Virtual Reality Scene Generator (VRSG)

MVRsimulation® Virtual Reality Scene Generator® (VRSG®) is a Microsoft DirectX 11-based render engine that provides geospecific simulation as an image generator (IG) with game quality graphics. MVRsimulation's IG enables users to visualize geo-graphically expansive and detailed virtual worlds on commercial off-the-shelf Windows PCs. Since 1997, VRSG has provided real-time, single- or multi-channel visualization of virtual environments, dynamic moving models, and special effects. VRSG is used as a:

- *Dedicated computer image generator* coupled to an external simulation host in single or synchronized multi-channel mode. VRSG supports features often required for manned/unmanned flight training, driving simulations, and other applications.
- *DIS stealth visualization tool* for real-time or after-action analysis of distributed simulation exercises.
- *Self-contained first person shooter* to simulate individual combatants, JTACs, or forward air controllers.
- *Self-contained* UAS camera operator to render HD simulated UAS video and to stimulate video players such as a full-motion video (FMV) receiver.

Using advanced terrain and texture paging algorithms VRSG renders geospecific imagery over expansive round-earth 3D terrain while providing full-scene anti-aliasing and continuous level-of-detail morphing. VRSG is delivered with robust libraries of 3D models and high-resolution terrain of most of the world.

As an executable-ready render engine with native DIS support, VRSG supports but does not require programming. Configuration files and interface protocols provide the ability to control basic components of the render engine. Developers can use the plugin interface to augment functionality with low-level features.

VRSG is a component of MVRsimulation's rapid virtual world terrain creation and visualization technologies.

Image generator features in version 7

Asynchronous texture paging technology for visualizing high-resolution, photo-realistic databases at 60 Hz.

Database geometry paging, level-of-detail blending, decoupled terrain and texture level-of-detail.

Support for multiple synchronized channels and multiple viewports per channel.

Multi-texture techniques such as normal maps, shadow maps, light maps, and decals.

Light points that respond realistically to visibility conditions.

Realistic light lobes that yield per-pixel radial attenuation and per-vertex axial attenuation.

Object-on-object dynamic shadows cast by models and clouds.

Dynamic lighting and time-of-day conditions, light-point based star fields, horizon glow, and multiple sky models. Atmospheric model consists of 16 distinct layers each with unique visibility ranges and wavelength-dependent absorption and scattering properties for light, haze, and cloud interactions; ground fog and haze with sun-angle dependent density and color. Volumetric clouds and storm cells with optional volumetric precipitation effects. Ephemeris model for sun and moon position, moon phase, and star position.

Simulation of ocean sea states: realistic 3D wave motion and wake waves, accurate environment reflections, and bathymetry.

User-extensible particle effects that respond to wind: dust trails, contrails, tactical smoke, volumetric flames, and blown sand or snow. Other effects include dynamic craters, wakes, track and wheel impressions, and solid particle ballistic effects.

Dynamic cratering, deforming terrain surfaces to represent craters resulting from munitions impact.

Utilities to convert FBX models and OpenFlight databases and models to MVRsimulation's model and round-earth terrain formats.

Full support for mission functions including height above terrain, laser range, line-of-sight (intervisibility), and collision detection.

OpenGL interoperability plugin for coding 2D overlay graphics in machine-native OpenGL and rendering in VRSG.

Significant Common Image Generator Interface (CIGI) support.

Native high-performance 3D human character render engine; no third-party software required. Capable of managing thousands of character entities and displaying hundreds in the field-of-view.

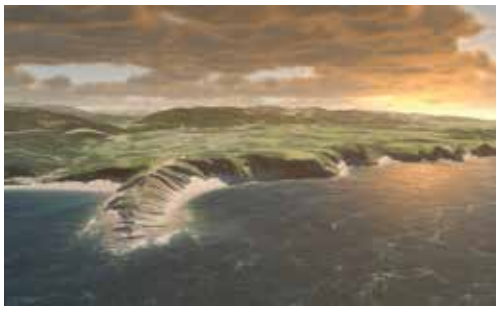
Support for VR and mixed-reality systems: Varjo XR and Varjo VR, HP Reverb, HTC Vive Pro and Tracker, and Valve Index VR.

Edge blending and distortion correction support of solutions from Scalable Display Technologies, VIOSO, and Dome Projection.

VRSG real-time scene visualizing the gaze of the pilot through the collection of eye-tracking data, in a flight simulator wearing a Varjo XR-3 mixed-reality headset.





Sensor simulation

Physics-based infrared simulation featuring on-the-fly classification of geospecific visual spectrum imagery. Sensor simulation responds to environmental conditions and diurnal cycles. Radiance-based automatic gain control, manual level/gain override, and noise as a function of dynamic range. Mid-range and far IR wavebands supported to model thermal imagers. Post-processing effects include noise, blur, depth-of-field, level, gain, polarity, digital zoom, and heat refraction. Electro-Optic (EO) and Night Vision Goggle (NVG) stimulation. Radar simulation to support applications such as F-16 DRLMS, SAR, and ISAR.

3D content libraries

In VRSG 7, over 9,740 culture and dynamic models, including over 4,230 military models with ongoing entity additions in support of Combat Air Force Distributed Mission Operations (CAF DMO) requirements. Over 375 commercial vehicle models; 615 character and weapon models, with 1,930 BVH animations; over 5,220 culture models of buildings (many now with damage states) and other structures, foliage, signage, and street elements. Ability to preview model switch states, damage states, articulated parts, and thermal hot spots in Model Viewer. Ability to add or modify model animations and other attributes/metadata in a JSON file.

Geospecific round-earth 3D terrain of most of the world in 15 meter or better resolution with higher resolution insets of areas of interest, some with cultural features. (CONUS++ terrain at 1 meter or better NAIP imagery and 10 meter NED elevation; over 35 geographically accurate modeled airports and MOUT sites.)

Analysis / after-action review features

Capture and visualize DIS stream entities for real-time or after-action review functions including eye-tracking data in Varjo mixed-reality headsets. Also attachment modes: tether, mimic, orbit, compass, and track; fire lines and shot lines; visualization of designator PDUs; savable viewpoints, entity-relative or database-relative; and virtual world 3D sound capability.

Scenario Editor

In-game drag-and-drop interface for adding and manipulating static culture to build up areas of interest on the terrain, and to script pattern-of-life scenarios intended to be played in VRSG.

Mixed reality in VRSG 7

Making use of the eye-tracking technology in Varjo XR mixed-reality headsets, VRSG can visualize the tracked gaze of a pilot or JTAC trainee. VRSG tracks the pilot's or JTAC's head position and orientation, the gaze vector using the Varjo device's pupil tracking functionality, and then depicts the gaze of each eye independently as a color-coded 3D cone. VRSG can export this data via DIS as a PDU log for later after-action playback, enabling reviewers to see where exactly the pilot's head movement and eye gaze were during the simulated mission.

UAS / RPA simulation

Built-in UAS sensor payload model allowing any DIS airborne platform to be used as a UAS, when a notional UAS is sufficient. Real-time HD H.264/.265 video generation with embedded KLV metadata using STANAG 4609-compliant MISB ST 0601.1, 0601.9, or 0601.17 KLV metadata and MISB security metadata standard 0104.5. Full NGA Community Motion Imagery Test Tool (CMITT) compliance. MVRsimulation's own video player, optimized for VRSG H.264/H.265 streaming; can decode and display KLV metadata. Ability to configure H.264/.265 video streaming plugin as a Real Time Streaming Protocol (RTSP) server. Built-in 2D overlays for several UAS and targeting pod platforms.

JTAC / FAC simulation

Laser rangefinder/designator mode for designating targets for other simulations. NVG IR pointer mode for night-time target marking. Stimulate FMV devices with streaming HD digital video of UAS or targeting pod feeds. Integration with simulated military equipment, such as emulated Type 163, SOFLAM, or IZLID device; support for commercial devices such as NVIS Ranger 47 virtual binoculars. Coupled with BSI MACE, can simulate digitally aided close air support on a device running the Special Warfare Assault Kit (SWAK) or WinTAK.

For more information, visit www.mvrsimulation.com or contact sales@mvrsimulation.com.