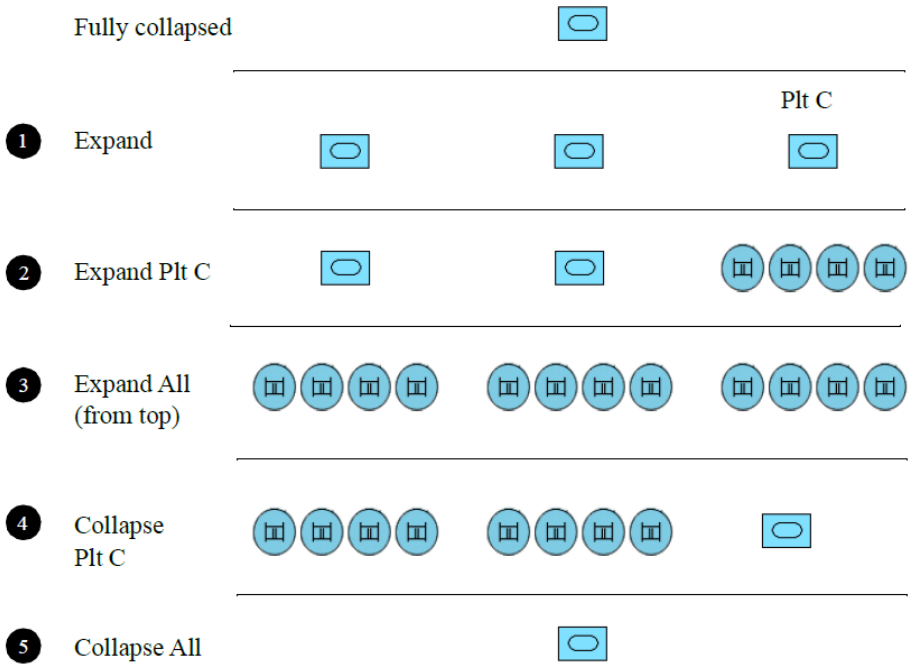
When a unit is collapsed, it displays as one icon. When a unit is expanded, all the members of the unit are visible as individual entities or subordinate units and the unit icon is hidden. Multi-level units can expand and collapse at each level of aggregation. For example, a company could be collapsed to the company level (one icon), the platoon level (an icon for each platoon), or fully expanded.

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

Figure 174 illustrates these relationships. Assume a company with three platoons, each of which has four vehicles.

- If you Expand the top level unit, it expands to the platoon level. (1)
- If you select Plt C and choose Expand or Expand All, it expands just Plt C. (2)
- If you select the top level unit and expand all, it expands to the leaf level – 12 individual vehicles. (3)
- If the unit is fully expanded and you select one member of Plt C and choose Collapse, just Plt C collapses. (4)
- If you select any member of an expanded unit and select Collapse All, the entire unit collapses. (5)

Figure 174. Unit expand and collapse



➤ To expand a unit, right-click the unit icon or its entry in the Objects List View of the Objects List Panel and choose **Expand** on the shortcut menu.

➤ To expand a unit and all its subordinate units, right-click the unit icon or its entry in the Objects List View of the Objects List Panel and choose **Expand All** on the shortcut menu.

➤ To collapse a unit one level, right-click any member of the unit and choose Collapse on the shortcut menu.

➤ To collapse a unit to its root level, right-click any member of the unit and choose Collapse All on the shortcut menu.

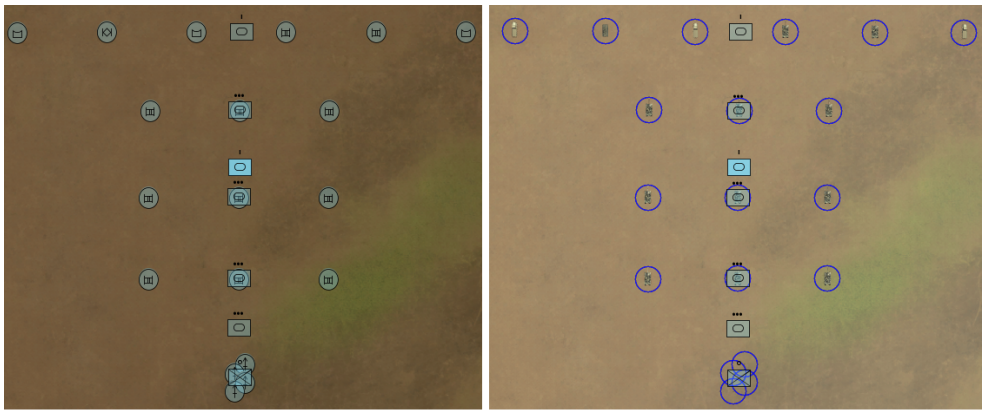
20.3. Displaying Ghosted Icons

If you want to select units, you need to collapse them so that you can select the unit icon. However, when you do this, you can no longer see where individual subordinate simulation objects are located and if subordinates are destroyed, you cannot see which ones are destroyed and which are functional. VR-Vantage provides the following options for displaying unit icons to allow you to work with them in a way that best meets your visualization and simulation object management needs:

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

In the Plan View observer mode, when you display ghosted units, the unit icon is displayed normally, and the subordinate members are displayed using semi-transparent icons. In 3D observer modes, units that are subordinate to the top level unit are displayed using semi-transparent icons. Leaf-level entities are displayed using the appropriate model for the observer mode (Figure 175).

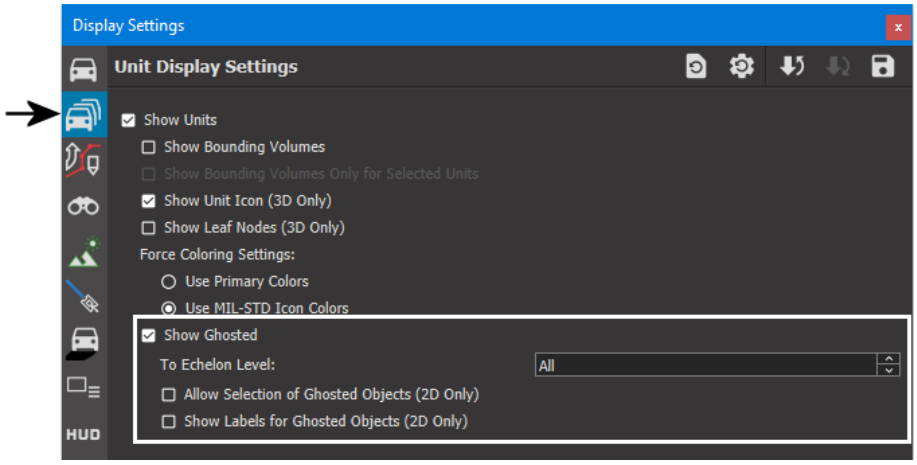
Figure 175. Ghosted icons



➤ **To configure the display of unit icons:**

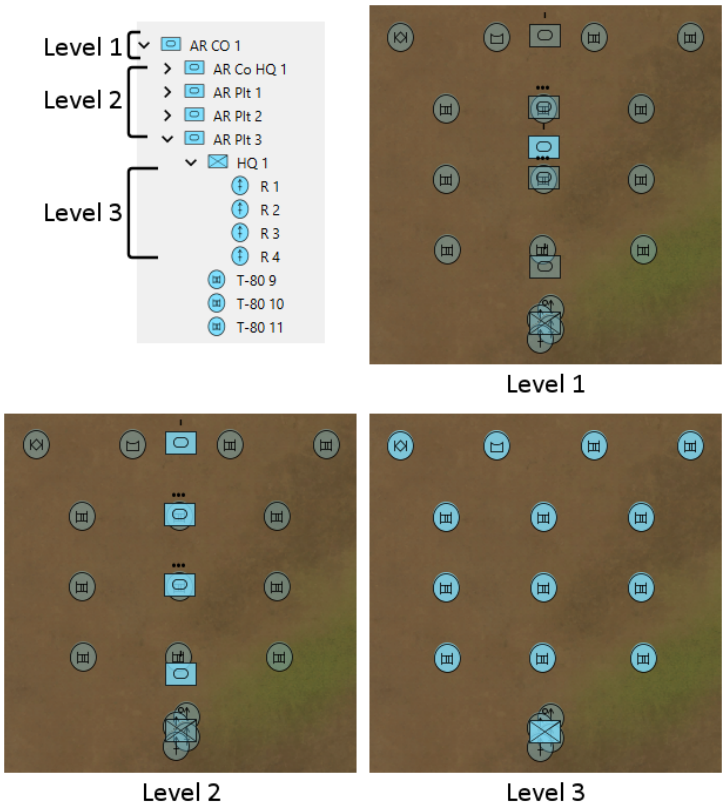
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 176).

Figure 176. Unit Display Settings page



3. To display unit members based on the current level of aggregation only, clear Show Ghosted.
4. To display ghosted icons:
    a. Select Show Ghosted.
    b. In the To Echelon Level box, select the level of aggregation to show ghosted icons for. To show all levels without needing to consider how many levels there are, select All. Figure 177 illustrates the effect of changing the echelon level for displaying ghosted icons for the VR-Forces unit 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.)
    d. To display symbol decorations for ghosted icons (2D view only), select Show Labels for Ghosted Objects.

Figure 177. Displaying ghosted icons by echelon level



20.4. Displaying Unit Icons and Bounding Volumes

VR-Vantage lets you configure when to display unit icons and bounding volumes. Bounding volumes are translucent polygons that show the extents of the unit. This is useful when the individual entity icons or models are not displayed. You can configure icons and bounding volumes as follows:

- Enable and disable the display of units. When disabled, only the 2D icons or 3D models for leaf level unit members are displayed.
- Enable and disable the display of bounding volumes. Bounding volumes are displayed only for collapsed units. You can restrict the display of bounding volumes to the selected units.
- In 3D observer modes, enable or disable the display of unit icons.

Figure 178 shows a unit bounding volume in Stealth observer mode, with leaf nodes displayed.

Figure 178. 3D bounding volume

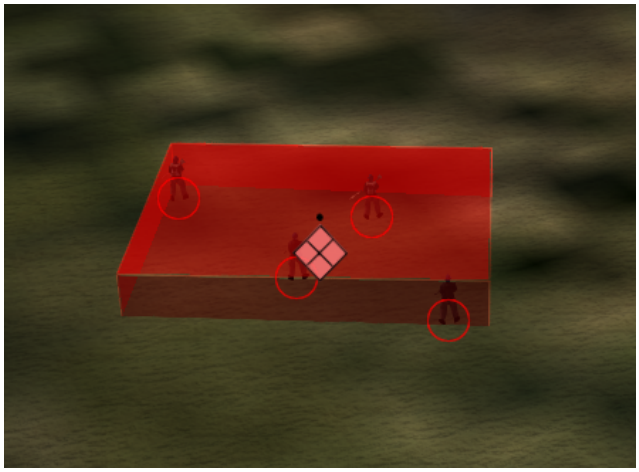
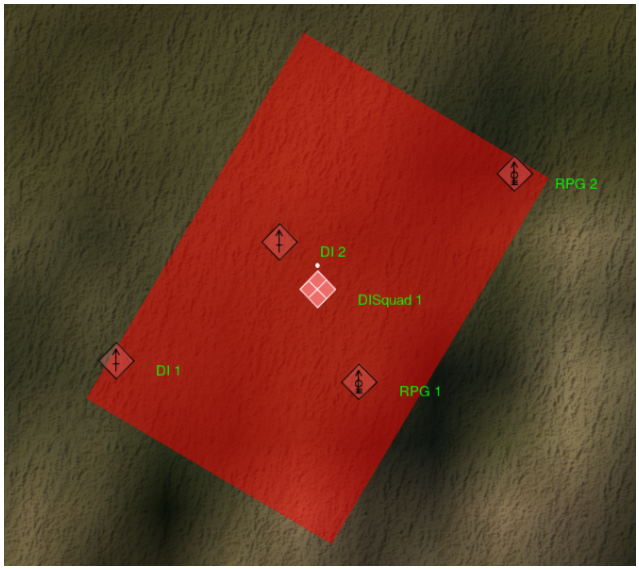


Figure 179 shows a unit bounding volume in Plan View observer mode, with ghosting enabled.

Figure 179. 2D bounding volume



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

➤ **To configure the display of unit icons and bounding volumes:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 176 on page 349).
3. To enable the display of unit icons, bounding volumes, or both, select Show Units.
4. To display bounding volumes for collapsed units, select Show Bounding Volumes.

5. To restrict the display of bounding volumes to the selected units, select Show Bounding Volumes Only for Selected Units.
6. To display unit icons in 3D observer modes, select Show Aggregate Icon (3D Only).



You can also enable and disable units by choosing **Settings > Units**.

20.4.1 Specifying the Color Scheme for Unit Bounding Volumes

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

➤ **To specify the color scheme to use for unit bounding volumes:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Unit Display Settings page (Figure 176 on page 349).
3. Select the Force Coloring Settings option that you want (Use Primary Colors or Use MIL-STD Icon Colors).



VI. Visual and Audio Effects

VR-Vantage has many visual effects that add to your understanding of the interactions between simulation objects. These include fire and detonation lines, communications lines, and emitter volumes. You can test for line-of-sight with the intervisibility feature. You can also display many different lighting effects.



21. Viewing Entity Effects

This chapter describes how to display various types of entity-related graphics.

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21.1. Using Ground Clamping

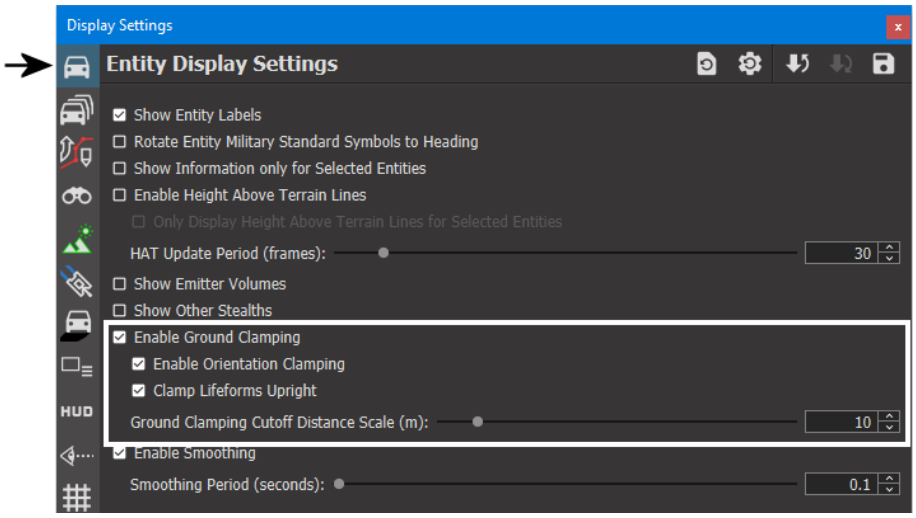
Because of differences in terrain databases among exercise participants, entities can sometimes appear to be underground or hovering above the terrain surface. To compensate, VR-Vantage can clamp land and sea entities to the terrain surface. When ground clamping is enabled, VR-Vantage keeps an entity anchored to the terrain surface regardless of the altitude data contained in its state update.

Use of ground clamping can reduce your frame rate. If you correlate the simulation and visualization terrain databases, you can eliminate the need to use ground clamping.

➤ **To enable or disable ground clamping:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 180).

Figure 180. 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**.

21.1.1 Configuring Ground Clamping

You can configure the following aspects of ground clamping:

- Enable or disable ground clamping.
- Enable or disable orientation clamping.

- Force lifeforms to remain upright relative to the plane of their location when moving up slopes or steps, rather than being perpendicular to the terrain.
- The distance from the terrain within which entities are clamped.

➤ **To configure ground clamping:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 180 on the previous page).
3. To enable or disable a ground clamping option, select or clear its check box.
4. To specify the distance from the terrain in which entities are ground clamped, adjust the Ground Clamping Cutoff Distance Scale slider or type a value, in meters, in the box.

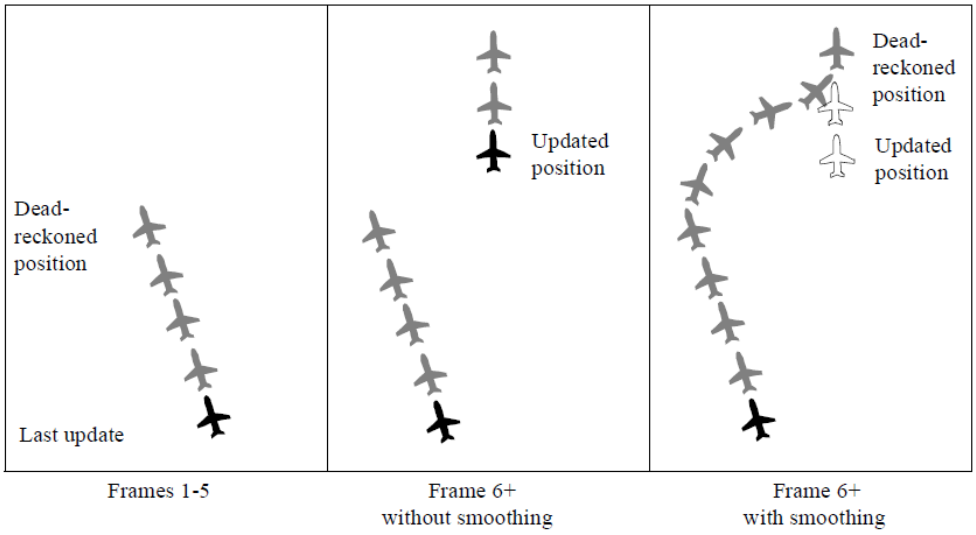
The setting for the Ground Clamping Cutoff Distance Scale maximizes at 100 meters. If you set it to the maximum, the distance is infinite and all entities are ground-clamped.

21.2. Trajectory Smoothing

From the time VR-Vantage receives a state update message for a simulation object until it receives the next update, it calculates the location of the simulation object based on the heading and acceleration in the most recent state update. This process is called dead-reckoning. When the next state update arrives for the simulation object, VR-Vantage moves it to the new position. If the actual position is significantly different from the dead-reckoned position, the simulation object could appear to jump from the dead-reckoned position to the actual position. VR-Vantage can eliminate these discontinuities by smoothing trajectories and rotation paths.

Figure 181 illustrates dead-reckoning and smoothing.

Figure 181. 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.

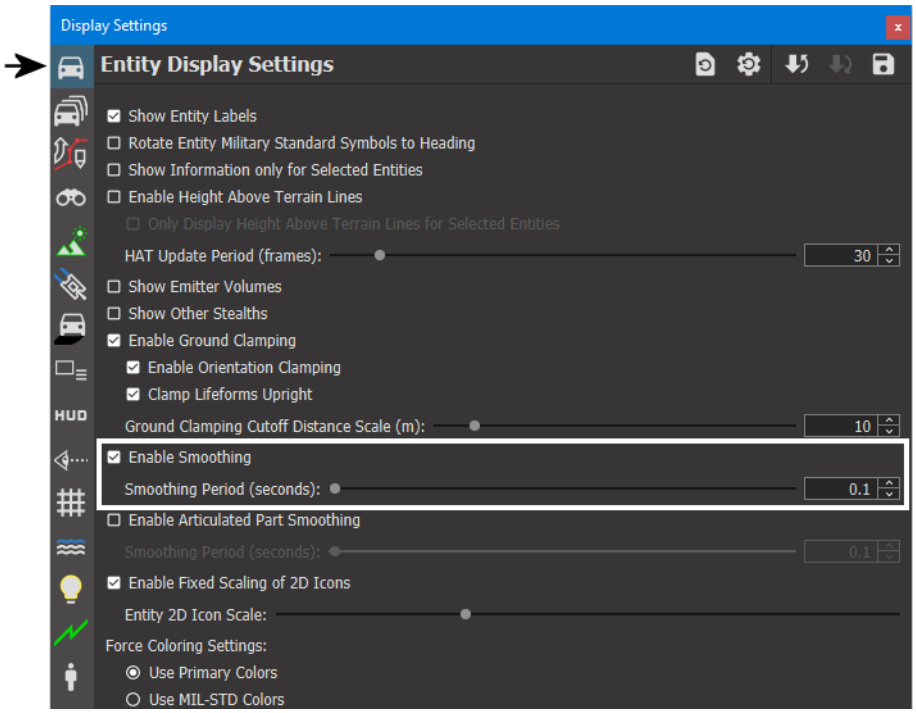
> Smoothing makes fast-moving entities, such as fixed wing aircraft, look better. Slow moving entities, such as dismounted infantry, may look worse. If your simulation is mostly one or the other of these types of entities, enable or disable smoothing as appropriate for the best visualization experience.

21.2.1 Configuring Trajectory Smoothing

➤ **To configure trajectory smoothing:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 182).

Figure 182. Smoothing settings



3. To enable or disable smoothing, select or clear the Enable Smoothing check box.
4. To change the smooth period, adjust the Smoothing Period slider or type a value, in seconds, in the box.

21.2.2 Configuring Articulated Part Smoothing

Articulated parts are also dead-reckoned if velocities are provided for their values. This dead-reckoning can be smoothed in a manner similar to trajectory smoothing.

➤ **To configure articulated part smoothing:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page.
3. To enable or disable articulated part smoothing, select or clear the Enable Articulated Part Smoothing check box.
4. To change the articulated part smooth period, adjust the articulated part Smoothing Period slider, or enter a value in seconds.

21.3. Displaying Trailing and Decal Effects (3D Only)

VR-Vantage supports trailing effects such as contrails for missiles and aircraft and dust clouds for vehicles. It also supports decal effects, such as tire tracks, footprints, and wakes. In essence, trailing effects are effects that are dispersed through the air, while decal effects are effects that are printed on the ground.

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

Figure 183 illustrates some trailing effects.

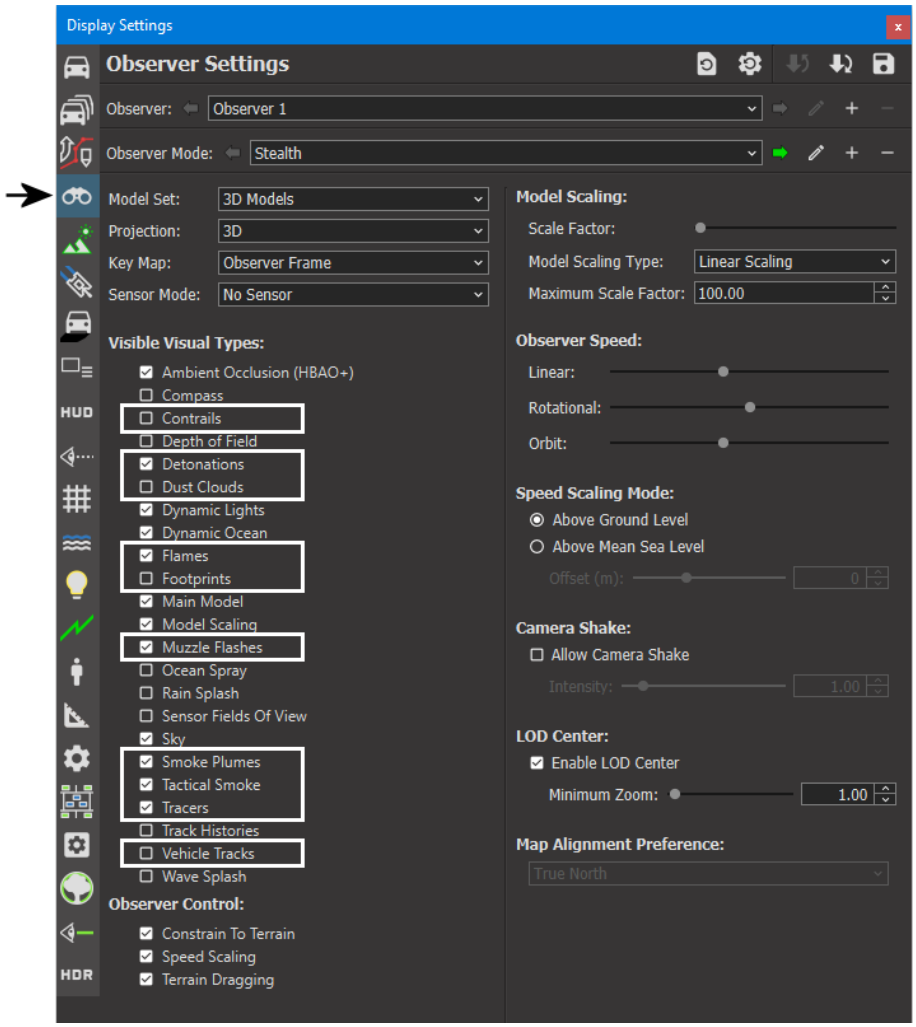
Figure 183. Vehicle tracks, dust cloud



➤ **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 184).

Figure 184. 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***.

21.3.1 Specifying Models for Trailing Effects and Decal Effects

Trailing effects and decal effects are configured through model definitions. (For the purposes of configuration, trailing effects are categorized as decals.) Each effect must have a model definition that uses a decal schema. Then, in an entity's entity definition, you configure a visualizer for the effect. For details about creating model definitions, see "Creating and Editing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.

21.4. Displaying Track Histories

Track histories allow you to track the paths of simulation objects during an exercise, including the path of munitions as they travel from the shooter to the target. When track histories are enabled, each simulation object leaves a track ribbon. The ribbon's default color is based on the simulation object's force. Figure 185 illustrates track histories.

Figure 185. Track history



3D 2D

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

- Track histories have a significant performance and memory cost. For simulations with large simulation object counts, turning track histories off can improve performance and memory usage.
- If a ground entity is traveling over uneven terrain, the track history may appear broken. If you want to see it as a complete, solid line, you must edit the entity's definition and change the Track History's **allowocclusion** setting to false. You must apply this setting before connecting to the simulation. See the chapter on *Element Definitions* in the *Adding Content to MAK ONE Applications Reference Manual*.

➤ **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 184 on the previous page).
3. Select the observer mode for which you want to change the Track Histories setting.
4. Select or clear the Track Histories check box.

You can also enable or disable track histories by choosing **Observer > Track Histories** or clicking the Track Histories button on the Observer Settings Toolbar.

21.4.1 Configuring Track History Segments and Timeout

You can configure how long track history ribbons are drawn. A track history is composed of a series of segments joined together to form a line. You can configure how long each segment is and how many segments at a time can be displayed. Drawing shorter segments improves the accuracy of the track history, but can degrade performance. Increasing the maximum number of segments provides a longer history, but can clutter up the screen if there are many simulation objects and can also affect performance. Figure 186 illustrates the visual result of drastically changing the segment length. The left track history uses the default segment length of 0.5 meters. The right track history has a segment length of 5000 meters.

Figure 186. Track history segment length



When a track history reaches the maximum number of segments configured, it starts dropping segments from the beginning of the history (the oldest segments).

You can specify that track histories have an infinite length. In this case they never drop segments.

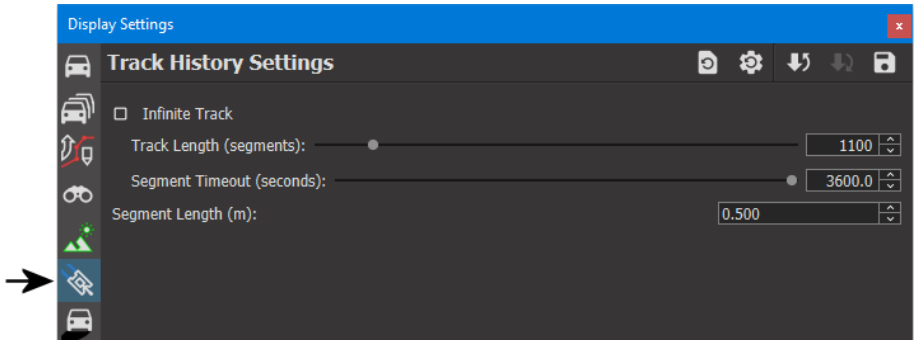
> If you specify infinite length for track histories, it is possible that you could eventually use up all the memory in your computer and the program would crash.

You can also specify a timeout value for track histories. The total length of a track history is determined by a combination of the oldest segment creation time, the segment length, and the number of segments.

➤ **To configure track histories:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Track History Settings page (Figure 187).

Figure 187. Track History Settings page



3. If you want track histories to have an indefinite length, select the Infinite Track check box.
4. To change the number of segments that can be displayed for a track history, adjust the Track Length slider, or enter a value in the box.
5. To change the segment timeout, adjust the Segment Timeout slider. The default is 3600 seconds (60 minutes).
6. To specify the length of each track history segment, enter a value in the Segment Length box.

21.4.2 Coloring an Entity's Track History

You can change the color of an entity's track history. (By default, the track uses the color assigned to the entity's force.) The color you assign is visible only to you in your local GUI and does not persist in later sessions.

➤ **To change an entity's track history color:**

1. Right-click the entity and select **Color Track History**.
2. In the submenu, select a color or **Custom Color**.
3. If you selected **Custom Color**, choose a swatch from the basic colors, click a spot on the palette, specify a shade using its HTML color code, or click **Pick Screen Color** to use a color you see on the screen.
4. To return the entity to its default color, select **Color Track History > Clear Override**.

21.5. Viewing Fire and Detonation Effects

VR-Vantage can display the following graphic effects when munitions are fired and detonated:

- Flaming effects.
- Smoke plumes.
- Detonations.
- Muzzle flashes.

- Tracers. Tracers are displayed if the munition in a fire interaction is a tracer munition and the munition is mapped to a tracer model, and the munition must be direct fire. Tracers are not supported in 2D observer modes.

➤ **To enable fire and detonation effects:**

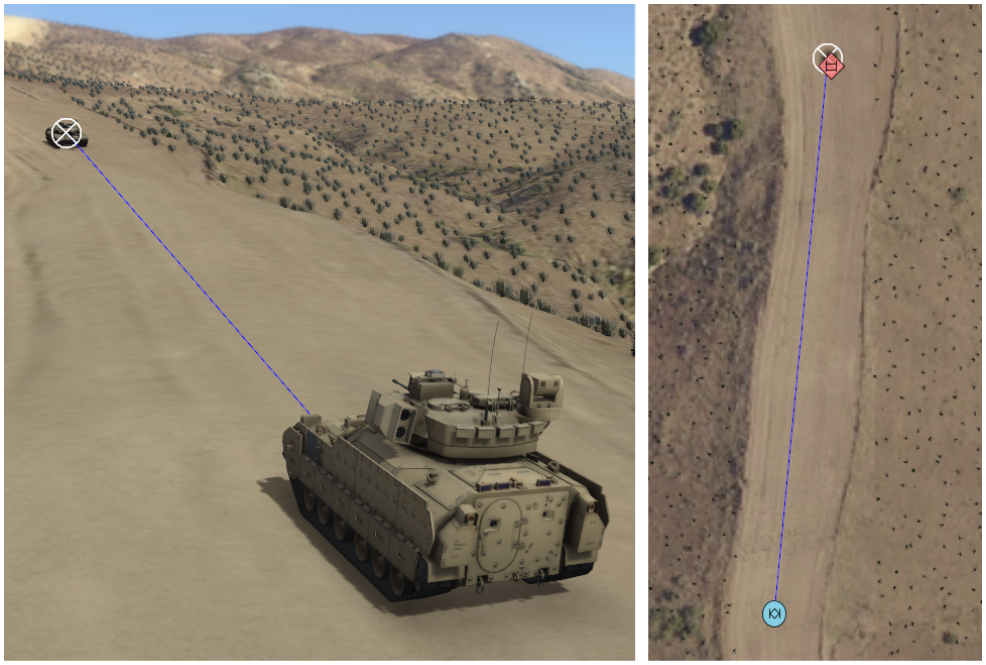
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 184 on page 360).
3. Select or clear the appropriate check boxes.

You can also enable or disable display of a fire or detonation effect by choosing **Observer >** *effect*, where *effect* is Flames, Smoke Plumes, Detonations, Muzzle Flashes, or Tracers.

21.6. Viewing Fire and Detonation Lines

If fire and detonation lines are enabled, when an entity fires a munition, a line is drawn between the entity and the location of the detonation. The line is colored for the force of the shooter (Figure 188).

Figure 188. Fire line and detonation



3D 2D

A detonation is identified by a circle with an X through it. The detonation color indicates the result of the detonation, as follows:

- Entity impact – white.
- Ground impact – gray.

- Airburst – black.
- Other – white.

➤ To enable or disable display of fire and detonation lines, choose **Settings > Fire / Detonate Lines** or click the Fire/Detonate Lines button ( ) on the Display Settings Toolbar.

21.7. Displaying Tactical Smoke

VR-Vantage can display tactical smoke munitions fired by VR-Forces entities. You may want to disable tactical smoke if it obscures the observer's view. Also, if many entities are generating smoke, it could affect performance.

Do not confuse tactical smoke and smoke plumes. Smoke plumes are a visual effect displayed when an entity is on fire. Tactical smoke visualizes a smoke munition.

➤ **To enable tactical smoke:**

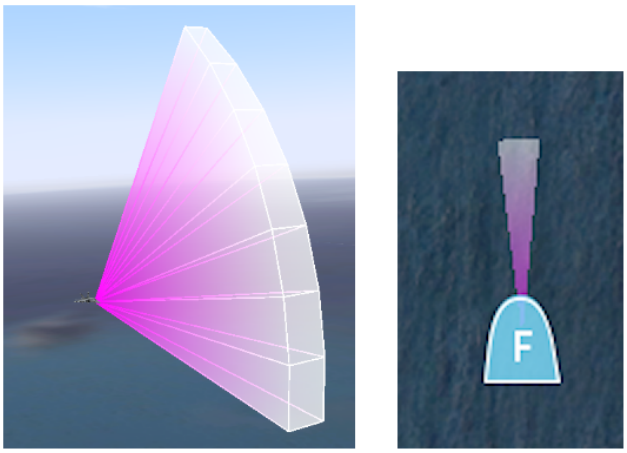
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 184 on page 360).
3. Select or clear the Tactical Smoke check box.

You can also enable or disable display of a fire or detonation effect by choosing **Observer > Tactical Smoke**.

21.8. Displaying Electromagnetic Emissions

VR-Vantage can display electromagnetic emissions (emitter volumes) for entities that have emitter systems (Figure 189). You can configure the colors used to represent emitter frequencies and you can configure the size of the emitter volumes. (For details about configuring emitter volumes, please see "24.1. Configuring Emitter Volumes" on page 396.)

Figure 189. Emitter volumes



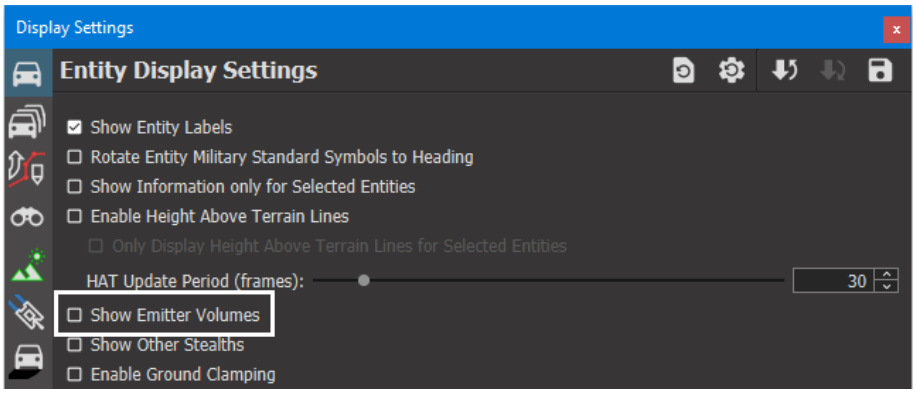
3D 2D

Display of emitter volumes only affects entities that have emitter systems.

➤ **To enable or disable display of electromagnetic emissions:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 190).

Figure 190. Entity Display Settings page



3. Select or clear the Show Emitter Volumes check box.

> You can also enable or disable emitter volumes by choosing **Settings > Emitter Volumes**, or clicking the Emitter Volumes button ( ) on the Display Settings Toolbar.

21.9. Displaying Radio Communication Lines

VR-Vantage can display squawk indicators when a simulation object sends a signal interaction. It can also display communication lines between simulation objects when a VR-Forces simulation object (or a simulation object in an application built with the

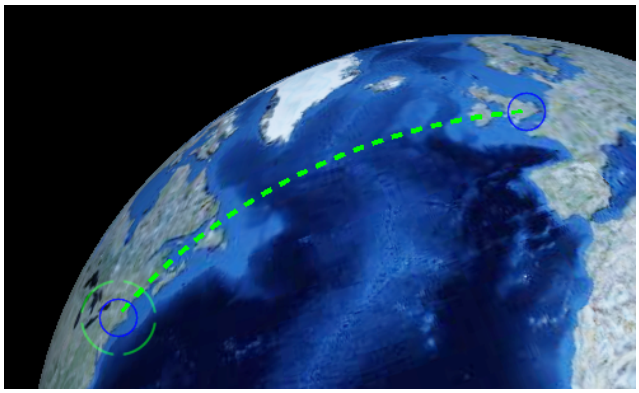
appropriate MAK libraries) sends a radio message to another simulation object. You can configure a communication line's color and lifetime. Figure 191 displays squawk indicators and a line-of-sight communication line.

Figure 191. Radio communication line and squawk indicators



For communications over large distances, a line-of-sight communication line would travel through the earth. Therefore, you can also display communication lines drawn with the curvature of the earth (Figure 192).

Figure 192. Curvature of the earth communication line



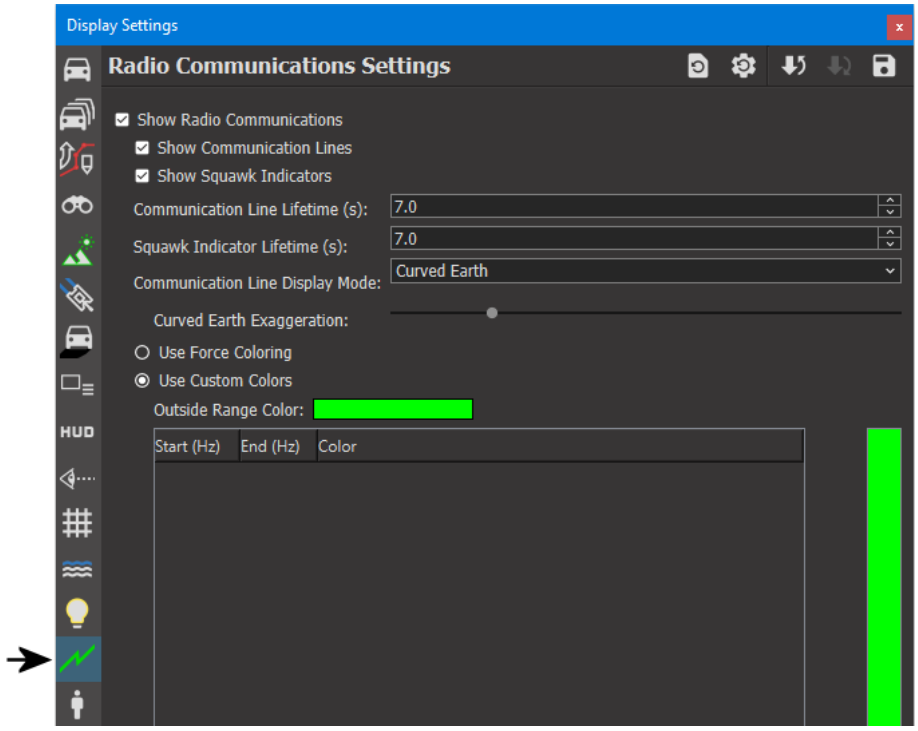
21.9.1 Enabling Radio Communications Graphics

You can globally enable or disable the ability to display radio communication lines. When they are enabled, you can enable and disable communication lines and squawk indicators separately.

➤ **To enable or disable radio communications graphics:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 193).

Figure 193. Radio Communications Settings page



3. Select or clear the Show Radio Communications check box.

> You can also enable and disable communication lines by choosing **Settings > Radio Communication Display** or by clicking the Radio Communications button ( ) on the Display Settings Toolbar.

➤ **To enable or disable communication lines:**

1. Enable radio communication lines.
2. Select or clear the Show Communication Lines check box.

➤ **To enable or disable squawk indicators:**

1. Enable radio communication lines.
2. Select or clear the Show Squawk Indicators check box.

21.9.2 Configuring the Lifetime and Display Mode

You can configure how long a radio communication line is displayed. You can also configure whether it is displayed using line-of-sight or curvature of the earth.

➤ **To configure the lifetime and display mode for radio communication lines:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 193 above).

3. To specify how long a communication line or squawk indicator should be displayed, enter a value, in seconds, in the Communication Line Lifetime and Squawk Indicator Lifetime fields.
4. To specify the display mode, select an option in the Communication Line Display Mode list.
5. If you select Curvature of the Earth, adjust the Curved Earth Exaggeration slider to change the degree to which the curvature is exaggerated.

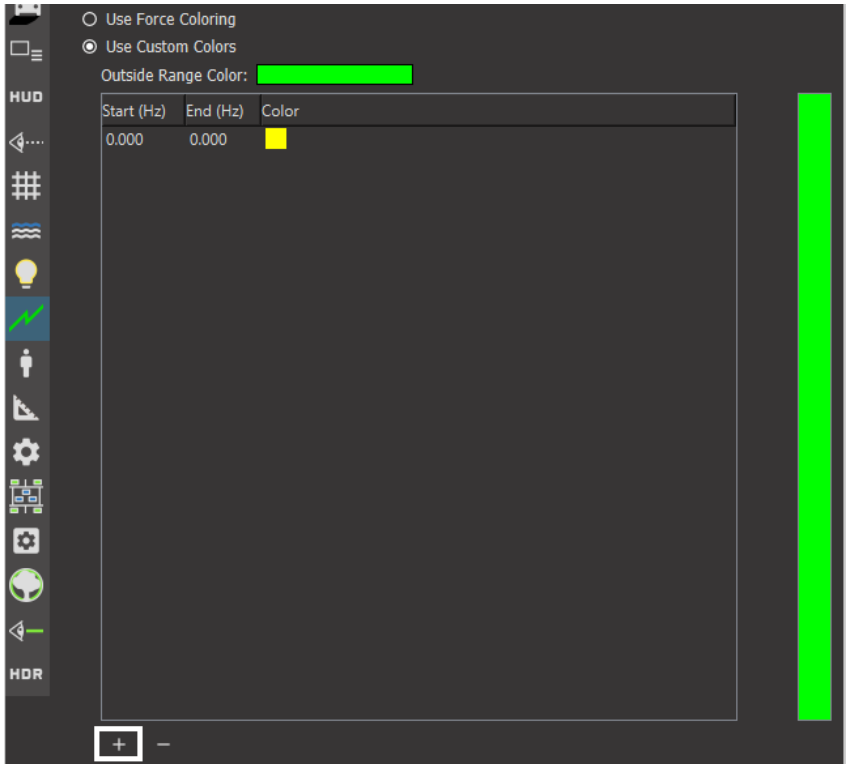
21.9.3 Configuring the Color of Radio Communication Lines

By default, radio communication lines are green. You can configure communication lines to use force coloring or to be colored based on the frequency of the message. When you color by frequency, you specify colors for the frequency ranges you are interested in and a color to use for all messages outside the specified frequencies.

➤ **To configure the color of radio communication lines:**

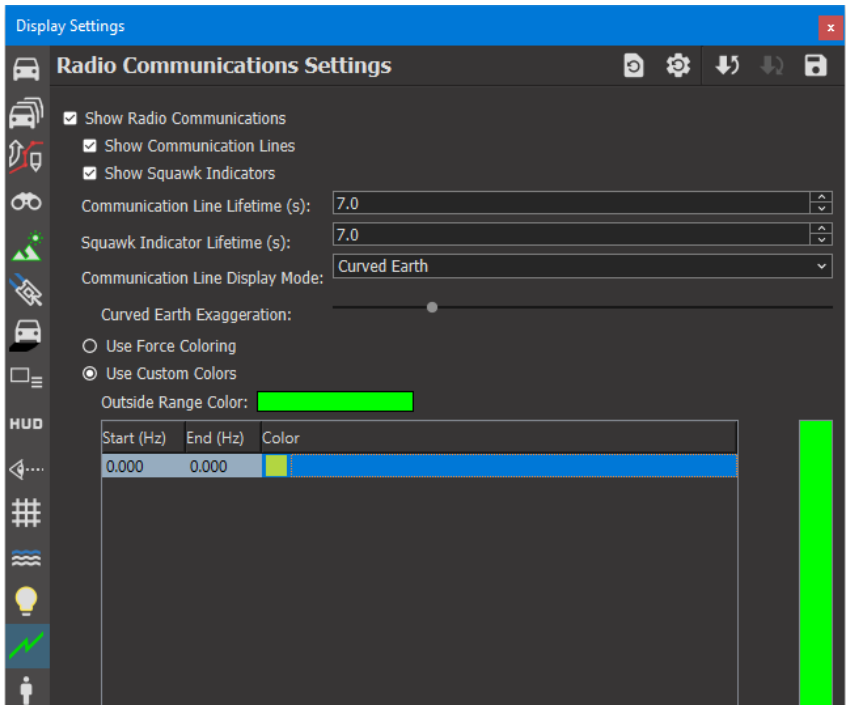
1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Radio Communications Settings page (Figure 193 on the previous page).
3. To color radio communication lines using the force color, select the Use Force Coloring option.
4. To color radio communication lines by frequency:
   a. Select the Use Custom Colors option.
   b. Click the Add button ( ). A range is added to the frequency list with a default color (Figure 194).

Figure 194. New frequency point



c. Double-click the starting value of the range to make it editable (Figure 195).

Figure 195. Editable frequency point



d. Type the starting frequency you want to use.

e. Edit the end frequency.

f. Double-click the color swatch and select a color for this range.

g. Optionally, add points for different frequency ranges.

h. Optionally, click the Outside Range Color color swatch and specify a color for all frequencies not specified in the frequency list.

If you configure multiple frequency ranges, you cannot add a range whose values are within those of an existing range.

21.10. Using the Depth of Field Effect

Depth of field controls the area in the scene that is in focus. Depth of field is calculated based on a focal depth and a focal range. The focal depth is the distance from the observer that is the center (focal point) of the area in focus. The focal range is the distance from the focal point that is in focus.

In Figure 196, the focal depth is about 10 meters, fairly close to the observer, and the focal range is also small, so that the scene is out of focus just past the car (note that the first large tree is out of focus). In Figure 197, the focal depth is the same, but the range is much greater, so the scene is in focus to the back of the parking lot.

In Figure 198, the focal depth is centered at the second large tree. The focal range is, again, fairly narrow, so that the person and car in the foreground are out of focus.

VR-Vantage lets you set the focal depth automatically or manually. In either case, you can adjust the focal range.

Figure 196. Depth of field (close)



Figure 197. Depth of field (far)



Figure 198. Depth of field, middle distance



➤ **To enable depth of field:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 184 on page 360).

3. Select the observer mode for which you want to enable depth of field.
4. Select or clear the Depth of Field check box.

> You can also enable or disable depth of field by choosing **Observer > Depth of Field**.

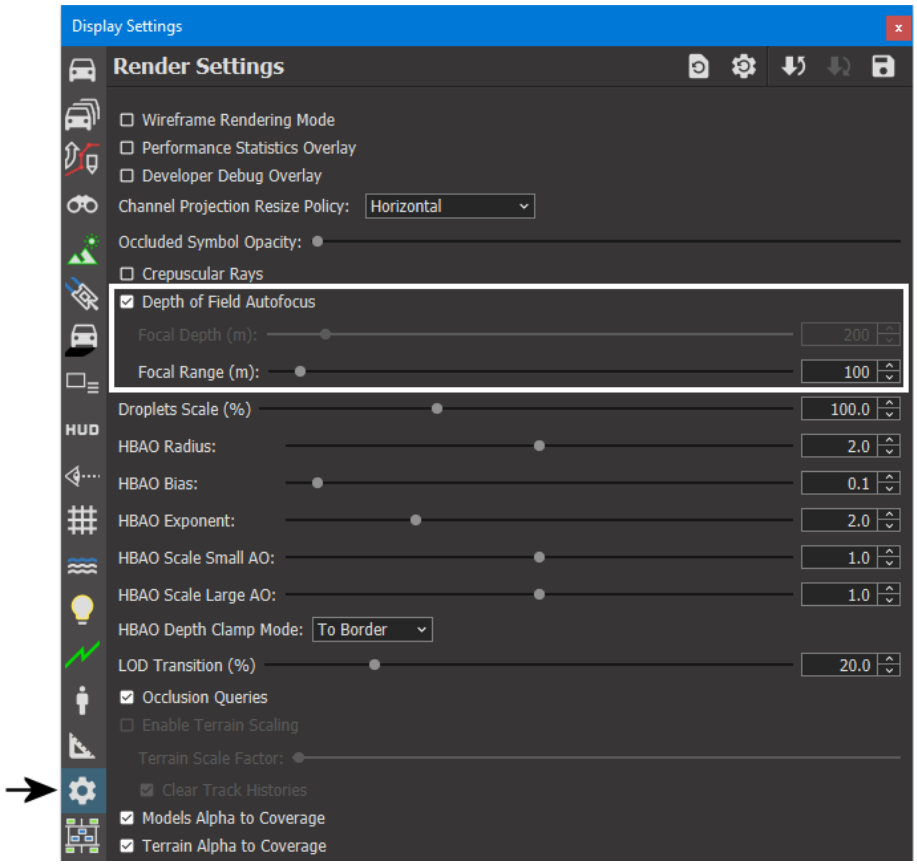
21.10.1 Configuring Depth of Field

You can enable and disable automatic depth of field and you can adjust the focal depth and focal range.

➤ **To configure depth of field:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 199).

Figure 199. Depth of Field settings



3. To use autofocus for focal depth, select the Depth of Field Autofocus check box.
4. To set the focal depth manually, clear the Depth of Field Autofocus check box and adjust the Focal Depth slider or specify a value in the box.
5. To adjust the focal range, adjust the Focal Range slider or specify a value in the box.

21.11. Displaying Wakes and Spray Effects

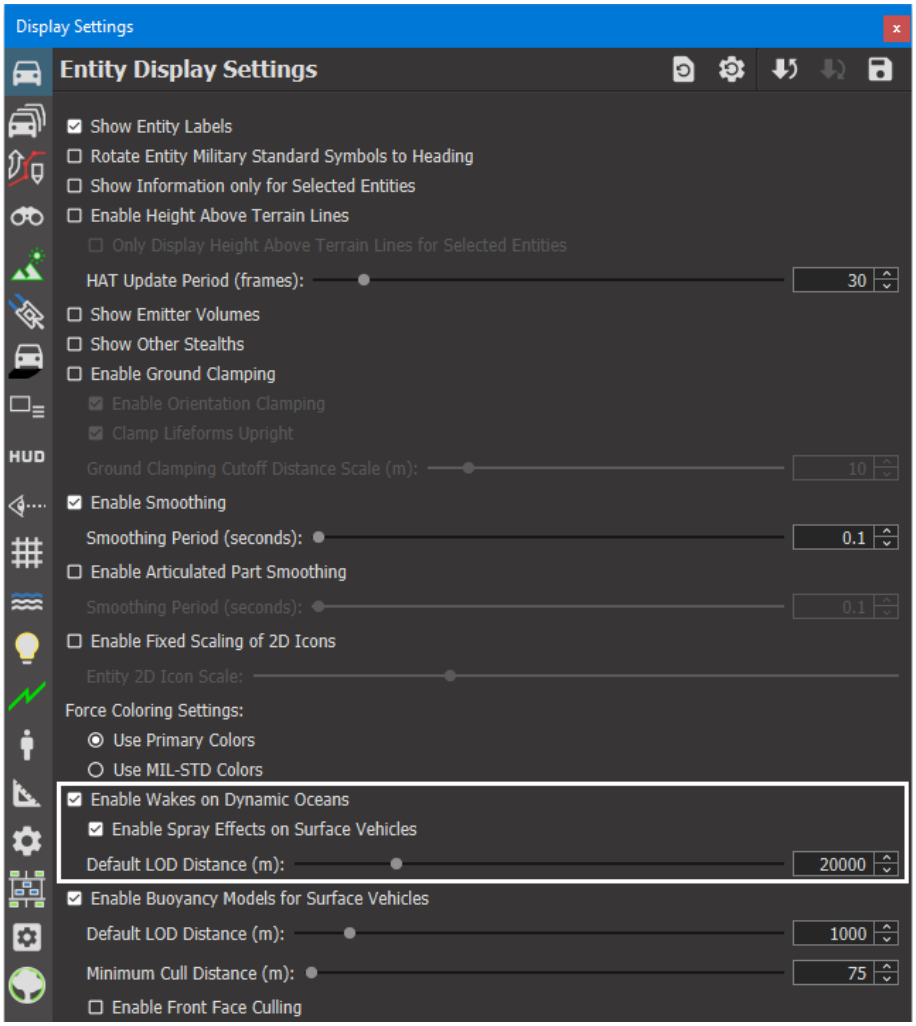
When dynamic ocean is enabled, surface entities display wakes and spray effects. However, these effects affect performance. You can disable them if you need to emphasize performance over visual effects.

Wakes have their own schema, with many attributes, including length, offset, the amount of time over which they fade out, and LOD distance. You can edit these attributes for individual entities in the Visual Model Editors dialog box.

➤ **To enable or disable wakes and spray effects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 200).

Figure 200. Entity Display Settings page



3. To enable or disable wakes, select or clear the Enable Wakes on Dynamic Oceans check box.

4. If wakes are enabled, select Enable Spray Effects on Surface Vehicles to enable spray effects. Clear the check box to disable them. Disabling wakes also disables spray effects.

21.12. Enabling Buoyancy for Surface Entities

When dynamic ocean is enabled, surface entities can bob up and down with wave action. Be aware that the buoyancy models affect performance. You can disable buoyancy if you need to emphasize performance over visual effects. You can also control the area where buoyancy models are calculated.

If buoyancy is enabled, VR-Vantage calculates buoyancy only for models within certain distances of the observer, as follows:

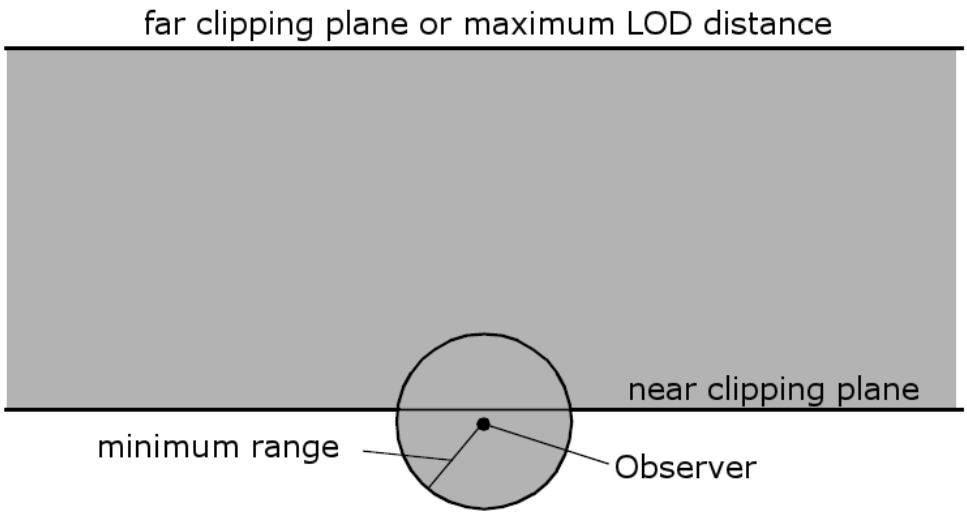
- Buoyancy models are always calculated for entities within the minimum cull distance. This ensures that if the observer turns, entities that are relatively near show buoyancy immediately.
- Buoyancy models are not calculated for entities that are beyond the maximum buoyancy LOD range. You can set this value on a per-entity basis in its entity model definition. If it is not set in the model definition, VR-Vantage uses the default LOD distance specified on the Entity Display Settings page. If the default distance is set to 0.0, then entities that do not have an LOD range set in their model definitions have an infinite buoyancy range (although buoyancy is still not calculated past the far clipping plane).
- Buoyancy models are not calculated for entities beyond the far clipping plane or nearer than the near clipping plane.



VR-Vantage uses the nearer of the far clipping plane or the maximum buoyancy LOD range to determine the distance at which it stops calculating buoyancy models.

When buoyancy is enabled, you can specify that VR-Vantage use face front culling. VR-Vantage calculates buoyancy models for all entities within the minimum range and all entities between the near clipping plane and the far clipping plane or maximum buoyancy LOD range, whichever is closest. In Figure 201, the shaded area is the area in which buoyancy models are calculated.

Figure 201. Face front culling



By default, face front culling is disabled and only distance culling is used.

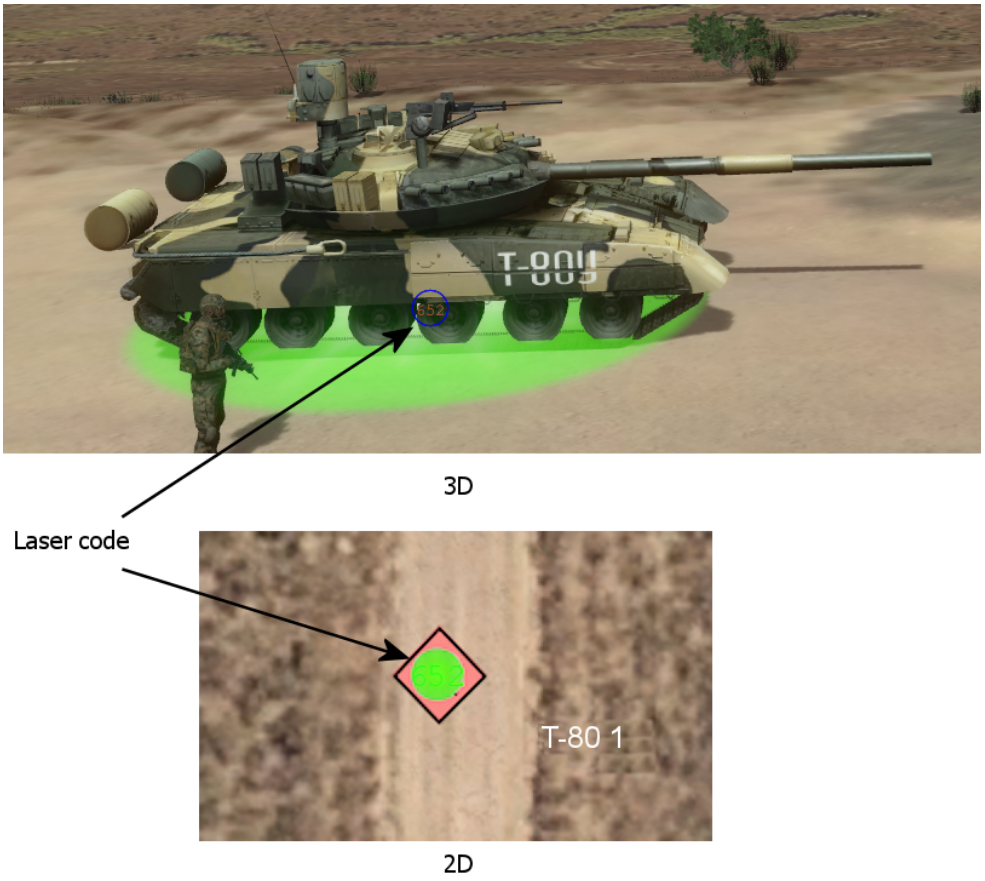
➤ **To enable or disable the buoyancy models:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 200 on page 374).
3. Select or clear the Enable Buoyancy Models for Surface Vehicles check box.
4. To specify the distance beyond which buoyancy models are not calculated, adjust the Default LOD Distance slider or change the value in the box. (If the default distance is set to 0, then entities that do not have an LOD range set in their model definitions have an infinite buoyancy range. However, buoyancy is not calculated past the far clipping plane.)
5. To specify the radius within which all entities have their buoyancy models calculated, adjust the Minimum Cull Distance slider or change the value in the box.
6. Optionally, specify use of face front culling.

21.13. Displaying Laser Designators

You can display laser designation information if it is available. VR-Vantage displays a green circle and the laser code (on top of the entity icon or model) (Figure 202).

Figure 202. Laser designators



➤ To display laser designators, choose **Settings > Laser Designators**.

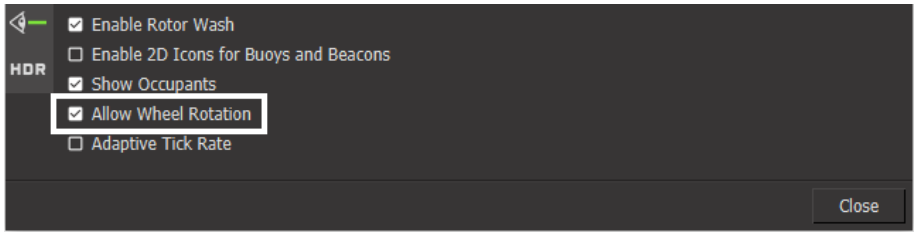
21.14. Enabling and Disabling Wheel Rotation

For vehicles that have articulated parts specified for the wheels, you can enable and disable rotation of the wheels. The rate of rotation is determined by the size of the wheel, the speed of the vehicle, and whether the vehicle is turning.

➤ **To enable or disable the rotation of vehicle wheels:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Entity Display Settings page (Figure 203).

Figure 203. Wheel Rotation Settings



3. Select or clear the Allow Wheel Rotation check box.



22. Intervisibility Objects

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

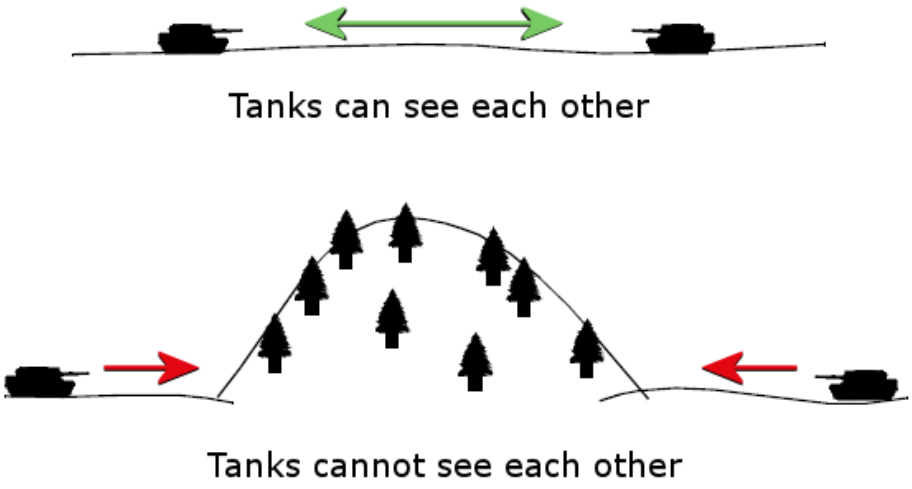
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22.1. Intervisibility (Line-of-Sight)

You can display intervisibility (line-of-sight or LOS) between points, within areas, and between a point and all simulation objects in a defined area. Intervisibility displays can be transient or permanent. Permanent intervisibility displays are objects. You can resize them and move them around the terrain. Intervisibility objects can be tied to a particular simulation object.

You can display a terrain profile for point-to-point intervisibility lines.

Figure 204. Intervisibility



You can configure parameters for intervisibility objects, such as the height above the terrain from which intervisibility is calculated. You can also change the colors used to display intervisibility.

- By default, intervisibility between simulation objects is calculated from the center of their bounding volumes. It is possible that this may not match the line-of-sight calculations used by the simulation application whose output you are viewing. If so, simulation objects may shoot at targets for which they do not appear to have line-of-sight. The VR-Forces target detection sensor uses an offset, which is often above the center of the entity. Unless you change the Origin LOS Elevation value in the Intervisibility Options dialog box to use the same offset as the target detection sensor, simulation objects may shoot at targets for which they do not appear to have line-of-sight.
- Linear and areal features do not block line-of-sight. Only point features block LOS.

22.2. 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.

22.2.1 Point-to-Point Intervisibility

Point-to-point intervisibility (Figure 205) 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.

Figure 205. Point-to-point intervisibility



2D 3D

22.2.2 Intervisibility Fan

An intervisibility fan (Figure 206) 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, see "22.5. Configuring Intervisibility Lines and Fans" on page 385.)

Figure 206. Intervisibility fan

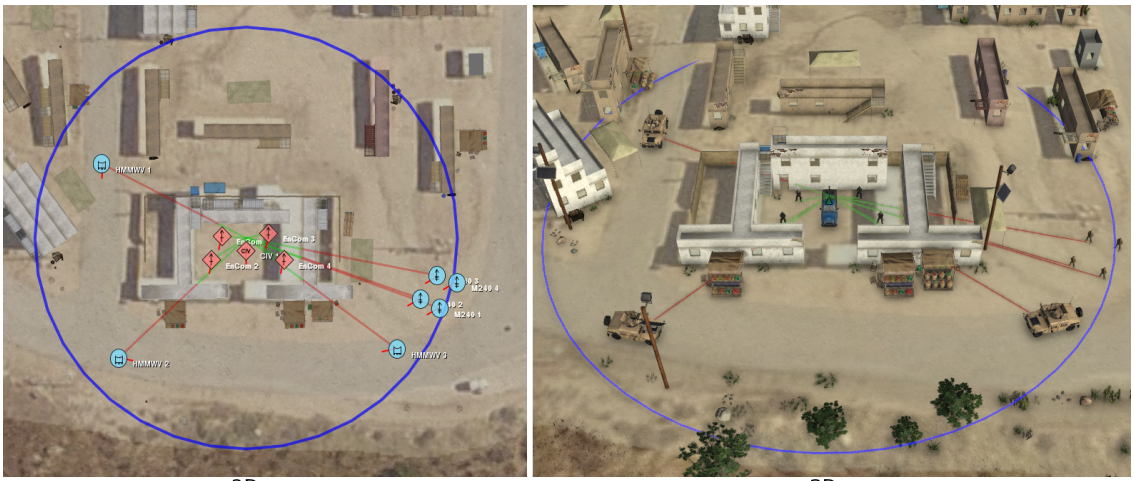


2D 3D

22.2.3 Simulation Object Intervisibility

Simulation object intervisibility (Figure 207) shows which simulation objects are visible from the center of a defined area and whether or not the simulation objects can see the center point. If you center the intervisibility circle on a point on the terrain, you can see which simulation objects can see that point. If you lock the circle to a simulation object, you can see which simulation objects can see that object and which it can see. (For details, see "22.5. Configuring Intervisibility Lines and Fans" on page 385.)

Figure 207. Simulation object intervisibility



2D 3D

22.3. Intervisibility Objects Can Be Transient or Permanent

You can configure intervisibility objects to be transient or permanent. (For details, see "22.5. Configuring Intervisibility Lines and Fans" on page 385.) 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.

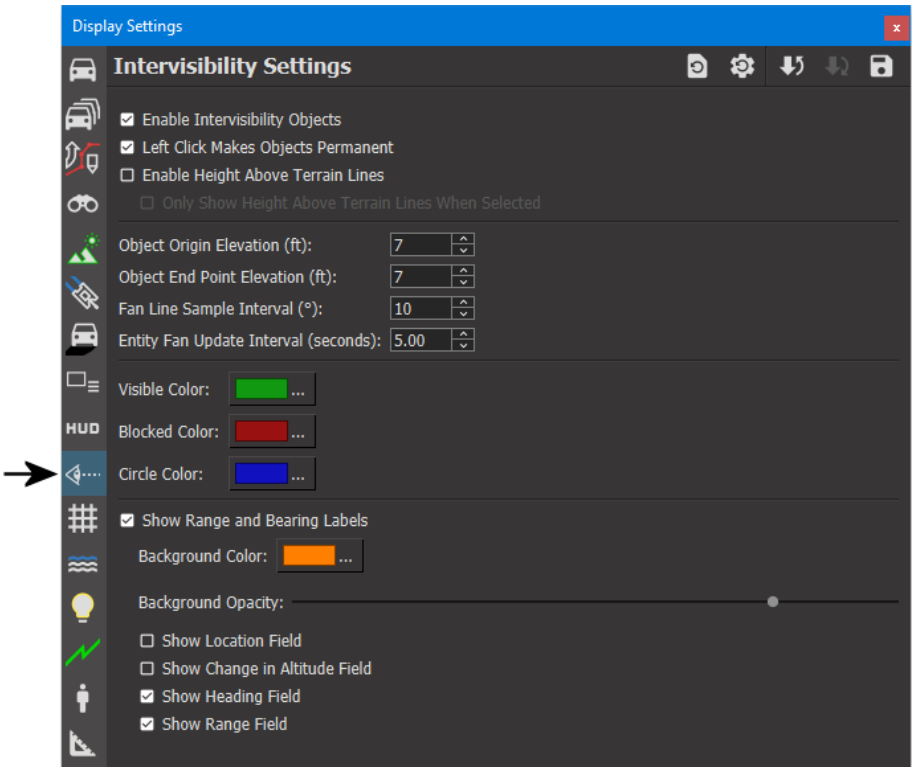
22.3.1 Creating a Transient Intervisibility Object

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 208).

Figure 208. Intervisibility Settings page



3. Clear the Left Click Makes Objects Permanent check box.
4. Choose **Intervisibility > Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar.
5. Click on the terrain to place the origin of the intervisibility object.
6. Move the cursor around the terrain to expand and contract the object. For point-to-point intervisibility, moving the cursor also changes the direction of the line.

7. To change the origin of the intervisibility display, click another location on the terrain.
8. Right-click to cancel intervisibility mode.

22.3.2 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 208 on the previous page).
3. Select Enable Intervisibility Objects.
4. Select Left Click Makes Objects Permanent.
5. Choose **Intervisibility > Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar.
6. Click on a simulation object or on a location on the terrain where you want the origin of the intervisibility object to be located. An intervisibility object is displayed. As you move the cursor closer to the origin, or farther away from it, the circle or line contracts and expands. If you are displaying point-to-point, you can rotate the line around the origin before you specify the end point.
7. Click on the terrain where you want to fix the end point of a line or border of a circle.

22.4. Editing an Intervisibility Object

You can change the following aspects of an intervisibility object:

- The location of either end point of an intervisibility line, to change its length and direction.
- The origin of an intervisibility fan, thereby moving the entire fan.
- The diameter of an intervisibility fan.



If an intervisibility object is anchored to a simulation object, you cannot change the origin.

➤ **To change the length or diameter of an intervisibility object:**

1. To edit a line, double-click its end point.

   To edit a fan, select the object, then double-click the outer ring of the fan.

   The cursor changes to  .
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.

22.5. Configuring Intervisibility Lines and Fans

You can configure the following attributes of intervisibility objects:

- The elevation of the origin and end point.
- The sampling rate for intervisibility fans.
- The update rate for entity intervisibility fans.
- Display of height above terrain lines (3D) and height labels (3D and 2D).
- The colors used to display intervisibility objects.
- Display of bearing and range labels. For more information about bearing and range labels, see "22.8. Displaying Intervisibility Line Information" on page 387.

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.

VR-Forces can calculate intersections in the front-end or in the back-end.

➤ **To configure intervisibility objects:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 208 on page 383).
3. For Intersection configuration, select the intervisibility object to configure in the Intervisibility list.
4. Change the settings as desired. Table 16 describes the settings.

Table 16. Intervisibility settings

Option	Description
Enable Intervisibility Objects	Enables the creation of intervisibility objects.
Left Click Makes Objects Permanent	Enables permanent intervisibility objects. See "22.3.1 Creating a Transient Intervisibility Object" on page 383 and "22.3.2 Creating a Permanent Intervisibility Object" on page 384.
Enable Height Above Terrain Lines	Enables or disables display of height above terrain lines (3D) and height labels (3D and 2D).
Only Show Height Above Terrain Lines Only for Selected	If selected, HAT lines are displayed only for the selected intervisibility objects.
Object Origin Elevation	The height, in meters, above the terrain at the origin point from which to calculate intervisibility.
Object End Point Elevation	The height, in meters, above the terrain at the end point to use to calculate intervisibility.
Fan Line Sample Interval	The distance, in degrees, between each ray in a intervisibility fan. After changing this value, press **Enter** or click away from the field.
Entity Fan Update Interval	How frequently, in seconds, to update the entity intervisibility fan.
Visible Color Blocked Color	The colors to use for the portion of an intervisibility line that a simulation object can see and the portion where visibility is blocked.
Circle Color	The color to use for the outer circle of an intervisibility fan.
Range and Bearing	
Show Range and Bearing Labels	Enable or disable display of range and bearing labels.
Background Color	Specify the background color for range and bearing labels.
Background Opacity	Specify the opacity of the background for range and bearing labels.
Show Location Field	If range and bearing labels are displayed, show the location of the endpoints.
Show Change in Altitude Field	If range and bearing labels are displayed, show the difference in altitude between the endpoints.
Show Heading Field	If range and bearing labels are displayed, show the heading of each endpoint relative to the other point.
Show Range Field	If range and bearing labels are displayed, show the length of the intervisibility line.

22.6. Pinning an Intervisibility Object to a Simulation Object

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

➤ **To pin an intervisibility object to a simulation object:**

1. Select the simulation object to which you want to pin the intervisibility object.
2. Choose **Intervisibility > Create** *intervisibility_type*, where *intervisibility_type* is a type of intervisibility object, or click one of the buttons on the Intervisibility Toolbar. The origin is placed on the simulation object icon or model.
3. Specify the end point for the intervisibility object.

22.7. 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 208 on page 383).
3. Select or clear the Enable Intervisibility Objects check box.

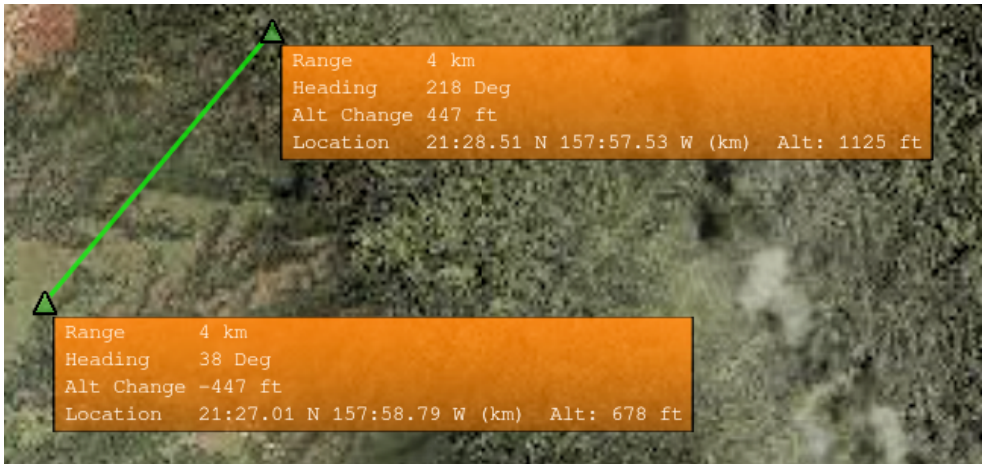
> You can also enable and disable display of intervisibility objects by choosing **Intervisibility > Enable/Disable Intervisibility**, or by clicking the Enable/Disable Intervisibility button ( ) on the Intervisibility Toolbar.

22.8. Displaying Intervisibility Line Information

You can display the following information about an intervisibility line:

- Location of each endpoint.
- Heading of the line from each endpoint.
- Altitude of each endpoint.
- Length of the line (range).

Figure 209. Intervisibility line information (2D)



The information label has a background. You can adjust the color and opacity of the background.

➤ **To display information about an intervisibility line:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Intervisibility Settings page (Figure 208 on page 383).
3. Select or clear the Show Range and Bearing Labels check box.
4. Select the check boxes for the type of information you want to display. For descriptions of the check box options, see Table 16 on page 386.
5. To change the background color for the label:
    a. Click the Background Color button. A color picker opens.
    b. Select the color you want to use for the background.
    c. Click OK.
6. To change the opacity of the background, adjust the Background Opacity slider.

22.9. Deleting Intervisibility Objects

➤ To delete an intervisibility object, select the object and choose **Intervisibility > Delete** (or press **Delete**).



23. Sound Effects

This chapter explains how to enable and configure sound effects.

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23.1. Introduction to Sound Effects

VR-Vantage can associate sound effects with entities, fire events, and detonation events. You can enable and disable use of sound effects and you can specify settings that determine how sounds are perceived.

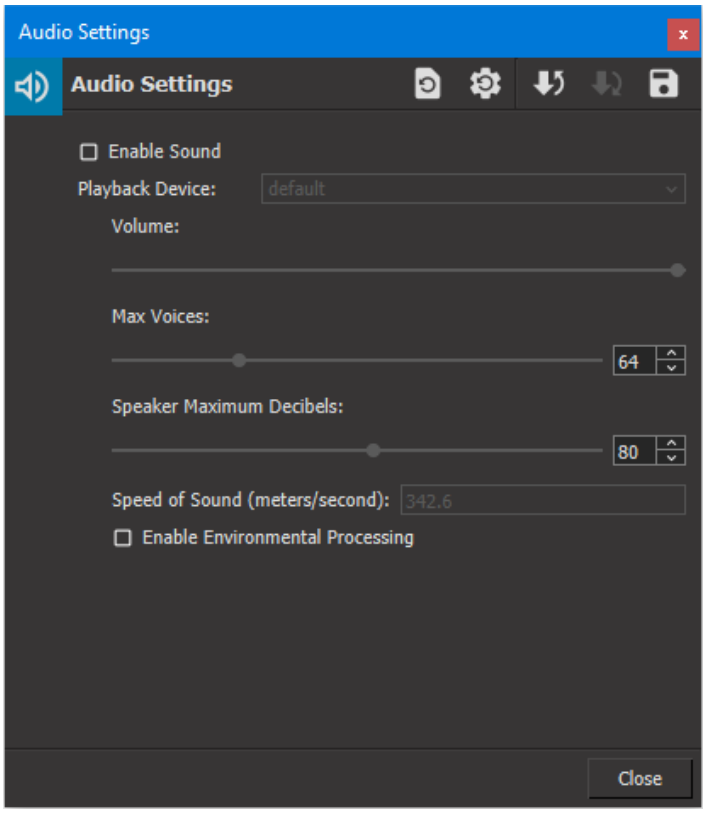
Using sound effects can degrade performance.

23.2. Enabling Sound Effects

➤ **To enable sound effects:**

1. Choose **Settings > Audio Settings**. The Audio Settings dialog box opens (Figure 210).

Figure 210. Audio Settings page



2. Select the Enable Sound check box.
3. Optionally, specify the playback device (speaker).

You can also enable and disable sound effects by clicking the Audio button ( ) on the Display Settings toolbar.

23.2.1 Configuring Sound Effects

You can configure the following sound settings:

- Volume. This is the volume of the system.
- Max Voices. You can have from 1 to 256 voices, or maximum simultaneous playing sounds. Sounds that play at the same time are mixed into a single sound wave prior to being sent to the speaker. This mixing has a CPU cost. A high number of allowable voices can affect performance when there are many audio sounds trying to play.
- Speaker Maximum Decibels. Calibrates the audio system for the speakers that the system is played on. This affects how sounds at a distance fall off so that the sound loudness is realistically replicated. The default setting of 80db represents headphones or a desktop PC's speakers. See "23.2.2 Decibels Configuration" below for more information.
- Speed of Sound. This is the speed of sound in the atmosphere in meters/second. The default value is derived by using a standard day as parameters (20 C, 50% relative humidity, 1013.25 mbar/29.92 inHg). This affects the delay in playing sounds at a distance. For example, an explosion 2km away has a several second delay from the time you can see the visual effect to when you can hear the audio effect.
- Enable Environmental Processing. Enables low pass filtering. As sound propagates through air, higher frequency sounds get absorbed more the further you move from the source of the sound. This setting lets you replicate air absorption of a sound based on the distance the sound is from the listener.

➤ **To configure sound settings:**

1. Choose **Settings > Audio Settings**. The Audio Settings dialog box opens (Figure 210 on the previous page).
2. To set the volume, adjust the Volume slider.
3. To specify the maximum number of voices, adjust the Max Voices slider or change the value in the text box.
4. To set the speaker maximum decibels, adjust the Speaker Maximum Decibels slider or change the value in the text box.
5. To set the speed of sound, type a value in the Speed of Sound box.
6. To enable lowpass filtering, select the Enable Environmental Processing check box.

23.2.2 Decibels Configuration

As a feature, the VR-Vantage audio system uses a sound decibel scaling system to compensate for the deployed sound systems such as headphones, computer speakers, and amplifiers. This helps provide a similar audio experience regardless of the system that you use.

You can configure each individual entity sound to match real world characteristics. For example:

- A whisper or rustling of leaves registers at 20 dB.
- A conversation at home is approximately 50 dB.
- A passenger car traveling on the freeway at 50 feet away is 70 dB.
- Inside a helicopter cabin 100 dB.

When configuring the decibels (dB) for a sound, you should select a decibel level that represents the level near the sound source. The dB setting should be the loudest level that you would ever want to hear the sound, which might differ from the real-life level. This allows the audio system to calibrate the sound levels automatically.

For each sound, based on the Speaker Maximum Decibels setting, the audio system computes a sound "reference" distance and "falloff" distance:

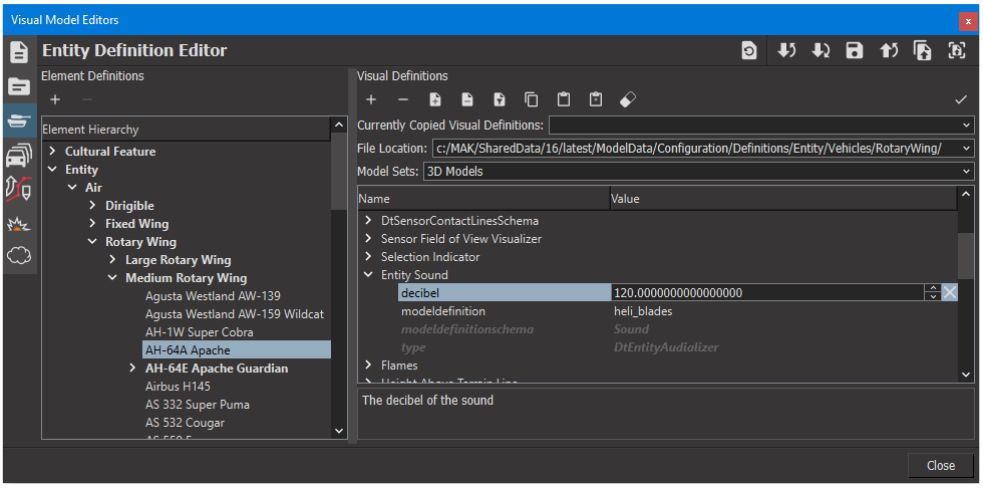
- The reference distance is the distance at which the sound is the loudest it can be heard.
- The falloff distance is the distance at which the sound can no longer be heard.

These examples show when a VR-Vantage entity's sound is configured to be 80 dB and the observer is closet to the entity:

- If the Speaker Maximum Decibels is set to 80 dB or lower, then the sound will be played and heard at its maximum volume.
- If the Speaker Maximum Decibels is set to 120 dB, then the sound will be played at a lower volume because the speaker system is expected to increase the heard volume to 80 dB.

Other sound effects settings are covered in "23.2.1 Configuring Sound Effects" on the previous page.

Figure 211. Example of entity decibel setting in Entity Definition Editor



23.3. Associating Sound Files with Entities and Events

VR-Vantage includes a set of sound files (WAV format) for generic entity platforms and for fire and detonation events. The files are in *./SharedData/16/latest/Audio/Sounds*. You add and edit mappings between entity

types, fire events, or detonation events and sound files in the Visual Models Editor.

Sound files are associated with model definitions. For example, the **filename** parameter for the heli_blades model definition specifies *$(SHARED_DATA_DIR)/Audio/Sounds/heli_blades.wav*. The Rotary Wing element definition has a parameter called **Entity Sound**. The value for the **model definition** attribute is **heli_blades**.

You can quickly see which model definitions are available for sounds by filtering the list of the Visual Model Editors, Model Definitions Editor page for the Sound schema.



24. Configuring Emitter Volumes

This chapter explains how to configure the display of emitter volumes.

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24.1.1 Configuring Emitter Volume Color 396
24.1.2 Controlling Emitter Volume Radius 397
24.1.3 Configuring Emitter Volume Segments 397

24.1. Configuring Emitter Volumes

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



In order for an entity to display emitter volumes in 2D observer modes and 3D observer modes, it must have a 2D Emitter Volume visualizer in its 2D model set and 3D Emitter Volume visualizer in its 3D model sets. The DefaultEllipsoidArc model definition is an attribute of the visualizer.

24.1.1 Configuring Emitter Volume Color

By default, emitter volumes are displayed using fixed colors for high frequency and low frequency. You can configure emitter volumes to be colored based on the emission frequency or pulse rate. When emitter volume color represents frequency, color is determined by the frequency field of the EM Emission update message. In both cases, you specify a low frequency or pulse rate value and a high value.

If the emitter frequency or pulse rate is lower than your specified low value, the emitter volume is red. As frequency rises above the specified low value, emitter volume color changes, progressing through the colors of the visible spectrum until the specified high value is reached. At the high value and above, the emitter volume is violet.

To change coloring from the default, you must add the appropriate attributes to the emitter volume visualizer for the entities whose model definitions you want to change. Table 17 describes the emitter volume visualizer attributes that affect emitter volume color.

Table 17. Emitter volume visualizer attributes

Attribute	Description
colorByFrequency	If True, color by frequency instead of using static colors.
lowFrequency	The low frequency threshold for coloring by frequency. Default: 800 MHz.
highFrequency	The high frequency threshold for coloring by frequency. Default: 1 GHz.
usePulseFrequency	If **colorByFrequency** is True and **usePulseFrequency** is True, color emitter volumes by pulse frequency.
lowPulseFrequency	The low pulse rate threshold for coloring by frequency. Default: 100 Hz.
highPulseFrequency	The high pulse rate threshold for coloring by frequency. Default: 3 KHz.

24.1.2 Controlling Emitter Volume Radius

An emitter volume's radius (that is, the distance it extends from the emitter) is based in part on emitter power and in part on elevation and azimuth sweep data obtained from EM-Emission state messages. A higher emitter power value results in a longer radius, while a wider field of view results in a shorter radius (because the radiated power is distributed over a wider area).

If VR-Vantage relied exclusively on these values, the range of sizes among different emitter types could become too wide to be practical, with some emissions being barely visible, and other emissions covering the entire virtual world. Therefore, a configurable exponent weight and scale factor have been added to help fine tune the emitter beam radii. The radius exponent weight (a value between 0 and 1) slows the growth of the radius when power or area is greater than 1 and increases the growth of the radius when power or area is less than 0. The scale factor increases the radii of all beams by the given value.

To change the scale factor and exponent from the default, you must add one or both of the following attributes to the emitter volume visualizer for the entities whose model definitions you want to change:

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

How VR-Vantage Calculates the Radius

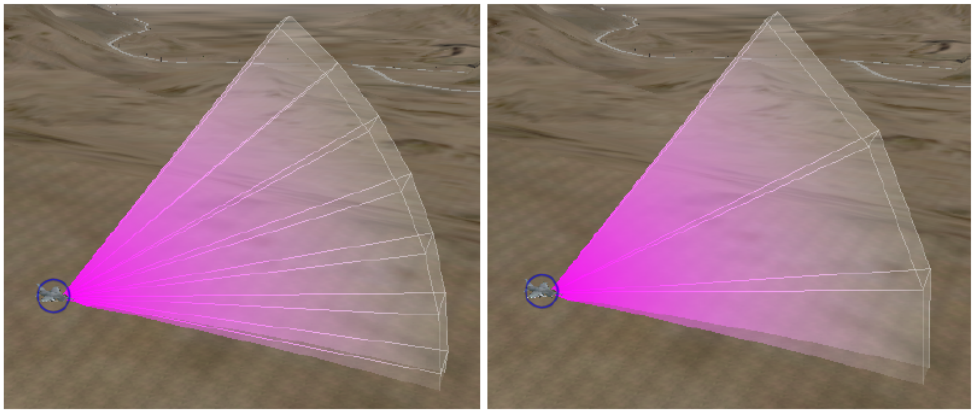
VR-Vantage calculates emitter volume radius by approximating the spread of the emissions based on the elevation and azimuth sweeps. If the approximate coverage is zero, it sets the value to 1. Then it applies the linear and exponential scaling values. The code for implementing this is as follows:

```
double tempVar = 8*elevationSweep*sin(2*azimuthSweep);
if (tempVar <=0) tempVar=1.0;
scale = linearScale * pow(sqrt(power/tempVar), exponentialScale );
```

24.1.3 Configuring Emitter Volume Segments

VR-Vantage displays an emitter volume as a group of spherical sections projecting from the sensing device. By default, for each 10 degrees (or portion thereof) in the emitter's field of view, VR-Vantage draws one segment. Figure 212 shows segments set to 10^0 (the default) and 30^0.

Figure 212. Emitter volume segments



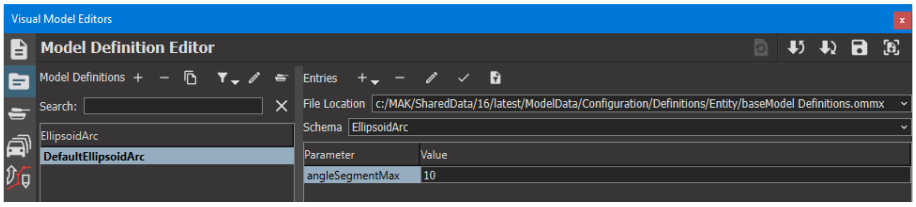
Emitter volume segments are managed by the EllipsoidArc schema and model definitions based on it. VR-Vantage ships with one ellipsoid arc model definition – DefaultEllipsoidArc. You can edit this model definition or create copies of it and customize them. If you want to have different emitter volumes for different entities, assign a different ellipsoid arc model definition to each one.

Specifying the Segment Angle

➤ **To specify the segment angle:**

1. Decide whether you want to export the edited model definition to its own file or to an existing file. (For details about the model definition work flow, see "Model Definition Files" in the *Adding Content to MAK ONE Applications Reference Manual*.)
2. Choose **Settings > Visual Model Editors**. The Visual Model Editors dialog box opens.
3. Select the Model Definition Editor page (Figure 213).
4. If you want to export the edited model definition to an existing file, use the Load and Replace procedure to load the file. (For details, see "Importing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)
5. Click the Filter button ( ) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
6. Select DefaultEllipsoidArc (Figure 213).

Figure 213. EllipsoidArc model definition

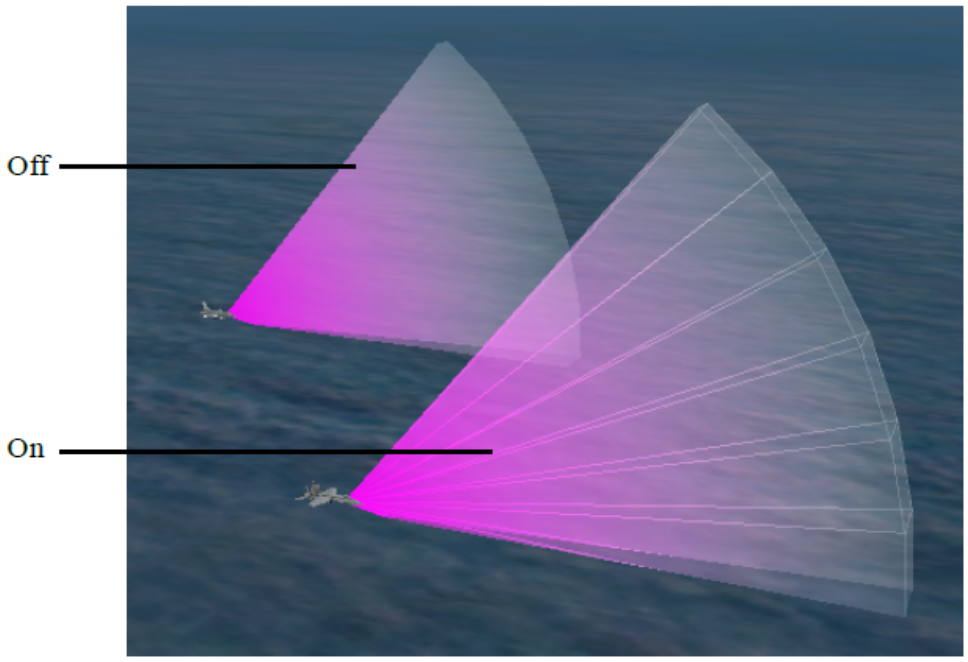


7. Click the Add a new parameter button ( ) and select **angleSegmentMax**.
8. Change the value of the **angleSegmentMax** parameter. The minimum value is 10 (degrees); the maximum is 45.
9. Export the updated setting to the loaded definition file or to a separate file.

Displaying Segment Outlines

By default, VR-Vantage displays opaque outlines showing the segment edges along the surface of the emitter volume.

Figure 214. Segment outlines



➤ **To display or hide segment outlines:**

1. Decide if you want to export the edited model definition to its own file or to an existing file. (For details about the model definition work flow, see "Model Definition Files" in the *Adding Content to MAK ONE Applications Reference Manual*.)
2. Choose **Settings > Visual Model Editors**. The Visual Model Editors dialog box opens.
3. Select the Model Definition Editor page.
4. If you want to export the edited model definition to an existing file, use the Load and Replace procedure to load the file. (For details, see "Importing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)
5. Click the Filter button ( ) and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
6. Select DefaultEllipsoidArc.

7. Change the value of the **showLines** parameter.
8. Export the updated setting to the loaded definition file or to an individual file.

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. Decide if you want to export the edited model definition to its own file or to an existing file. (For details about the model definition work flow, see "Model Definition Files" in the *Adding Content to MAK ONE Applications Reference Manual*.)
2. Choose **Settings > Visual Model Editors**. The Visual Model Editors dialog box opens.
3. Select the Model Definition Editor page (Figure 213 on page 398).
4. If you want to export the edited model definition to an existing file, use the Load and Replace procedure to load the file. (For details, see "Importing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.)
5. Click the Filter button () and select EllipsoidArc. The ellipsoid arc model definitions are listed in the window.
6. Select DefaultEllipsoidArc.
7. Click the Duplicate Model Definition button (). The Duplicate Model Definition dialog box opens with a default definition name.
8. Accept the generated name or type a new name for the model definition.
9. Click OK. The model definition is added to the list.
10. Change the parameter values for the new model definition as desired.
11. Select the Entity Definition Editor page.
12. Select the entity whose emitter volume you want to change.
13. Select the 3D Sensor Volume visualizer for the entity.
14. Click the Value column for the **modeldefinition** attribute. The Choose Model Definition dialog box opens. It has a list of model definitions.
15. Select the model definition that you just created.
16. Click OK.
17. Export the updated setting to the loaded definition file or to an individual definition file.
18. If you are connected to an exercise, disconnect and then reconnect to enable the new model definition.



VII. Terrain

A terrain is a representation of the earth or a portion of it on which simulated entities move about. VR-Vantage allows you to build your terrain at runtime using a variety of database and vector formats. It can load OpenFlight, DTED, CDB, MetaFlight, and GDB (MAK 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.

Terrain Databases Provided with VR-Vantage

Table 18 describes the terrain databases provided with VR-Vantage. Some have variants, which indicate the coordinate system or other variations. Terrains with "(online)" in the title connect to VR-TheWorld Server or another online server and require an internet connection. Some terrains have variations that emphasize a particular set of features or other data. VR-Vantage also has a supplemental data package that includes additional terrains. Please contact your MAK salesperson for download details.

Table 18. Terrain databases shipped with VR-Vantage

Variation	Description
Aeronautical Charts.mtf	US Sectional Air Charts for IFR (Instrument Flight Rules) with base imagery. This terrain is designed for airspace simulation using the 2D projection (plan view).
Ala Moana.mtf Ala Moana - optimized for VR.mtf	A high-resolution area of Honolulu, Hawaii, USA, set into a raster map of the world. This terrain is stored locally and does not require an internet connection. The optimized version is intended for use with Virtual Reality devices. It is much smaller than the standard Ala Moana terrain.
ArrivalsHall.mtf	An interior model of an international arrivals hall with passport control stations.
Bakersfield Topo Map (online).mtf	VR-TheWorldOnline with topographical maps for the area around Bakersfield, California, USA. This terrain contains some feature data that simulation objects in aggregate-level scenarios can take advantage of.
Brooklyn.mtf Brooklyn (online).mtf	A high resolution city center surrounded by an extruded cityscape. Located geographically in Brooklyn, NY, USA, but not an actual location in that city.
DestructibleTerrain.mtf	A small terrain for demonstrating destructible terrain based on switch nodes.
Ground_DB II	FBX. A simple, generic ground terrain, including a road and some buildings, surrounded by water.
LittlePond (online).mtf	Flat earth. Shape data. Imagery. A detailed suburban inset in a larger, less detailed terrain covering Boston, Massachusetts, USA and points west.

Table 18. Terrain databases shipped with VR-Vantage (continued)

Variation	Description
MAK Earth (online).mtf MAK Earth (online) - Optimized for VR.mtf	VR-TheWorld Server terrain with high resolution insets for California, Honolulu, Hawaii, and some other cities. Includes streaming feature data. The optimized version is intended for use with Virtual Reality devices. It is a more basic version of the MAK Earth (online) terrain.
MAK Earth Base (online).mtf	VR-TheWorld Server MAK Earth terrain with high resolution insets for Honolulu, Hawaii, and Boston, Massachusetts. Includes streaming feature data.
MAK Earth Space (online).mtf	A procedurally generated earth merged with high-resolution imagery and elevation.
MAK Proving Ground.mtf	A non-realistic terrain with buildings, trees, roads, a runway, different types of soil, slopes, and other environments. It is designed specifically for testing.
MAK Proving Ground Island.mtf MAK Proving Ground Island Geocentric.mtf	A simple island you can use for testing. There is a flat earth version and a geocentric version.
Makland.mtf	UTM. OpenFlight. A fictional terrain created by MAK. It includes a variety of terrain and feature data, including underwater features. It is placed in the Indian Ocean.
Massachusetts S-57 (online).mtf	A terrain that has S-57 chart data for Boston Harbor in Massachusetts.
ProceduralEarth (online).mtf ProceduralEarth - OpenStreetMap (online).mtf	Procedurally generated terrains. Images are generated based on land use data, resulting in high quality visual imagery without the overhead of high resolution static images. Terrains include procedural airports with airport data for all airports in the world, and street data from OpenStreetMap.
RhoneValley (online).mtf	A procedurally generated view of the Rhone Valley in France, including procedural airports.
Sadr City.mtf Sadr City (online).mtf	An urban geotypical Middle Eastern terrain in Sadr City, Iraq, a suburb of Baghdad. Ideal for urban scenarios.
SanLuisObispo.mtf	Flat earth. DTED. Imagery. A terrain that covers a portion of California, USA.
SanLuisObispoTopoGdal.mtf	Geocentric. San Luis Obispo in topographic coordinates as local streaming terrain using an earth file.

Table 18. Terrain databases shipped with VR-Vantage (continued)

Variation	Description
Test terrains	Multiple terrains used for testing different terrain database capabilities.
Truman Carrier.mtf	A model in VR-Forces of an aircraft carrier as a terrain object rather than a simulation object.
VR-Village.mtf	GDB. Feature data. OpenFlight terrain. VR-Village is a fictional database created by MAK. It has a highly detailed small town in a larger, sparsely detailed desert environment. The town includes multilevel buildings, underground tunnels, and a road that tunnels through a mountain. The coordinates place it off the west coast of Africa.
WorldFlatEarthNoElevation.mtf	Flat earth. Low resolution projected image of the world.
WorldGeocentric.mtf	Geocentric. Low resolution projection of the world.



25. Changing How the Terrain Displays

This chapter explains how to find out information about a terrain by changing how it displays.

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25.1.1 Displaying a List of Vector Features 407
25.1.2 Changing the Colors Used for Feature Data 408
25.2. Displaying Grid Lines 409
25.2.1 Configuring Grid Lines 410
25.3. Selecting a 2D View Layer 411
25.4. The Map Scale Overlay 411
25.5. Configuring Visible Surfaces (GDB Soil Types) 412
25.6. Displaying Models and Terrain in Wireframe Mode 413

25.1. Displaying Feature Data (2D)

If a terrain contains feature data, you can display it in the Plan View observer mode. Figure 215 shows a section of the Little Pond terrain with features disabled and enabled.

Figure 215. Feature data



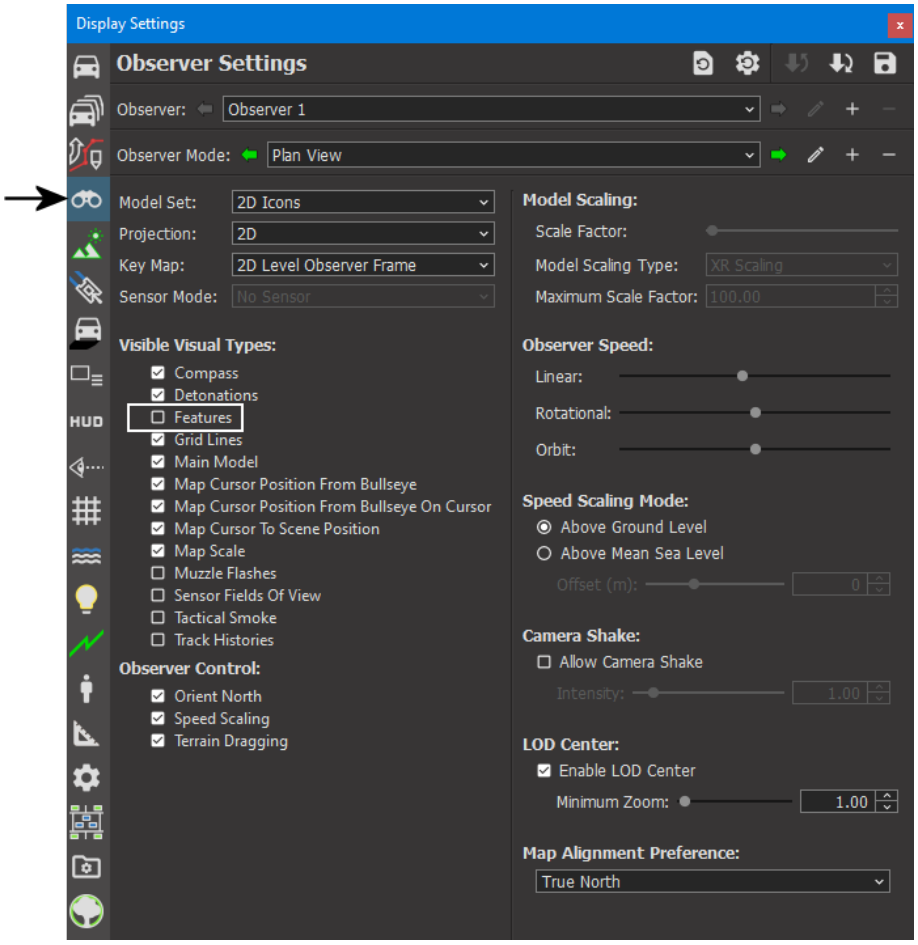
This setting only displays features imported from GDB files or shapefiles. It does not display features streamed from a terrain server. If you load features using an earth file, they are drawn (or not drawn) based on the configuration information in the file.

If your terrain has many features, displaying them can take a long time.

➤ **To show or hide feature data:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page.
3. In the Observer Mode list, select Plan View (Figure 216).

Figure 216. Observer Settings page, Plan View observer mode



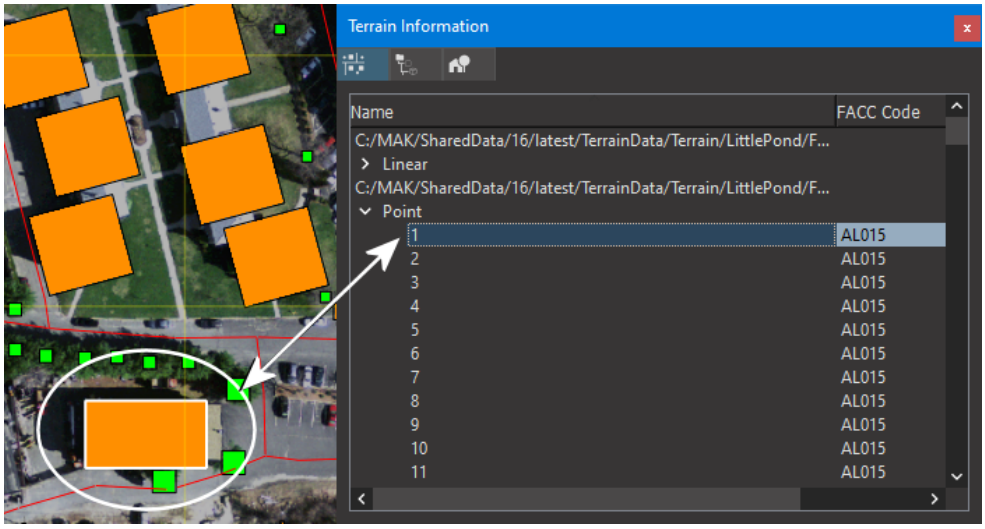
4. Select or clear the Features check box.

> You can also enable or disable display of feature data by choosing **Observer > Features**.

25.1.1 Displaying a List of Vector Features

If a terrain has vector features, they are listed on the Vector Network tab of the Terrain Information Panel. If you select a feature in the list, it is highlighted in the display, and the other way around (Figure 217).

Figure 217. Vector feature selected



➤ **To display the feature list:**

1. Choose **View > Terrain Information Panel**. The Terrain Information Panel opens.
2. Select the Vector Network tab (Figure 217).
3. Expand the top-level categories to see the lists of individual features.

25.1.2 Changing the Colors Used for Feature Data

If a terrain database contains feature data, you can change the colors used to display it. In Figure 218 the Woodland feature in the Little Pond terrain was changed to pink. Compare it to the default color (Figure 215 on page 406).

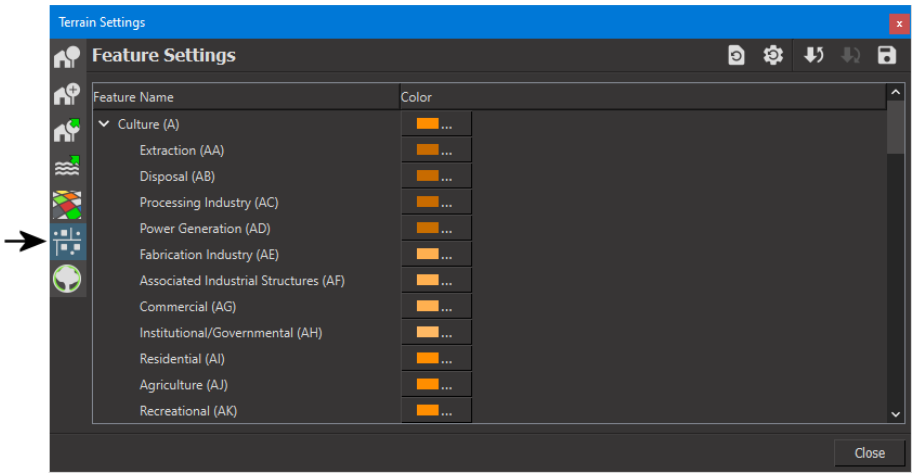
Figure 218. Feature data with color change



➤ **To change the color of feature data:**

1. Choose **Settings > Terrain**. The Terrain Settings dialog box opens.
2. Select the Feature Settings page (Figure 219).

Figure 219. Feature Settings page



3. Click the color swatch for the feature that you want to change. A color picker dialog box opens.
4. Select the color that you want to use.
5. Click OK.

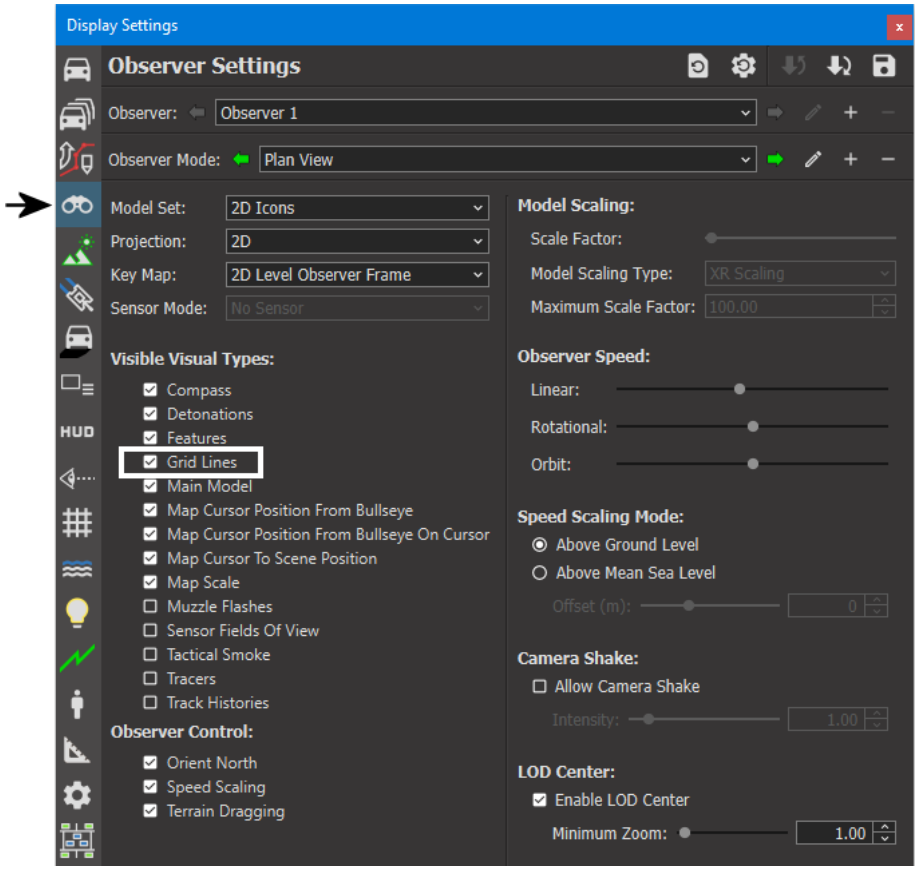
25.2. Displaying Grid Lines

VR-Vantage can display grid lines in the 2D view. Grid-lines are an observer-specific setting.

To enable or disable grid lines:

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Observer Settings page (Figure 220).

Figure 220. Observer Settings page



3. Select Plan View mode (or a locally created 2D observer mode).
4. Select or clear the Grid Lines check box.

> You can also enable or disable grid lines by choosing **Observer > Grid Lines**.

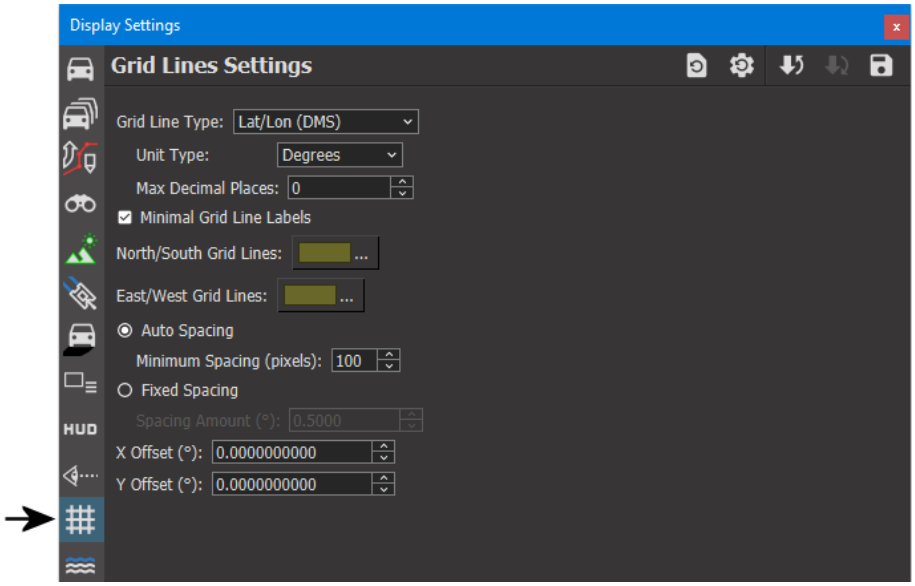
25.2.1 Configuring Grid Lines

You can configure the coordinate system used for grid lines, the precision, and the spacing. Spacing can be fixed, in meters, or determined by VR-Vantage using a specified number of screen pixels. Fixed spacing can result in a very tight grid and unreadable labels as you zoom out. Auto spacing does not have this problem. However, the grid lines 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 221).

Figure 221. Grid Lines Settings page



3. To change the coordinate system used for grid lines, select an option in the Grid Line Type list. The list displays grid line types that are appropriate for the type of database loaded. (If no database is loaded, the coordinate system is set to Flat Earth.)
4. To specify the unit type for the grid line labels, select an option on the Unit Type list.
5. To specify the precision of the grid line labels, enter a value in the Max Decimal Places box.
6. To show more or less information at each grid line, clear or select the Minimal Grid Line Labels check box.
7. To use different colors for the north/south or east/west grid lines, choose a color for the lines.
8. To change the spacing type, select AutoSpacing or Fixed Spacing and specify a value for the chosen spacing type.
9. To specify an offset from the origin, change the values for X Offset and Y Offset.

25.3. Selecting a 2D View Layer

osgEarth terrains can have different visible layers to display in the Plan View observer mode. These can be layers defined specifically to display contour lines, annotations, and so on.

➤ To select a 2D View Layer, choose the layer from the 2D View Layer toolbar.

25.4. The Map Scale Overlay

In Plan View Observer mode, you can display a map scale overlay on the terrain.

Figure 222. Map scale overlay

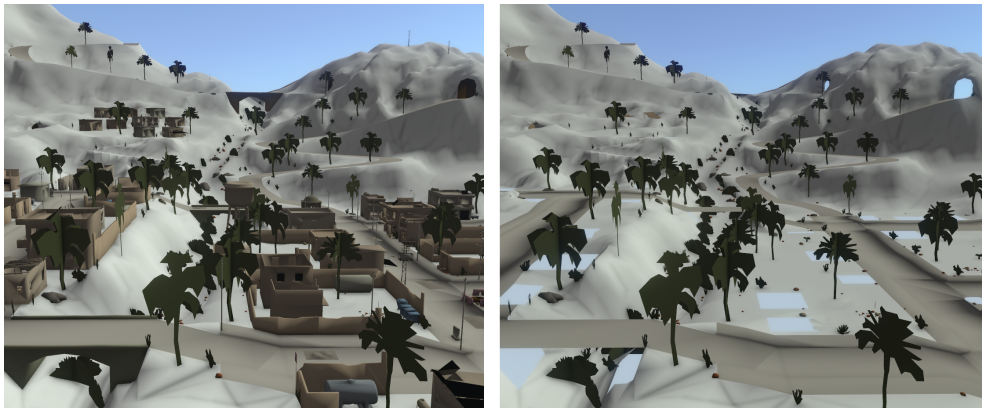


➤ To view or hide the map scale overlay, choose **Observer > Map Scale**.

25.5. 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 223 shows the *VR-Village.gdb* terrain file. The view on the left shows all soil types. The view on the right has Building, Grass, and Rock surfaces hidden.

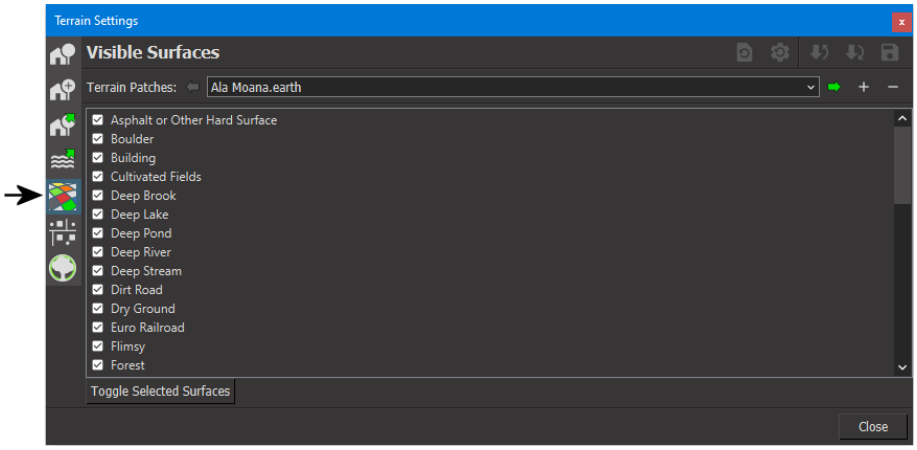
Figure 223. Visible surfaces toggled off



➤ **To display or hide GDB soil types:**

1. Choose **Settings > Terrain**. The Terrain Settings dialog box opens.
2. Select the Visible Surfaces page (Figure 224).

Figure 224. Visible Surfaces page

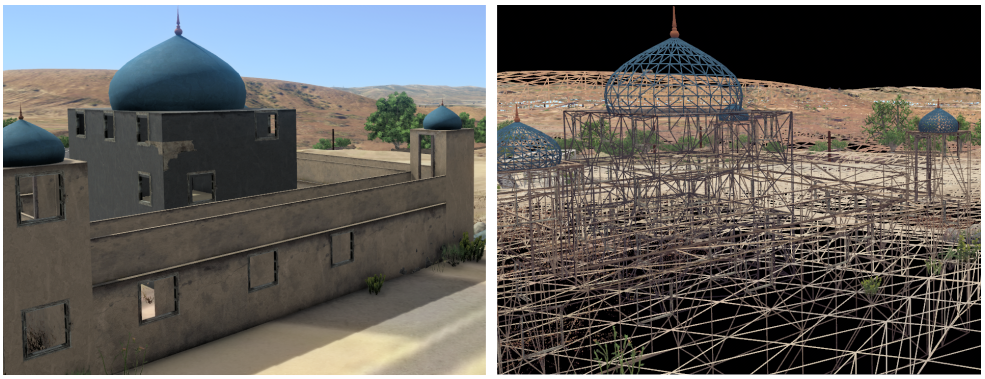


3. In the Terrain Patches list, select the terrain patch that you want to configure.
4. Select the check box for each soil type that you want to be visible.
5. Clear the check box for each soil type that you want to hide.
6. To change the state of multiple soil types at one time:
    a. Select (highlight) the names (not the check boxes) of the soil types whose state you want to change.
    b. Click Toggle Selected Surfaces.

25.6. Displaying Models and Terrain in Wireframe Mode

In wireframe mode, VR-Vantage displays the polygons that make up the terrain and objects (Figure 225).

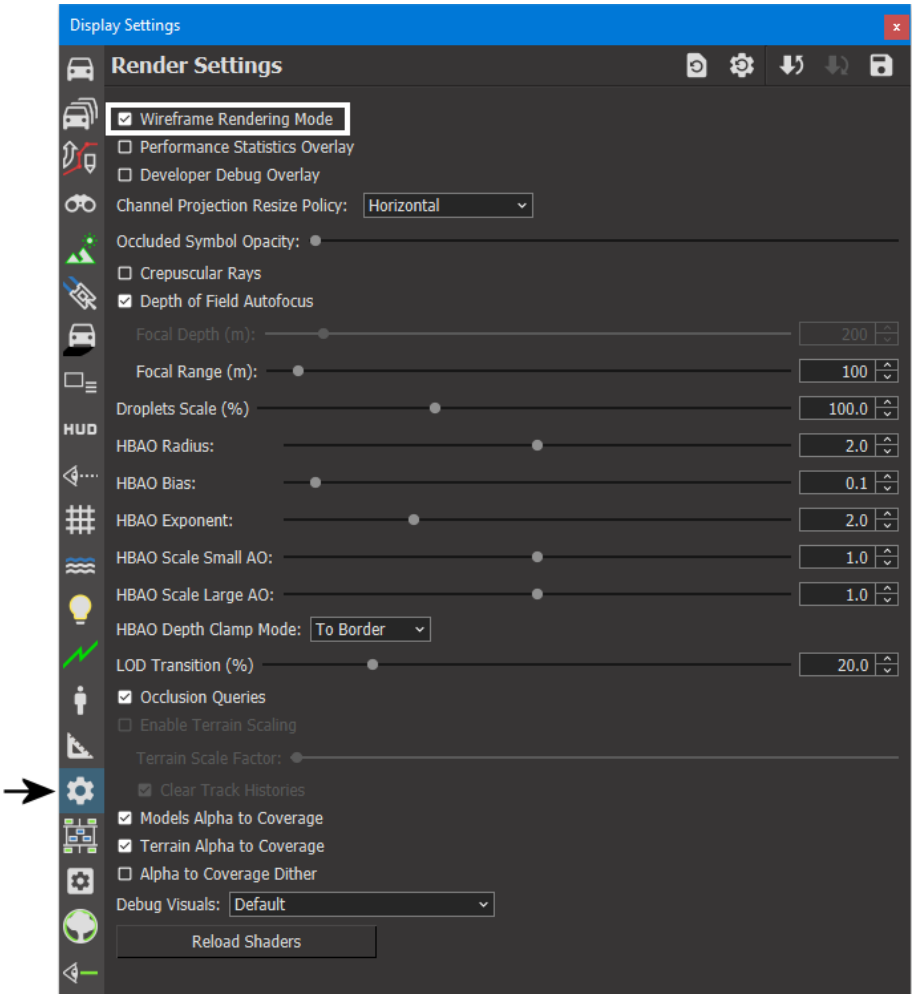
Figure 225. Wireframe off and on



➤ **To enable or disable wireframe mode:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Render Settings page (Figure 226).

Figure 226. Render Settings page



3. Select or clear the Wireframe Rendering Mode check box.

> You can also enable and disable wireframe mode by choosing **Settings > Wireframe Rendering**.



26. Composing Terrains in VR-Vantage

This chapter explains how to combine various types of data to build a terrain.

26.1. Terrain Agility and Composability 416
26.1.1 Supported File Formats 416
26.1.2 Feature Layers and Props 418

26.1. 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 terrain patches, elevation, image, and feature data files. This method is best for relatively small terrains that do not require paging. It supports all of the coordinate systems that VR-Vantage supports. The Makland (*Makland.mtf*) and VR-Village (*VR-Village.mtf*) terrains provided with VR-Vantage are examples of this method. For more information, see "Creating a Composed Terrain" in the *Adding Content to MAK ONE Applications Reference Manual*.
- Specify a set of files to load using an earth file. Use this method to stream terrain data from local or remote sources. This method is best for terrains with large amounts of elevation or image data, which would benefit from paging. For more information, see "Connecting to Terrain Servers" in *Adding Content to MAK ONE Applications Reference Manual*.

When you compose a terrain, you can save it as a MAK terrain file (MTF), which is essentially a description of all of the data used to visualize the simulated 2D and 3D environment. Later, you can open the MTF file and VR-Vantage will automatically load all of the data that you loaded manually when you first created the terrain.

These two methods of loading terrain data are not mutually exclusive. You can stream terrain using an earth file and also load hand-modeled terrains as terrain patches. *MAK Earth (online).mtf* is an example of combining streamed terrain from VR-theWorld Server, and hand-modeled terrain (the Ala Moana inset in Honolulu, Hawaii, USA).

You can save terrains in a cached format that loads terrain data more quickly than if the terrain is created from the source data. For details, see "Configuring File Caching" in the *Adding Content to MAK ONE Applications Reference Manual*.

26.1.1 Supported File Formats

VR-Vantage can import elevation, terrain, images, models, and feature data. Some types of files can contain more than one type of information. For example, GeoTIFF files can have elevation data or only image data. The following sections list the supported formats.

In theory, VR-Vantage can load any format supported by osgEarth if you use the earth file format to load them. However, VR-Vantage does not include drivers for all of the formats supported by osgEarth. Furthermore, when using osgEarth, VR-Vantage only supports geocentric terrains. If you are uncertain about support for a particular format, please contact support at https://www.mak.com/mak-one/support/portal.

Terrain Data

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

- MAK encrypted data format (*.medf*)
- OpenFlight (*.flt*)
- MetaFlight (*.mft*)
- Shape terrain data (*.shp*)
- TerraPage (*.txp*)
- CDB (using an earth file)

VR-Vantage provides limited support for data in the following formats. If you have problems loading data in these formats, MAK will try to assist you, but cannot guarantee that it will be possible to use your data.

- 3DS
- OSG

Elevation Data

VR-Vantage supports the following types of elevation data:

- DTED (*.dto*, *.dt1*, *.dt2*, *.dted*)
- GeoTIFF
- DEM
- Arc/Info Binary Data (*.adf*)
- Other formats supported by osgEarth

Supported Image Formats

You can import images in the following formats:

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

- GIF
- ECW (Windows only)
- Other formats supported by osgEarth using the GDAL driver. For a list of formats supported by GDAL, go to https://gdal.org and select the Supported Formats link. If you have problems loading an image format that is not in this list, please contact our support at https://www.mak.com/mak-one/support/portal. However, we cannot guarantee that unlisted formats are fully supported. For more information about earth files, see "Connecting to Terrain Servers" and the chapter on *Loading Data Using Earth Files* in the *Adding Content to MAK ONE Applications Reference Manual*.

Supported Feature Data Formats in the Front-end

VR-Vantage supports the following feature data formats in the front-end:

- Shape files
- S-57
- OGR vector formats referenced in earth files

26.1.2 Feature Layers and Props

A terrain can have objects such as buildings and trees embedded in it. These objects cannot be manipulated in this format. However, VR-Vantage lets you extract these types of objects from the terrain and render them independently as props. Props are terrain elements that you can manipulate as separate objects.

You can add props to a terrain by extracting them from an external reference in a terrain patch or from a feature layer. You can also add props directly from the Props Palette.

A feature layer is a file that contains feature data such as point features, linear features, and areal features. You can extract point features as props. You can extract props from MAK Terrain Format (GDB) files, shapefiles (SHP), or DFAD data (DFD).

For more information, see "Adding Props to a Terrain" in the *Adding Content to MAK ONE Applications Reference Manual*.

Geometric Representation of Point Feature Data

There are differences between how the front-end and back-end process feature data. This is because the information needed to simulate simulation object interaction with features is different from the information needed to render the scene.

The front-end renders point features such as buildings or trees based on the data provided in the feature layer. These objects could have been extracted as props, in which case they are represented as geometric objects in the terrain.

If you are streaming features using an earth file, you can configure the earth file to extrude buildings into 3D geometry. This capability is demonstrated in some of the insets in *MAK Earth (online).mtf*, for example the Boston and Honolulu insets.

The back-end representation of point features depends on how they are used. Collision avoidance treats them as bounding volumes with infinite height. Line-of-sight calculations treat them as bounding volumes with a defined height. If you extract features as props, the back-end treats them as geometry where that is appropriate and as features otherwise.

The back-end does not recognize extruded geometry.

Feature Data Types Supported by the Back-end

The back-end supports the following types of feature data files:

- MAK terrain database (*.gdb*)
- Shape terrain data (*.shp*)
- S-57
- WFS
- OGR vector formats referenced in earth files
- VMAP

The preferred format for adding features is shapefiles. You can extract feature data from GDB, DFD, and VMAP into shapefiles with the vectorNetworkToShapeFiles utility. For details, see "Extracting Feature Data from GDB to Shapefiles" in the *Adding Content to MAK ONE Applications Reference Manual*. You can extract feature data from S-57 files into shapefiles with the ogr2ogr tool. For details, see "Converting S-57 Feature Data to Shapefiles" in the *Adding Content to MAK ONE Applications Reference Manual*.



27. Using MetaFlight Terrains

To display MetaFlight files in VR-Vantage applications, you must first process them. This chapter explains how to do so.

27.1. Loading MetaFlight Terrains 422
27.2. Scaling the View Distance for MetaFlight Tiles 422

27.1. Loading MetaFlight Terrains

VR-Vantage supports MetaFlight terrain databases. To load a MetaFlight terrain, add a terrain patch, as you would for any other terrain. However, before you can load a MetaFlight file, you must process it using the mftTool and medfTool. For details, see the *Processing MetaFlight Files* chapter in the *Adding Content to MAK ONE Applications Reference Manual*.

When you load a MetaFlight file, VR-Vantagethe application is actually loading many individual OpenFlight files. If file caching is enabled, VR-Vantagethe application 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, see "Configuring File Caching" in the *Adding Content to MAK ONE Applications Reference Manual*.

> Geometry files referenced by a MetaFlight file must be in OpenFlight format, and not in Vega Prime's binary format (*.vsb*). MAK's terrain libraries do not support *.vsb* files.

27.2. Scaling the View Distance for MetaFlight Tiles

The LOD settings in a MetaFlight terrain determine the amount of detail that gets paged in for a given distance from the observer to a tile. The higher the detail of the tiles that get paged in, the greater the possibility that the frame rate may drop. Therefore, it makes sense to set LODs so that you do not page in tiles that are more detailed than you need to provide a good viewing experience. If a terrain's LODs are set too high, you need to rebuild the terrain to change the LODs. VR-Vantage lets you scale the view distance for tiles so that you can have the effect of lower LODs without needing to rebuild a terrain.

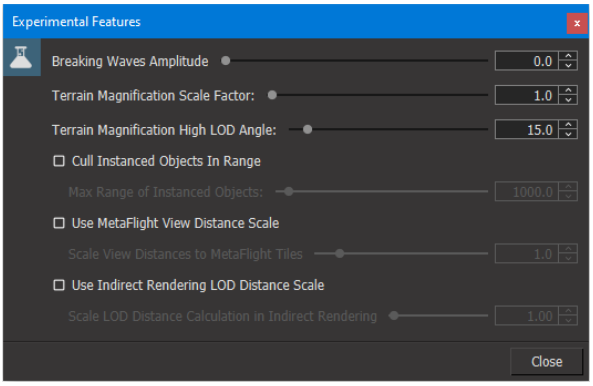
If you scale the view distance to a value greater than 1, VR-Vantage draws tiles as if they were farther away than they actually are. For example, if you set the scale to 2, a tile that is 500 meters away is drawn as if it is 1000 meters away.

> In addition to being useful for adjusting the behavior of terrains without rebuilding them, this feature can be used by terrain developers to help determine which LOD settings to use as they construct a new terrain.

➤ **To scale the viewing distance for MetaFlight tiles:**

1. Choose **Settings > Experimental Features.** The Experimental Features dialog box opens (Figure 227).

Figure 227. Experimental Features dialog box



2. Select the Use MetaFlight View Distance Scale check box. The Scale View Distances to MetaFlight Tiles slider becomes active.
3. Adjust the slider as desired.
4. Click Closed.



VIII. Graphics

This section discusses tactical and remote graphics.



28. 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.

28.1. Displaying Tactical Graphics 428
28.1.1 Showing and Hiding Tactical Graphics 428
28.1.2 Showing and Hiding Tactical Graphics Labels 429
28.1.3 Displaying Height-Above-Terrain Lines for Vertices 429
28.2. Displaying Remote Graphics 430
28.2.1 Viewing a List of Remote Graphics 432

28.1. Displaying Tactical Graphics

Tactical graphics are graphical objects that represent points, lines, areal objects, text, and symbols used for various purposes in simulations (Figure 228 and Figure 229). They could represent routes that simulation objects are following, a destination point, or a way to show some sort of relationship, such as height-above-terrain (HAT) lines. VR-Vantage can display tactical graphics published by VR-Forces.

You can configure the display of tactical graphics as follows:

- Enable and disable the display of tactical graphics.
- Show or hide vertex indicators for point, linear, and areal objects. (By default, vertex indicators are displayed only when a tactical graphic is selected, except for intervisibility and range lines.)
- Show or hide height-above-terrain lines.
- Display height-above-terrain lines only for selected graphics.

Figure 228. Tactical graphics with height-above-terrain lines (3D)

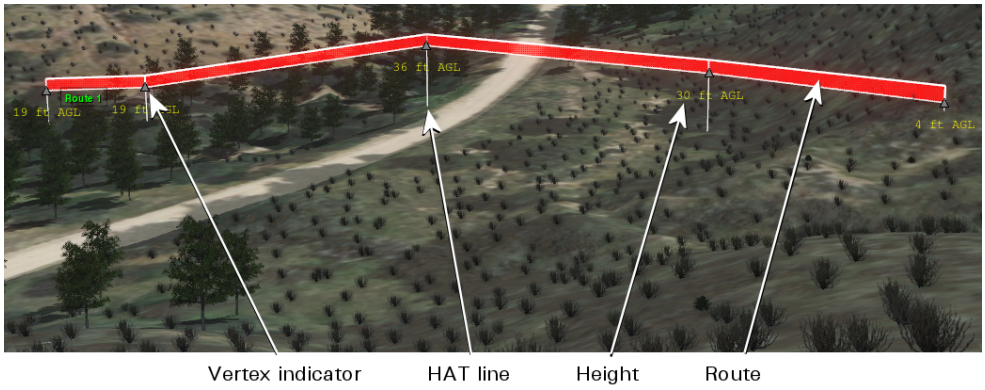


Figure 229. Tactical graphic (2D)



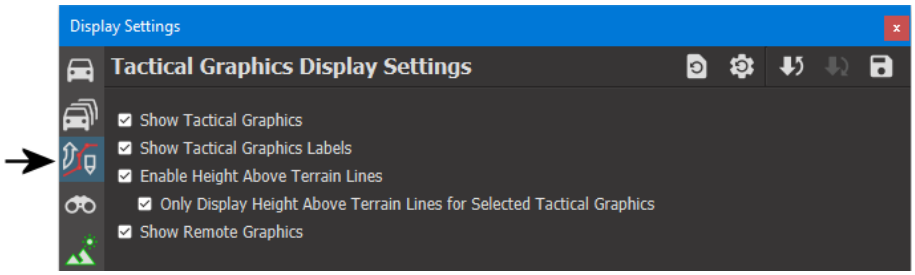
28.1.1 Showing and Hiding Tactical Graphics

You can control the display of tactical graphics from the Display Settings dialog box, Tactical Graphics Display Settings page, and also from menu and toolbar options.

➤ **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 230).

Figure 230. Tactical Graphics Display Settings page



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

You can also enable and disable tactical graphics by clicking the Tactical Graphics button ( ) on the Display Settings Toolbar.

28.1.2 Showing and Hiding Tactical Graphics Labels

In addition to displaying the outlines of tactical graphics, you can display graphics (labels) for the vertices of these objects. Vertex labels are enabled in Figure 228 on the previous page and Figure 229 on the previous page. In Plan View mode, VR-Vantage also displays a tactical graphic's name, label, and extended labels, if any. For details about displaying labels for 2D icons, please see "19.2.4 2D Icon Labels (Symbol Decorations)" on page 330.

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 230 above).
3. Select or clear the Show Tactical Graphics Labels check box.

You can also enable and disable tactical graphics labels by choosing **Settings > Tactical Graphics Labels** or clicking the Tactical Graphics Labels button ( ) on the Display Settings Toolbar.

28.1.3 Displaying Height-Above-Terrain Lines for Vertices

In 3D observer modes, you can display height-above-terrain (HAT) lines for the vertices of tactical graphics (Figure 228 on the previous page). These vertical lines

The height for each vertex is displayed (using whatever units are configured on the Display Units Settings page).

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.

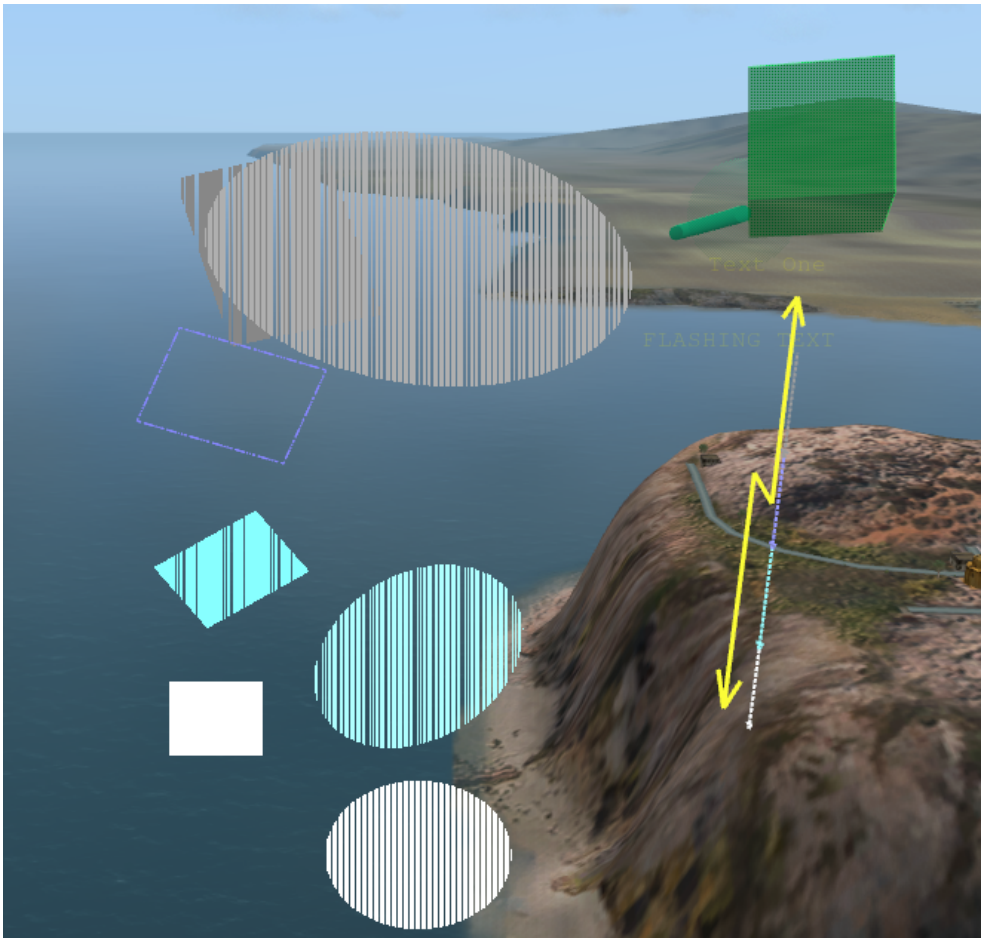
➤ **To show or hide height-above-terrain lines:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Tactical Graphics Display Settings page (Figure 230 on the previous page).
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.

28.2. Displaying Remote Graphics

VR-Vantage can display graphics sent from other applications using the VR-Vantage Remote Draw API (Figure 231).

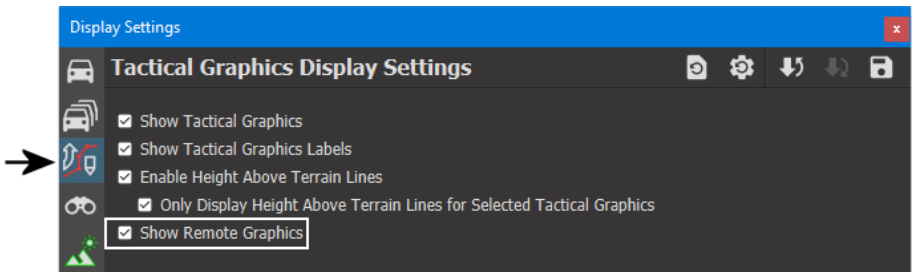
Figure 231. Remote graphics



➤ **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 232).

Figure 232. Tactical Graphics Display Settings page



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

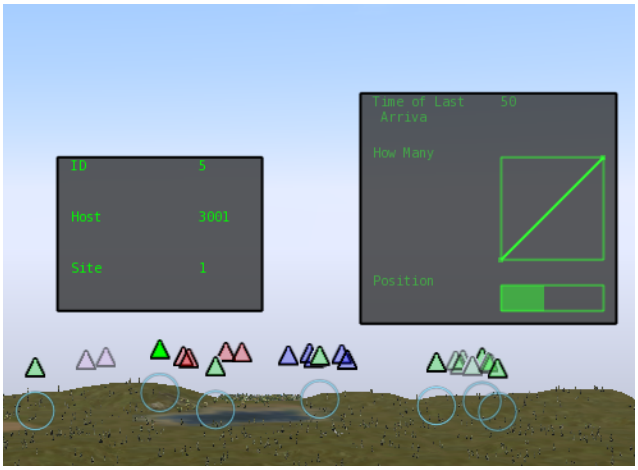
You can also enable and disable remote graphics by choosing **Settings > Remote Graphics**.

28.2.1 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 233 illustrates the attributes for the Entity and Packet attribute group templates displayed in Figure 234.

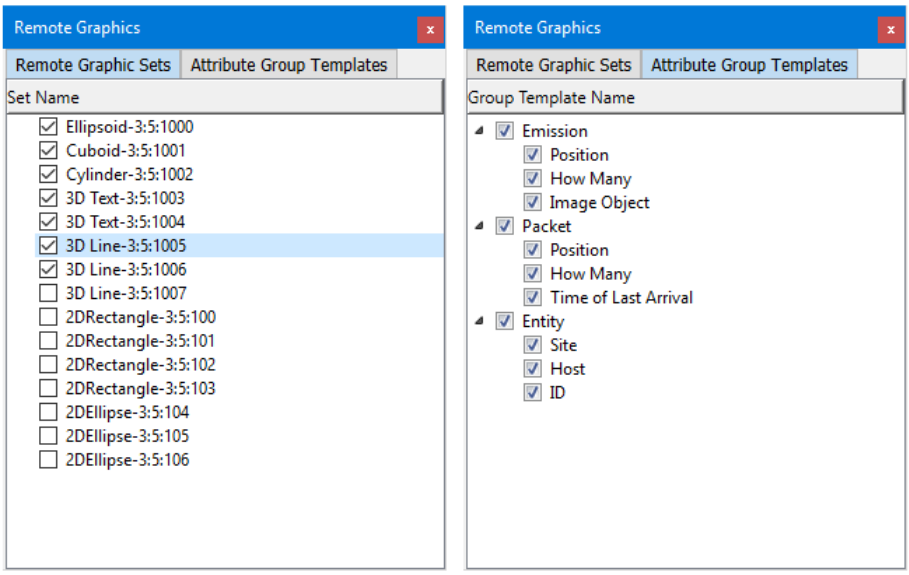
Figure 233. Remote graphics attribute group display



➤ **To view a list of remote graphics:**

1. Choose **View > Remote Graphics Panel**. The Remote Graphics Panel is displayed (Figure 234). The Remote Graphics Sets tab lists remote graphics by set.

Figure 234. 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.



IX. VR-Vantage Support for CIGI

VR-Vantage supports the Common Image Generator Interface (CIGI). The chapters in this section describe the extent of CIGI support. This includes a tutorial for using the included CIGI host application.



29. 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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29.1.2 CIGI Packet Support 439
29.1.3 Mapping CIGI Input to VR-Vantage 440
29.2. Mapping Entity Models for CIGI 440
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29.6. Controlling DI-Guy Links Using CIGI Articulated Part IDs 456
29.7. Prototypical Host – IG Configurations 457

29.1. 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 https://cigi.sourceforge.net. "Chapter 30. CIGI Host Emulator Tutorial" on page 459 describes how to use the host emulator to control VR-Vantage.

29.1.1 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 multithreaded 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.

29.1.2 CIGI Packet Support

VR-Vantage can receive the following CIGI packets:

- IG Control
- Entity Control. Collision Detection is not supported
- Entity Animation Control
- Entity Position Control
- Rotorwash Diameter Component Control
- Component Control
- Short Component Control
- Articulated Part Control
- Short Articulated Part Control
- Rate/Velocity Control
- Celestial Sphere Control: Only date/time is supported.
- Atmosphere Control
- Weather Control: Only rain and snow are supported.
- Maritime Surface Conditions Control
- Wave Control
- View Control
- Sensor Control
- View Definition: Mirror, Pixel Replication, and Orthographic projection are not supported.
- Collision Detection Segment Definition
- HAT/HOT Request
- Line of Sight Segment Request
- Line of Sight Vector Request
- Position Request
- Symbol Surface Definition
- Symbol Text Definition
- Symbol Circle Definition
- Symbol Line/Polygon Definition
- Symbol Control
- User-defined packet: VR-Vantage supports a user-defined packet for CIGI. For details, please see *DtCigiDiGuyCtrl.h*.

VR-Vantage can send the following packets:

- Start of Frame
- HAT/HOT Response
- HAT/HOT Extended Response
- Line of Sight Response
- Line of Sight Extended Response
- Sensor Response
- Sensor Extended Response
- Position Response
- Collision Detection Segment Notification

For a complete list of supported and unsupported fields for each packet type, see "Chapter 32. CIGI Packets Supported" on page 475.

29.1.3 Mapping CIGI Input to VR-Vantage

You map CIGI input to VR-Vantage models and other data files in the CIGI Mappings dialog box. You can map the following objects and components:

- CIGI entity models
- CIGI entity components
- CIGI system components
- CIGI regional sea surface components
- CIGI view components
- CIGI model states
- CIGI model animations
- CIGI database mappings
- CIGI observer mode mappings
- CIGI active sensor regions
- CIGI atmosphere components
- CIGI global terrain surface components
- CIGI light point groups
- CIGI sensor IDs
- CIGI sensor components
- CIGI fonts
- CIGI environmental conditions

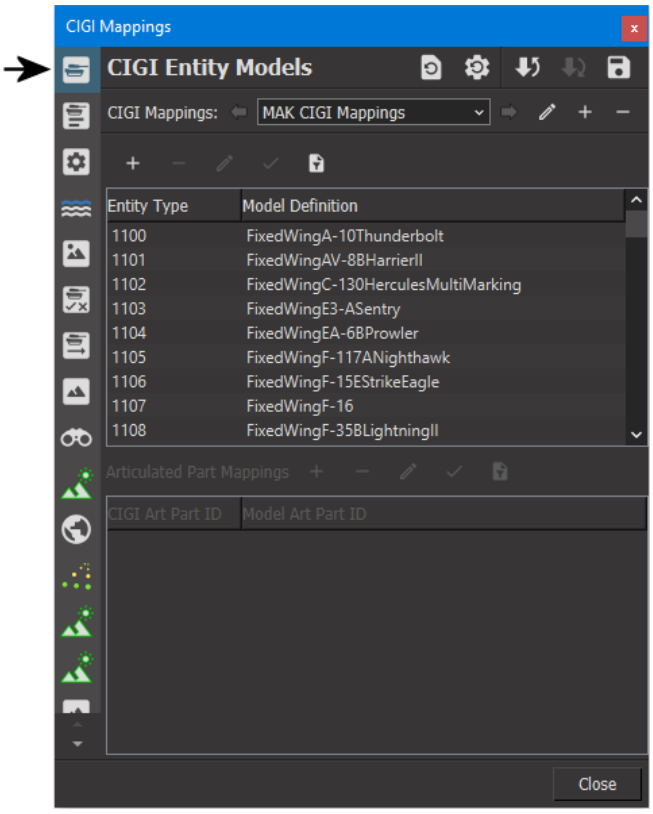
29.2. Mapping Entity Models for CIGI

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:**

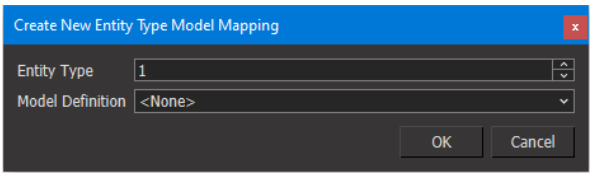
1. Choose **Settings > CIGI Mappings**. The CIGI Mappings dialog box opens.
2. Select the CIGI Entity Models page (Figure 235).

Figure 235. CIGI Entity Models page



3. Click the Add button (+) above the list of entity types. The Create New Entity Type Model Mapping dialog box opens (Figure 236).

Figure 236. 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.

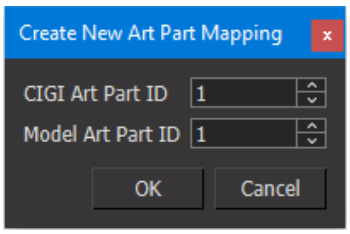
29.2.1 Adding an Articulated Part Mapping to an Entity Model

You can map articulated parts to an entity.

➤ **To add an articulated part mapping to an entity:**

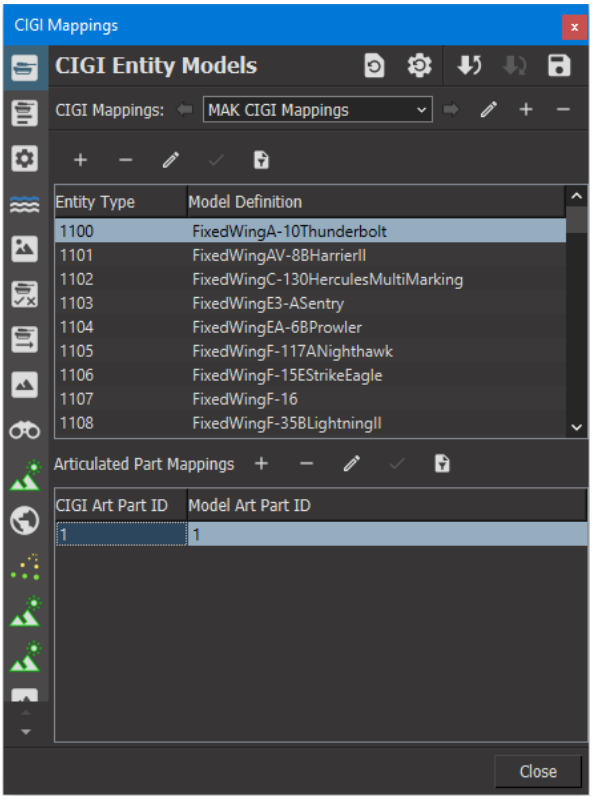
1. Choose **Settings > CIGI Mappings**. The CIGI Mappings dialog box opens.
2. Select the CIGI Entity Models page (Figure 235 on the previous page).
3. In the list of entity types, select the entity to which you want to add an articulated part. The Articulated Part Mappings window becomes active.
4. Click the Add button (+) next to the Articulated Part Mappings label. The Create New Art Part Mapping dialog box opens (Figure 237).

Figure 237. 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.

Figure 238. Articulated part mapping



29.3. 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.
  - Model State (Table 19 on page 445)
  - Animation speed (Table 20 on page 446)
  - Animation frame (Table 22 on page 446)
  - Animation range (Table 21 on page 446)
  - Waterline Origin Offset (Table 23 on page 447)
  - Sensor State (Table 24 on page 447)
  - Sensor Track Acquisition Box Control (Table 25 on page 447)
  - Amphibious Indicator (Table 26 on page 448)
  - Rotor wash diameter (Table 27 on page 448)
  - Rotor wash windspeed (Table 28 on page 448)
- Regional Sea Surface Component
  - Water Current (Table 29 on page 449)
- System Components

  - Shadows (Table 30 on page 449)
  - Wireframe Mode (Table 32 on page 450)
  - Performance Overlay (Table 31 on page 449)
  - Pager LOD Scale (Table 33 on page 450)
- View and View Group Components
  - View Magnification (Table 34 on page 451)
  - LOD Scale (Table 35 on page 451)
  - Attach View to Articulated Part (Table 36 on page 451)
  - Turn Channel On/Off (Table 37 on page 451)
- Atmosphere Component
  - Environmental Conditions Component Control (Table 38 on page 452)
  - Fog Color (Table 39 on page 452)
- Global Terrain Surface Components
  - Light Point Group (Table 40 on page 453)
  - Rain accumulation (Table 41 on page 453)
  - Snow accumulation (Table 42 on page 453)

The various component pages in the CIGI Mapping Settings dialog box allow you to specify the component IDs for these messages. The model state mappings specify the data for entity component controls.

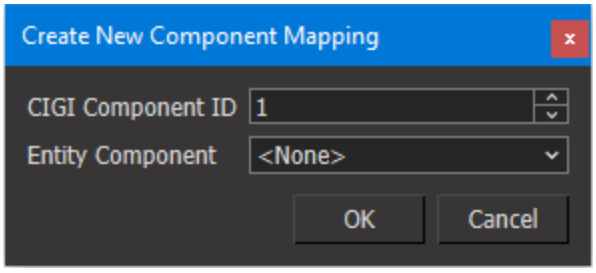
For each type of component, if there are two or fewer data fields being used, you can use a component control or short component control message to set the component data. If there are more than two data fields in use, you cannot use a short component control.

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 235 on page 441).
2. Select the page for the type of component you want to map.
3. Click the Add button (+) above the mapping window. The Create New Component Mapping dialog box opens (Figure 239).

Figure 239. Create New Component Mapping dialog box



4. Type an integer value for the component ID. This is the value that will be used in the Component ID field of a component control message.
5. Complete the dialog box as follows:
   - For entity, view, or system components, select the component type from the list. The options vary for the different component types.
   - For animation controls, type the name of an animation.
   - For model state, select an appearance from the list.
6. Click OK. The mapping is added to the window.

29.3.1 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 CIGI Entity Components page and a model state mapping as configured on the CIGI Model States mappings page.

Table 19. 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 20. Animation speed component control

Component Class	Entity (0)
Instance ID	Entity ID
Component ID	ID for animation speed, as set on the Entity Components Mappings page
Component State	Animation ID, as set on the Model Animations mappings page
Data 1	Speed (float)
Data 2	Not applicable

Table 21. 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 22. 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

Waterline Origin Offset Control

Entity models can have a waterline offset.

Table 23. Waterline offset component control

Component Class	Entity (0)
Instance ID	Entity ID
Component ID	ID for waterline offset, as set on the Entity Components Mappings page
Component State	Not applicable
Data 1	Offset (float)

Sensor State

Entity models can have a sensor state.

Table 24. Sensor state component control

Component Class	Entity (0)
Instance ID	Entity ID
Component ID	ID for sensor state, as set on the Entity Components Mappings page
Component State	Active region sensor state
Data 1	Active Region Number, as set in CIGI Active Sensor Region mappings page (unsigned int)

Sensor Tracking Acquisition Box

Sensors have an acquisition box.

Table 25. Sensor tracking acquisition box component control

Packet ID	4
Packet Size	32
Component ID	34
Sensor ID	ID of the sensor to which to apply the acquisition box
Component Class	Sensor (3)
Component State	Render Acquisition Box and Tracked Target
Center X	Pixels for X center of acquisition box (32-bit integer)
Center Y	Pixels for Y center of acquisition box (32-bit integer)
Box Width	Width in pixels of acquisition box (32-bit integer)
Box Height	Height in pixels of acquisition box (32-bit integer)

Amphibious Indicator

Entity models can have an amphibious indicator.

Table 26. Amphibious indicator component control

Component Class	Entity (0)
Instance ID	Entity ID
Component ID	ID for amphibious indicator, as set on the Entity Components Mappings page
Component State	On or Off

RotorWash Controls

A rotor wash is a DtCigiRotorWashEntity. You create these with Entity Control Packets, which are then attached to a rotary-wing vehicle with the Entity Control (v.3) or an Entity Position Packet (v.4).

There is one rotor wash for each DtCigiRotorWashEntity. To transition between terrains (for example, from dust to snow), delete one rotor wash entity and then create another. The particles remain for a short period after you delete the CigiEntity (up to ten seconds).

Table 27. RotorWash diameter component control

Component Class	Entity (0)
Instance ID	ID of DtCigiRotorWashEntity
Component ID	8 (CIGI entity components mapping)e
Component State	Not applicable
Data	Rotor wash diameter (float, 4 bytes)

Table 28. RotorWash windspeed component control

Component Class	Entity (0)
Instance ID	ID of DtCigiRotorWashEntity
Component ID	8 (CIGI entity components mapping)e
Component State	Not applicable
Data	Rotor wash windspeed (float, 4 bytes)

Regional Sea Surface Component Control

The Regional Sea Surface Component controls allow you to manage the water current. The table describes the fields and values for the control.

Water Current Control

Specify the water current.

Table 29. Water current component control

Component Class	Regional sea surface
Instance ID	Not applicable
Component ID	ID for Regional Sea Surface, as set on the Regional Sea Surface Components Mappings page
Component State	Not applicable
Data 1	Speed (float)
Data 2	Direction (float)

System Component Controls

There are system component controls that allow you to manage shadows, performance statistics overlay, wireframes, and pager LOD. The tables describe the fields and values for the 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 30. 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

You can also enable or disable the performance statistics overlay and wireframe mode. The component ID of either component can be set through the CIGI System Components page in the CIGI Mappings dialog box.

Table 31. Performance overlay component control

Component Class	System (13)
Instance ID	Not applicable
Component ID	Set in the System Components mappings page

Table 31. Performance overlay component control (continued)

Component State	0 — Disable performance statistics overlay 1 — Enable overlay
Data 1	Not applicable.
Data 2	Not applicable

Table 32. Wireframe mode component control

Component Class	System (13)
Instance ID	Not applicable
Component ID	Set in the System Components mappings page
Component State	0 — Disable wireframe mode 1 — Enable wireframe mode
Data 1	Not applicable.
Data 2	Not applicable

You can control the configuration of LOD scaling for database paging.

Table 33. Pager LOD Control

Component Class	System (13)
Instance ID	Not applicable
Component ID	Set in the System Components mappings page
Component State	Not applicable
Data 1	Floating point “terrain scale factor”. For details, see "15.6.3 Setting the Scale Factor for Terrain" on page 273.
Data 2	Floating point “High LOD View Angle”. For details, see "15.6.4 Setting the Magnification LOD Angle for Terrains" on page 274.

View and View Group Component Controls

You can enable or disable the view magnification and level of detail scale for both individual views and view groups using View and View Group Component Control messages, respectively. You can set the component ID for the components through the CIGI View Components page in the CIGI Mappings dialog box.

The same component IDs are used for View and View Group Control messages. The instance ID is the view ID for View Component Control messages or the view group ID for View Group Component Control messages. See "6.4.7 Channel Keywords" on page 130 for more information on assigning view IDs, and the CIGI specification for combining views into view groups using the View Definition message.

Table 34. View Magnification component control

Component Class	View (1) or View Group (2)
Instance ID	View ID or View Group ID (see above)
Component ID	Set in the View Components mappings page
Component State	Not applicable
Data 1	Floating point magnification value greater than 0. For details, see "15.6.1 Zooming the Observer in the 3D Projection" on page 272.
Data 2	Not applicable

Table 35. LOD Scale component control

Component Class	View (1) or View Group (2)
Instance ID	View ID or View Group ID (see above)
Component ID	Set in the View Components mappings
Component State	Not applicable
Data 1	Floating point LOD scale value greater than 0. For details, see "6.4.3 Changing a Channel's Frustum (Field of View)" on page 126.
Data 2	Not applicable

Table 36. Attach View to Articulated Part short component control

Component Class	View
Instance ID	View ID
Component ID	3
Component State	Not applicable
Component Data 1	CIGI View Group ID (unsigned int 16) & CIGI Entity ID (unsigned int 16)
Component Data 2	Articulated Part ID (unsigned int 32)

Table 37. Turn Channel On/Off

Instance ID	View ID
Component State	Enable/Disable Channel

Table 37. Turn Channel On/Off (continued)

View Component ID	4
Component ID	Not applicable
Component Data	Not applicable

Atmosphere Component Controls

You can use component controls packets to set environmental conditions. You can also set the color of an atmosphere obscurant. (This does not affect ground fog published by another application, such as VR-Forces.)

Table 38. Environmental Conditions Component Control Packet

Component Class	Atmosphere
Component State	1 - Clear 2 - Mostly Clear 3 - Partly Cloudy 4 - Cloudy 5 - Mostly Cloudy 6 - Overcast 7 - Rainy 8 - Snowy 9 - Sandstorm
Component ID	1 - "Change Environmental Condition"
Instance ID	Not applicable

Table 39. Fog Color Component Control Packet

Component Class	Atmosphere (10)
Component State	Not applicable
Component ID	2 - "Fog Color"
Instance ID	Not applicable
Float Data 1	Red (0 to 1)
Float Data 2	Green (0 to 1)
Float Data 3	Blue (0 to 1)

Global Terrain Surface Control and Light Point Groups

Light Point Groups

You can change the color setting for a light point group using the Terrain Surface Control messages. You can set the component ID used to specify that the message is for light point groups on the CIGI Global Terrain Surface Components page in the CIGI

Mappings dialog box. You can map the instance ID for a particular light point group to a light point group name on the CIGI Light Point Groups page in the CIGI Mappings dialog box.

Table 40 below describes the fields and values for the light point group color component control.

Table 40. Light point group color component control

Component Class	Global Terrain Surface Control (8)
Instance ID	Set in the Light Point Groups mappings page
Component ID	Set in the Global Terrain Surface Components page
Component State	Unused
Data 1	Floating point value for group's color red component
Data 2	Floating point value for group's color green component
Data 3	Floating point value for group's color blue component
Data 4	Floating point value for group's color alpha component

Rain and Snow Accumulation

You can use component control packages to directly manipulate the rain and snow accumulation parameters.

Table 41. Rain accumulation component control

Component Class	Global Terrain Surface Control (8)
Component ID	ID for rain accumulation, as set on the Global Terrain Surface Components Mappings page.
Float Data 1	Depth, in meters (interpreted as a percent coverage, from 0 to 0.01 (0-10 mm)

Table 42. Snow accumulation component control

Component Class	Global Terrain Surface Control (8)
Component ID	ID for snow accumulation, as set on the Global Terrain Surface Components Mappings page.
Float Data 1	Ground depth, in meters (interpreted as a percent coverage, from 0 to 0.01 (0-10 mm)
Float Data 2	Road depth, in meters (interpreted as a percent coverage, from 0 to 0.01 (0-10 mm)
Float Data 3	Minimum elevation in meters (Elevation where snow accumulation begins to appear)
Float Data 4	Elevation range in meters (Altitude from the minimum elevation point to the full amount of snow coverage)

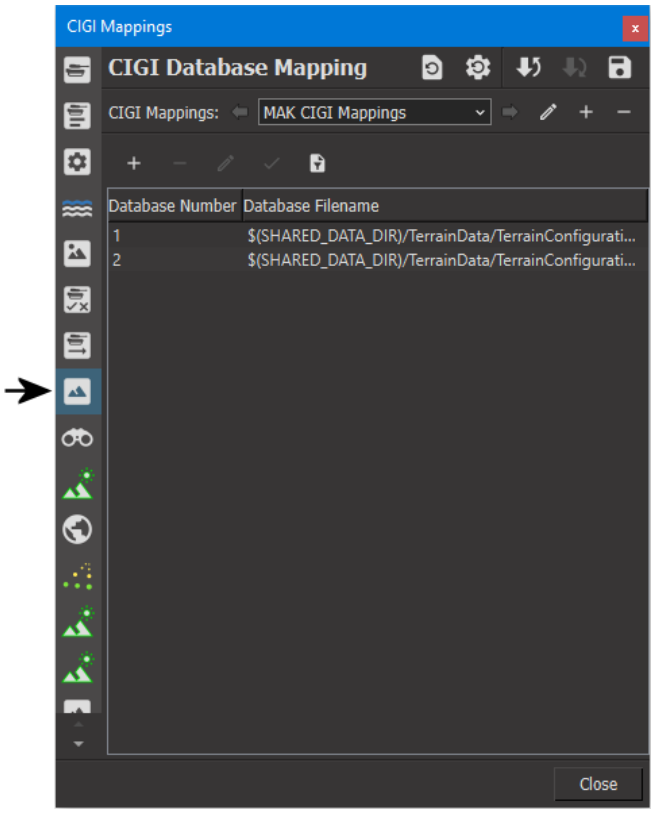
29.4. Mapping a Database

Similar to mapping components to IDs, in a simulation using CIGI you can map databases to database numbers. If the host sends a control message that specifies a database, VR-Vantage loads it. If a database is not mapped or the host does not send a control message to load a database, you must load the database in VR-Vantage as you normally would for other connection types.

➤ **To map a database:**

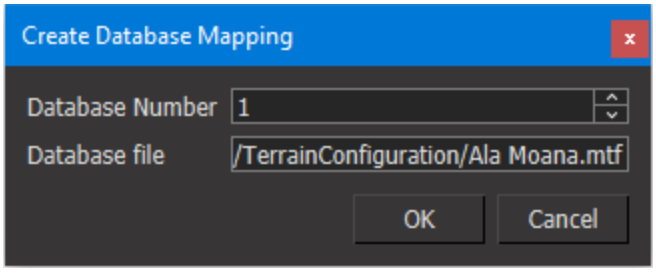
1. Choose **Settings > CIGI Mappings**. The CIGI Mappings dialog box opens (Figure 236 on page 441).
2. Select the CIGI Database Mapping page (Figure 240).

Figure 240. CIGI Database Mappings page



3. Click the Add button (+) above the list of databases. A file chooser dialog box opens.
4. Select the database that you want to map to.
5. Click Open. The Create Database Mapping dialog box opens (Figure 241).

Figure 241. 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.

29.5. Mapping CIGI Views

VR-Vantage associates CIGI views with VR-Vantage channels using channel keywords. (For details about channel keywords, see "6.4. Changing a Channel's Attributes" on page 120.) Any channel with keyword cigiView*X* is associated with CIGI view *X*. For example, keyword cigiView2 would map to CIGI view 2.

CIGI view control packets actually affect the observer that is controlling the specified view. VR-Vantage looks up the channel that has the keyword that matches the view ID specified in the view control packet. Then it finds the observer controlling that channel and applies the view control commands to that observer. If multiple channels have the same keyword, then the first channel found with a matching keyword is used.

Multiple channels with the same keyword are fine, as long as they are all controlled by the same observer. This removes the need for CIGI view groups, although VR-Vantage supports them.

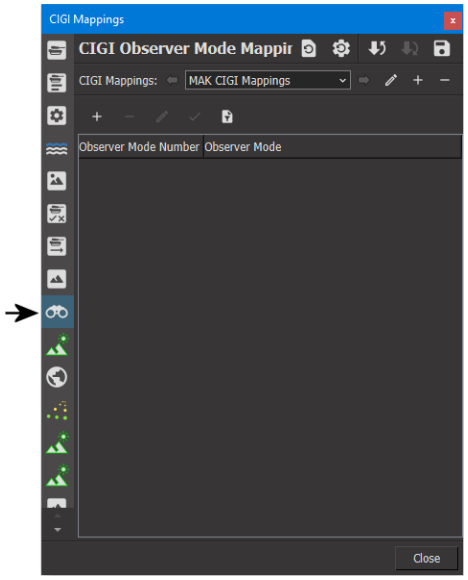
29.5.1 Mapping a CIGI View to an Observer Mode

You can map an observer mode to the **ViewType** parameter in a CIGI view definition message.

➤ **To map an observer mode to a CIGI view:**

1. Choose **Settings > CIGI Mappings**. The CIGI Mappings dialog box opens (Figure 236 on page 441).
2. Select the CIGI Observer Mode Mapping page (Figure 242).

Figure 242. CIGI Observer Mode Mapping page



3. Click the Add button (+) above the list of observer mode mappings. The Create New Observer Mode Mapping dialog box opens.
4. Type the CIGI ID or select an ID from the list.
5. Select an observer mode from the Observer Mode list.
6. Click OK.

29.6. Controlling DI-Guy Links Using CIGI Articulated Part IDs

The CIGI connection has built-in support for mapping CIGI articulated part IDs sent for DI-Guy-based entities to a pre-defined set of DIS articulated part numbers that DI-Guy can use to control individual DI-Guy links. These DIS articulated part numbers are also usable in DIS and the HLA RPR FOM.

The CIGI articulated part mappings are as follows:

- 0 DiGuyDisArtPartBase (10272)
- 1 DiGuyDisArtPartBack (10304)
- 2 DiGuyDisArtPartCervical (10336)l
- 3 DiGuyDisArtPartShoulderLeft (10368)
- 4 DiGuyDisArtPartShoulderRight (10400)
- 5 DiGuyDisArtPartElbowLeft (10432)
- 6 DiGuyDisArtPartElbowRight (10464)
- 7 DiGuyDisArtPartWristLeft (10496)
- 8 DiGuyDisArtPartWristRight (10528)
- 9 DiGuyDisArtPartHipLeft (10560)
- 10 DiGuyDisArtPartHipRight (10592)

- 11 DiGuyDisArtPartKneeLeft (10624)
- 12 DiGuyDisArtPartKneeRight (10656)
- 13 DiGuyDisArtPartAnkleLeft (10688)
- 14 DiGuyDisArtPartAnkleRight (10720)

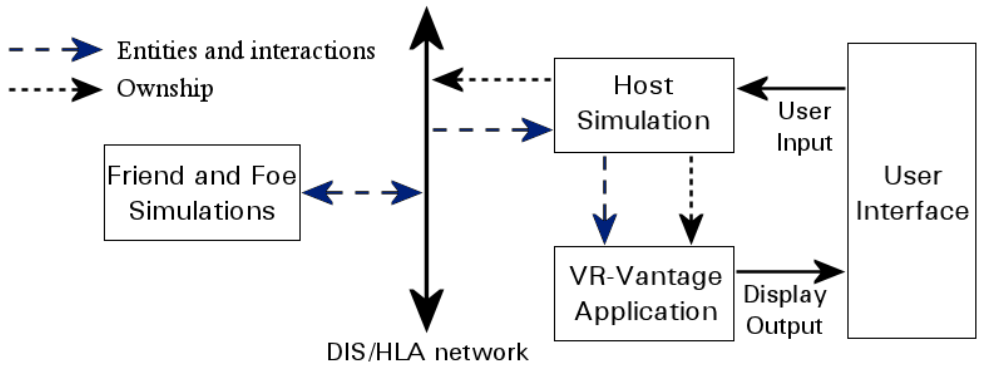
The standard CIGI art part mapping scheme is still used (and works on a per-entity basis). If no CIGI art part mapping has been configured for a DI-Guy-based entity receiving art part control, then the CIGI connection will try to map the art part as described above.

29.7. 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.

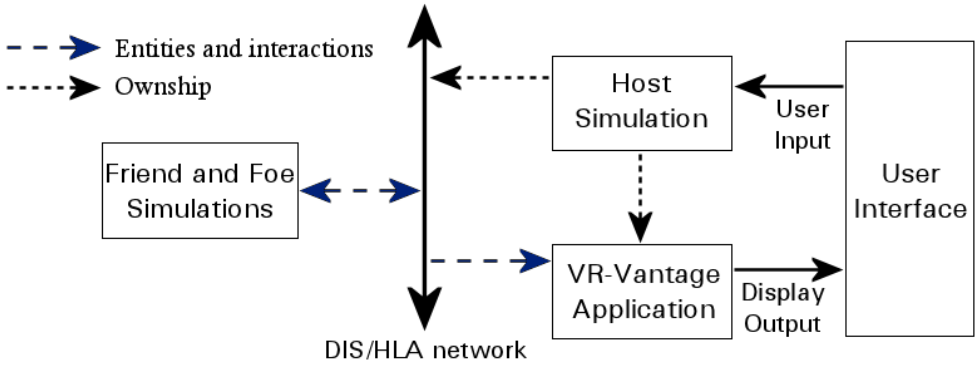
In the classic IG configuration (Figure 243), the host simulation connects to the network and filters all the entities and interactions, providing only the relevant ones to the image generator (shown as the VR-Vantage Application) using a protocol like CIGI. The IG renders the scene and presents it to the user on display screens of some sort.

Figure 243. Classic IG Configuration



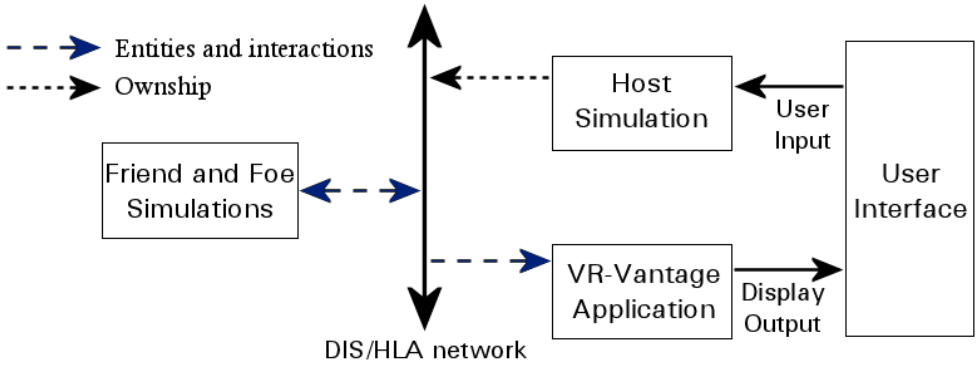
In the networked IG configuration (Figure 244), the host simulation communicates only the “ownship” (the one entity the host is simulating) to the image generator, using a protocol like CIGI. The image generator presents all the other entities and interactions in the distributed simulation.

Figure 244. Networked IG Configuration



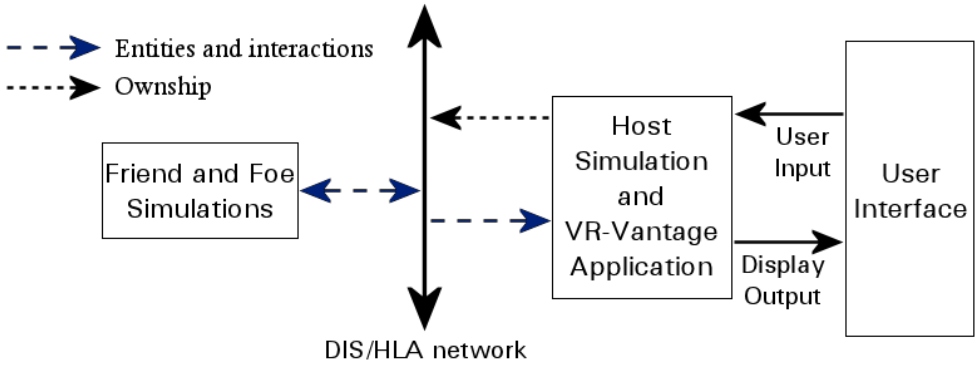
In the distributed visual/simulation configuration (Figure 245), the host simulation communicates with the visual application over the DIS/HLA network. (This is the way the VR-Forces back-end talks to the front-end, and the way VR-Vantage connects to any distributed simulation entity.)

Figure 245. Distributed Visual/Simulation Application IG Configuration



In the integrated visual/simulation application (Figure 246), 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 246. Integrated Visual/Simulation Application Configuration





30. CIGI Host Emulator Tutorial

VR-Vantage includes CIGI host emulators (Windows only). This tutorial explains how to run them and interact with VR-Vantage.



The CIGI Host emulator does not display or read HATHOT response packets from the IG. If you would like to test these, please use our CIGI Python Utilities. See "Chapter 31. CIGI Utilities" on page 469.

30.1. Using the CIGI Host Emulator (Windows Only) 460
30.1.1 Start the Host Emulator 460
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30.1.4 Create a Simulated Entity on the Host Emulator 464
30.1.5 Change an Entity's Model State 464
30.1.6 Add an Effect 466
30.1.7 Change the Weather 467

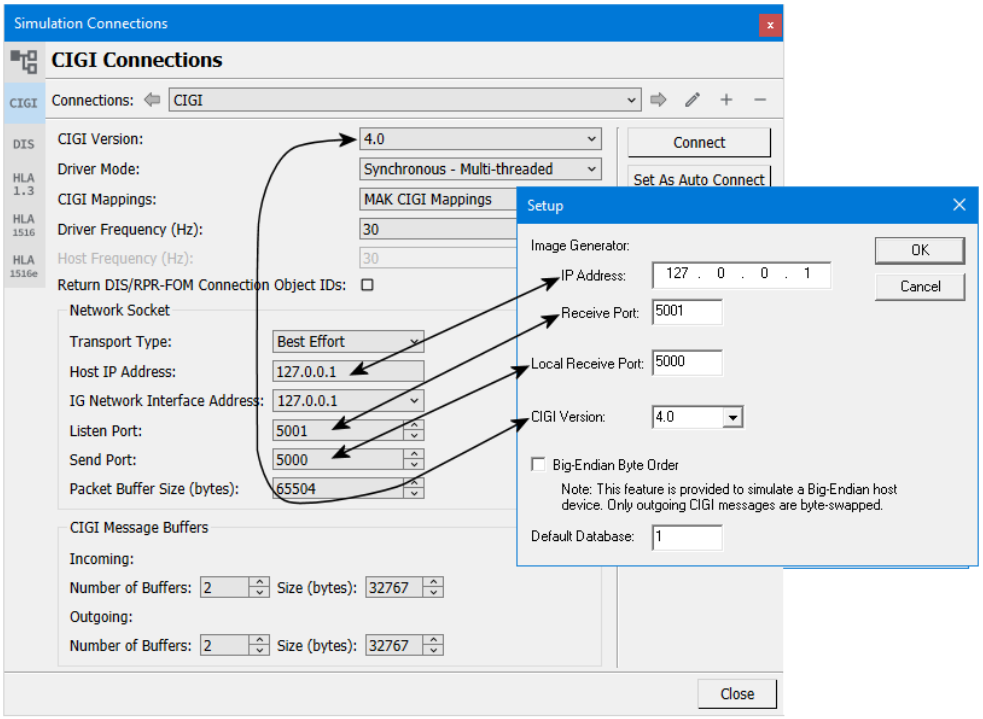
30.1. Using the CIGI Host Emulator (Windows Only)

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 247 illustrates connection settings that must be the same on the host emulator ("30.1.1 Start the Host Emulator" below) and the CIGI connection in VR-Vantage ("30.1.2 Connect VR-Vantage to the CIGI Host Emulator" on page 462).

- For best results, shut down VR-Vantage before you start this tutorial. Start it when instructed to do so.
- To see a set of brief videos that illustrate this tutorial, go to https://www.mak.com/support/tutorials.

Figure 247. Connection settings and host emulator setup



30.1.1 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 **MAK Technologies > CIGI Host Emulator** #, where # is the version of CIGI that you want to use. The host emulator starts up (Figure 248). The first time you run it, the Setup dialog box opens automatically (Figure 249). (Thereafter, to change the setup, in the host emulator, choose **File > Setup**.)

Figure 248. CIGI host emulator

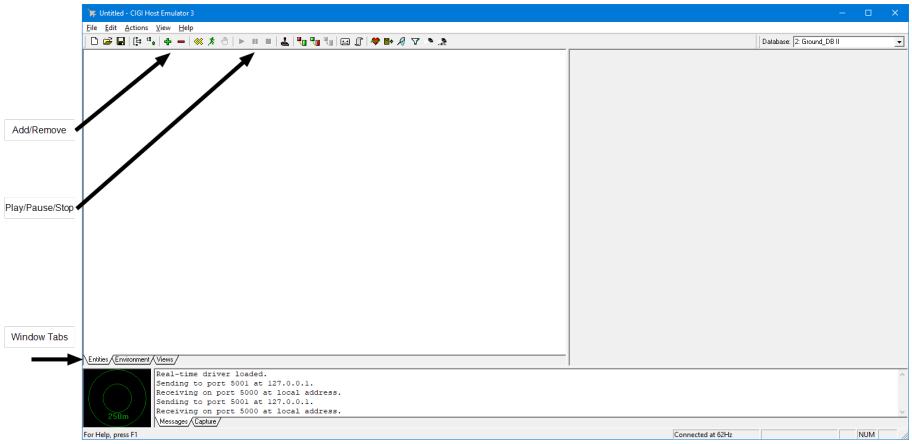
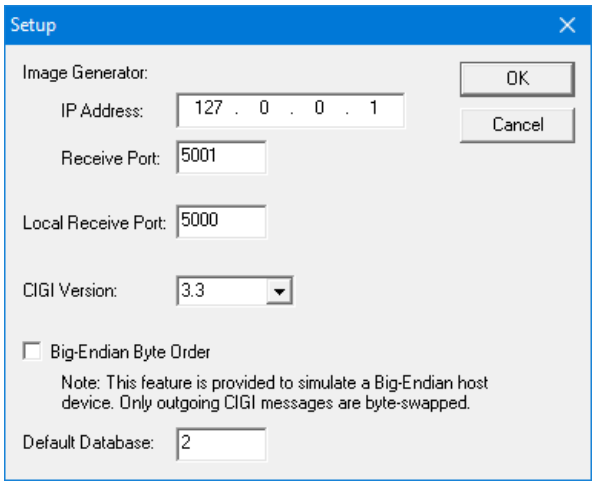


Figure 249. Setup dialog box



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, either a version of 3.x or 4.x.

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 dialog box in VR-Vantage. (Database 2 is Ground_DB II and that is the terrain we use in this tutorial.)
7. Click OK.

30.1.2 Connect VR-Vantage to the CIGI Host Emulator

➤ **To connect VR-Vantage to the CIGI Host Emulator:**

1. Start VR-Vantage.
2. Close the Load Terrain dialog box.
3. Choose **Settings > Connection**. The Simulation Connections dialog box opens.
4. Select the CIGI Connections page (Figure 247 on page 460).
5. Select a connection or create a new one.
6. Set the CIGI Version to the same CIGI version you specified in the host emulator setup.
7. Set CIGI Mappings to MAK CIGI Mappings.
8. Set the Host IP Address to the IP address of the computer on which the host emulator is running.
9. Set the IG Network Interface Address to the IP address of the computer running VR-Vantage. The Image Generator IP Address in the host emulator setup must match this value.
10. Set the Listen Port to the same value as the Image Generator Receive Port value in the host emulator setup.
11. Set the Send Port to the same value as the Local Receive Port value in the host emulator setup.
12. Change any other connection parameters as desired.
13. Click Connect. After a few seconds, VR-Vantage displays the database configured in the host emulator.
14. Click Close in the Simulation Connections dialog box.

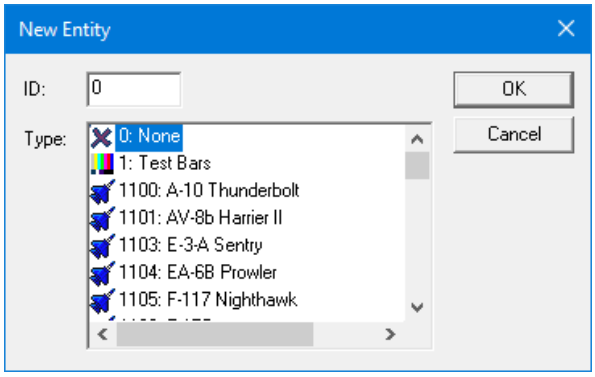
30.1.3 Create an Ownship Entity on the Host Emulator

The ownship entity controls the observer in VR-Vantage.

➤ **To create the ownship entity:**

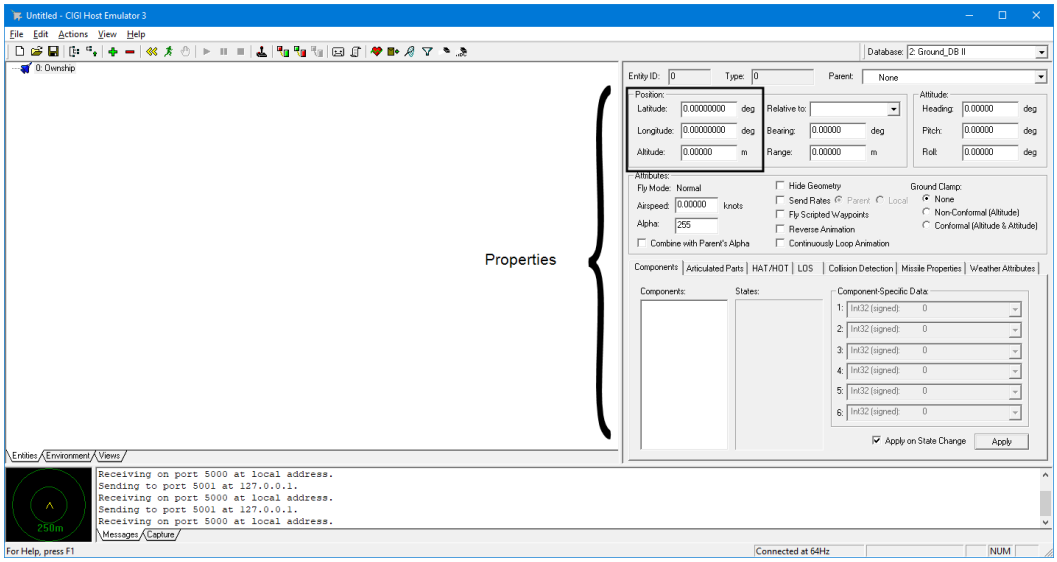
1. In the CIGI host emulator, select the Entities tab (Figure 248 on the previous page). The window is empty because there are no entities.
2. On the toolbar (Figure 248 on the previous page), click the Add button (). The New Entity dialog box opens (Figure 250).

Figure 250. 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 251).

Figure 251. Entity properties for ownship entity



5. In VR-Vantage, an entity called CIGI Ownship is added to the Objects 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 2 (Ground_DB II), the view changes to a view of the sky.)
    d. Close the Send View Control Packet dialog box.

7. In the Position group box on the host emulator, change the Altitude attribute (Figure 251). The view in VR-Vantage changes.

30.1.4 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:

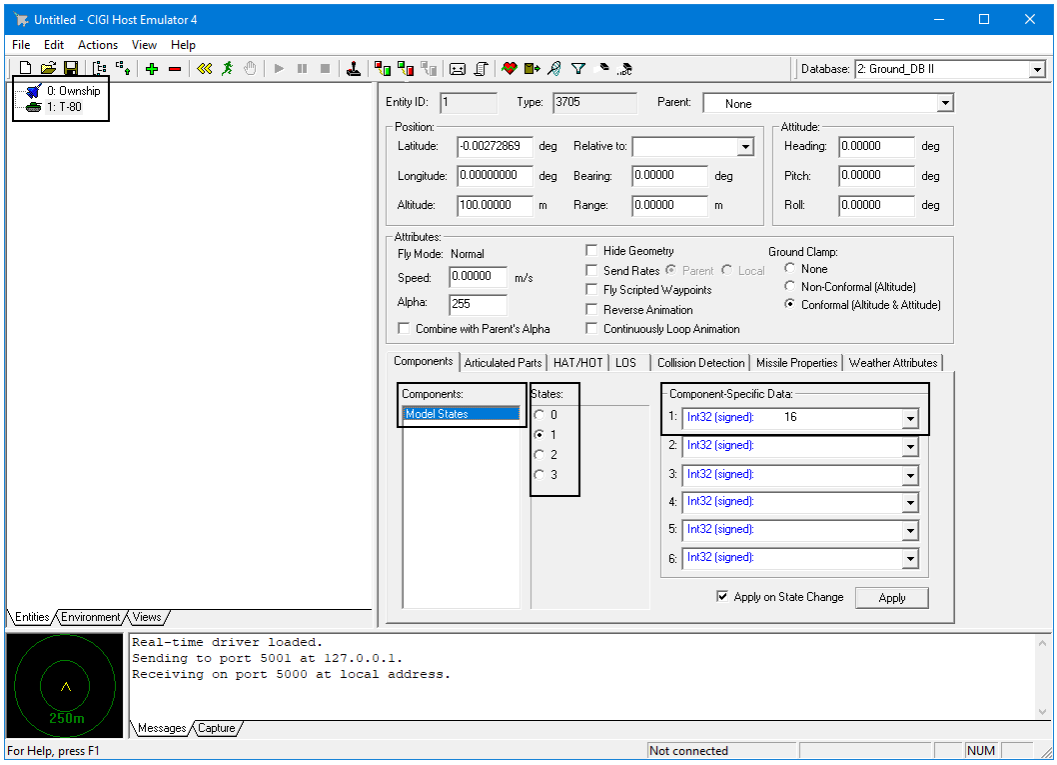
1. In the CIGI host emulator, select the Entities tab (Figure 248 on page 461).
2. On the toolbar (Figure 248 on page 461), click the Add button (). The New Entity dialog box opens (Figure 250 on the previous page).
3. Select 3705: T-80.
4. Click OK. The entity is added to the entity list.
5. In VR-Vantage, an entity called CIGI Entity 1 is added to the Objects List.

30.1.5 Change an Entity's Model State

➤ **To change an entity's model state:**

1. In VR-Vantage, attach to the T-80.
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 T-80 entity (Figure 252).

Figure 252. Entity attributes



5. In the properties panel, select the Components tab (Figure 252).
6. Select Model States.
7. In the States list, select option 1.
8. In the Component Specific Data list, put the cursor in the first box.
9. Type 16.
10. Click Apply. The brake lights on the tank turn on (Figure 253).

Figure 253. Brake lights



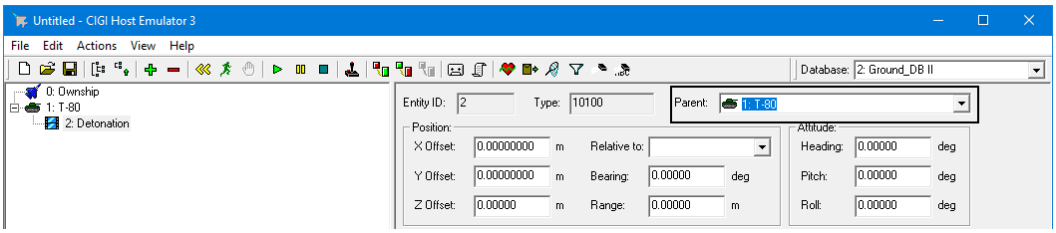
30.1.6 Add an Effect

To add an effect in the MAK 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 248 on page 461).
2. On the toolbar (Figure 248 on page 461), click the Add button (). The New Entity dialog box opens (Figure 250 on page 463).
3. Select 10100:Detonation.
4. Click OK. The effect is added to the entity list.
5. On the properties panel, in the Parent list, select T-80. In the entity list, the Detonation is now subordinate to the T-80 entity (Figure 254).

Figure 254. Entity attributes



6. To display the detonation:
   - For CIGI 3.x, click Play. In VR-Vantage, you see a detonation at the tank.
   - For CIGI 4.x, to display the detonation, you must send an animation control packet as described below.

The detonation is visual only and does not affect the state of the T-80. The T-80 entity is not destroyed.

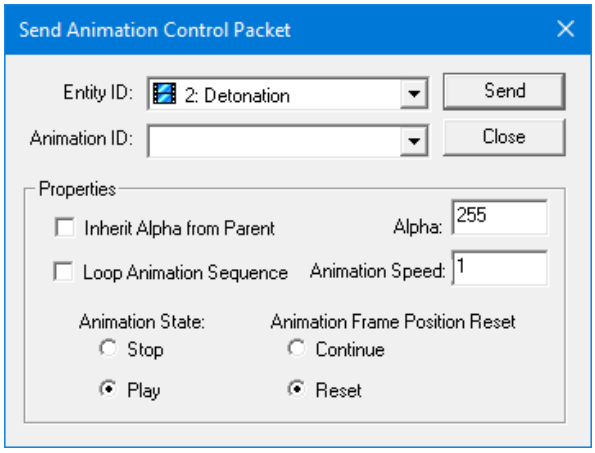
Play the Effects in CIGI 4

The Play button in the Host Emulator toolbar does not work for CIGI 4.x. Instead, you must send an animation control packet to see the detonation.

➤ **To send an animation control packet:**

1. Choose **Actions > Send Packet > Animation Control**. The Send Animation Control Packet dialog box opens (Figure 255 on the facing page).
2. Set the Entity ID field to the Detonation you created earlier.
3. Set the Animation Speed to 1.
4. Under Animation State, select Play.
5. Under Animation Frame Position Reset, select Reset.

Figure 255. Send Animation Control Packet dialog box



6. Click the Send button. The detonation displays.

30.1.7 Change the Weather

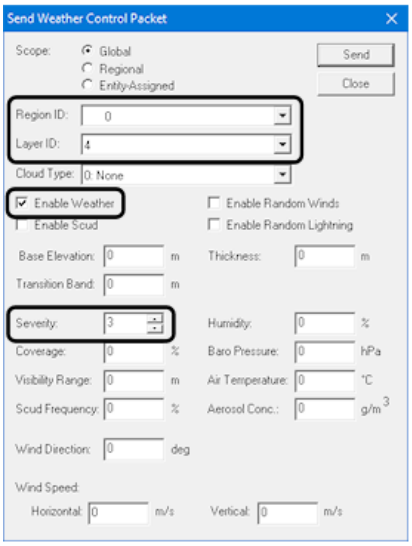
You can send control messages to enable and disable precipitation. VR-Vantage supports layer 4 (rain) and 5 (snow).

➤ **To change the weather:**

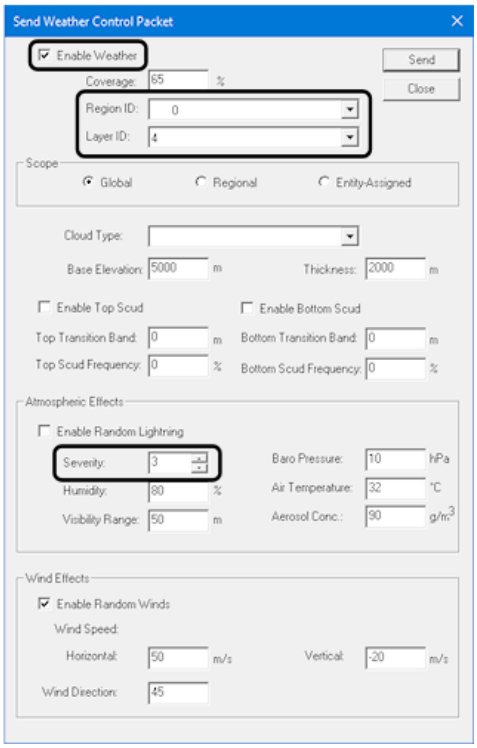
1. In the host emulator, choose **Actions > Send Packet > Weather Control**. The Send Weather Control Packet dialog box opens (Figure 256).

Figure 256. Send Weather Control Packet dialog box

CIGI Host Emulator 3



CIGI Host Emulator 4



2. Select the Enable Weather check box.
3. In the Region ID box, type 0.
4. In the Layer ID box, type 4 (for rain) or 5 (for snow).
5. In the Severity box, select an option greater than zero.
6. Click Send. VR-Vantage displays the selected form of precipitation.



31. CIGI Utilities

This chapter describes the utilities provided for testing CIGI connections.

31.1. Introduction 470
31.2. Using asynchHostTest.py 470
31.3. Using logger.py 471
31.4. Using snooper.py 472
31.5. The pyCigi Module 473

31.1. Introduction

VR-Vantage includes a set of utilities for testing CIGI messages. They are written in Python. To use them you must install Python 3.8 or earlier.

31.2. Using asynchHostTest.py

The *./tools/CigiUtilities/Vx/asynchHostTest.py* script (where *Vx* is the version, either V3 or V4) has two functions. It acts as a simple CIGI host that sends test packets to a socket for test purposes. It also serves as an example of how you can write a script to test your CIGI network.

This script opens a socket and repeatedly sends IGControl and EntityControl messages to the socket until you press **Ctrl**+**C**. The script instructs the IG to load 700 FixedWingA-10Thunderbolt entities from VR-Vantage. It then cycles the roll of the entities at a given frame rate.

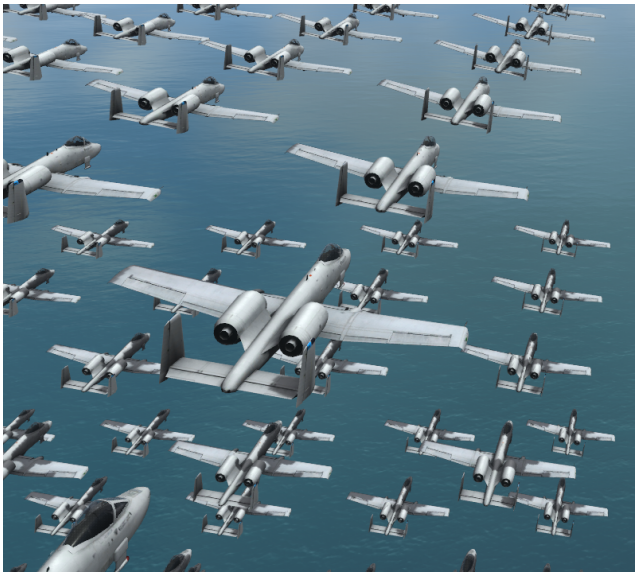
To run *asyncHostTest.py* with default values (port 5001, IP 127:0:0:1), use:

```
asyncHostTest.py
```

➤ **To see the entities in VR-Vantage:**

1. Start VR-Vantage.
2. Choose **Settings > Connection**. The Simulation Connections dialog box opens.
3. Select the CIGI Connections page. The Listen Port (5001) and Host IP Address match the default values for the host created by the script.
4. Change the IG Network Interface Address to 127.0.0.1.
5. Click Connect. VR-Vantage displays the entities (Figure 257).

Figure 257. Entities generated by *asyncHostTest.py*



31.3. Using logger.py

The *./tools/CigiUtilities/Vx/logger.py* script (where *Vx* is the version, either V3 or V4) listens to a UDP socket (unicast or multicast) and records the packets it receives. It can then play the packets back.

To record:

```
logger.py -r
```

The default log file is *cigiSession.log*.

To play:

```
logger.py
```

The logger records data in a binary format. However, you can convert it to a readable format. To convert the data, run:

```
logger.py -c
```

The default output file is *cigiSession.txt*. The following is an example of converted log entries:

```
<Time(0.000000)>
<IGControl({'lastFrame': 0, 'timeStamp': 0, 'dbNum': 6, 'frameNum':
1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
122.988, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0, 'alpha': 255,
'yaw': 0.0, 'lat': 36.00827037, 'entID': 1, 'bits1': 1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
122.9883, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0, 'alpha': 255,
'yaw': 0.0, 'lat': 36.00827037, 'entID': 2, 'bits1': 1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
122.98859999999999, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0,
'alpha': 255, 'yaw': 0.0, 'lat': 36.00827037, 'entID': 3, 'bits1':
1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
122.98889999999999, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0,
'alpha': 255, 'yaw': 0.0, 'lat': 36.00827037, 'entID': 4, 'bits1':
1})>
<EntityControl({'bits2': 0, 'alt': 140.0, 'parentID': 0, 'lon': -
122.98919999999998, 'pitch': 0.0, 'entType': 1100, 'roll': 1.0,
'alpha': 255, 'yaw': 0.0, 'lat': 36.00827037, 'entID': 5, 'bits1':
1})>
```



When the logger records packets, it does not compress them. The log file can quickly grow quite large.

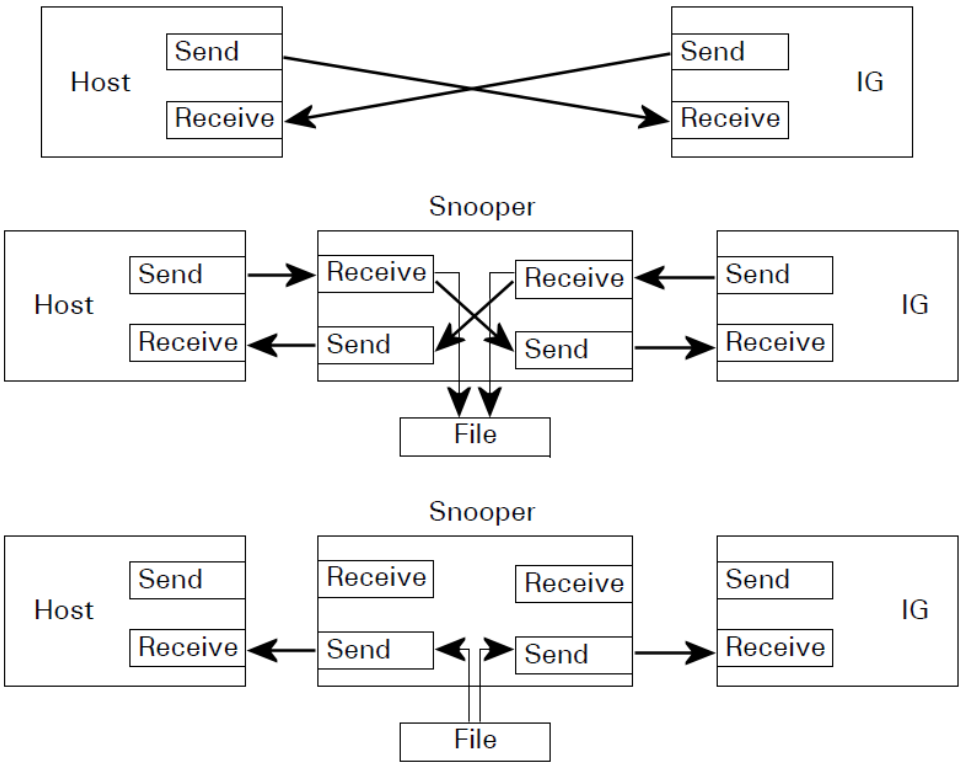
31.4. Using snooper.py

The *./tools/CigiUtilities/Vx/snooper.py* script (where *Vx* is the version, either V3 or V4) can connect to the host and the IG at the same time and can record traffic and then play it back. Figure 258 illustrates the snooper as follows:

- Host/IG interaction without the snooper.
- Host/IG interaction with the snooper mediating. The snooper receives the packets from the host and IG and passes them on. It also records them to a file.
- Snooper playback. The snooper sends the logged packets to the proper destination.

When the snooper records packets, it does not compress them. The log file can quickly grow quite large.

Figure 258. Using the snooper



To run the snooper you must specify send and receive ports for both the host and IG, for example:

```
snooper.py --host_send_port 5000 --host_recv_port 5001
  --ig_recv_port 5002 --ig_send_port 5003
```

Since this is a long command line, you can save the command line to a configuration file, as follows:

```
snooper.py --host_send_port 5000 --host_recv_port 5001
  --ig_recv_port 5002 --ig_send_port 5003 --save [-f myfile]
```

If you do not specify a file with `-f`, the command is saved to *snooper.cfg*.

To load the saved configuration, run:

```
snooper.py --load [-f myfile]
```

31.5. The pyCigi Module

The pyCigi module (*./tools/CigiUtilities/Vx/pyCigi*, where *Vx* is the version) is a package of modules to handle the reading, writing, packing and unpacking of CIGI messages. pyCigi has modules to handle each of the CIGI message types that are supported by VR-Vantage. For a list of supported packets, see Chapter 32 on page 475.

Each module within pyCigi is self-documented and contains a unit test. The documentation for a module can be seen from inside a Python shell:

```
python
>>> import pyCigiStartOfFrame
>>> help(pyCigiStartOfFrame.StartOfFrame)
```

To run the unit test for a module, run the module as a script from a shell window:

```
pyCigiStartOfFrame.py
```

The script *pyCigiMappings.py* gets information about mappings from *./appData/settings/stealth/MAK CIGI Mappings.mcsx*. Do not move this file or the script will not work.

For complete documentation of the pyCigi module, please see *./tools/CigiUtilities/Vx/Readme.txt*.



32. CIGI Packets Supported

This Simulation Object Type Mappings lists the various CIGI packets and the fields that VR-Vantage supports.

32.1. CIGI Packet Support 476
- 32.1.1 Host to IG Packets 476
- 32.1.2 IG to Host Packets 488
- 32.1.3 Support for CIGI Weather Control Packet 492

32.2. DI-Guy Packet Extensions 492
- 32.2.1 DI-Guy Control (Extended) 493
- 32.2.2 Execute Gesture 494
- 32.2.3 End Gesture Packet 495

32.1. CIGI Packet Support

The tables in this section cover VR-Vantage support for CIGI packet types. They cover Host to IG control and request packets and IG to Host response packets and notification packets.

The tables list whether the features are supported in CIGI versions 3.x or 4.x. X indicates the field is supported for the version, NA indicates the field is not available in the version, and a blank indicates the field is not supported.

32.1.1 Host to IG Packets

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

- IG Control (Table 43 on the facing page).
- Entity Control (Table 44 on the facing page).
- Entity Animation Control (Table 45 on page 478).
- Entity Position Control (Table 46 on page 478).
- Component Control (Table 47 on page 479).
- Short Component Control (Table 48 on page 479).
- Articulated Part Control (Table 49 on page 479).
- Short Articulated Part Control (Table 50 on page 479).
- Rate/Velocity Control (Table 51 on page 480).
- Celestial Sphere Control (Table 52 on page 480).
- Atmosphere Control (Table 53 on page 480).
- Weather Control (Table 54 on page 481).
- Maritime Surface Conditions Control (Table 55 on page 482).
- Wave Control (Table 56 on page 482).
- View Control (Table 57 on page 482).
- Sensor Control (Table 58 on page 483).
- View Definition (Table 59 on page 483).
- Collision Detection Segment Definition (Table 60 on page 483).
- HAT/HOT Request (Table 61 on page 484).
- Line-of-sight Segment Request (Table 62 on page 484).
- Line-of-sight Vector Request (Table 63 on page 485).
- Position Request (Table 64 on page 485).
- Symbol Surface Definition (Table 65 on page 485 and Table 66 on page 486).
- Symbol Text Definition (Table 67 on page 487).
- Symbol Circle Definition (Table 68 on page 487).

- Symbol Line/Polygon Definition (Table 69 on page 487).
- Symbol Control (Table 70 on page 488).

Table 43. IG control packets

Field	3.x	4.x
Database Number	X	X
IG Mode	X	X
Timestamp Valid	X	X
Extrapolation/Interpolation Enable	X	NA
Smoothing Enable	NA	X
Entity Type Substitution Enable		
Host Frame Number	X	X
Timestamp	X	X
Last IG Frame Number	X	X

Table 44. Entity control packets

Field	3.x	4.x
Entity ID	X	X
Entity State	X	X
Attach State	X	X
Collision Detection Enable		
Inherit Alpha		
Ground/Ocean Clamp	X	X
	(Conformal Only)	
Animation Direction	X	NA*
Animation Loop Mode	X	NA*
Animation State	X	NA*
Linear Extrapolation/Interpolation Enable	X	X
Alpha	X	X
Entity Type	X	X
Parent ID	X	X
Roll/Pitch/Yaw	X	NA*
Latitude/Longitude/Altitude or X/Y/Z offset	X	NA*

Table 44. Entity control packets (continued)

Field	3.x	4.x
* In CIGI v. 4.x, animation and position are managed in separate packets and they are required. Please see Table 45 below and Table 46 below.		
Note: The Entity Control packet is used to create and destroy entity instances. This establishes a relationship between an Entity ID and the entity type to be created/destroyed, and controls attributes that describe an entity's state that are modified on an infrequent basis.		

Table 45. Animation control packets

Field	3.x	4.x
Entity ID	NA	X
Alpha	NA	X
Animation State *	NA	X
Animation Frame Position Reset	NA	X
Animation Loop Mode	NA	X
Inherit Alpha	NA	X
Animation Speed *	NA	X
* To pause an animation in CIGI 4.x, set Animation State to play, Animation Speed to 0.0, and Animation Frame Reset Mode to continue.		
Note: Particle systems and Animation Entities based on DtAnimationModel do not support animation speed changes, but the speed must be set to zero to pause them. Entities based on DtArticulatedModel will support animation speed changes.		

Table 46. Position control packets

Field	3.x	4.x
Entity ID	NA	X
Parent ID	NA	X
Roll/Pitch/Yaw	NA	X
Latitude/X Offset	NA	X
Longitude/Y Offset	NA	X
Altitude/Z Offset	NA	X
Attach State	NA	X
Ground/Ocean Clamp	NA	X

Table 47. Component control packets

Field	3.x	4.x
Component ID	X	X
Instance ID	X	X
Component Class	X	X
Component State	X	X
Component Data	X	X

Table 48. Short component control packets

Field	3.x	4.x
Component ID	X	X
Instance ID	X	X
Component Class	X	X
Component State	X	X
Component Data	X	X

Table 49. Articulated part control packets

Field	3.x	4.x
Entity ID	X	X
Articulated Part ID	X	X
Articulated Part Enable	X	X
X/Y/Z Offset Enable	X	X
Roll/Pitch/Yaw Enable	X	X
X/Y/Z Offset	X	X
Roll/Pitch/Yaw	X	X

Table 50. Short articulated part control packets

Field	3.x	4.x
Entity ID	X	X
Articulated Part ID 1	X	X
Articulated Part ID 2	X	X
DOF Select 1	X	X
DOF Select 2	X	X
Articulated Part Enable 1	X	X
Articulated Part Enable 2	X	X
DOF 1	X	X
DOF 2	X	X

Table 51. Rate/velocity* control packets

Field	3.x	4.x
Entity ID	X	X
Articulated Part ID	X	X
Apply To Articulated Part	X	X
Coordinate System	X	X
X/Y/Z Linear Rate/Velocity*	X	X
Roll/Pitch/Yaw Angular Rate/Velocity*	X	X
* The control packet is “rate” in 3.x and “velocity” in 4.x.		

Table 52. Celestial sphere control packets

Field	3.x	4.x
Hour	X	X
Minute	X	X
Seconds	NA	
Ephemeris Model Enable	X	X
Continuous Time-of-Day Enable	NA	
Sun Enable		
Moon Enable		
Star Field Enable		
Date/Time Valid	X	X
Date	X	X
Star Field Intensity		

Table 53. Atmosphere control packets

Field	3.x	4.x
Global Humidity		
Global Air Temperature		
Global Visibility Range	X	X
Global Horizontal Wind Speed	X	X
Global Wind Direction	X	X
Global Barometric Pressure		

Table 54. Weather control packets

Field	3.x	4.x
Entity/Region ID		
Layer ID	X	X
	(Only Rain/Snow)	
Humidity		
Weather Enable	X	X
Scud Enable		NA
Bottom Scud Enable	NA	
Random Winds Enable		
Random Lightning Enable		
Cloud Type		
Scope		
Severity	X	X
Top Scud Enable	NA	
Air Temperature		
Visibility Range*	X	X
Scud Frequency		NA
Bottom Scud Frequency	NA	
Coverage		
Base Elevation		
Thickness		
Transition Band		NA
Bottom Transition Band Thickness	NA	
Horizontal Wind Speed*	X	X
Vertical Wind Speed		
Wind Direction*	X	X
Barometric Pressure		
Aerosol Concentration		
Top Scud Frequency	NA	
Top Transition Band Thickness	NA	
For more information, please see "32.1.3 Support for CIGI Weather Control Packet" on page 492		

Table 55. Maritime Surface Conditions Control packets

Field	3.x	4.x
Packet ID	X	X
Packet Size	X	X
Surface Conditions Enable		
Whitecap Enable	X	X
Scope		
Entity ID / Region ID		
Sea Surface Height	X	X
Surface Water Temperature		
Surface Clarity	X	X

Table 56. Wave Control packets

Field	3.x	4.x
Packet ID	X	X
Packet Size	X	X
Wave Enable		
Scope		
Breaker Type		
Entity ID / Region ID		
Wave ID	X	X
Wave Height	X	X
Wavelength	X	X
Period		
Direction	X	X
Phase Offset		
Leading		

Table 57. View control packets

Field	3.x	4.x
View ID	X	X
Group ID	X	X
X/Y/Z Offset Enable	X	X
Roll/Pitch/Yaw Offset Enable	X	X
Entity ID	X	X
X/Y/Z Offset	X	X
Roll/Pitch/Yaw	X	X

Table 58. Sensor control packets

Field	3.x	4.x
View ID	X	X
Sensor ID	X	X
Gain	X	X
Level	X	X
AC Coupling	X	X
Noise	X	X
Sensor On/Off	X	X
Polarity	X	X
Line-by-Line Dropout Enable	X	X
Automatic Gain	X	X
Track White/Black	X	X
Response Type	X	X
Track Mode	X	X
	Only 0 (Off) and 5 (Line of Sight) are supported	

Table 59. View definition packets

Field	3.x	4.x
View ID	X	X
Group ID	X	X
Near/Far/Left/Right/Top/Bottom Enable	X	X
Mirror Mode		
Pixel Replication Mode		
Projection Type		
Reorder		
View Type	X	X
Near/Far/Left/Right/Top/Bottom	X	X

Table 60. Collision detection segment definition packets

Field	3.x	4.x
Packet ID	X	X
Entity ID	X	X
Segment ID	X	X
X1/Y1/Z1	X	X

Table 60. Collision detection segment definition packets (continued)

Field	3.x	4.x
X2/Y2/Z2	X	X
Segment Enable	X	X
Material Mask		
Notes: Collision Detection Segment Definitions are computationally expensive, which can cause a sim to freeze.		
Collision Detection Segment Definitions are not deleted when they are set to Disable; they are simply turned off. The particular Segment ID that is disabled will continue to exist (and be associated with its Entity ID) until the entity is destroyed or that segment ID is used again.		

Table 61. HAT/HOT request packets

Field	3.x	4.x
HAT/HOT ID	X	X
Request Type	X	X
Coordinate System	X	X
Update Period	X	X
Entity ID	X	X
Latitude/Longitude/Altitude or X/Y/Z offset	X	X

Table 62. Line-of-sight segment request packets

Field	3.x	4.x
LOS ID	X	X
Source Entity ID	X	X
Destination Entity ID	X	X
Request Type	X	X
Source Point Coordinate System	X	X
Destination Point Coordinate System	X	X
Response Coordinate System	X	X
Destination Entity ID Valid	X	X
Alpha Threshold		
Source Latitude/Longitude/Altitude or X/Y/Z Offset	X	X
Destination Latitude/Longitude/Altitude or X/Y/Z Offset	X	X
Material Mask		
Update Period	X	X

Table 63. Line-of-sight vector request packets

Field	3.x	4.x
LOS ID	X	X
Entity ID	X	X
Request Type	X	X
Source Point Coordinate System	X	X
Response Coordinate System	X	X
Alpha Threshold		
Azimuth	X	X
Elevation	X	X
Minimum Range	X	X
Maximum Range	X	X
Source Latitude/Longitude/Altitude or X/Y/Z Offset	X	X
Material Mask		
Update Period	X	X

Table 64. Position request packets

Field	3.x	4.x
Packet ID	X	X
Articulated Part ID	X	X
Object ID	X	X
Update Mode	X	X
Object Class	X	X
	Motion Tracker not supported	
Coordinate System	X	X

Table 65. Symbol Surface Definition packets - attached to View

Field	3.x	4.x
Surface ID	X	X
View ID	X	X
Surface State	X	X
Attach Type	X	X
Left	X	X
Right	X	X
Top	X	X
Bottom	X	X
Min U	X	X

Table 65. Symbol Surface Definition packets - attached to View (continued)

Field	3.x	4.x
Max U	X	X
Min V	X	X
Max V	X	X
For View attached surfaces, the scale and origin/position of the surface calculations are: scaleX = (Right - Left) / (MaxU - MinU) scaleY = (Top - Bottom) / (MaxV - MinV) originX = Left - (MinU * scaleX) originY = Bottom - (MinV * scaleY)		
Notes: Non-uniform scales are supported. Rotations for surfaces are not supported. If you set a surface with non-uniform scales and then attach children and rotate a child, the child symbol will shear or skew. This is expected because it is a product of parent/child matrix hierarchies.		

Table 66. Symbol Surface Definition packets - attached to Entity

Field	3.x	4.x
Surface ID	X	X
Entity/View ID	X	X
	When the surface is attached to an entity, the upper 4 bits of the entity ID field are used for the view ID.	
Surface State	X	X
Attach Type	X	X
X Offset	X	X
Y Offset	X	X
Z Offset	X	X
Width		
Height		
Min U	X	X
Max U	X	X
Min V	X	X
Max V	X	X
For Entity attached surfaces, we support attachment only in a “billboard” fashion.		

Table 67. Symbol Text Definition packets

Field	3.x	4.x
Symbol ID	X	X
Alignment	X	X
Font ID	X	X
Font Size	X	X
Text up to max packet size	X	X
You can map to fonts in the *./data/Fonts* folder.		

Table 68. Symbol Circle Definition packets

Field	3.x	4.x
Symbol ID	X	X
Stipple Pattern	X	X
Drawing Style	X	X
Line Width	X	X
Center U1-n	X	X
Center V1-n	X	X
Radius1-n	X	X
Inner Radius1-n	X	X
Start Angle1-n	X	X
End Angle1-n	X	X

Table 69. Symbol Polygon Definition packets

Field	3.x (Line)	4.x (Polygon)
Symbol ID	X	X
Stipple Pattern	X	X
Primitive Type - All	X	X
	Point, Line, Line Strip, Line Loop, Triangle, Triangle Strip, Triangle Fan	
Line Width	X	X
Vertex U1-n	X	X
Vertex V1-n	X	X

Table 70. Symbol Control packets

Field	3.x	4.x
Symbol ID	X	X
Symbol State	X	X
Attach State	X	X
Flash Control	X	X
Inherit Color	X	X
Parent Symbol ID	X	X
Surface ID	X	X
Layer	X	X
Flash Duty Cycle Percentage	X	X
Flash Period	X	X
Position U	X	X
Position V	X	X
Rotation	X	X
Red	X	X
Green	X	X
Blue	X	X
Alpha	X	X
Scale U	X	X
Scale V	X	X
When a symbol is attached (drawn on) to a surface, the surface is the symbol's parent in the API. In the CIGI sense, however, the symbol does not have a parent; it has an associated surface ID. The attach state flag is only for parent IDs; it does not apply to surfaces. To draw a symbol on a surface, the attach state must be set to 'detached'. You must complete all the fields in the symbol control packet. Unlike other CIGI packets, it does not contain enabled flags for its fields; checks cannot be made on what fields you intended to use. For example, if you do not set the scale on the host side, VR-Vantage reads in (0,0) for xy scale and does not render anything.		

32.1.2 IG to Host Packets

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

- Start of Frame (SOF) (Table 71 on the facing page).
- HAT/HOT Response (Table 72 on the facing page).
- HAT/HOT Extended Response (Table 73 on the facing page).

- Line of Sight (LOS) Response (Table 74 on the next page).
- LOS Extended Response (Table 75 on the next page).
- Sensor Response (Table 76 on page 491).
- Sensor Extended Response (Table 77 on page 491).
- Position Response (Table 78 on page 491).
- Collision Detection Segment Notification (Table 79 on page 492).

Table 71. SOF packets

Field	3.x	4.x
Packet ID	X	X
Database Number	X	X
IG Status Code	X	X
IG Mode	X	X
Timestamp Valid	X	X
Earth Reference Model		
IG Condition - Overframing	NA	
IG Condition - Paging	NA	
IG Condition - Excessive Variable Length Data	NA	
IG Frame Number	X	X
Timestamp	X	X
Last Host Frame Number	X	X

Table 72. HAT/HOT response packets

Field	3.x	4.x
Packet ID	X	X
HAT/HOT ID	X	X
Valid	X	X
Response Type	X	X
Host Frame Number LSN	X	X
Height	X	X

Table 73. HAT/HOT extended response packets

Field	3.x	4.x
Packet ID	X	X
Packet size	X	X
HAT/HOT ID	X	X
Valid	X	X

Table 73. HAT/HOT extended response packets (continued)

Field	3.x	4.x
Host Frame Number LSN	X	X
HAT	X	X
HOT	X	X
Material Code *	X	X
Normal Vector Azimuth	X	X
Normal Vector Elevation	X	X
* Note: Material Code returns a DTElementType.		

Table 74. LOS response packets

Field	3.x	4.x
Packet ID	X	X
LOS ID	X	X
Entity ID	X	X
Valid	X	X
Entity ID Valid	X	X
Visible	X	X
Host Frame Number LSN	X	X
Range	X	X

Table 75. LOS extended response packets

Field	3.x	4.x
Packet ID	X	X
LOS ID	X	X
Entity ID	X	X
Response Count	X	X
Valid	X	X
Entity ID Valid	X	X
Visible	X	X
Host Frame Number LSN	X	X
Range	X	X
Latitude/Longitude/Altitude or X/Y/Z Offset	X	X
Material Code		
Normal Vector Azimuth or Elevation	X	X
Red, Green, Blue		
Alpha	X	X

Table 76. Sensor response packets

Field	3.x	4.x
View ID	X	X
Sensor ID	X	X
Gate X Size	X	X
Gate Y Size	X	X
Gate X Position	X	X
Gate Y Position	X	X
Host Frame Number	X	X
Sensor Status	X	X

Table 77. Sensor extended response packets

Field	3.x	4.x
View ID	X	X
Sensor ID	X	X
Entity ID	X	X
Gate X Size	X	X
Gate Y Size	X	X
Gate X Position	X	X
Gate Y Position	X	X
Host Frame Number	X	X
Track Point Latitude	X	X
Track Point Longitude	X	X
Track Point Altitude	X	X
Sensor Status	X	X
Entity ID Valid	X	X

Table 78. Position response packets

Field	3.x	4.x
Packet ID	X	X
Articulated Part ID	X	X
Object ID	X	X
Object Class	X	X
Coordinate System	X	X
Latitude/Longitude/Altitude or X/Y/Z Offset	X	X
Roll/Pitch/Yaw	X	X

Table 79. Collision detection segment notification packets

Field	3.x	4.x
Packet ID	X	X
Entity ID	X	X
Contacted Entity ID	X	X
Segment ID	X	X
Collision Type	X	X
Material Code	X	
Intersection Distance	X	X

32.1.3 Support for CIGI Weather Control Packet

VR-Vantage supports the CigiWeatherCtrlV3 packet's wind direction, horizontal wind direction, and visibility range fields (WindDir, HorizWindSp, and VisibilityRng respectively).

Prior to VR-Vantage 2.1, this packet was used just for precipitation. To provide backward compatibility, the RegionID field (which we normally do not support) is used as a flag set to indicate which weather control items are supported and which are ignored.

The flags are:

```
enum WeatherControlState
  {
    WindDirSet = 0           // bit 0
    , WindSpeedSet = 1         // bit 1
    , VisibilitySet = 2        // bit 2
    , PrecipitationIgnore = 3  // bit 3
  };
```

As before, WeatherEn enables or disables precipitation, with LayerID indicating precipitation type (4 == rain, 5 == snow). Therefore, existing CIGI Weather Control packets used with VR-Vantage work as they did before.

If you want to specify wind direction, horizontal wind speed, visibility, or some combination of them, the appropriate flags must be set into the RegionID field. Precipitation values can be ignored by setting bit 3 of the RegionID field.

32.2. DI-Guy Packet Extensions

VR-Vantage supports additional packets for controlling DI-Guy functions, such as postures, animations (actions), appearances, and gestures. The packet layouts and code are included as part of the Developer's Toolkit; a separate, external package, makCigiExtensions, is also available for non-toolkit users.

32.2.1 DI-Guy Control (Extended)

The DI-Guy Control (Extended) packet replaces the deprecated DI-Guy control packet that was available in earlier versions of VR-Vantage. It is used to control several common DI-Guy functions. The packet names are DtCigiDiGuyCtrlExt for CIGI 3.x (defined in *./include/makCigiExtensions/DtDiGuyCtrlExt.h*) and DtCigiDiGuyCtrlExtV4 for CIGI 4.x (defined in *./include/makCigiExtensions/DtDiGuyCtrlExtV4.h*).

Table 80. DI-Guy Control (Extended) Packet

Field	3.x	4.x
Packet ID	202	0xf000
Packet Size	16 + length of strings (padded to 8 bytes each)	32 + length of strings (padded to 8 bytes each)
Entity ID (unsigned short)	ID of the character entity this applies to	same as 3.x
Action Paused (1 bit)	Paused or running the current action	"
Weapon State (1 bit)	Deployed or stowed	"
Health State (1 bit)	Alive or dead	"
Posture (2 bits)	Upright(0), Crouched(1), Prone(2), Sitting(3)	"
Action Paused Enabled (1 bit)	Whether the Action Paused field contains valid data	"
Weapon State Enabled (1 bit)	Whether the Weapon State field contains valid data	"
Health State Enabled (1 bit)	Whether the Health State field contains valid data	"
Posture Enabled (1 bit)	Whether the Posture field contains valid data	"

Table 80. DI-Guy Control (Extended) Packet (continued)

Field	3.x	4.x
Animation Speed Enabled (1 bit)	Whether the Animation Speed field contains valid data	"
Scale Enabled (1 bit)	Whether the Scale fields contain valid data	"
Weight Enabled (1 bit)	Whether the Weight field contains valid data	"
X Scale (float)	Scale factor (X) for the character	"
Y Scale (float)	Scale factor (Y) for the character	"
Z Scale (float)	Scale factor (Z) for the character	"
Weight (float)	Weight of the character	"
Animation Speed (double)	For moving animations (such as "walk" or "jog"), the speed at which the character moves	"
Animation (string)	Animation to use for the character	"
Item Appearance (string)	Appearance of hand item This may be specified as part of the model definition used in the entity control, but this field makes it possible to change. Note that this can be specified as "" or its equivalent, "default".	"
Head Appearance (string)	Appearance of head item This may be specified as part of the model definition used in the entity control, but this field makes it possible to change. Note that this can be specified as "" or its equivalent, "default".	"

32.2.2 Execute Gesture

The Execute Gesture packet is used to start executing a DiGuy gesture. The packet names are DtCigiDiGuyExecuteGesture for CIGI 3.x (defined in *./include/makCigiExtensions/DtDiGuyExecuteGesture.h*) and DtCigiDiGuyExecuteGestureV4 for CIGI 4.x (*./include/makCigiExtensions/DtDiGuyExecuteGestureV4.h*).

Table 81. Execute Gesture Packet

Field	3.x	4.x
Packet ID	241	0xf001
Packet Size	16 + string length (padded to 8 bytes)	24 + string length
Entity ID (unsigned short)	ID of the character to execute the gesture	same as 3.x
Repetitions Enabled (1 bit)	Whether the Repetitions field contains valid data	"
Duration Enabled (1 bit)	Whether the Duration field contains valid data	"
Channel A Weight Enabled (1 bit)	Whether the Channel A Weight field contains valid data	"
Repetitions (unsigned short)	The number of times to execute the indicated gesture	"
Duration (float)	The length of time over which to execute the (possibly repeated) gestures	"
Channel A Weight (float)	Some gestures may be made up of two parts; an A part and a B part. By default, such a gesture with play each part for an equal duration. The Channel A Weight can be used to change the percentage of time (from 0. to 1.) that the A part consumes.	"
Gesture Name (string)	Name of the gesture to execute	"

32.2.3 End Gesture Packet

The End Gesture packet is used to interrupt a gesture that a character is currently executing. If a gesture (or repetitions of a gesture) are allowed to complete, this packet is not necessary. The packet names are DtCigiDiGuyEndGesture for CIGI 3.x (defined in *./include/makCigiExtensions/DtCigiDiGuyEndGesture.h*) and DtCigiDiGuyEndGestureV4 for CIGI 4.x (defined in *./include/makCigiExtensions/DtCigiDiGuyEndGestureV4.h*).

Table 82. End Gesture Packet

Field	3.x	4.x
Packet ID	242	0xf002
Packet Size	16 + string length (padded to 8 bytes)	16 + string length (padded to 8 bytes)
Entity ID (unsigned short)	ID of the character executing the gesture to end	same as 3.x
Ramp Down Enabled (1 bit)	Whether the ramp down field contains valid data	"
Ramp Down (double)	Maximum amount of time spent trying to smooth over any motion seams; use 0.5 for a smooth transition, 0 for an immediate stop.	"
Gesture Name (string)	Name of the gesture to interrupt. Note that all currently executing gestures can be stopped using the special string "all".	"



X. SensorFX

SensorFX is a plug-in module for VR-Vantage built in partnership with sensor experts JRM Technologies. These topics describe SensorFX, how to use it, how to integrate materially classified models, and how to set sensor parameters using the toolkit.

SensorFX is licensed separately from VR-Vantage. To request a license, contact keys@mak.com.

For information about installing SensorFX, see "2.1.4 Installing SensorFX with VR-Vantage" on page 48.



33. Using SensorFX

This chapter introduces SensorFX and explains how to use it.

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33.1. Introduction to SensorFX

SensorFX is a plug-in to VR-Vantage. SensorFX was created by JRM Technologies. It provides physics-based sensor views for Long Wave Infrared (LWIR), Midwave Infrared (MWIR), and night vision goggles (NVG). In physics-based sensor views, the rendering of terrain and simulated objects takes into account the material of the object, air and material temperature, ambient light, and the characteristics of the sensor. Therefore, SensorFX provides much more realistic sensors than the CameraFX sensors included in VR-Vantage, which are more akin to putting a colored filter on a camera.

To take advantage of physics-based sensors, the terrain and simulated objects must be "materially classified". That is, their composition must be specified and included in the terrain and model definitions. The ability to classify materials is not part of SensorFX or VR-Vantage. You must use the GenesisMC™ software from JRM.

SensorFX can apply material classification on demand for terrains loaded using osgEarth earth files.

Material classifications have been provided for the *Ala Moana.mtf* and *VR-Village.mtf* terrain databases. Scenarios that use these terrains will probably reference entities and effects that have not been material classified, so they may not look correct. The material classifications are notional only to provide some indication of capability, but not reflect actual vehicle signatures.

The terrains *MAK Earth - MCOD (online).mtf* and *MAK Earth - MCOD with Lights (online).mtf* are configured for material classification on demand.



- SensorFX supports only one observer at a time being fully sensorized. If you open additional windows that use different observers, for example, inset views, they will show a sensor view similar to that provided by the VR-Vantage CameraFX sensors. (However, note that when you run the SensorFX version of VR-Vantage, the CameraFX sensors are not directly available as user options.)
- SensorFX terrains use much more texture memory than non-SensorFX terrains. If the amount of memory your terrain requires exceeds the capability of your video card, performance can drop dramatically. You can check the performance of your video card by enabling VR-Vantage's performance statistics display.

33.2. Starting VR-Vantage with SensorFX

VR-Vantage with SensorFX has its own startup shortcut. This allows you to run VR-Vantage with SensorFX or the standard VR-Vantage applications without SensorFX.

➤ To start VR-Vantage with SensorFX, on the Start menu, choose **MAK Technologies > VR-Vantage with SensorFX**.

SensorFX does not support geocentric terrains if they are part of a terrain that does not include an osgEarth terrain patch. For more information, see "33.10. Using SensorFX with Geocentric Terrains" on page 519.

33.3. Using SensorFX

When you install SensorFX, you choose the sensor to use by choosing an observer mode that has a sensor as part of its configuration, just as you do with the native CameraFX sensors. (For details, see "12.2. Enabling Sensors" on page 218.) SensorFX includes the following observer modes:

- Stealth. Uses the Visual mode sensor. It displays the scene using the visual spectrum that is viewable by the human eye.
- MWIR (Out-the-Window). This sensor uses mid-wave infrared. MWIR is also called intermediate infrared (IIR): 3-8 μm. In guided missile technology the 3-5 μm portion of this band is the atmospheric window in which the homing heads of passive IR heat seeking missiles are designed to work. They home in on the infrared signature of the target aircraft, typically the jet engine exhaust plume. The default MWIR mode is white hot. You can change it to black hot on the Display Settings dialog box, Sensor Settings page.
- LWIR (Out-the-Window). This sensor uses long wave Infrared: 8–15 μm. This is the thermal imaging region, in which sensors can obtain a completely passive picture of the outside world based on thermal emissions only and requiring no external light or thermal source such as the sun, moon or infrared illuminator.
- NVG (Out-the-Window). This sensor mimics night-vision goggles, which allow images to be produced in levels of light approaching total darkness.

SensorFX works with multiple observers. However secondary observers do not provide materially classified effects. They provide the equivalent of CameraFX effects. If you have multiple windows that use the same observer, they all use SensorFX. (For information about CameraFX, see "Chapter 12. Using Sensors" on page 217.) If you have multiple observers, you can specify which observer should be the SensorFX observer with the SENSORFX_OBSERVER_NAME environment variable.

Clouds and precipitation are not correlated between the sensor modes and visual or no sensor modes.

When you switch observer modes, there may be a delay of several seconds before the new sensor takes effect.

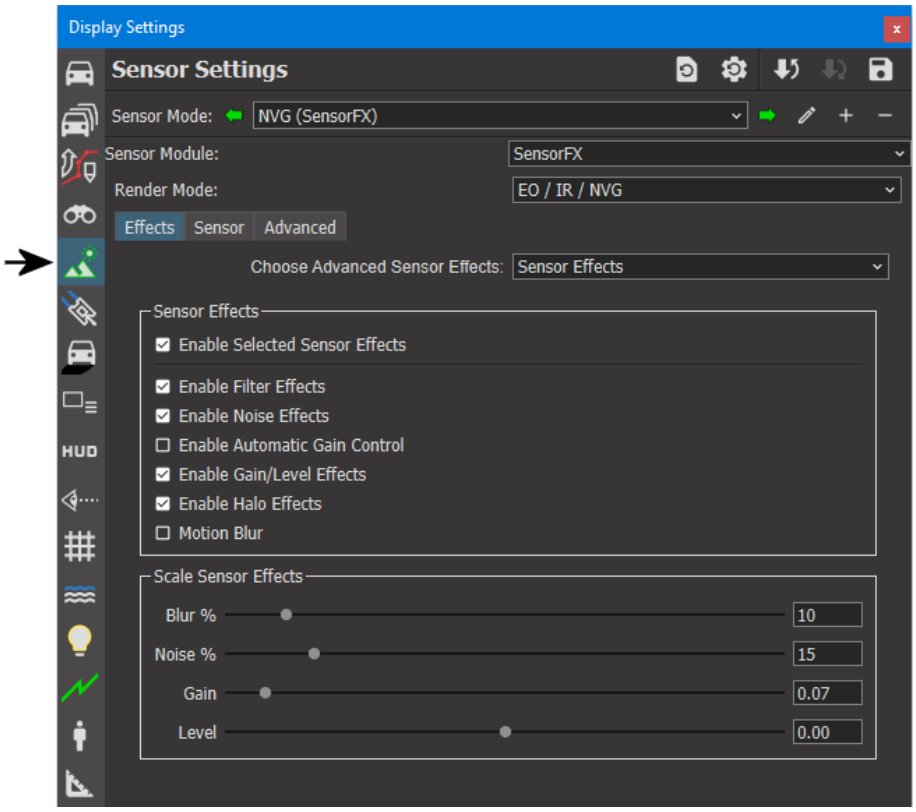
33.3.1 Creating New Sensors

You can create new sensors with settings that vary from the installed IR and NVG sensors. The process for creating new sensors is generically the same as for creating new sensors with CameraFX. You add a new sensor on the Sensor Settings page and then you configure it. (For details, see "33.4. Configuring SensorFX Sensors" on the next page.)

➤ **To add a sensor:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Sensor Settings page.

Figure 259. Sensor Settings page



3. Select a sensor mode that is similar to the one you want to create.
4. On the Sensor Mode line, click the Add button (+). A new sensor called sensor_*number* is added. It copies the settings of the sensor you selected. (To rename the sensor, click the Rename button (✎) and enter a new name.)
5. Change the settings for the new sensor as desired.

33.4. Configuring SensorFX Sensors

The SensorFX sensors are configured on the Display Settings dialog box, Sensor Settings page. Configuration options are organized into tabs as follows:

- Effects.
  - Sensor Effects Table 83 lists options for IR (MWIR and LWIR) and NVG.)
  - Optics (Table 84)
  - Detector (Table 85)

  - Electronics (Table 86)
- Sensor (Table 87)
- Advanced (Table 88)

Table 83. Effects tab, Sensor Effects

Option	Description
Enable Selected Sensor Effects	Enables or disables the selected options on this page.
Enable Filter Effects	Enables filtering.
Enable Noise Effects	Enables noise.
Enable Automatic Gain Control	SensorFX automatically adjusts the scene to provide the best contrast and brightness given time-of-day, weather, and other scene parameters. It overrides the Gain and Level settings.
Enable Gain/Level Effects	Enables the settings in the Scale Sensor Effect group box.
Enable Halo Effects	Show halos around bright points of light such as head lights and street lamps. (NVG Only)
Enable Blackhot	Changes IR from white hot to blackhot. (IR Only)
Motion Blur	Enables motion blur effects.
Blur	Affects the focus of the scene.
Noise	Affects the graininess of the scene.
Gain	Affects the contrast in the scene.
Level	Affects the brightness of the scene.

Table 84. Effects tab, Optics Effects

Option	Description
Aperture Shape	Choose elliptical or rectangular.
Aperture Aspect Ratio	Ratio between horizontal and vertical Instantaneous Field of View (IFOV). Changes are most noticeable when blur is high.
Aperture Diameter	Specified in millimeters. It is used in diffraction calculations. Lower values produce more diffraction spreading (blur).

Table 84. Effects tab, Optics Effects (continued)

Option	Description
Blur Spot Diameter	This quantity [mrad] is a measure of the amount of spherical aberration, and thus the focusing power of the lens. The more this number varies from the focal point the more blur in the scene.
F-Number	Non-editable field. It is calculated based on the FOV and aperture diameter.
Focal Length	Non-editable field. It is calculated based on the FOV and aperture parameters. Units are cm.
Halo Threshold	The point at which halo effects are used. A halo is shown around bright points of light such as vehicle headlights or street lights.
Halo Radius	Determines the overall maximum size of the halo.
Halo Intensity	Determines the maximum brightness of the halo.

Table 85. Effects tab, Detector Effects

Option	Description
Dwell Time	Dwell time is the time [μsec] over which the post-detector electronics integrates the detector output voltage. A value of zero denotes no integration. Increasing dwell time results in higher signal-to-noise ratio.
Temporal NEdR	This is the “noise-equivalent delta-temperature”. Any real IR sensor will produce self-noise, which adds a constant to the effective apparent temperature of the scene, and may be generated from a variety of effects. Noise converted to a DeltaT. If o then no noise impacting the temperature.
% Fixed Pattern	Unwanted signal component that is usually constant or very slowly changing with time. May vary spatially and so could potentially be confused with true fringes. Examples of fixed pattern noise are the pixel to pixel gain variations cosmetic defects in CCD detectors parasitic interference caused by unwanted reflections from various air/glass surfaces.
% Poisson	The Percent Poisson Noise is the statistical fluctuations in charge carrier number. It is also known as “shot” noise. Percent Poisson Noise is more important for optical wavelengths than infrared because in the short wavelengths the energy per photon is higher and so there are fewer photons per unit power of illumination.
% 1/F	Also known as “flicker” or “pink noise”, this occurs in any biased detector and is a thermo-mechanical effect related to material inhomogeneity or transistor recombination.
Horizontal Detector Pitch	The horizontal distance between detector centers [mm], used in determining focal length.

Table 85. Effects tab, Detector Effects (continued)

Option	Description
Vertical Detector Pitch	The vertical distance between detector centers [mm], used in determining focal length.
Background Temperature	The effective temperature [degK] of the ambient background. Can usually be set to nominal air or ground temperature.
Detector Pixel Fill	Term of measurement of FPA performance, which measures how much of the total FPA is sensitive to IR energy. Because the FPA is made of numerous individual detector cells, the total amount of sensitivity is measured by the pathways used to separate the cells and transmit signals. The higher the fill factor, the higher the ratio of sensitivity.
FPA Operability	This indicates the effectiveness of the detector and 100% would be fully functional and as the operability percentage drops the image quality drops.
Noise Frequency Exponent	[Also known as “beta”, this is the exponent of the 1/f noise power spectrum.
Noise Frequency Knee	The frequency above which 1/f noise is overshadowed by thermal or statistical noise from other processes.

Table 86. Effects tab, Electronics Effects

Option	Description
Frame Rate	The frame rate parameter is used to determine the change in temporal noise per frame.
Pre-Amp Cuton Frequency	Frequency at which amplification of the signal occurs after conversion to a voltage. Good values to use for this parameter are 1 – 10.
Post-Amp Cutoff Frequency	Frequency at which amplification of the signal ceases. Good values to use for this parameter are 50 – 500.
Manual Gain	This is the manual gain value and also the maximum gain used by the automatic gain control. The Effects section will scale the gain from 0 – 100% of this value.
Manual Level	This is the manual level and is added to the value from the Effects section, so if you are using a slider for that, then this would be set to zero. This could probably be left out of a GUI if the slider was being used.
Max AGC Gain Min AGC Gain	Maximum and minimum values for automatic gain control.

Table 87. Sensor tab

Option	Description
Lower Band	Lowest wavelength of band in microns.
Upper Band	Highest wavelength of band in microns.
Min Temp	If Automatic Radiance Scaling is not set, then this determines the range used to encode the response textures generated from the mcm textures (for IR).
Max Temp	If Automatic Radiance Scaling is not set, then this determines the range used to encode the response textures generated from the mcm textures (for IR).
Max Light Level	Sets the maximum light level [uW/cm2] which the NVG sensor can detect without saturating. (Visual sensor and NVG only)
Light Pool Gain	(NVG only) Adjusts the brightness of light pools under street lights.
Intensity Modulation Gain	Together with the geometry-model-specific IMOD files, this governs the extent to which detail variance present in the RGB texture for the entity or terrain models is translated into additional variance in the NVG scene. Typical value: 0 – 1.00.

Table 88. SensorFX Advanced tab

Option	Description
Non-uniformity On	The non-uniformity feature applies a gain and/or an offset to each pixel at the end of the sensor effects processing.
Non-uniform Gain File	Specifies the gain to apply.
Non-uniform Offset File	Specifies the offset to apply.
Min Gain Max Gain Min Offset Max Offset	The Min/Max Gain and Min/Max Offset parameters can be adjusted to increase/decrease the amount of variation.
Scanning Direction	The direction of the Sensor scanning direction.
Scanline Spacing	The Scanline Spacing can be changed to make it more blocky.
Color Mapping On	A monochrome format with value interpolated from user-defined LUT scaling curve.

Table 88. SensorFX Advanced tab (continued)

Option	Description
Color Mapping Type	1) User-Defined ColorMap: A monochrome format with value interpolated from user-defined LUT scaling curve. 2) LADAR ColorMap: A format designed to emphasize blue at low input values, green in mid-range values, and red at high values. 3) NVG ColorMap: A format characterized by low blue and red channels (until saturation, when they switch to high values), and a constantly-increasing scaled green channel. 4) LogScale ColorMap: A monochrome format based on a logarithmic scaling of the input.
User Defined File	A user-defined color mapping file.
Pre-Aperture	If selected, record the image before applying sensor effects.
Image(s) File Path	Location to store recorded images.

33.4.1 Using Active Sensor Regions (Dynamic Hot Spots)

SensorFX supports active sensor regions. An active sensor region changes its sensor effect as part of a model, such as an engine or gun barrel heats up or cools down. Models that support active sensor regions have a *.ar* file. The following list is a partial list of models have active sensor regions:

- SH-60 Sea Hawk helicopter
- USS Harry S. Truman
- T-72 main battle tank
- DB_AH-64D_LONGBOW_ARMED_GREEN_V7.0
- DB_Mi-24D_ARMED_CAMO_V7.0_RUSSIA
- DB_UH-60L_DESERT_CAMO_V7.0
- Mi-24D_HIND_ARMED_CAMO_V7.0_RUSSIA
- MI-28_Havoc
- UH-60L_BLACK_HAWK_DESERT_CAMO_V7.0
- Y345-Tug Boat
- Leclerc-FR
- M113
- T-80UM1
- ZSU-23-4
- BMW320DBlue
- ChevroletTahoeSilver

- fire_engine_LOD1
- Ford_Contour_Sedan
- GMCYukonGold
- JeepCommanderWhite
- LandRoverDiscoveryWhite
- M-923_5TONS_TRUCK_DESERT_V7.0
- M1025_M2_HMMWV_DESERT_V7.0
- MercedesMSilver
- MI-28
- MiniCooperBlue
- police_car_LOD1
- VBL
- VolksWagenGolfWhite

When using a DIS or HLA connection, these models activate a dynamic region when the power_plant_status appearance bit is set. Additionally, the T72's tracks grows hotter when the tank is moving and the gun barrel heats up as the result of firing its main gun.



Sensor effects that happen over time require the Ephemeris model (clock) to be active.

If you are using CIGI, you can activate dynamic sensor regions using a Component Control or Short Component Control message. Active sensor regions are named (the names can be found in *.ar* files in the data directories for the models included). CIGI Mappings are provided to map integer values to the names of sensor regions found in the example models. The Component Control message contains a Component class of Entity(0); the instance ID is the ID of the entity to change; the Component State is Sensor State(6), and the component data is a long value of '0' or '1'. '1' turns an active region on; '0' turns it off. The gun barrel on the T72 is an exception. It is impulsed-based. You should send a component data value of '1' each time the gun is fired. '0' is not used.

33.4.2 Specifying When Models Are Displayed

By default, when you are in a sensor mode, such as NVG, simulation object models do not get displayed until SensorFX has processed the materials for the model to determine how to display it. This may cause a delay of several seconds before the model is displayed. If you want models to get shown immediately, you can change this behavior with the SENSORFX_DISABLE_MODEL_DISPLAY_DELAY environment variable. To have models displayed immediately, set this variable to 1. To wait until the materials have been processed, set it to 0. If models are shown before their materials have been processed, they will usually be all black until processing is complete.

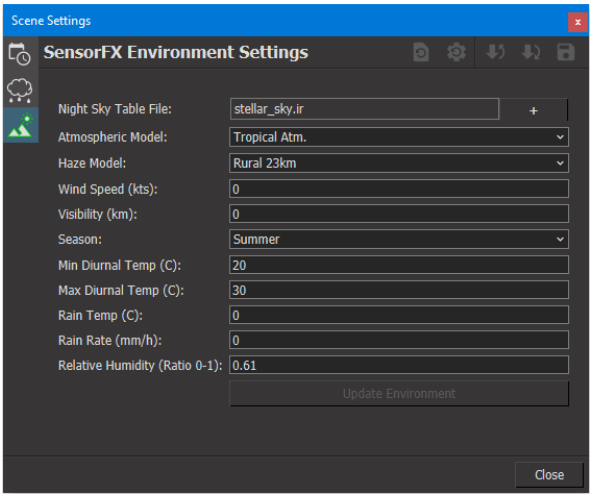
33.5. Configuring the Environment

Sensors are sensitive to environmental factors such as lighting and temperature.

➤ **To change the environment settings:**

1. Choose **Settings > Scene**. The Scene Settings dialog box opens.
2. Select the SensorFX Environment Settings page (Figure 260).

Figure 260. SensorFX Environment Settings page



3. Change settings as desired. Table 89 describes these options.

Table 89. SensorFX Environment page

Option	Description
Night Sky Table File	Contains planetary and stellar irradiance info.
Atmospheric Model	An atmospheric model is a mathematical model constructed around the full set of primitive dynamical equations which govern atmospheric motions. It can supplement these equations with parameterizations for turbulent diffusion, radiation, moist processes (clouds and precipitation), heat exchange, soil, vegetation, surface water, the kinematic effects of terrain, and convection. Select an atmospheric model from the drop-down menu. Select the model that best describes the simulated scene. User Specified: You can define custom Atmospheric models and identify the model by name in the “User Specified Atmosphere” field.
Haze Model	The amount of haze in the atmosphere. Select an option from the list.

Table 89. SensorFX Environment page (continued)

Option	Description
Wind Speed	This is used in the thermal temperature calculations and would likely be constant for a short scenario.
Visibility	This overrides the Modtran visibility when not using a user defined atmosphere file. The units are meters. A setting of 0.0 instructs Modtran to use the default visibility for the chosen atmosphere, and is a recommended setting.
Season	Sets the Season used by the Modtran environment calculations. Choose Summer, Winter, or AutoSelect to use the date.
Min Diurnal Temp Max Diurnal Temp	These specify the temperature range of the air through out a diurnal cycle and would not need to change during a short run scenario, but is important to set correctly even for such scenarios.
Rain Temp	This setting affects objects in the scene, not the actual temperature of rain. Increasing the temperature leads to a brighter scene.
Rain Rate	The precipitation rate per hour. Increasing the rain rate reduces the contrast in the scene.
Relative Humidity	The amount of water vapor in a mixture of air and water vapor. It is defined as the partial pressure of water vapor in the air-water mixture, given as a percentage of the saturated vapor pressure under those conditions. The relative humidity of air thus changes not only with respect to the absolute humidity (moisture content) but also temperature and pressure, upon which the saturated vapor pressure depends. Relative humidity is often used instead of absolute humidity in situations where the rate of water evaporation is important, as it takes into account the variation in saturated vapor pressure.

4. Click Update Environment. It can take 30 seconds or longer for the changes to affect the scene.

33.6. Configuring Light Points

In addition to the light point configuration described in "Configuring Light Points" in the *Adding Content to MAK Applications Reference Manual*, you can configure the light points for SensorFX. Once a light point has been assigned a light point type from the *Lights_DefaultValues_3_2.csv* file, it will have a specific bulb type assigned to it. This is the last parameter in the CSV file for a particular light point type. The default is 1, but SensorFX comes with 12 bulb types preconfigured for use (in *./data/sensorFX/atm/mm_lsources.dat*). Here are general descriptions of how the 12 types behave in IR and NVG.

Table 90. Preconfigured bulb types

Name in mm_lsources.dat	Bulb Type Index	IR behavior	NVG behavior
Mercury_Pure	1	Air temperature	Bright
HPSodium	2	Air temperature	Bright
Mercury_Vap	3	Warmer than air	Bright
ECE_H7	4	Warmer than air	Dimmer than 3
500T14/8	5	Very Hot	Bright
500T14/8	6	Very Hot	Bright
500T14/8	7	Very Hot	Dimmer than 6
500T14/8	8	Very Hot	About the same as 7
500T14/8	9	Very Hot	About the same as 8
500T14/8	10	Very Hot	Dimmer than 9
500T14/8	11	Very Hot	About the same as 10
500T14/8	12	Very Hot	Dimmer than 11

In addition to the preconfigured types specified in Table 90, an advanced use case would be to add new types to *mm_lsources.dat*. Each line represents a light bulb type, with tab separated parameters starting with the name on the left. Here are descriptions of the parameters in the order that they are specified in the line.

Table 91. Bulb parameters

Parameter Name	Parameter Description
ID	String name of the light bulb type.
posN[m]	Unused by SensorFX.
posE[m]	Unused by SensorFX.
posD[m]	Unused by SensorFX.
dirN [unitless]	Unused by SensorFX.
dirE [unitless]	Unused by SensorFX.
dirD [unitless]	Unused by SensorFX.
T[degK]	Floating point value that is the effective black-body temperature of filament in degrees Kelvin.
P[W]	Floating point value that is the source total spectrally-integrated power.
etha [unitless]	Floating point value between 0 and 1 that is the source efficiency (that is, fraction of input power P converted into EO-band light field).

Table 91. Bulb parameters (continued)

Parameter Name	Parameter Description
cutoff[deg]	Unused by SensorFX.
area[cm2]	Floating point value that is the effective area of light source (bulb). If <=0 then the default value of 400cm2 is used.
thickness [cm]	Floating point value that is the thickness of bulb glass or other material through which excess heat is conducted.

33.7. Using SensorFX with Remote Display Engines

You can use SensorFX with remote display engines.

➤ To run a remote display engine that uses SensorFX, on the Start menu, choose **MAK Technologies > VR-Vantage Display Engine with SensorFX**.

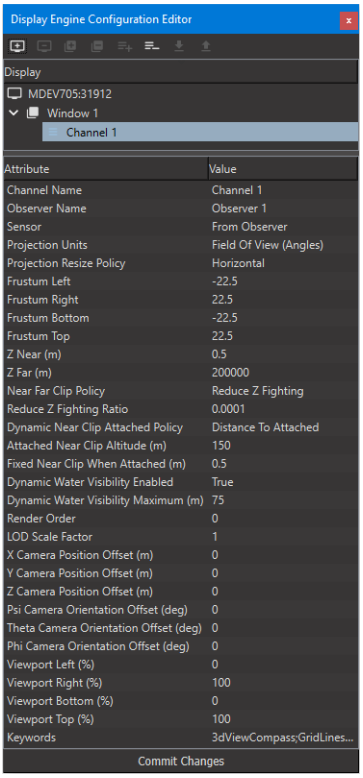
33.7.1 Changing the Sensor on a Remote Display Engine

Ordinarily, to change the sensor being used, you change to an observer that has the sensor you want. However, you cannot change the observer on remote display engines. If you want to change the sensor on a remote display engine, you can do so by changing the sensor for the remote display engine's channel. (You can change the sensor for any channel this way, not just remote display engines.)

➤ **To change the sensor for a remote display engine:**

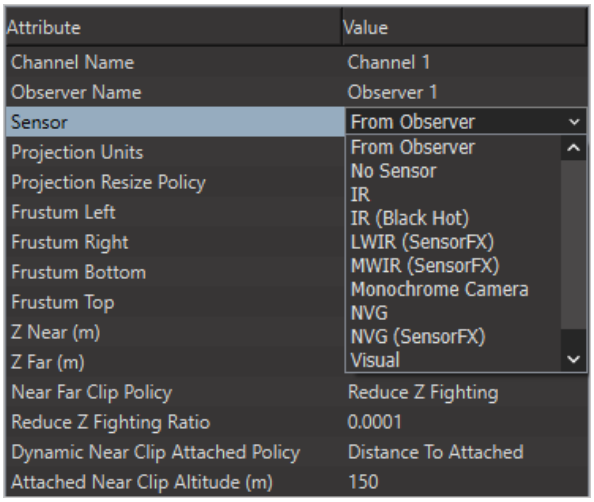
1. Choose **View > Display Engine Configuration Editor Panel**. The Display Engine Configuration Editor opens.
2. Select the channel for the remote display engine. By default, the Sensor attribute has the value From Observer (Figure 261).

Figure 261. Display Engine Configuration Editor



3. Click the value to make it editable.
4. Select a sensor from the list (Figure 262).

Figure 262. Sensor list



5. Click Commit Changes. The sensor in the remote display engine changes.

33.8. Material Classification on Demand

SensorFX material classification on demand (MCOD) provides automatic material classification using vector shape-files, and combines them with an intensity-modulated image to produce material encoded textures used in the real-time sensor rendering. The material encoded textures use JRM's Eigen material technique, which provides excellent rendering capabilities with the ability to mimic an unlimited number of material systems through the combination of multiple eigen materials.

Eigen materials can be thought of as a basic material group that can be combined to form specific material systems. These textures are in a continuous parameter space that is not dependent on time-of-day and other environmental conditions and can be Mipped/interpolated and compressed. The textures can be used to simulate all the different sensor bands (NVG, IR, and so on) without being regenerated.

The process is done automatically as the data is paged in from the server, and once the material textures have been generated, the texture array images are saved to the standard osgEarth file cache ready for fast loading on subsequent runs.

This section explains how to define generation of a material classified texture in an earth file.

The MCOD process:

- Processes any number of vector shape-files as raster images for each LOD. These shape-files represent material features (for example, roads, building footprints, water, and so on.)
- Combines the image textures to produce a per-pixel intensity modulation that maintains the spatial variation.
- Generates the material classified texture layers that are processed in real-time to calculate sensor wavelength-specific output using JRM's sensor suite.

MCOD:

- Supports an unlimited number of material types by the use of texture arrays. Individual Eigen materials are stored as distinct components in each of the texture array layers.
- Stores individual materials as distinct components in each of the texture array layers.
- Specifies material components using osgEarth earth files. A feature component's color is specified using the standard style symbol set. This section describes how to use the styles necessary to define features plus any custom styles particular to MCOD.
- Caches files using the standard osgEarth pipeline to accelerate run-time load performance.

The MCOD plug-in uses standard osgEarth terminology plus the following terms:

- texture layer. Corresponds to an index of an output texture array (0 to number of available layers-1).
- channel. An image color component (for example, R,G,B or A).

- default material. The material to use in the areas that are not defined by a shape-file.
- Intensity Modulation (IM). An optional channel to hold a gray scale representation of the visual imagery.
- feature level. Extends the osgEarth concept of level, but is particular to features, such as shapefiles.

The following code is a template for setting up an MCOD layer in an earth file:

```
<map name="Name of the Map" type="geocentric" version="2">
    <!-- [Optional] Visible Image layers go here -->

    <!-- [Optional] Elevation source can be specified here -->
    <image name="MaterialClassificationOnDemand" driver="mcod"
visible="false" shared="true">
        <!-- optional file cache id -->
        <cacheid>mcod</cacheid>
        <!-- defines the depth of the texture array, must be 1 or more
-->
        <num_texture_layers>2</num_texture_layers>

         <!-- for now texture compression MUST be set to none -->
         <texture_compression>none</texture_compression>
         <!-- assign default material channel (RGBA) and texture layer
-->
         <default_material_channel>#0000ff00</default_material_
channel>
         <default_material_texture_layer>0</default_material_texture_
layer>

         <!-- assign intensity modulation color channel (RGBA)
and             texture layer -->
         <intensity_modulation_channel>#000000ff</intensity_
modulation_channel
        <intensity_modulation_texture_layer>0</intensity_modulation_
texture_layer>

        <!-- specify minimum level where features (shapefiles) will
begin             to render -->
        <min_feature_level>10</min_feature_level>
        <!-- [Optional] image layers - to compute intensity modulation
-->
        <image>
            ...
        </image>
        <image>
             ...
         </image>
```

```
        <!-- features layers - contain material shapefiles to render
-->
        <features>
            ...
        </features>
        <features>
            ...
        </features>
        <!-- define rendering styles, by name, for the features -->
        <styles>
            <style type="text/css">
                ...
            </style>
        </styles>
    </image>
</map>
```

Layer flags (osgEarth standard):

- driver="mcod". Specifies the MCOD plug-in.
- visible="false". Layer will not be rendered directly.
- shared="true". Textures are made available to shaders.

MCOD specific variables:

- num_texture_layers. The number of texture layers defining the creation of the output texture array.
- default_material_channel. Channel (color component, RGBA order) that will contain the default material. in the example above, default material channel is defined as #0000ff00 indicating that the 8-bit Blue channel will contain the default material.
- default_material_texture_layer. Texture array id [0 to num_texture_layers-1] for the default material.
- intensity_modulation_channel. Channel (color component, RGBA order) that will contain intensity modulation. In the example above, the intensity modulation channel is defined as #000000ff, indicating that the 8-bit Alpha channel will contain IM.
- intensity_modulation_texture_layer. Texture array id [0 to num_texture_layers-1] for intensity modulation.
- min_feature_level. Similar to the osgEarth variable min_level, but is specific to features (material shapefiles). Default: 0.
- splat_combine_mode. Specifies how the procedural imagery materials should be combined with the MCOD layer's materials and what to use as the intensity modulation. This can be one of the following options:

- NO_COMBINE. Default value for splat_combine_mode. Use this mode if there is not a procedural imagery/splatting layer that can be combined with the MCOD layer.
- IM_SPLAT. Uses the visual procedural image layer as the intensity modulation for the SensorFX sensor modes. This mode requires that both the procedural imagery material layer and the MCOD layer use the same *.ms* file. See *./userData/terrains/MAK Earth - MCOD - Splat - Im Splat (online).earth* for an example of how to configure this mode.
- IM_IMAGE_LAYER. Uses an image layer as the intensity modulation for the SensorFX sensor modes. This mode can use two separate *.ms* files, one for the procedural imagery material layer and one for the MCOD layer. See *./userData/terrains/MAK Earth - MCOD - Splat - Im Image Layer (online).earth* for an example of how to configure this mode.

The following code shows the MCOD setup in *MAK Earth - MCOD (online).earth*:

```
<image name="features"
                driver="mcod"
                opacity="1.0"
                visible="false"
                shared="true"
                min_filter     = "LINEAR_MIPMAP_LINEAR"
                mag_filter     = "LINEAR"
                max_range      = "100000000">
    <cacheid>mcod</cacheid>

    <!-- specify the minimum level that features (shapefiles) will
begin to render -->
    <min_feature_level>10</min_feature_level>

    <num_texture_layers>1</num_texture_layers>

    <texture_compression>none</texture_compression>
    <!-- assign default material channel (RGBA) and texture layer -->
    <default_material_channel>#0000ff00</default_material_channel>
    <default_material_texture_layer>0</default_material_texture_layer>

    <!-- assign intensity modulation color channel (RGBA) and texture
layer -->
    <intensity_modulation_channel>#000000ff</intensity_modulation_
channel
    <intensity_modulation_texture_layer>0</intensity_modulation_
texture_layer>
```

33.8.1 Associating Styles and Features

Styles specify how features are rasterized into a layer. The feature rasterization is implemented using the osgEarth framework that wraps the AggLite renderer. Styles defined in the earth file control raster characteristics such as color and stroke width.

MCOD features must be associated with style. (Please see osgEarth documentation for information on setting up feature styling.) In addition to the osgEarth styling support, MCOD also supports a simple styling configuration by matching the feature name to the style name.

The following code is from *MAK Earth - MCOD (online).earth*:

```
<features name="buildings-1" driver="wfs">
    <url>http://vr-theworld.com/vr-theworld/features/wfs</url>
    <build_spatial_index>true</build_spatial_index>
    <typename>65</typename>
</features>

<features name="roads-1" driver="wfs">
    <url>http://vr-theworld.com/vr-theworld/features/wfs</url>
    <build_spatial_index>true</build_spatial_index>
    <typename>55</typename>
</features>

<styles>
    <style type="text/css">
         roads-1 {
             stroke:             #ff0000;
             stroke-width:       50m;
             stroke-min-pixels:  0;
             altitude-clamping:  terrain-drape;
            texture-layer:      0;
         }
        buildings-1 {
            fill:          #00ff00;
             stroke:           #00ff00;
             stroke-min-pixels:  0;
             stroke-width:  0px;
            texture-layer:      0;
         }
    </style>
</styles>
```

This example has the MCOD specific style variable texture-layer, a texture array id [0 to num_texture_layers-1] for the feature.

33.9. Streaming Sensorized Imagery

SensorFX supports streaming imagery. It is set up through the earth file. Create an image section with a name that contains emat. For example:

```
<GDALImage name="streaming emat2" driver="gdal"  lod_blending="true"
shared="true" visible="false">
    <shared_sampler>jrmuSensorTex2</shared_sampler>
    <shared_matrix>jrmuSensorTexMatrix2</shared_matrix>
    <url>../../TerrainData/Terrain/DATABASENAME/emat2</url>
</image>

<GDALImage name="streaming emat3" driver="gdal"  lod_blending="true"
shared="true" visible="false">
    <shared_sampler>jrmuSensorTex3</shared_sampler>
    <shared_matrix>jrmuSensorTexMatrix3</shared_matrix>
    <url>../../TerrainData/Terrain/DATABASENAME/emat3</url>
</image>
```

emat2 and emat3 should be in separate directories. They need to be GeoTIFF versions of the emat textures so that osgEarth has the location information to correctly place the textures.

To specify an ms file, do the following:

```
<external>

<msfile>../../TerrainData/Terrain/DATABASENAME/databaseEmat.ms</msfile>
</external>
```

This ms file can be used with streaming imagery, MCOD, or osgEarth terrains that are not material classified at all.

For information about ms files and emat files, see "Chapter 34. Adding GenesisMC Models to SensorFX" on page 521.

The example HawaiiTifExample has a sample earth file called *HawaiiTifExample.earth* and an *.mtf* file called *HawaiiTifExample.mtf*. It shows how to set up the earth file and the terrain directory for using GeoTIFFs directly.

33.10. Using SensorFX with Geocentric Terrains

If you load a geocentric terrain without using an earth file, SensorFX does not work properly. You can work around this problem by creating an earth file that does not do anything and creating an MTF file that loads the earth file and the terrain.

The earth file should look like this:

```
-->
<map name="MAK Earth" type="geocentric" version="2">
<options>
<terrain color = "#00000000" />
</options>
</map>
```

1. In SensorFX, load the earth file as a terrain server.
2. Load the geocentric terrain as a terrain patch.
3. Save the terrain as an MTF terrain.

By default, the observer will be in space, so create a saved view of the terrain at a useful location.



34. Adding GenesisMC Models to SensorFX

This chapter explains how to integrate materially classified models generated by GenesisMC into SensorFX.

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34.1. Introduction to Adding Models Processed by GenesisMC

GenesisMC is an application created by JRM Technologies that processes models and creates the files needed by SensorFX to render them based on material classification. This chapter assumes you have generated material classified versions of your models using GenesisMC and explains how to set up the files forSensorFX to use them.

34.2. Model File Setup

SensorFX uses the following types of files to load the materially classified version of a model:

- Material classification file (*.emat*).
- Material system file (*.ms*).
- Intensity modulation file (*.imod*) (optional).
- Active regions file (*.ar*) (optional).

The *.emat*, *.ms*, and *.imod* files are generated by GenesisMC. The *.ar* file is created by the model developer or someone who understands the location of hotspots on the model.

SensorFX uses the names of the textures and models to look for the material classified configuration files. For example, the base set of files for the SH-60 SEA-HAWK (in *./SharedData/16/latest/Vehicles/RotaryWing/SH-60 SEA-HAWK*) before material classification is:

- DB_ROTOR_4PALES_128_rgba.meif
- DB_SH60L_1024_DESERT_CAMO_NML_rgb.meif
- DB_SH60L_1024_DESERT_CAMO_RFL_rgb.meif
- DB_SH60L_1024_DESERT_CAMO_rgb.meif
- DB_SH60L_1024_DESERT_CAMO_SPC_rgb.meif
- DB_SH60L_1024_rgb.meif
- DB_SH-60L_DESERT_CAMO_V7.0.medf
- DB_SH60L_FLOOR_256_rgb.meif
- DB_SH60L_INTERIOR_512_rgb.meif
- DB_SH60L_SHADOW_256_rgba.meif
- DB_SH60L_WINDOW_512_RFL_rgba.meif
- DB_SH60L_WINDOW_512_rgba.meif
- DB_SH60L_WINDOW_512_SPC_rgba.meif

34.2.1 The *.emat* Files

EMAT files are materially classified versions of the visual RGB textures. One of the RGB textures for the SH-60 is DB_SH60L_1024_rgb.meif. After processing the textures, GenesisMC creates three EMAT textures for *DB_SH60L_1024_rgb.meif – DB_*

SH60L_1024.emat1.dds, *DB_SH60L_1024.emat2.dds*, and *DB_SH60L_1024.emat3.dds*. SensorFX does not use the emat1 file. In order to save texture memory, VR-Vantage uses the *.imod* file to fulfill the same purpose.

Copy the **.emat2.dds* and **.emat3.dds* files to the same directory as the RGB textures so that SensorFX can find them. The complete list of *.emat* files for the SH-60 is as follows:

- DB_ROTOR_4PALES_128.emat2.dds
- DB_ROTOR_4PALES_128.emat3.dds
- DB_SH60L_1024.emat2.dds
- DB_SH60L_1024.emat3.dds
- DB_SH60L_1024_DESERT_CAMO.emat2.dds
- DB_SH60L_1024_DESERT_CAMO.emat3.dds
- DB_SH60L_FLOOR_256.emat2.dds
- DB_SH60L_FLOOR_256.emat3.dds
- DB_SH60L_INTERIOR_512.emat2.dds
- DB_SH60L_INTERIOR_512.emat3.dds
- DB_SH60L_WINDOW_512.emat2.dds
- DB_SH60L_WINDOW_512.emat3.dds.

34.2.2 Material System File (*.ms*)

SensorFX uses the material system file to map a channel of the emat texture to a particular material. There might be multiple material system files in the GenesisMC output directory. The one that SensorFX needs ends in *Emat.ms*. The contents of the file will be nine lines that define six materials. In the SH-60 example, this file is *DB_SH-60L_DESERT_CAMO_V7.0Emat.ms*.

There are two ways to point to a material system file. The simplest way is to give the file the same name as the model file name minus the extension and add *Emat.ms*. This file must be in the same directory as the model file. In the SH-60 example, the model filename is *DB_SH-60L_DESERT_CAMO_V7.0.medf*. Therefore, the material system file is *DB_SH-60L_DESERT_CAMO_V7.0Emat.ms*.

The other way to point to a material system file is in a model definition. For details, please see "34.3.1 The msFilename Parameter" on the next page.

34.2.3 Intensity Modulation File (*.imod*)

An intensity modulation file or *.imod* file is an optional file that defines how much of the RGB texture to mix with the Sensor response in the final result. It allows the intensity modulation to be defined on a per-material and per-sensor band level. The file must have the same name as the material system file, except that the extension must be *.imod* instead of *.ms*. This file must be in the same directory as the material system file. In the SH-60 example the material system file is *DB_SH-60L_DESERT_CAMO_V7.0Emat.ms* which corresponds to intensity modulation file *DB_SH-60L_DESERT_CAMO_V7.0Emat.imod*.

34.2.4 Active Region File (*.ar*)

The active region file is an optional file that lets you define which materials are dynamic. (Active regions are also called hotspots.) The file defines a material for the off state and another material for the on state. If the model does not have any active regions then it does not need an active region file.

The active region file is a text file that you create. It is not created by GenesisMC.

See *DB_SH-60L_DESERT_CAMO_V7.0Emat.ar* for an example of an active region file. For a more complex example, see *./SharedData/16/latest/Vehicles/Tracked/T-72B_DESERT_V7.0/DB_T72B_DESERT_V7.0Emat.ar*.

The *.ar* file must have the same name as the *.ms* file it corresponds to, except that the extension is changed to *.ar*. For example *DB_SH-60L_DESERT_CAMO_V7.0Emat.ar* corresponds to *DB_SH-60L_DESERT_CAMO_V7.0Emat.ms*.

34.3. Model Definitions for Materially Classified Models

If you have generated material classification files for a model that is already configured in VR-Vantage, all you have to do is put the required files in the model directory as described in previous sections. You do not have to edit the model definition.

If you have created a new model, you must create a model definition, as described in "Creating and Editing Model Definitions" in the *Adding Content to MAK ONE Applications Reference Manual*.

SensorFX supports the following optional parameters that you can add to schemas and model definitions: **msFilename**, **powerPlantActiveRegions**, **movingActiveRegions**, and **weaponFireActiveRegions**.

34.3.1 The msFilename Parameter

The **msFilename** parameter lets you point to a material system file that does not use the naming convention described in "34.2.2 Material System File (.ms)" on the previous page. Possible reasons for this are if there are two models that need to use the same material system file or there are multiple variations of the same model that need different material systems.

The **msFilename** parameter is not available by default. You must be added to the model's schema before you can use it. See "Adding a Parameter to a Schema" in the *Adding Content to MAK ONE Applications Reference Manual* for information about how to add a parameter to a schema.

The parameter must be called **msFilename** and have its type set to string.

To determine which schema to edit, look at the schema listed for the model definition for the model you are editing. The most likely schemas are Entity and Watercraft.

34.3.2 The powerPlantActiveRegions Parameter

The power plant active regions are active regions that should be turned on when the model's power plant is turned on and turned off when the model's power plant is turned off.

In the active region file, the first column of each line specifies the name of an active region. The SH-60 has two active regions, EngineGlass and EnginePaint. In order to map them to the power plant active state in VR-Vantage, the model definition needs a parameter added called **powerPlantActiveRegions**. The value of that parameter is a comma-separated list of active regions that should map to the power plant state. For the SH-60, the value for **powerPlantActiveRegions** is EngineGlass,EnginePaint. This maps the EngineGlass and EnginePaint active regions to the power plant state.

The default value for the **powerPlantActiveRegions** parameter is **powerPlant** if the parameter is not specified for a given model definition. If the model definition specifies a **powerPlantActiveRegions** parameter, then it overrides the default and **powerPlant** is no longer a valid active region unless it is also specified in the parameter value.

34.3.3 The movingActiveRegions Parameter

The moving active regions are active regions that should be turned on when the model is moving and turned off when the model is stationary. *./SharedData/16/latest/Vehicles/Tracked/T-72B_DESERT_V7.0/DB_T72B_DESERT_V7.0Emat.ar* is an example of an active regions file that has a moving active region. The Track active region corresponds to the material on the tracks of the tank. Therefore it must be mapped to the moving active region in the model definition. The **movingActiveRegions** parameter in the model definition for the T-72 has a value of Track. It maps the Track active region to the moving state of the tank.

The default value for the **movingActiveRegions** parameter is **moving** if the parameter is not specified for a given model definition. If the model definition specifies a **movingActiveRegions** parameter, then it overrides the default and **moving** is no longer a valid active region unless it is also specified in the parameter value.

34.3.4 The weaponFireActiveRegions Parameter

The weapon fire active regions are active regions that should be triggered when the model fires its weapon. *./SharedData/16/latest/Vehicles/Tracked/T-72B_DESERT_V7.0/DB_T72B_DESERT_V7.0Emat.ar* is an example of an active regions file that has a weapon fire active region. The Artillery active region corresponds to the material on the weapon of the tank. SensorFX supports only one weapon system per entity for Active Regions, typically the main gun. The **weaponFireActiveRegions** parameter in the model definition for the T-72 it has a value of Artillery. It maps the tank's main large gun active region to the weapon fire event in VR-Vantage.

The default value for the **weaponFireActiveRegions** parameter is **weaponFire** if the parameter is not specified for a given model definition. If the model definition specifies a **weaponFireActiveRegions** parameter then it overrides the default and **weaponFire** is no longer a valid active region unless it is also specified in the parameter value.

34.4. Configuring Particle Systems

Particle systems are configured slightly differently than other models in SensorFX. Instead of using emat textures to define the materials that are used, they use PIP files to define how the particle system should be handled in sensor modes. In order for

SensorFX to know that the model is a particle system instead of a regular model, the MS file must end in *.specialeffect.ms* instead of *.ms*. These MS files are searched for by taking the model name, removing the extension and replacing it with *.specialeffect.ms* (for example, *smoke.osg* would look for *smoke.specialeffect.ms*).

Once SensorFX determines that there is a *.specialeffect.ms* file, it looks for the corresponding *.pip* file. First it looks for the same filename as the MS file except without the *.ms* extension (for example, for *smoke.specialeffect.ms* it would look for *smoke.specialeffect.pip* in the same directory as the MS file). If it does not find that PIP file, it looks for a keyword that it can match to a default PIP file. The default PIP files are in *./data/SensorFX/particleEffects*.

Continuing our example, assume the *smoke.osg* model has a *smoke.specialeffect.ms* file. SensorFX looks for *smoke.specialeffect.pip*. If it does not find it, it uses *smoke.pip*, because it matches the smoke keyword in *smoke.specialeffect.ms*.

Table 92 lists the default PIP files.

Table 92. Default PIP files

Keyword	PIP file
dust	*dust.pip*
smoke	*smoke.pip*
flame	*flame.pip*
plume	*plume.pip*
flare	*flare.pip*



35. Setting Sensor Parameters Using the API

This chapter explains how to set sensor parameters using the VR-Vantage Toolkit.

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35.1.1 Calculating Noise 536

35.1. Sensor Attribute Names and Types

Table 93 lists attribute names and types for settings SensorFX sensor parameters using the **setParameter()** functions in the **DtMasterSensorController** class. The exampleSensorSettings example project shows how to use these parameters to control the SensorFX settings through the API. These also correspond to the attribute value pairs in *default_Sensors.sfx* for SensorFX.

Table 93. Attributes and types for sensor parameters

Attribute	Type	Description
ApertureShape	Integer	Specifies the shape of the sensor lens aperture. Elliptical = 0 Rectangular = 1.
ColorMapType	Integer	16-bit output image format options. Accepted values are: 1 - User-Defined ColorMap: A monochrome format with value interpolated from user-defined LUT scaling curve. 2 - Pseudo ColorMap: A format designed to emphasize blue at low input values, green in mid-range values, and red at high values. 3 - NVG ColorMap: A format characterized by low blue and red channels (until saturation, when they switch to high values), and a constantly-increasing scaled green channel. 4 - LogScale ColorMap: A monochrome format based on a logarithmic scaling of the input.

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
ModtranAtmModel	Integer	An atmospheric model is a mathematical model constructed around the full set of primitive dynamical equations that govern atmospheric motions. It can supplement these equations with parameterizations for turbulent diffusion, radiation, moist processes (clouds and precipitation), heat exchange, soil, vegetation, surface water, the kinematic effects of terrain, and convection. Accepted values are: 1 - Tropical 2 - MidLatitudeSummer 3 - MidLatitudeWinter 4 - SubArcticSummer 5 - SubArcticWinter 6 - USStandard 7 - UserDefinedAtm
ModtranHazeModel	Integer	Specifies the Modtran haze model to use for the atmospheric calculations. Available values are: Accepted values are: -1 - NoAerosol (but might have clouds) 0 - NoHaze (No aerosol or clouds) 1 - Rural_23km 2 - Rural_5km 3 - NavyMaritime 4 - Maritime_32km 5 - Urban_5km 6 - Tropospheric_50km 7 - UserDefined (uses the atm state file for definition) 8 - Fog_200m 9 - Fog_500m 10 - Desert
ModtranSeason	Integer	Set the season of the year that should be used by the ModTran environment calculations. AutoSelect = 0 Summer = 1 Winter = 2

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
RenderMode	Integer	Sets the render mode to use for this sensor. Set to 0 for visual sensors and 2 for EOIR sensors (NVG or IR).
ScanMaskDirection	Integer	Sets the direction of the Sensor scanning. Horizontal = 0 Vertical = 1 Full Image Scan = 2.
ScanMaskLineSpacing	Integer	Scanline spacing can be changed to make it blockier. Value between 1 and 512.
ColorMapEnable	Boolean	Enables the color mapping effect which converts the grayscale intensities to colored values.
OptimizedFilterEnable	Boolean	Enables a performance optimized filtering technique for the blur calculations.
ScanMaskUserDefined	Boolean	Enables the application of a scan mask user defined file to the image.
ScanningSensorEnable	Boolean	Enables the scan mask to the image.
agcOn	Boolean	Enables automatic gain control. gainOn must be set to True for this to be fully enabled.
blackHotOn	Boolean	Enables black hot to be applied to the image. When this is False, the image is displayed in white hot.
filterOn	Boolean	Enables blur to be applied to the image.
gainOn	Boolean	Enables gain and level effects to be applied to the image and must be set to True for automatic gain control to be enabled.
halosOn	Boolean	Enables halos to be applied to the scene. This effect is only applied if the sensor mode is NVG.
motionBlurOn	Boolean	Enables motion blur to be applied to the scene.
noiseOn	Boolean	Enables noise to be applied to the scene.
sensorEffectsOn	Boolean	Enables or disables all the sensor effects. If set to False all other sensor effects are disabled.
AGCMaxGain	Float	Sets the maximum gain value that can be used by the automatic gain control.
AGCMinGain	Float	Sets the minimum gain value that can be used by the automatic gain control.

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
ApertureAspectRatio	Float	Allows for a non-circular/non-square aperture to be specified as a ratio of the width and height.
ApertureWidth	Float	Diameter of the aperture in millimeters.
BackgroundTemp	Float	Temperature used to determine radiance of the noise delta in IR = Radiance(Tback + NEdT) – Radiance (Tback) (Degrees Kelvin; typically 293K.)
BlurSpotDiameter	Float	Measure of the amount of spherical aberration and thus the focusing power of the lens. (millirads)
DwellTime	Float	Time over which the post-detector electronics integrates the detector output voltage. A value of zero (0) denotes no integration. Increasing dwell time results in higher signal-to-noise ratio and thus a higher quality image/scene. Dwell time is measured in microseconds. This also affects the motion blur as the higher the dwell time, the more that previous frames affect the current frame.
FInverseNoisePercent	Float	The Percent 1/f Noise, also known as “flicker” or “pink noise” occurs in any biased detector and is a thermo-mechanical effect related to material inhomogeneity or transistor recombination. For more information about calculating noise, please see "35.1.1 Calculating Noise" on page 536.
FilterAdjustment	Float	Specifies the amount of blur to apply to the image. A value of 1.0 will use the rest of the blur configuration settings directly. Values between 0.0 and 1.0 reduce the amount of blur accordingly.
FixedPatternNoisePercent	Float	An unwanted signal component that is usually constant or very slowly changing with time. Examples of Fixed Pattern Noise include pixel to pixel gain variations, cosmetic defects in the CCD detectors, and parasitic interference caused by unwanted reflections from various air or glass surfaces. For more information about calculating noise, please see "35.1.1 Calculating Noise" on page 536.

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
FrameRate	Float	Frame rate of the sensor. Typically between 30 and 60hz.
GainAdjustment	Float	Sets the percentage of the manual gain value to apply to the image.
HaloIntensity	Float	Represents the maximum brightness of the Halo.
HaloRadius	Float	Measured in pixels, and represents the maximum size of the Halo.
HaloThreshold	Float	Determines how bright a light point needs to be before it creates a halo. A higher halo threshold means less haloing and a lower halo threshold means more light points will create halos.
HorizontalFOV	Float	Refers to how far it can look left and right without physically moving, similar to the way you can scan a room with your eyes without moving your head.
HorizontalPitch	Float	The horizontal distance between detector centers, in millimeters. Used in determining focal length.
IntensityModulationGain	Float	Together with the geometry-model-specific IMOD files, this governs the extent to which detail variance present in the RGB texture for the entity or terrain models will be translated into additional variance in the IR scene. Between 0.0 and 1.0
LevelAdjustment	Float	Sets the amount of level to apply to the image in addition to the manual level value.
LightPoolGain	Float	Scales the dynamic lighting intensity for EO and NVG sensor modes.
LowerBand	Float	Lowest wavelength of band in microns.
ManualGain	Float	Sets the amount of gain to apply to the image if the gain adjustment value is set to 1.0.
ManualLevel	Float	Sets the amount of level to apply to the image if the level adjustment value is set to 0.0.

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
MaxDiurnalTemperature	Float	Specifies the maximum temperature of the air throughout a diurnal cycle and would not need to change during a short run scenario, but is important to set correctly even for such scenarios. (Degrees Celsius)
MaxLightLevel	Float	Sets the maximum light level [uW/cm2] that the EO/NVG sensor can detect without saturating.
MaxTemp	Float	(Upper Temp Limit): If Automatic Radiance Scaling is not set, then this determines the range used to encode the response textures generated from the mcm textures (for IR).
MinDiurnalTemperature	Float	Specifies the minimum temperature of the air throughout a diurnal cycle and would not need to change during a short run scenario, but is important to set correctly even for such scenarios. (Degrees Celsius)
MinTemp	Float	(Minimum Temp Limit): If Automatic Radiance Scaling is not set, then this determines the range used to encode the response textures generated from the mcm textures (for IR).
ModtranVisibility	Float	Specifies the visibility, in meters, to use for the Modtran calculations when there is not a user defined atmosphere file specified. If set to 0 then it will use the haze model to determine the visibility.
MtfMotionBlurSize	Float	Sets the motion blur spot size (millirads). Currently this is not implemented as a motion blur but is added to the other MTFs.
NoiseAdjustment	Float	Specifies the amount of noise to apply to the image. Between 0.0 and 1.0.
NoiseEquivalentRadiance	Float	The Noise-Equivalent delta Radiance is applied when using an NVG/EO sensor. NEdR is another means of specifying the noise level. It takes into account the effect of external factors on overall uncertainty in output levels. This quantity is used instead of NEdT when outside of the IR regime. Typically between 0.00003 and 0.0003

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
NoiseEquivalentTemp	Float	The Noise-Equivalent delta Temperature. All IR sensors will produce self –noise, which will add a constant to the effective apparent temperature of the scene and may be generated from a variety of effects.
NoiseFrequencyExp	Float	Known as “beta” is the exponent of the 1/f noise power spectrum.
NoiseFrequencyKnee	Float	The frequency above which 1/f noise is overshadowed by thermal or statistical noise from other processes. (Hz)
PercentDeadPixel	Float	Specifies the percentage of the total number of pixels that are dead.
PercentPixelFill	Float	Between 100 and 0 with lower values increasing the amount of blur.
PoissanNoisePercent	Float	The Percent Poisson Noise is the statistical fluctuation in charge carrier number. This is also referred to as “shot” noise. For more information about calculating noise, please see "35.1.1 Calculating Noise" on page 536.
PostCutoffFreq	Float	The frequency at which amplification of the signal ceases. (Hz)
PreCutonFreq	Float	The frequency at which amplification of the signal occurs after conversion to a voltage. (Hz)
RainRate	Float	Specifies the rate of precipitation, in mm/hr.
RainTemp	Float	Specifies the temperature of the precipitation. (Degrees Celsius)

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
RelativeHumidity	Float	The amount of water vapor in a mixture of air and water vapor. It is defined as the partial pressure of water vapor in the air-water mixture, given as a percentage of the saturated vapor pressure under those conditions. The relative humidity of air thus changes not only with respect to the absolute humidity (moisture content), but also temperature and pressure, upon which the saturated vapor pressure depends. Relative humidity is often used instead of absolute humidity in situations where the rate of water evaporation is important, as it takes into account the variation in saturated vapor pressure. Floating point value between 0.0 and 1.0.
ScanMaskMaxGain	Float	Sets the maximum gain to apply to the image based on the scan mask.
ScanMaskMaxLevel	Float	Sets the maximum level to apply to the image based on the scan mask.
ScanMaskMinGain	Float	Sets the minimum gain to apply to the image based on the scan mask.
ScanMaskMinLevel	Float	Sets the minimum level to apply to the image based on the scan mask.
UpperBand	Float	Highest wavelength of band in microns.
VerticalFOV	Float	Refers to how far it can look up and down without physically moving, similar to the way you can scan a room with your eyes without moving your head.
VerticalPitch	Float	The vertical distance between detector centers and is used in determining focal length.
WindVelocity	Float	Specifies the wind speed to use for the Modtran calculations, in meters/second.
AtmosphereStateFile	String	Specifies a user defined atmosphere state file to use for the Modtran atmospheric calculations.
ColorMapUserDefined-RadFile	String	File defining a custom color mapping.
NightSkyTableFile	String	Specifies the file to use for the planetary and stellar irradiance information.

Table 93. Attributes and types for sensor parameters (continued)

Attribute	Type	Description
ScanMaskGainFilename	String	An image file to use as a mask for adjusting the gain of the final image.
ScanMaskLevelFilename	String	An image file to use as a mask for adjusting the level of the final image.

35.1.1 Calculating Noise

The default noise is varying Gaussian noise. The **FInverseNoisePercent**, **FixedPatternNoisePercent**, and **PoissanNoisePercent** parameters indicate the percent of the noise to combine with the default noise. In other words if these parameters are 0, then the noise is 100% varying Gaussian. If not, the percentage of the noise that is varying Gaussian is whatever is left over after each of these noise sources are applied.



XI. Configuring the Graphical User Interface

The chapters in this section describe the graphical user interface (GUI) and how to configure it.



36. The VR-Vantage User Interface

The VR-Vantage graphical user interface has features typical for modern windowing systems and follows standard conventions for using menus and selecting objects. This chapter describes some features that might not be immediately obvious.

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- 36.1.4 Docking a Toolbar Vertically 541
- 36.1.5 Displaying and Hiding Panels and Toolbars 542
- 36.1.6 Restoring the Layout of Toolbars and Panels 542

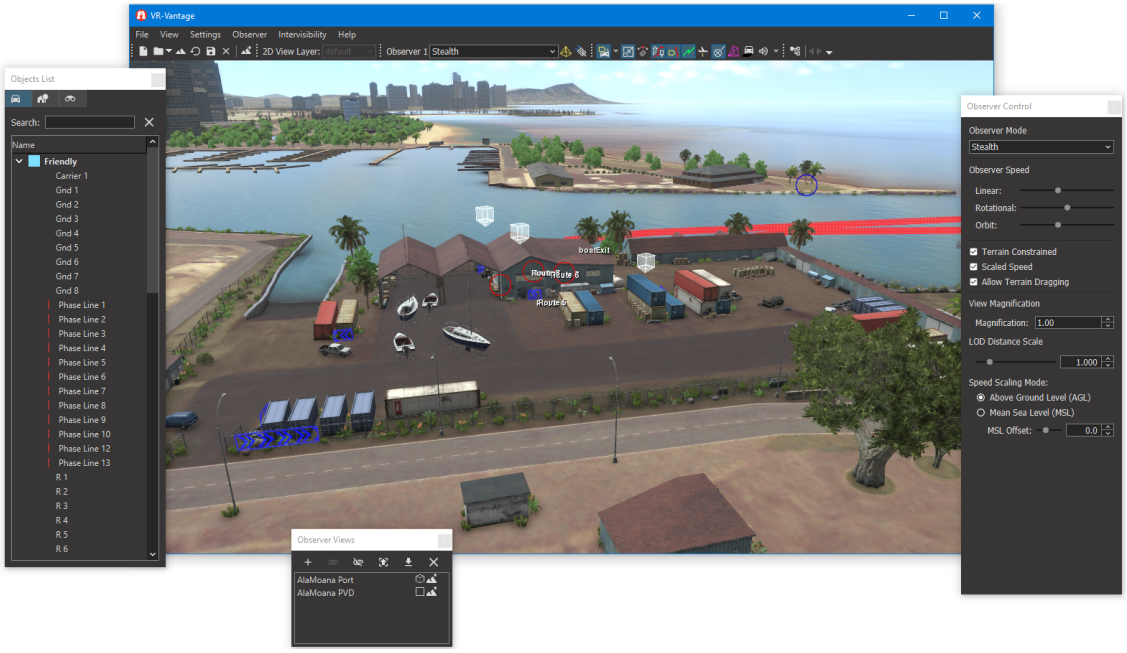
36.2. Viewing the Window in Full-Screen Mode 542
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36.1. Dockable Panels and Toolbars

VR-Vantage has floating, dockable panels for many of its important functions (Figure 263). It also has toolbars that let you quickly access the commands available on the menus.

Figure 263. VR-Vantage window and undocked panels



36.1.1 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.



You can also undock a panel by clicking the pop out button ⧉.

➤ To dock a floating panel, double-click its title bar.

36.1.2 Docking Panels as Tabs

You can have multiple panels in the same part of the GUI by making them tabbed panels.

➤ **To dock a panel as a tab:**

1. Place the cursor over the panel's title.
2. Press and hold the left mouse button.
3. Drag the panel on top of another panel.

36.1.3 Docking and Undocking a Toolbar

➤ **To undock a toolbar:**

1. Place the cursor over the handle.

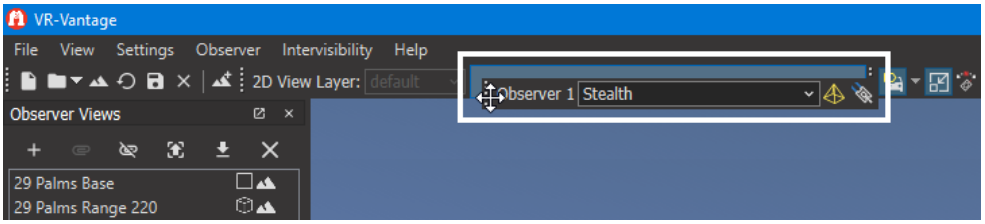
Figure 264. Toolbar handle



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 move to create a space to drop in the toolbar (Figure 265).

Figure 265. Docking a toolbar

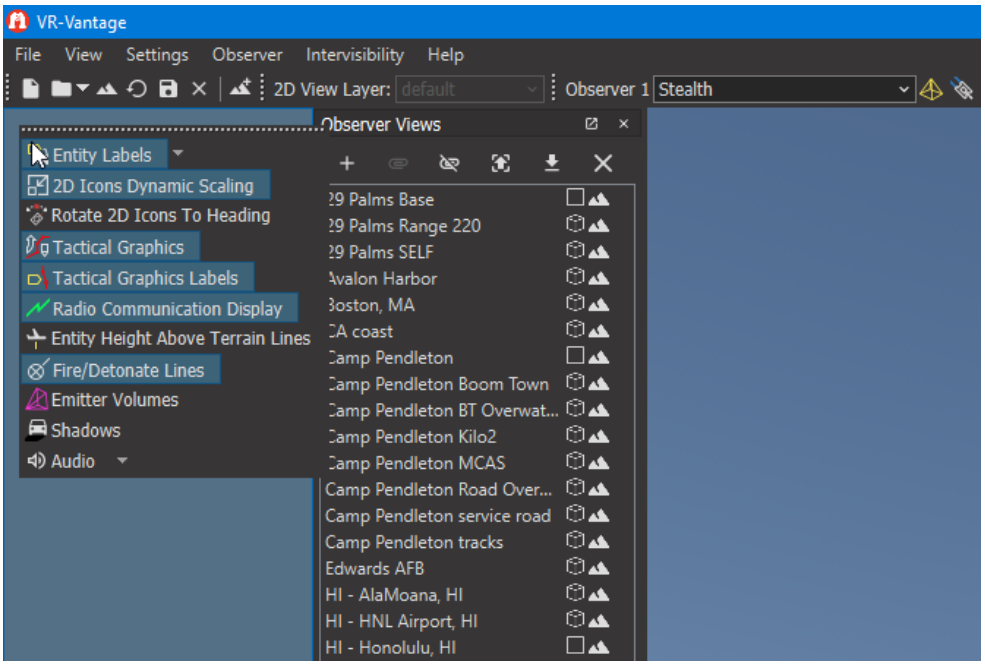


36.1.4 Docking a Toolbar Vertically

You can dock a toolbar vertically. Doing so displays the label for each button.

➤ To dock a toolbar vertically, drag it to the left- or right-hand edge of the window.

Figure 266. Vertically docking a toolbar



36.1.5 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.

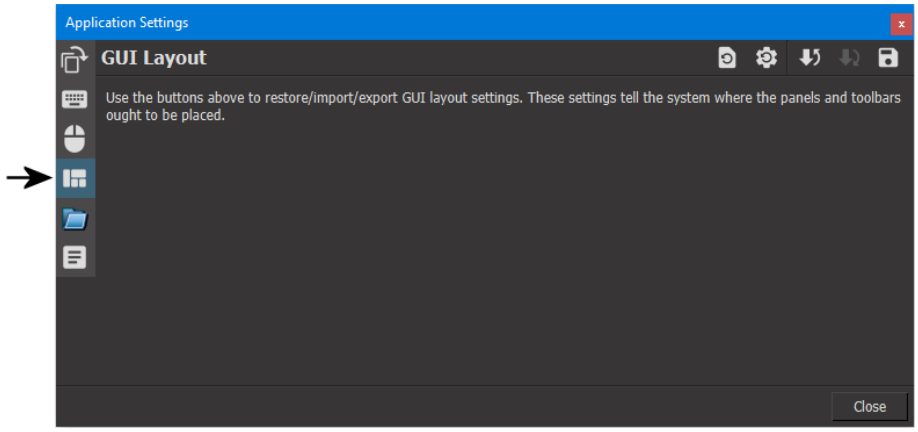
36.1.6 Restoring the Layout of Toolbars and Panels

VR-Vantage saves the layout of toolbars and panels when you shut down. (It does not save the size and location of the main window.) You can restore the factory layout or the last saved layout.

➤ **To restore the layout of toolbars and panels:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the GUI Layout page (Figure 267).

Figure 267. GUI Layout page



3. Click the settings button for the operation you want to perform. (For a summary of common settings buttons, see "3.5. Managing VR-Vantage Settings" on page 79.)

36.2. Viewing the Window in Full-Screen Mode

You can display VR-Vantage so that it covers the entire screen and does not show the title bar or border. This mode is intended for use in demonstrations. When menus and panels are hidden, you can still use all keyboard controls, and you can still click simulation objects in the window to attach the observer to them.

You can configure VR-Vantage to start in full screen mode with the `--fullScreen` command-line option. If you are viewing a simulation that takes place primarily over the ocean, you may get better performance using the `--pseudoFullScreen` command-line option.

➤ To view VR-Vantage in full-screen mode, choose **View > Show Full Screen**, or press **Ctrl**+**Enter**.

➤ To exit full screen mode, press **Ctrl**+**Enter**.

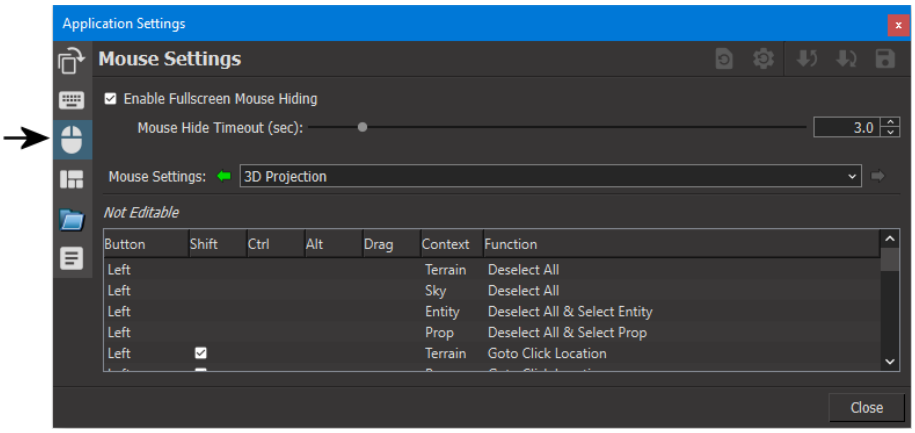
36.2.1 Hiding the Mouse in Full Screen Mode

Since full screen mode is often used only for display purposes, with no user interaction, the mouse is automatically hidden in this mode. As soon as you move the mouse, it displays. If you then stop using it, it is hidden when the threshold is reached.

➤ **To hide the mouse in full screen mode:**

1. Choose **Settings > Application**. The Application Settings dialog box opens.
2. Select the Mouse Settings page.

Figure 268. Mouse Settings page



3. Select the Enable Fullscreen Mouse Hiding check box.
4. Optionally, change the Mouse Hide Timeout value.

36.3. Specifying the Window Size and Location at Startup

By default, when you start VR-Vantage, it opens up with the window maximized. If you want to specify the window size and location at startup, you can do so with the `--guiWindowRectangle` command-line argument. The syntax is either of the following:

```
--guiWindowRectangle "width height x y"
--guiWindowRectangle width,height,x,y
```

All four values are required. They are specified in pixels.

36.4. Using Context-Sensitive Menus

VR-Vantage has context sensitive menus (also called shortcut menus, popup menus, or right-click menus) that you can display by clicking the right mouse button.

If you right-click a simulation object, tactical graphic, or other scene object, the menu displays the actions that you can take.

If you right-click the menu bar, you can select the commands available on the View menu.

36.5. Common VR-Vantage Buttons

VR-Vantage dialog boxes have a common set of buttons, as follows:

-  Add an item (definition, model, and so on).
- Remove the selected item.
-  Copy the selected item and add the copied version to the list.
-  Select a filter of some type.
-  Rename the selected item.
-  Add from a list.
-  Move up in the list.
-  Move down in the list.
-  Select the previous item.
-  Select the next item.
-  Add an attribute.
-  Remove local attribute definition and use the parent's definition.

36.6. Specifying Display Units

You can specify the units used to display coordinate system, distance, altitude, and other measurements. Display units are configured by measurement type, and can be specified for the application, simulation object platforms, and weather. This means that you can use different measurement units for different types of data. You can also specify the number of decimal places for measurement values. The available units of measurement for each data type are appropriate to that type.

When you change a measurement display unit, the changes take effect immediately. They are saved and applied the next time you run VR-Vantage.

> The coordinate system information for the observer location in the Observer Information Panel and grid line coordinates, units, and precision are not affected by the settings described in this section.

The types of data and the display objects that they affect are as follows:

- Coordinate system
- Distance

- Altitude
- Velocity (speed)
- Acceleration
- Rotational velocity
- Orientation (heading)

Table 94 describes the coordinate systems that you can specify.

Table 94. Coordinate systems supported

Coordinate system	Description
Latitude/Longitude (degrees:minutes:seconds)	Location is displayed as two position fields and one altitude field. Displays coordinates in the latitude and longitude using the geodetic WGS84 coordinate system. Each angle is displayed in degrees:minutes:seconds with seconds displaying base 10 fractional seconds.
Latitude/Longitude (degrees decimal minutes)	Location is displayed as two position fields and one altitude field. Displays coordinates in the latitude and longitude using the geodetic WGS84 coordinate system. Each angle is displayed in degrees:minutes with minutes displayed as a decimal.
Latitude/Longitude (decimal radians)	Location is displayed as two position fields and one altitude field. Displays coordinates in the latitude and longitude using the geodetic WGS84 coordinate system. Each angle is displayed in decimal radians.
Geocentric	Location is displayed as three position fields. Position coordinates are displayed in the geocentric coordinate system. The position fields are always in meters.
UTM	Location is displayed as two position fields and one altitude field. Position coordinates are displayed in the Universal Transverse Mercator system. The first position field displays the zone and the x location in meters. The second position field displays the y position in meters.
MGRS	Location is displayed as two position fields and one altitude field. Position coordinates are displayed in the Military Grid Reference System. The first position field displays the zone. The second position field displays the grid location. The precision controls the number of digits used in the grid display.
Database	Location is displayed as three position fields. Location is displayed using VR-Vantage's current internal cartesian database system. The position fields are displayed using the current distance units.

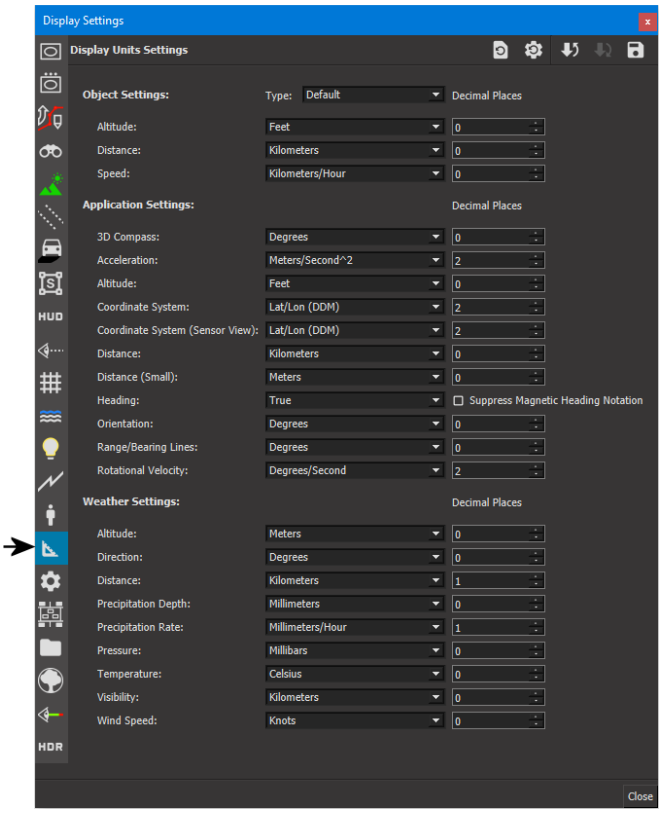
There are three options for Heading:

- True. True (geodetic) north is the direction pointing to the geographic location of the North Pole.
- Magnetic. Magnetic north is the point where the magnetic field points down.
- Grid. Grid north is the direction indicated by the vertical grid lines on ordnance survey maps.

➤ **To specify measurement units:**

1. Choose **Settings > Display**. The Display Settings dialog box opens.
2. Select the Display Units Settings page (Figure 269).

Figure 269. Display Units Settings page



3. To specify the measurement unit settings for objects, choose the type and then select the unit for each option from its list.
4. To specify the measurement unit settings for the application or weather, select the measurement unit you want for each option from its list.
5. Type a precision for each measurement unit in the corresponding box in the Decimal Places column, if applicable.
6. Specify the default time display format and zone.

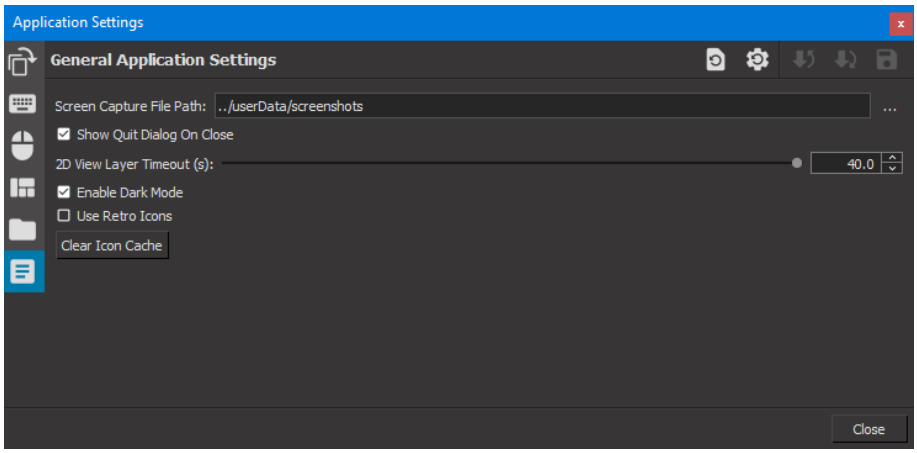
36.7. Disabling and Enabling Dark Mode

Dark mode is the default in VR-Vantage's graphical user interface. Light mode, the former standard, is also available. In addition, there are dark mode and retro icons that you can enable separately from the overall dark mode and light mode settings.

➤ **To switch the GUI from dark mode to light mode:**

1. Choose **Settings > Application**.
2. Select the General Application Settings page.

Figure 270. General Application Settings



3. Clear the Enable Dark Mode check box. The window immediately changes from dark mode to light mode. (Or select the Enable Dark Mode check box to see the window change from light to dark.)
4. Clear (or select) the Use Retro Icons check box. The icons immediately change.



37. Creating and Editing Key Mappings

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

37.1. Introduction to Key Maps 550
37.2. The Key Mapping Editor 550
37.2.1 Binary Key Mappings 550
37.3. Editing a Key Map 551
37.3.1 Adding a Key Mapping 551
37.3.2 Changing a Key Mapping 552
37.3.3 Deleting a Key Mapping 553
37.4. Using Combined Key Mappings 553
37.5. Filtering the Function List 554
37.6. Creating a Key Map 555
37.7. Deleting a Key Map 555

37.1. Introduction to Key Maps

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.

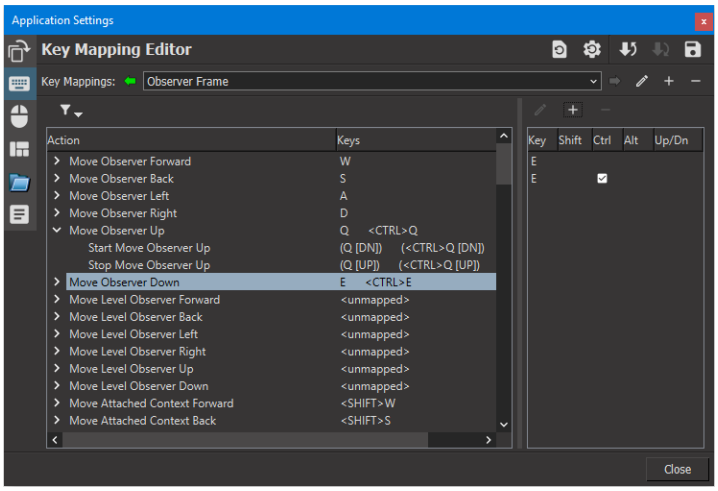
37.2. The Key Mapping Editor

The Key Mapping Editor (Figure 271) 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 271. Key Mapping Editor



37.2.1 Binary Key Mappings

Many navigation functions require you to press and hold a key. For example, you press and hold **W** to move the observer forward. (By contrast, some keyboard actions are toggles or unary functions, such as pressing period to attach to the next simulation object.) For these actions, VR-Vantage needs to keep track of when the key

is pressed down (start the action) and when it is released (stop the action). To a human user, a function like Move Observer Forward is experienced as one action. But the computer experiences it as two actions. Therefore, key mappings must take this into account. The Key Mapping Editor shows the key mappings for these functions as paired functions that are subordinate (children) to the primary function (the parent), as shown in the Move Observer Up entry in Figure 271.

37.3. 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 271 on the previous page).
3. Select the function whose key mappings you want to edit.
4. Edit the key mappings. as described in:
   - "37.3.1 Adding a Key Mapping" below.
   - "37.3.2 Changing a Key Mapping" on the next page.
   - "37.3.3 Deleting a Key Mapping" on page 553.
5. Optionally, export the key map to a file.
6. Click OK.

37.3.1 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 some 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, see "37.5. Filtering the Function List" on page 554.
2. Select the function to which you want to add a key mapping.
3. Click the Add button () above the Key Map window (Figure 272). The Key Entry dialog box opens (Figure 273).

Figure 272. Key Mapping Editor

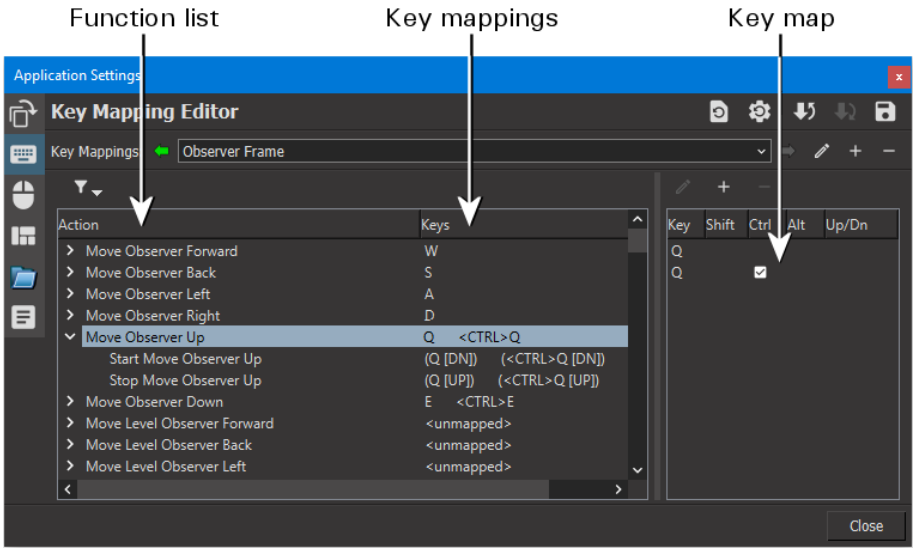
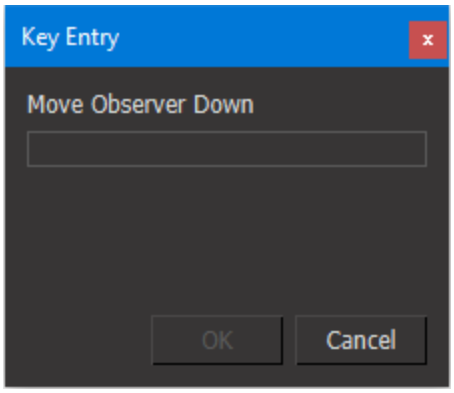


Figure 273. Key Entry dialog box



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, see "37.4. Using Combined Key Mappings" on the facing page.) The mapping is added to the function and is listed in the Keys column of the function list and in the Key Map window.

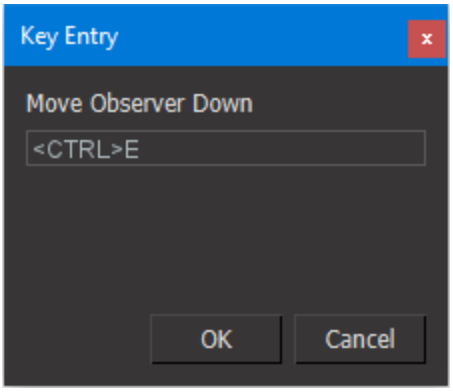
37.3.2 Changing a Key Mapping

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 are listed in the Key Map window (Figure 272).
2. In the Key Map window, select the key mapping that you want to change.
3. Click the Edit Key Mapping button ( ). The Key Entry dialog box opens (Figure 274). It shows the current key mapping.

Figure 274. 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 changes.

37.3.3 Deleting a Key Mapping

➤ **To delete a key mapping:**

1. Select the function whose key mapping you want to delete. Its key mappings are listed in the Key Map window (Figure 272).
2. In the Key Map window, select the key mapping that you want to delete.
3. Click the Delete button ( ) above the Key Map window. The mapping is deleted. The function list is updated.

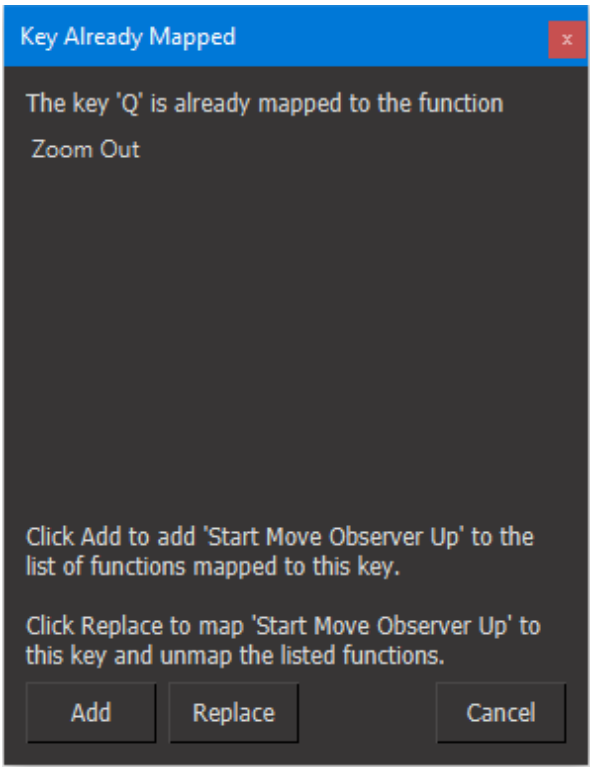
37.4. Using Combined Key Mappings

You can assign a key combination to more than one function. This allows you to combine the behaviors of two or more functions into one key combination. For example, the **Z** key detaches the observer from the attached simulation object. The **Spacebar** resets the observer view to the default view. Suppose that whenever you detach from a simulation object, you want the observer to return to the default view. You could map the Reset function to **Z**. **Z** is now mapped to two functions. When you press **Z**, VR-Vantage detaches from the attached simulation object and moves the observer to the default view.

➤ **To manage combined key mappings:**

1. Add the appropriate key mapping to a function.
2. Click OK. The Key Already Mapped dialog box opens (Figure 275). It lists the functions that already use this key mapping.

Figure 275. 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.

37.5. Filtering the Function List

You can filter the function list in the Key Mapping Editor. Functions are grouped thematically.

➤ To filter the function list, click the Filter button ( ) and select an option on the list.

37.6. Creating a Key Map

➤ **To create a key map:**

1. Choose **Settings > Application.**The Application Settings dialog box opens.
2. Select the Key Mapping Editor page (Figure 272 on page 552).
3. Click the Add button ( ). The Create New Key Map dialog box opens.
4. Type a name for the new key map.
5. Click OK.
6. Add key mappings for the movement actions as described in "37.3.1 Adding a Key Mapping" on page 551.

37.7. Deleting a Key Map

➤ **To delete a key map:**

1. Choose **Settings > Application.**The Application Settings dialog box opens.
2. Select the Key Mapping Editor page (Figure 272 on page 552).
3. In the key mapping list, select the key mapping that you want to delete.
4. Click the Delete button ( ).
5. Confirm that you want to delete the selected key map.



XII. Appendixes

The appendixes contain information that supplements the chapters in this manual.



A. Troubleshooting

This appendix describes solutions to common issues. If your problem is not covered here, visit MAK's Support Portal to request assistance.

A.1. Performance and Display Issues 560
A.2. Linux CentOS 8 Memory Issue 560
A.3. Issues with a Terrain's Level of Detail 560
A.3.1 Earth Files 560
A.3.2 MetaFlight Terrains 560

A.1. Performance and Display Issues

There are a few issues that require you to add the application name to the *BlackApps.dat* file.

- Nahimic can severely impact performance and frame rates because it interacts with certain hardware capabilities, vantage leverages, in an extremely detrimental way.
- Under certain circumstances, opening VR-Vantage on a second display prevents the program from starting.
- Dragging or resizing the window can cause the application to crash.
- In addition, launching from the main display and then moving the mouse cursor to the other monitor causes the program to freeze and not respond.
- Nahimic can also sometimes cause VR-Vantage to crash.

If you experience any of these issues, edit the Nahimic *BlackApps.dat* file and add the application name (for example, vrvantage.exe) to the list. You can search *C:\ProgramData* for *BlackApps.dat* to locate it. This file might be found in *C:\ProgramData\A-Volute\A-Volute.Nahimic\Modules\Scheduled\Configurator*, or *C:\ProgramData\A-Volute\AVolute.28054DF1F58B4\Modules\ScheduledModules\Configurator*, or something similar.

A.2. Linux CentOS 8 Memory Issue

There is a known problem with VR-Vantage and CentOS 8 running out of memory. When the OS runs out of memory or starts using the swap memory, it can become unresponsive. Here are some potential solutions:

- Upgrade the Linux kernel to at least version 5.7. We have found that the default kernel of 4.18 becomes unresponsive when the swap is being used but the 5.7 kernel does not have this problem.
- Adjust the terrain being loaded in VR-Vantage to have fewer osgEarth layers and simpler models to reduce the memory consumption.
- Add more RAM to your computer.

A.3. Issues with a Terrain's Level of Detail

A.3.1 Earth Files

There is an occasional issue with some earth files that causes the wrong LOD to show up on the terrain. If this occurs, delete the cache in *./appData/cache* and add the following to the terrain section of your earth file: `progressive="true"`.

A.3.2 MetaFlight Terrains

Indirect rendering and MetaFlight terrains have problems with holes appearing as LODs are paging in. The workaround is to disable indirect rendering for MetaFlight terrains.



B. Articulated Part IDs for DI-Guys

This appendix lists articulated part IDs for DI-Guys.

B.1. DI-Guy Articulated Part IDs 562

B.1. DI-Guy Articulated Part IDs

The DIS and HLA connections can send DIS articulated part numbers that DI-Guy can use to control individual DI-Guy links. The articulated part numbers are as follows:

- DiGuyDisArtPartBase 10272
- DiGuyDisArtPartBack 10304
- DiGuyDisArtPartCervical 10336
- DiGuyDisArtPartShoulderLeft 10368
- DiGuyDisArtPartShoulderRight 10400
- DiGuyDisArtPartElbowLeft 10432
- DiGuyDisArtPartElbowRight 10464
- DiGuyDisArtPartWristLeft 10496
- DiGuyDisArtPartWristRight 10528
- DiGuyDisArtPartHipLeft 10560
- DiGuyDisArtPartHipRight 10592
- DiGuyDisArtPartKneeLeft 10624
- DiGuyDisArtPartKneeRight 10656
- DiGuyDisArtPartAnkleLeft 10688
- DiGuyDisArtPartAnkleRight 10720

If you are an API developer, you can find these enumerations in *./include/vrvDiGuy/DtDiGuyArtPartLinkMapper.h*.



MAK Products Glossary

This glossary defines terms used in MAK ONE product documentation.

A

absolute dead reckoning

A method of dead-reckoning in which an application uses the timestamps contained within state updates if the sender is using absolute timestamping. Contrast with relative dead reckoning.

aggregate

The combination of individual entities, aggregates, or both into a single object — for example, an organizational group such as a platoon.

API

Application Programming Interface.

articulated part

A part of an entity that is capable of movement relative to the entity, such as a wheel, turret, or gun.

attached part

An object that is attached to another object, such as a rocket attached to a jet.

B

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.

C

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 (does not display) 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.

D

Data Distribution Management

The set of High-Level Architecture 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. See also absolute dead reckoning and relative dead reckoning.

DDM

See 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

See 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.

E

element definition

In VR-Forces and VR-Vantage, an element definition specifies all of the visualizers that control the various aspects of visualizing a scene element. For example, an element definition includes the main model or military symbology, trailing effects, cockpit displays, and so on.

emitter

A simulated device on an entity that emits electromagnetic radiation, for example, radar.

entity

An element in a simulation, such as a vehicle or a person, that is represented in the simulation through the issuance of state messages.

entity maintenance

A process by which the MAK Data Logger compensates for discontinuities following a time jump. The Logger sends out interim state messages for entities that were present before the time jump so that they do not time out before the next update message arrives.

entity-type

A list of seven components as specified by the DIS protocol and the HLA RPR FOM. If none of the seven components contains a wildcard (-1) value, then the entity type refers to a specific, narrowly-defined entity. If some components contain a wildcard, then the entity type refers to a class of entities. A larger number of wildcards indicates a broader, more general class.

The components of an entity-type are:

- Entity kind
- Domain
- Country
- Category
- Subcategory
- Specific
- Extra.

environmental process

According to the IEEE 1278.1a specification (DIS), environmental process PDUs communicate simple environment variables, small scale environmental updates, and embedded processes.

Euler angles

A set of three angles used to describe the orientation of an entity as a set of three successive rotations about three different orthogonal axes (x, y, and z). These angles specify successive rotations needed to transform from a reference coordinate system

to the entity's body coordinate system.

event

An interaction between objects or between an object and the terrain, such as firing of a munition, or a collision of entities.

exercise

The DIS term for a one or more interacting simulation applications. Compare to federation execution in HLA.

exercise connection

The object (DtExerciseConn) through which a VR-Link application connects to the network. State messages are sent through the exercise connection and information about remote entities is received through the exercise connection. (All MAK ONE products are VR-Link applications.)

exercise ID

A numeric identification for a DIS simulation exercise.

F

FED file

Federation Execution Data file. The Federation Execution Data is the subset of FOM data needed and read by the MAK Products Glossary. VR-Link applications also read the FED file.

federate

A connection to the MAK Products Glossary. 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 Federation Object Model. (Also supported by the HLA 1.3 and HLA 1516 versions of the MAK 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.

G

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 MAK ONE 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.

H

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 Protocol Data Units are sent to the network regardless of whether 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.

I

IG

image generator

interaction

A message describing a simulation event. An interaction describes an event, it does not update an objects state.

L

Logger control PDUs

A set of DIS PDUs or HLA interactions that let you control the MAK Data Logger remotely.

logical range

A suite of TENA Resources, sharing a common object model, that work together for a given range event. Similar in concept to the HLA Federation.

Local RTI Component

The libraries on a computer that implement a Run-Time Infrastructure. A federate communicates with the HLA network through the LRC.

LRC

See Local RTI Component.

M

MÄK Technologies Lisp

An adaptation of the Lisp language used in configuration files for MAK ONE 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 High-Level Architecture standard MOM. It is a subset of the Federation Object Model 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 Run-Time Infrastructure. The standard MIM can be replaced with a user-supplied MIM containing the standard MIM plus extensions.

model definition

In VR-Forces and VR-Vantage, a model definition specifies the 3D model and other basic attributes of a model. It is referenced by an element definition.

Modeling and Simulation Coordination Office

The executive secretariat for the Executive Council on Modeling and Simulation (EXCIMS), which provided a full-time focal point for information concerning Department of Defense modeling and simulation (M&S) activities. The MSCO promulgates M&S policy, initiatives, and guidance to promote cooperation among DoD components to maximize efficiency and effectiveness. (Formerly DMSO)

MSCO

Modeling and Simulation Coordination Office. (Formerly DMSO.)

MTL

See MÄK Technologies Lisp.

O

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 Run-Time Infrastructure 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 Run-Time Infrastructure, 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 MAK ONE 3D applications, the point of view into the scene. (Called the eyepoint in MAK Stealth 6.x and earlier.)

P

PDU

See Protocol Data Unit.

Protocol Data Unit

A unit of data message (packet) that is passed on a network between DIS simulation applications.

R

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.

Real-time Platform Reference FOM

An HLA reference Federation Object Model based on the DIS protocol.

recording

A MAK 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 Federation Object Model 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. Contrast with absolute dead reckoning.

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

Data required by a Run-Time Infrastructure during initialization, independent of the FOM being used. RID data is usually dependent on a specific implementation of the RTI.

RPR FOM

See MAK Products Glossary.

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.

S

scene element

In VR-Vantage and VR-Forces, any object that is rendered in the scene, such as an entity model, interaction, or tactical graphic.

Simulation Interoperability Standards Organization

A group that seeks to promote modeling and simulation interoperability and reuse for the benefit of diverse M&S communities, including developers, procurers, and users, world-wide.

simulation time

In VR-Forces, simulation time is used in dead-reckoning of remote entities and thresholding of local entities. Typically, simulation time is set once during each iteration of the application's main simulation loop so that all entities are dead-reckoned based on the same value of current time.

SISO

See Simulation Interoperability Standards Organization.

smooth period

The period of time over which trajectory smoothing takes place.

smoothing

A method of ensuring that transitions from an entity's dead-reckoned position to its actual position are not so abrupt as to be visually disconcerting.

state

The current status of an object, including location, direction of movement, extent of damage, and so on.

T

tape

An alternative term for a Logger recording. Not a physical magnetic tape.

terrain following

In a 3D visualization application, causes the observer (eyepoint) to maintain a constant distance above the terrain surface. The observer's height changes in tandem with the peaks and valleys as it passes over the geography.

timeout

The period of time in which an application continues to display an entity after that entity's update messages have stopped appearing on the network. Time-outs are usually not used in HLA because there is no set frequency (no heartbeat) for transmitting messages.

timescale

A factor by which time is accelerated or slowed during playback of a Data Logger recording.

topographic coordinates

A right-handed Cartesian coordinate system whose X-Y plane is tangent to the earth's surface at the origin, with the positive X axis pointing north, the positive Y axis pointing east, and the positive Z axis pointing down. There are an infinite number of topographic coordinate systems – one for each point on the earth's surface.

topographic coordinate frame

A coordinate frame in the context of the terrain.

trajectory smoothing

A method used by to smooth positional discontinuities that could occur when new state updates arrive.

U

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.

V

view control messages

A set of programmatic messages that let you control the view in VR-Vantage applications remotely.



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VR-Vantage Quick Reference Card

Table 1. Command-Line Options

Option	Description
(-- | --ignore_rest)	Ignore all command-line options after this one.
--antiAliasing *level*	Set the anti-aliasing level (0, 2, 4, 8, or 16). Default: 4.
--appCacheDir *directory*	Specify a directory for the cache if you want to run multiple remote display engines.
--appDataDir *directory*	Specifies the location of application data.
--autoReconnectPeriod *period*	Specifies the amount of time, in seconds, to wait before trying to attach to disconnected remote displays.
-B | --bindObservers "*observer1, observern,saved_views_file*"	Assigns the views in the specified saved view file to the observers in the order that the observers are listed in the command. Must also specify terrain file. For multiple observers, must specify display engine configuration with --dispSetting.
(-c | --showConsole)	Display a console window.
(-C | --autoConnect) {*filepath* | *connector_name*}	Automatically connect to the network using the specified connector.
--dataDir *directory*	Specifies the location of the data directory.

Table 1. Command-Line Options (continued)

Option	Description
`--depthBits` *bits*	Sets the depth of graphics to 24 bits or 32 bits. Default: 24.
`--disableBufferClearUsesCompute`	Do not use this option unless directed to do so by MAK technical support.
`--disableDynamicTerrain`	Disables the dynamic terrain engine.
`--disableErrorDialog`	Prevents error message in the case that a terrain is missing. Error prints to the console.
`--disableIndirectEntities`	Disables indirect rendering of entities.
`--disableNvidiaBindlessFix`	Do not use this option unless directed to do so by MAK technical support.
`--disableOcclusionCulling`	Disables occlusion culling, which can improve performance.
(`-z` | `--disableReverseZBuffer`)	Disables use of reverse Z-buffering, which is enabled by default to reduce Z-fighting.
`--disableTerrainObserverViews`	Disables the loading of terrain observer view files. Loading a terrain does not clear the observer views and the terrain's observer views do not load.
`--discoveredModelPreloadFileName` *filename*	Specifies a file to which the list of models discovered during a session that were not preloaded is written.
`--displayEnginePort` *port*	Specifies the display engine port used by a remote display engine. Used only if `--slave` is specified.
`--dispSetting` *filename*	Specifies the display engine configuration to load.
(`-e` | `--extraArgs`) *string* | "*string1 ... stringn*"	Allows you to send arbitrary strings to the initializer, which can be queried for by plug-ins. This option works around the restriction on adding new command-line arguments. It can take one argument or multiple arguments. Multiple arguments must be wrapped in double quotes.
(`-E` | `--entTypeMap`) *filename*	Load the specified entity type mapping file. The file extension determines the type of mapping.

Table 1. Command-Line Options (continued)

Option	Description
--enableDofConstraints	Enables the use of degree(s) of freedom constraints on simulation object models.
--enableTracyProfiling	Enables the Tracy Client when you launch the application.
--enableVSync	Turns on VSync.
--entDispSetting *filename*	Specifies the entity display setting to load.
--entityDefsDir *directory*	Loads the *.hier* and *.leaf* files in the specified directory.
--envSetting *filename*	Specifies the environment configuration file to load.
--factoryRootDir *directory*	Set the root directory used to restore settings to factory defaults.
--forceTextShaping	Force all text to use HarfBuzz shaping.
(-F | --frameRate) *rate*	Specifies a fixed frame rate for rendering. If 0, it is variable.
--fullScreen	Start in full screen mode.
(-G | --locale) *language*	Specifies the locale (for localization).
--guiWindowRectangle "*width height x y*" --guiWindowRectangle *width*,*height*,*x*,*y*	Specifies the window size and location at startup.
(-h | --help)	Displays command-line usage information.
--highestPriority	Changes application and the main render thread to the highest available priority.
(-K | --disableKDTrees)	Disable creation of KD trees for intersections.
(-l | --logFileName) *filename*	Specifies the log file name.
--limitEntityTextures "*width height*"	Uses only mip map levels at or below the resolution for entities. Use two integers for the maximum width and height of the texture mipmap to use, for example, "1024 1024" or "2k 2k".

Table 1. Command-Line Options (continued)

Option	Description
`--limitTerrainTextures "`*`width height`*`"`	Uses only mipmap levels at or below the resolution for terrain. Use two integers for the width and height, for example, "1024 1024" or "2k 2k".
`--limitGpuMemoryPercentage` *integer*	Set the cutoff percentage as a value between 0 and 100. Beyond the specified percentage, VR-Vantage does not make new textures or buffers as a percentage of the available video RAM.
`--mainScreenNum` *num*	Specifies the display that the main window should use.
`--mergeEntityTypeMap {`*directory* | *filename*`}`	Merges all entity type mapping files (*.*metx*) in a directory or individual entity type mapping files. Can be used multiple times.
`--mergeHierarchyEntityDef` *filename*	Merges the specified *.hier* file into the default hierarchy. Merging is additive.
`--mergeHierarchyTacticalGraphicsDef` *filename*	Merges the specified *.hier* file into the default hierarchy. Merging is additive.
`--mergeHierarchyUnitDef` *filename*	Merges the specified *.hier* file into the default hierarchy. Merging is additive.
`--mergeLeafEntityDef {`*directory* | *filename*`}`	Merges the leaf files in the specified directory or the individual leaf file into the default entity element definitions.
`--mergeLeafTacticalGraphicsDef {`*directory* | *filename*`}`	Merges the leaf files in the specified directory or the individual leaf file into the default tactical graphics element definitions. Can be used multiple times.
`--mergeLeafUnitDef {`*directory* | *filename*`}`	Merges the leaf files in the directory or the specified individual leaf file into the default unit element definitions.
`--mergeModelDefs {`*directory* | *filename*`}`	Merges all model definition files (*.*ommx*) in the specified directory or individual model definition files. Can be used multiple times.

Table 1. Command-Line Options (continued)

Option	Description
--mergeTacticalGraphicsTypeMap {*directory* | *filename*}	Merges all tactical graphics type mapping files (**.metx*) in a directory or individual tactical graphics type mapping files. Can be used multiple times.
--mergeUnitTypeMap {*directory* | *filename*}	Merges all unit type mapping files (**.metx*) in a directory or individual unit type mapping files. Can be used multiple times.
--modelPreloadFileName *filename*	Specifies a file that has a list of models to preload.
(-n | --notifyLevel) *notify_level*	Specifies the notification level for application messages. Range: 0-4.
--noAppDataEntityDefs	Do not load the entity element definitions in *./SharedData/16 /latest/ModelData/Configuration/Definitions*.
--noAppDataEntityTypeMap	Do not load entity type mappings in *./appData/settings/<application>*.
--noAppDataModelDefs	Do not load model definitions in *./SharedData/16 /latest/ModelData/Configuration/Definitions*.
--noAppDataTacticalGraphicsDefs	Do not load the tactical graphics element definitions in *./SharedData/16 /latest/ModelData/Configuration/Definitions*.
--noAppDataTacticalGraphicsTypeMap	Do not load tactical graphics type mappings in *./appData/settings/<application>*.
--noAppDataUnitDefs	Do not load the unit element definitions in *./SharedData/16 /latest/ModelData/Configuration/Definitions*.
--noAppDataUnitTypeMap	Do not load unit type mappings in *./SharedData/16 /latest/ModelData/Configuration/Definitions*.
--noGui	Start without the graphical user interface.

Table 1. Command-Line Options (continued)

Option	Description
(-O | --hasNTPSync)	Enables synchronized ocean between different display engines. System clocks must be synchronized.
--plugin *filename*	Load the specified plug-in. Can be used multiple times.
--pseudoFullScreen	Use pseudo full screen for full screen mode.
(-s | --slave)	Run as a remote display engine.
(-S | --suppressHatIntersectOnAttach)	Suppress the periodic HAT intersection when attached.
--sharedDataDir *directory path*	Defines the location of the shared data directory if you installed it somewhere other than the default.
--sharedDataRoot *directory root*	Defines the location of the shared data root.
--sharedDataStem *directorystem*	Defines the location of the shared data stem.
--stencilBits *bits*	Sets the number of stencil bits (0 or 8). Default: 0.
--tcpSendTimeout	Sets the timeout (in seconds) for the master display engine to wait for a remote display engine before giving up on a send. Default: 30 seconds.
(*terrain_MTF_file* | *scene_MSF_file*)	Specifies a terrain (MTF) or scene (MSF) file to load.
--unplug *filename*	Do not load the specified plug-in. Can be used multiple times.
--userDataDir *directory*	Specifies the user data directory.
(-v | --version)	Display version information and exit.
-W | --withDisplayEngine *port@netAddress;displayConfigFilename1 .... n* -W | --withDisplayEngine *port@netAddress:displayConfigFilename1 .... n*	Connect to a display engine running in subordinate mode on another computer. On Windows, use a semi-colon (;). On Linux, use a colon (:).
(-Z | --ignoreZoomForSpeedtreeLod	Disable zoom for SpeedTree LOD.

Table 2. Mouse Button Mappings

Navigation Action	Mouse Action	Context
Attach to entity.	**Shift**+left-click	Entity.
Attach to prop.	**Ctrl**+**Shift**+left-click	Prop.
Deselect all.	Left-click	Terrain or sky.
Drag terrain.	Left-click+drag	Terrain or prop.
Object selected, others unselected.	Left-click	Selected entity or prop.
Select entity or prop.	**Ctrl**+left-click	Unselected entity or prop.
Select object and unselect all others	Left-click	Unselected entity or prop
Teleport to location	**Shift**+left-click	Terrain
Teleport to prop	**Shift**+left-click	Prop
Teleport to entity	**Ctrl**+**Shift**+left-click	Entity
Unselect	**Ctrl**+left-click	Selected entity or prop
Display context-sensitive menu	Right-click	Entity or prop
3D Only		
Drag the view	Middle mouse button drag	All
Drag heading and pitch (mouse look)	Right Drag	All
Orbit drag	**Ctrl**+left-click+drag	Terrain or prop
Zoom in (magnification)	**Ctrl**+ mouse wheel forward	All
Zoom out (magnification)	**Ctrl**+ mouse wheel backward	All
Reset magnification	Middle mouse button	All
Move observer forward	Mouse wheel forward	All
Move observer back	Mouse wheel back	All
Move observer level observer forward	**Shift**+mouse wheel forward.	All
Move observer level observer backward	**Shift**+mouse wheel backward.	All
Move flashlight beam	Right mouse button drag	All
Expand flashlight beam	**Alt**+mouse wheel forward.	All
Contract flashlight beam	**Alt**+mouse wheel backward.	All

Table 2. Mouse Button Mappings (continued)

Navigation Action	Mouse Action	Context
2D Only		
Rotate terrain	Right-click + drag	All. Orient North disabled.
2D Zoom in	Mouse wheel forward; Middle button + drag	All
2D Zoom out	Mouse wheel backward; Middle button + drag	All

In keyboard mappings, K = numeric keypad (K8 means press Keypad 8). To use the numeric keypad for navigation, NumLock must be on.

Table 3. Observer Keyboard Mappings

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Move forward	**w**	unmapped	**w**	unmapped
Move back	**s**	unmapped	**s**	unmapped
Move left	**a**	unmapped	**a**	unmapped
Move right	**d**	unmapped	**d**	unmapped
Move up	**q**, **Ctrl**+**q**	unmapped	**q**, **Ctrl**+**q**	unmapped
Move down	**e**, **Ctrl**+**e**	unmapped	**e**, **Ctrl**+**e**	unmapped
Move forward level observer	unmapped	**w**	unmapped	**w**
Move back level observer	unmapped	**s**	unmapped	**s**
Move left level observer	unmapped	**a**	unmapped	**a**
Move right level observer	unmapped	**d**	unmapped	**d**
Move up level observer	unmapped	**q**, **Ctrl**+**q**	unmapped	unmapped
Move down level observer	unmapped	**e**, **Ctrl**+**e**	unmapped	unmapped
Move attached context forward	**Shift**+**w**	**Shift**+**w**	**Shift**+**w**	**Shift**+**w**
Move attached context back	**Shift**+**s**	**Shift**+**s**	**Shift**+**s**	**Shift**+**s**
Move attached context left	**Shift**+**a**	**Shift**+**a**	**Shift**+**a**	**Shift**+**a**
Move attached context right	**Shift**+**d**	**Shift**+**d**	**Shift**+**d**	**Shift**+**d**
Move attached context up	**Shift**+**q**	**Shift**+**q**	**Shift**+**q**	unmapped
Move attached context down	**Shift**+**e**	**Shift**+**e**	**Shift**+**e**	unmapped
Level yaw left	K **4**	K **4**	Left arrow	Left arrow

Table 3. Observer Keyboard Mappings (continued)

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Level yaw right	K **6**	K **6**	Right arrow	Right arrow
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**
Zoom in	unmapped	unmapped	unmapped	**Ctrl** + **e**
Zoom out	unmapped	unmapped	unmapped	**Ctrl** + **q**
Suppress constrain to terrain	**x**	**x**	**x**	**x**
Water impact	unmapped	unmapped	unmapped	unmapped
Reset observer: In absolute mode, go to the center of the scene. If attached, reset the attach position and orientation.	**Space**	**Space**	**Space**	**Space**

In absolute mode, go to the center of the scene. If attached, reset the attach position and orientation.

Table 3. Observer Keyboard Mappings (continued)

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Toggle speed scaling mode (MSL or AGL)	unmapped	unmapped	unmapped	unmapped
Level observer	K **5**	K **5**	**Shift** +**Space**+ ¯	K **5**
Toggle force north orientation	unmapped	unmapped	unmapped	unmapped
Toggle orient to target constraint	unmapped	unmapped	unmapped	unmapped
Toggle flashlight	**F**	**F**	**F**	**F**
Reset the camera	K **0**	K **0**		K **0**
Increase view magnification	**=**	**=**	**=**	unmapped
Decrease view magnification	**-**	**-**	**-**	unmapped
Reset view magnification	**0**	**0**	**0**	unmapped
Increase view resolution	unmapped	unmapped	unmapped	**=**
Decrease view resolution	unmapped	unmapped	unmapped	**-**
Detach	**z**	**z**	**z**	**z**
Toggle hide model on attach	unmapped	unmapped	unmapped	unmapped
Attach to the next entity allowed by the attachment filter	Period (.)	Period (.)	Period (.)	Period (.)
Attach to next entity or prop	**>**	**>**	**>**	**>**
Attach to the previous entity allowed by the attachment filter	Comma (,)	Comma (,)	Comma (,)	Comma (,)
Attach to previous entity or prop	**<**	**<**	**<**	**<**
Set mimic attach type	unmapped	unmapped	unmapped	unmapped
Set tether attach type	unmapped	unmapped	unmapped	unmapped
Next attach mode	**Shift**+**z**	**Shift**+**z**	**Shift**+**z**	**Shift**+**z**
Increase linear speed	K **7**	K **7**	K **7**	K **7**
Decrease linear speed	K **1**	K **1**	K **1**	K **1**
Increase orbit speed	K **+**	K **+**	K **+**	K **+**

Table 3. Observer Keyboard Mappings (continued)

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Decrease orbit speed	K -	K -	K -	K -
Increment rotation speed gain	unmapped	unmapped	unmapped	unmapped
Decrement rotation speed gain	unmapped	unmapped	unmapped	unmapped
Toggle speed scaling on or off	K *	K *	K *	K *
Toggle prop transparency	T	T	T	T
Toggle terrain scaling	unmapped	unmapped	unmapped	unmapped
Increment terrain scale	unmapped	unmapped	unmapped	unmapped
Decrement terrain scale	unmapped	unmapped	unmapped	unmapped
Toggle track histories	unmapped	unmapped	unmapped	unmapped
Toggle entity labels	L	L	L	L
Toggle rotate entity symbols	unmapped	unmapped	unmapped	unmapped
Toggle tactical graphics	Shift+G	Shift+G	Shift+G	Shift+G
Toggle entity height above terrain lines	unmapped	unmapped	unmapped	unmapped
Toggle tactical graphics HAT lines	unmapped	unmapped	unmapped	unmapped
Toggle entity height above terrain mode	unmapped	unmapped	unmapped	unmapped
Toggle tactical graphics height above terrain mode	unmapped	unmapped	unmapped	unmapped
Toggle constrain to terrain on or off	/	/	/	/
Toggle constrain to center	U	unmapped	unmapped	unmapped
Clear the current movement mode. This key is an escape mechanism if keys are not behaving as you expect. This is typically due to a loss of the window context.	c	c	c	c
Next observer mode	]	]	]	]
Previous observer mode	[	[	[	[

Table 3. Observer Keyboard Mappings (continued)

Observer Movement	Observer	Level Observer	Laptop	2D Level Observer
Toggle view controls on or off	**Shift**+c	**Shift**+**c**		**Shift**+**c**
Clear all trajectory histories	unmapped	unmapped	unmapped	unmapped
Toggle framerate statistics	**F2**	**F2**	**F2**	**F2**



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