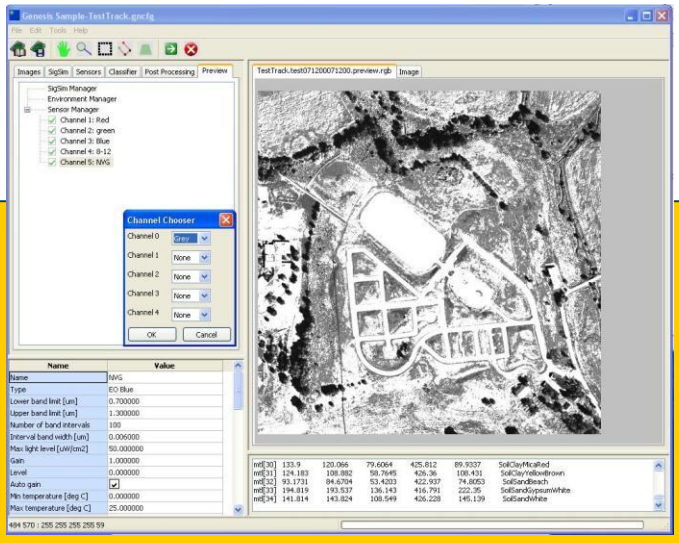
GenesisMC™

GUI-based Semi-automated Image Material Classifier



GenesisMC™ is an advanced-algorithm software tool for creating material-classified-maps from remote-sensed terrain imagery or RGB-textured 3D models -- complete with physical properties and boundary conditions for realistic physics-based sensor simulations.

A Complete MatClass Product

GenesisMC™ has tools for ingesting, managing, viewing, and processing large amounts of imagery in a user friendly and efficient manner.

Material Classified Maps (MCM)

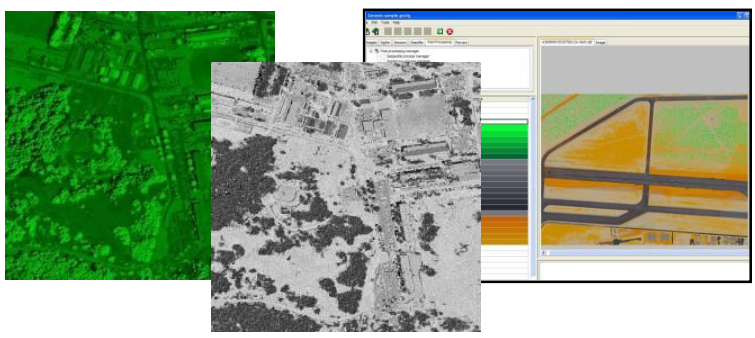
The output of GenesisMC™ is a multi-channel Material Classified Map (MCM), where each pixel contains a material-system (MS) ID and mixture percentages. The MS has layered material compositions and thermal boundary conditions.

Semi-automated Classification

GenesisMC™ allows you to "train" the algorithms on a representative sampling of your class of imagery, and then immediately perform quality control tests to ensure the algorithm settings are producing reasonable results. Then the trained algorithms are applied in a "batch" mode to all the imagery.

Validation Tools

The MCM Mapping Process Manager uses the resultant MCM and MS file to create a user defined colorized representation of the material assignments of the classified image. This process is used to verify/check the MCM classification assignments.



- ## Supports Various Imagery Sources

GenesisMC™ ingests arbitrary-resolution RGB, multispectral, or hyperspectral imagery in .tif, .rgb or .jpg formats.

- ## Utilizes Shape Data/ Vector Data

GenesisMC™ utilizes shape files to assist in the material classification of the terrain tiles.

- ## Multiple Masking Tool Options

GenesisMC™ includes automated and semi-automated tools for masking of generic material regions. These masks are used to assist in the overall material assignment and provide an additional confidence for batch processing and image classification.

- ## Output options

GenesisMC™ allows the user to select MCM outputs in the standard .rgb format or in the .tif (geotiff) format.

- ## NEW! Disturbed Earth/ Hidden Items

GenesisMC™ now offers the ability for end-users to define levels of compactness of the terrain materials in designated areas of the dataset and have this information reflected in the material classification.

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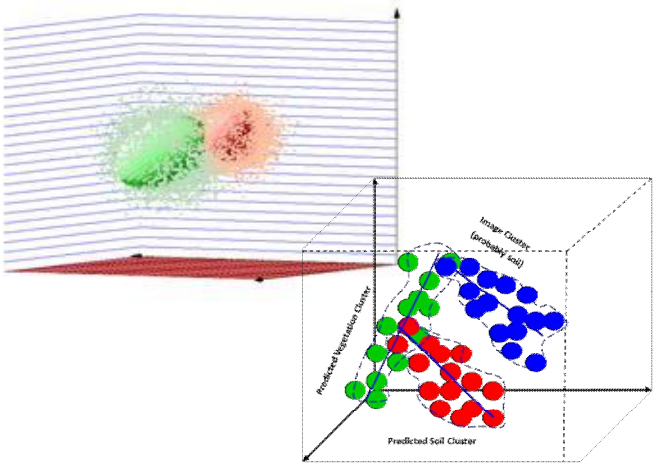
Physics-Based Material Classification of Scenes and 3D entities

GenesisMC™

Advanced Classification Algorithms

GenesisMC™ contains a number of advanced spectral algorithms for the identification of materials and material classes within an image, including PCA analysis, ellipsoidal k-means clustering in color and higher-order metric space, and channel ratio metrics (e.g. NDVI).

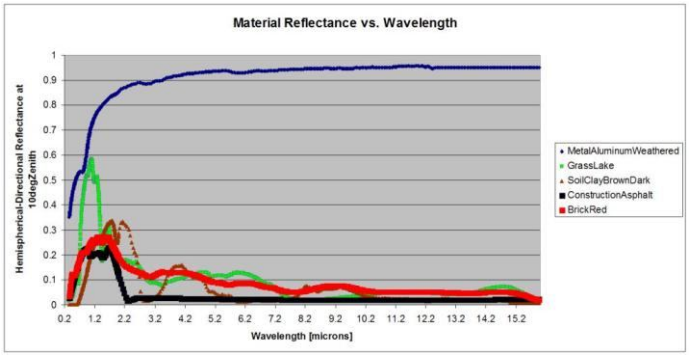


Signature Prediction and Spectral Matching

GenesisMC™ leverages JRM's signature synthesis run-time library, ***SigSim™***, to predict and spectrally match material responses to image pixel colors.

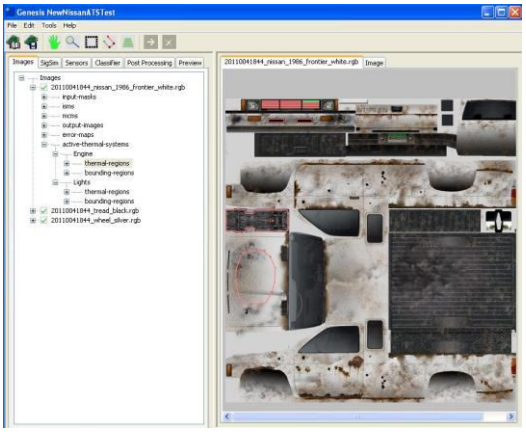
Extensive Material System Library

GenesisMC™ leverages JRM's Spectrometry Lab material database with spectral DHR, thermo-physical and EM properties of nearly 400 real-world materials.



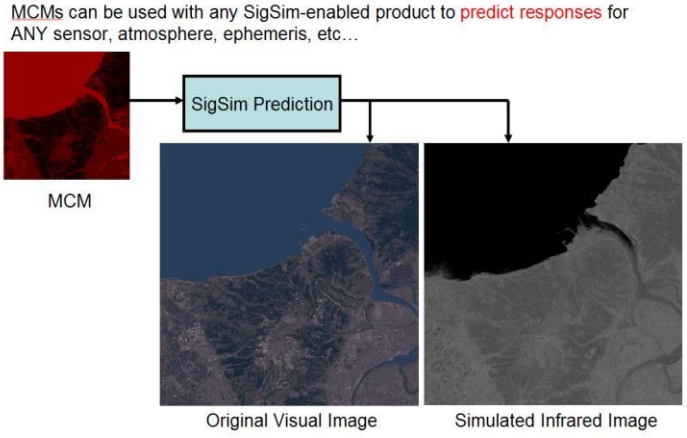
Active Thermal Regions

GenesisMC™ also provides an innovative process for approximating the dynamic surface thermal signature gradients of 3D objects like vehicles. **The NEW and IMPROVED workflow streamlines the process, making defining Active Systems easier and quicker**. Users can "rope-off" and assign "Active Thermal Regions" to portions of the model texture (exhaust, tracks, etc). These Active Thermal Systems are controllable at run-time in end-user applications.



Sensor Mode Previews

GenesisMC™ uses JRM's SigSim™ signature and atmospheric synthesis library to feature a Sensor Preview mode, allowing users to visualize how the resultant MCM will look in a typical Sensor Simulation. Preview sensors are user definable. Pre-defined options include: LWIR, MWIR and NVG.



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SigSimRT

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Signature & Atmospherics Library for Sensors & Out-the-Window Visuals

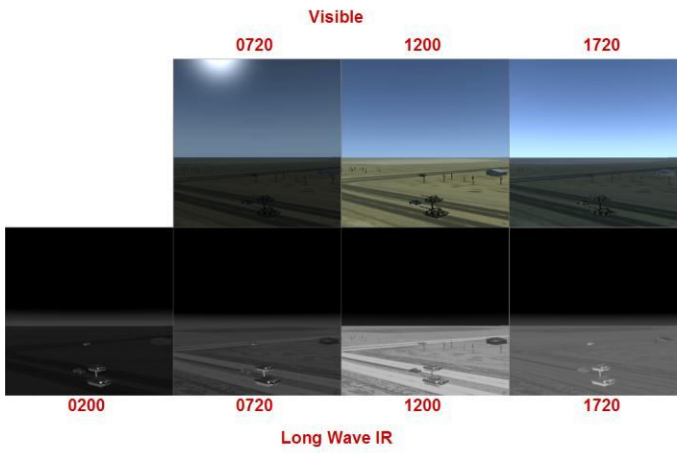
SigSimRT™ is an advanced signature synthesis and atmospheric propagation runtime library for radiometrically-correct sensor displays and Out-the-Window (OTW) visuals.

SigSimRT provides on-the-fly physics-based modeling over the 0.2-25.0 um spectrum (UV, visible, near-IR, thermal-IR) and for arbitrary RF frequencies. SigSim's ultra-fast algorithms and common material/property-attributed Synthetic Environment make it ideal for real-time multi-sensor, OTW, CGF/SAF, and Hardware-In-The-Loop (HWIL) applications.

Scene Graph Rendering Interface

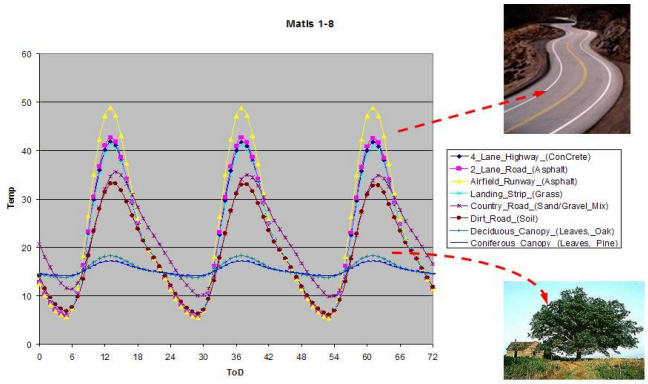
SigSimRT provides easy-to-use data structures and API methods to directly supply scene graph rendering engines such as OpenSceneGraph, OGRE, or a custom image generator with scaled spectral or passband-integrated radiances, emissive contributions, and reflectivities; broken down into ambient, diffuse, and specular.

SigSimRT allows changes in atmospheric state or weather conditions *on-the-fly*, and provides real-time updates for the thermal emissions (temperatures), light source irradiances and line-of-sight atmospherics. SigSimRT atmospherics modeling includes transmittance, thermal path radiance and scattering -- all completely correlated across sensor bands for the correct relative behavior. JRM provides an OSG-based example with source code and GPU shaders that illustrate the use of the SigSimRT API to aid in the addition of sensor simulation to a particular image generation system.



Real-time Thermal Emission & Reflection

SigSimRT has ultra-fast, fully-transient thermal model algorithms that respond on-the-fly to changes in boundary conditions, such as ambient wind-speed and air temperature, rain-rate, time-of-day and surface-normal-dependent solar loading, sky loading, etc.



As a result, SigSimRT correctly models effects such as the diurnal cycle phenomenon of "thermal cross-over" between vegetation and soil/roadways. SigSimRT also supports various BRDF reflection models, including Sanford-Robertson and energy-conserving Phong, and loads JRM's library of measured bulk thermophysical and spectral material surface properties.

Common Material Property-Encoded Synthetic Environment

In addition to a common atmospheric data-model, SigSimRT employs a common terrain and object data-model with the innovative *Material Systems Concept* (supported in a SEDRIS EDCS). Material Systems allow the assignment of material configurations and associated thermal boundary conditions to texels, vertices and/or facets in the database.

In this manner, fast SigSimRT algorithms retrieve intrinsic physical properties such as density, thermal conductivity, specific heat, BRDF, and RCS, and apply them along with context variables such as wind speed, engine-state, etc. to synthesize the correct pass-band signature for EO, IR or RF sensors.

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SigSimRT

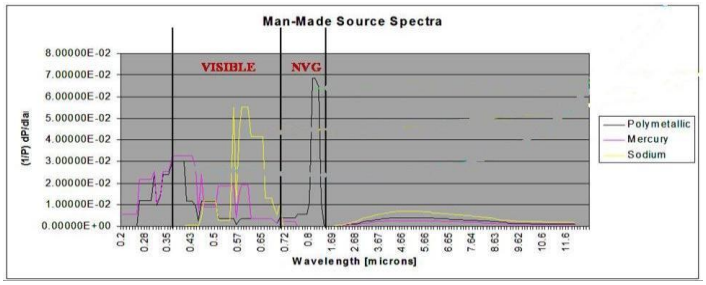
Signature & Atmospherics Library for Sensors & Out-the-Window Visuals

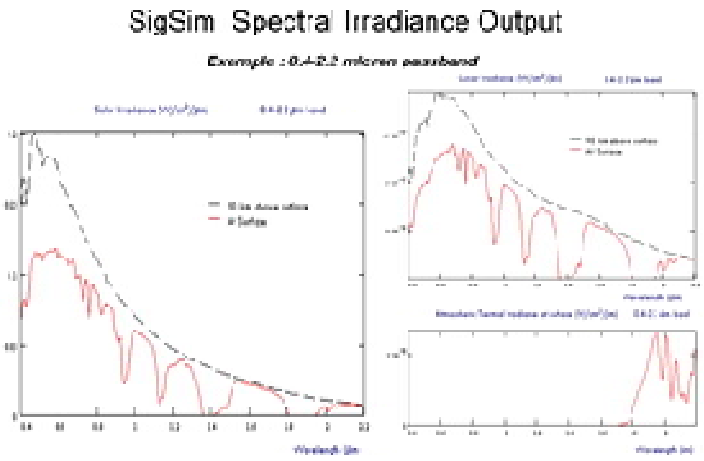
Real-time Radiance Modeling

For any 3D location, time, date and atmosphere/ weather condition, SigSimRT quickly provides all the natural source quantities necessary for accurate lighting, reflectance and thermal loading, including:

- Solar position, direct/diffuse spectral radiance
- Lunar position/phase, direct/diffuse spectral radiance
- Stellar constellation positions and spectral radiances
- Downwelling sky and cloud spectral radiances
- Upwelling earthshine spectral radiance

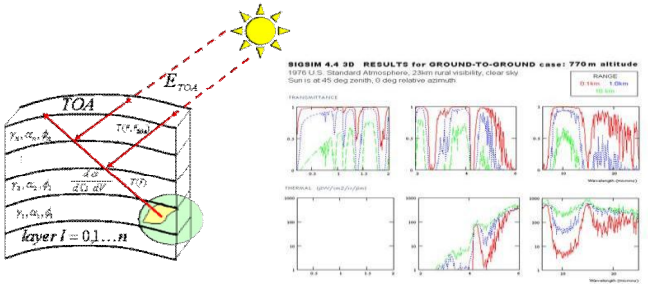
In addition, SigSimRT quickly provides the correct spectral radiance from man-made light sources, including tungsten, sodium, mercury, neon, and polymetallic lamps.

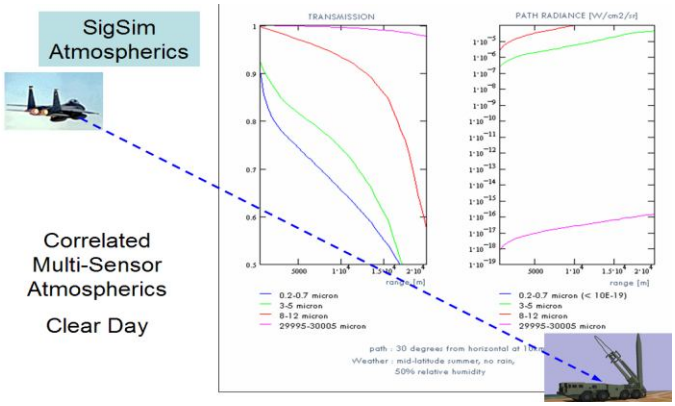


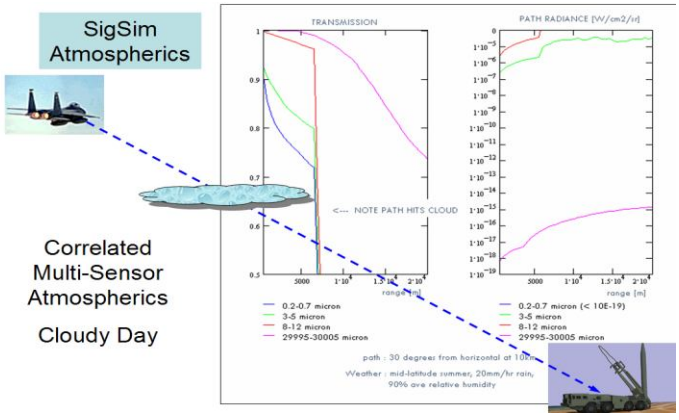


Real-time EO/IR/RF Atmospherics

SigSimRT uses innovative, extremely-fast path-integral/transport algorithms based on Modtran & Radtran-atmospheric physics licensed from AFRL. These algorithms operate on a common ellipsoidal atmospheric data model, allowing the user to assign such parameters as the pressure, temperature, molecular species concentrations and weather state at any altitude.







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SenSimRT

Advanced Real-Time EO/IR Sensor Effects SDK Library

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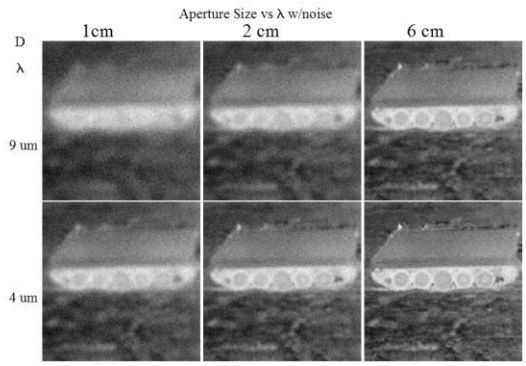
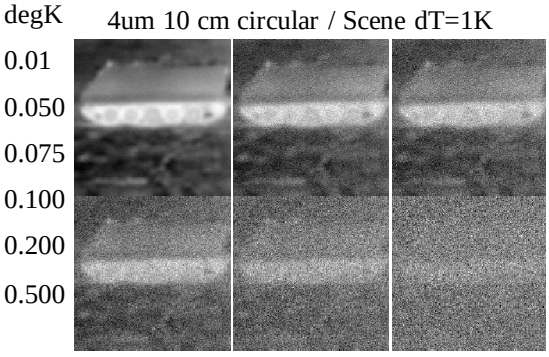
SenSimRT is an advanced sensor modeling toolkit and run-time library for real-time sensor effects simulation of any optical sensor in the EO or IR regime. It provides engineering-level modeling of the optics, detector, electronics and display components, simulating appropriate Modulation Transfer Functions (MTFs), detector sampling, noise, non-uniformity, dead-detectors, fill-factor, 1/f and white noise, pre-and post-amplifiers, and displays. SenSimRT can use the actual sensor component specifications to provide the most realistic sensor visualization experience.

SenSimRT Solution Suite

SenSim is an advanced optical sensor modeling and real-time effects solution suite that consists of two component technologies: SenSimMT, the Sensor Design Modeling Tool, and SenSimRT, the real-time Sensor Effects Post-Processor Library.

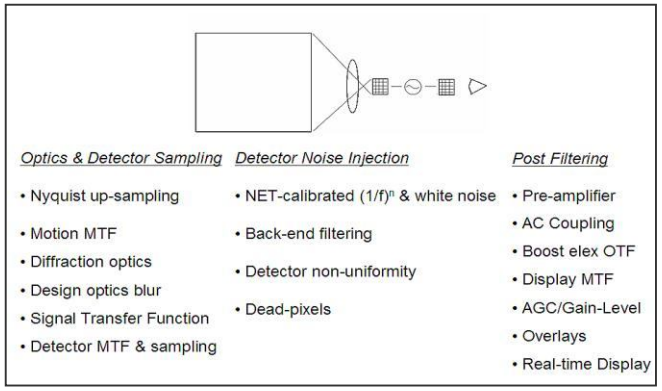




SenSim Diffraction Blur and NEDT Analyses

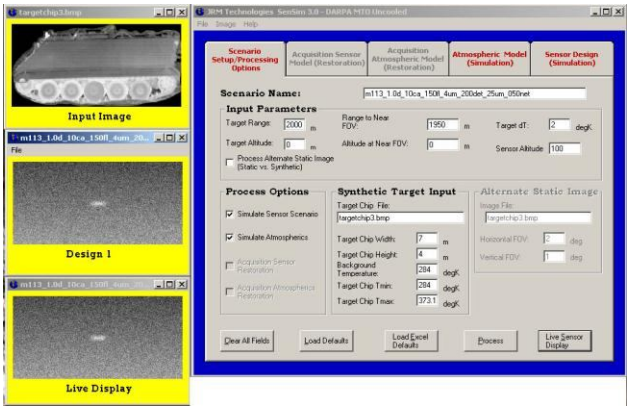
SenSimMT

SenSimMT is a powerful tool for sensor design and analysis studies. Users simply enter typical or known sensor specifications, and dynamically view the effect as would be on an actual sensor display.



SenSimMT ingests either a static sensor image or synthesizes a tactical scene on-the-fly with a target model at range based on user-specified inputs. Using advanced engineering models for simulating the sensor effects in non-real-time, it produces a play-back movie of that sensor against the user-specified scenario.

When the user has the precise specifications for the right sensor "look-and-feel", SenSimMT outputs the run-time data constructs to be used by SenSimRT for real-time sensor effects implementation.



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SenSimRT

Advanced Real-Time EO/IR Sensor Effects SDK Library

SenSimRT – GPU Real-time Sensors

SenSimRT is an innovative new library that ingests a SenSimMT output file, and configures itself to apply engineering-level NVG and FLIR sensor effects at the specified sensor frame rate – 60 Hz or better, depending on the SenSimMT design and graphics hardware.

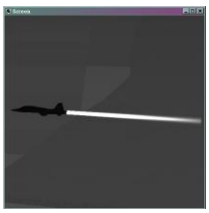
Scalable Solution

SenSimRT is a scalable solution using robust run-time software that implements SenSimMT modeling in the GPU on NVIDIA and ATI advanced graphics boards in real-time. Efficient GPU algorithms apply the effects to the at-aperture imagery in the frame-buffer with very minimal impact on scene rendering performance. The result is real-time advanced sensor effects on low cost PC-based hardware. SenSimRT will also run on tightly-coupled dual GPU hardware architectures, like SLI from nVidia, for larger at-aperture image- processing for higher frame-rates. SenSimRT performs physically-correct, engineering level effects simulation, like real-time NVG haloing, noise, and blur.

Features

- GPU-Based Real-Time Sensor Effects Library
- Easy integration into existing IGs like OpenSceneGraph
- Provides engineering-level modeling of the optics, detector, electronics and display components
- Gaussian, Poisson, and 1/f noise
- Diffraction, motion and design blur
- Dynamic range, gain/level and AGC
- Physically-correct NVG light-point haloing in the frame-buffer
- Supports real-time frame rates

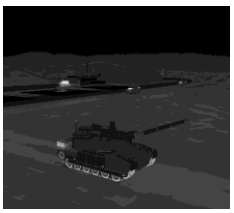
At-aperture Inputs vs. SenSimRT Outputs



T38a Aircraft

MWIR

T72 Tank

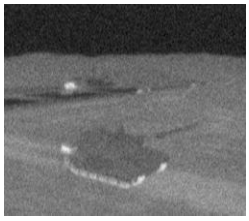


Tactical

T38a Aircraft

3-5 um FLIR

T72 Tank



Tactical

SenSimRT Physically-Correct GPU Haloing

SIMLABS

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JRM

OSV™ (OSG Sensor Viewer)

Advanced Spectral Scene Generator & Development Kit

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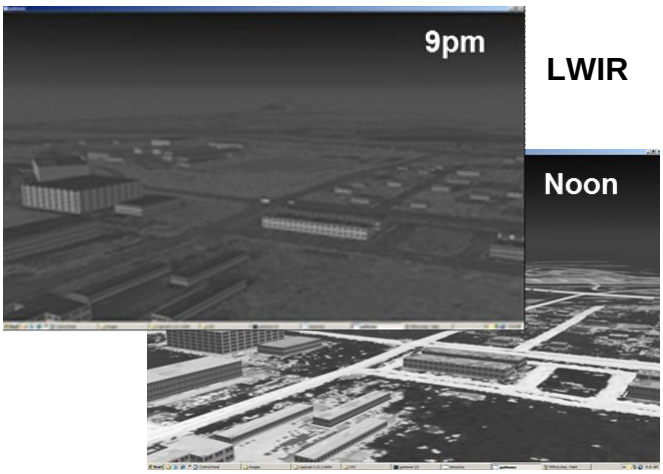
OSV™ is a physics-based spectral scene generation software development package based on JRM's Sensor SDKs and OpenSceneGraph (OSG). It comes with both turn-key applications and source examples.

Full Spectrum, Correlated Simulation from a single Database

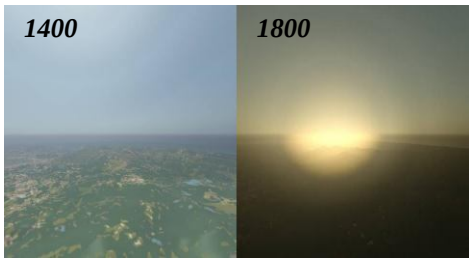
Leveraging JRM's signature synthesis and atmospheric propagation run-time library, SigimRT™, along with material encoded textures produced by JRM's GenesisMC™, OSV provides high-fidelity simulation of arbitrary imaging sensors in the UV through far IR (0.20–25.0μm) spectrum with highly-optimized, physics-based signature synthesis and Modtran -based atmospheric propagation modeling.



Dynamic At-Aperture Radiance Scenes

In real-time, OSV computes the at-aperture sensor-pass band radiances of complex scenes under *dynamic environmental and object conditions* such as:

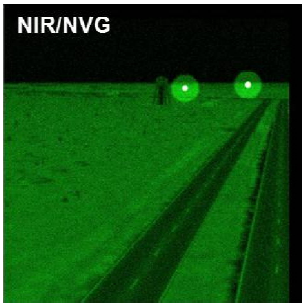
- Time of day
- Time of year
- Geolocation
- Humidity
- AirTemp
- Pressure
- Aerosols
- Wind speed
- Vehicle Speed
- and more



OSV Visible Atmospheric Scattering

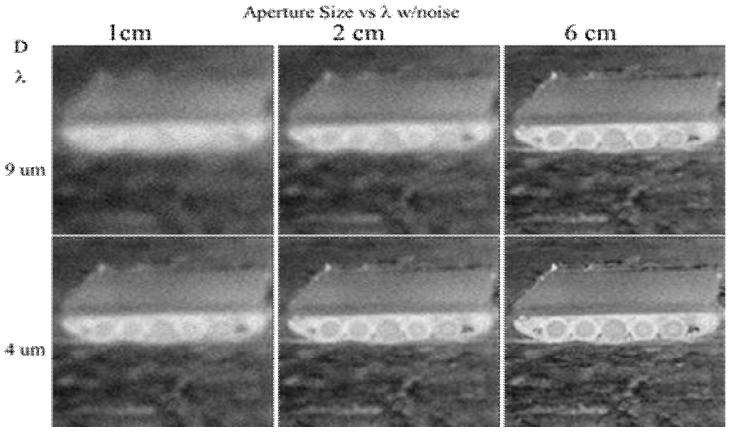
Passive & Active Sensor Modeling

OSV supports passband-integrated, multispectral, and full-spectral output, for arbitrary passbands, including ultraviolet (UV), color visible, shortwave (NVG, SWIR) and infrared (MWIR, LWIR, FLIR).

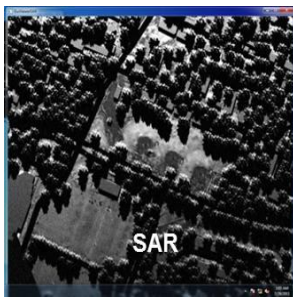


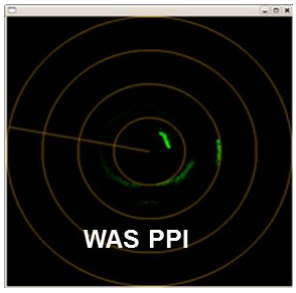
Dynamic Post-Aperture Sensor Effects

Using JRM's SenSimRT engineering-level sensor modeling library embedded, OSV provides component-level simulation of optics, detector arrays, signal processing and displays for realistic appearance.



OSV also supports an increasing variety of active mode outputs, including SAR, ISAR, Wide-Area Scan, MTI and Ladar/ Millimeter-wave. Terrain areal RCS parameters are stored in the same material data files as are used in EO/IR modeling, and RF propagation is based on Radtran calculations, using the same profile specification as for Modtran.





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OSV

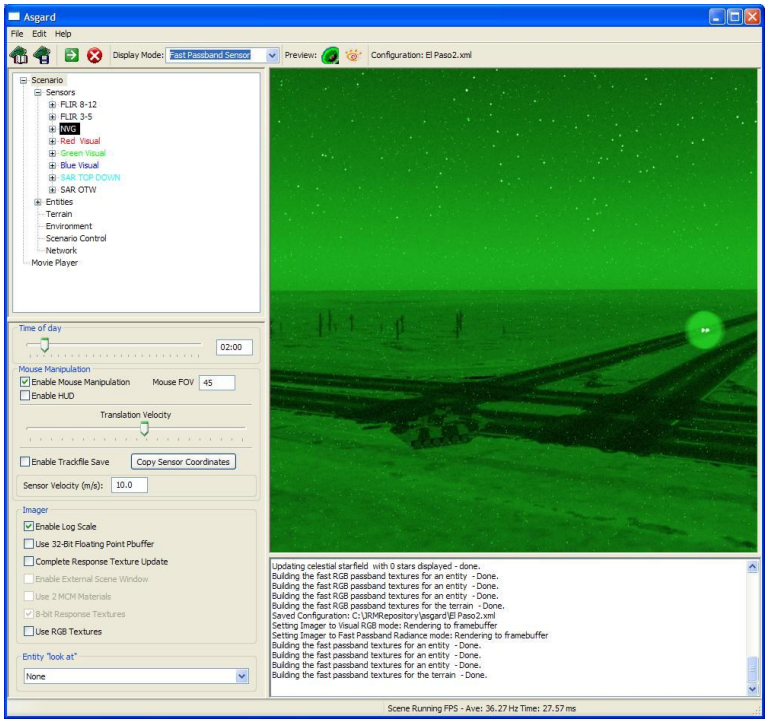
Advanced Spectral Scene Generator

Available as GUI Based Tool or SDK Library

OSV allows the user to easily create and simulate a dynamic tactical sensor scenario. With its easy-to-use GUI, one can load a 3D terrain database, specify any number of arbitrary sensors, atmospheric and weather conditions, place 3D vehicle models in the scene, and create track files to establish entity motion.

Mouse and joystick controls allow you to fly or drive your sensor as attached to a model throughout the database and the software allows you to capture still images or full movies at the scenario frame rate.

Alternatively, OSV is available in a cross-platform SDK version for developers to create their own sensor IG solutions.

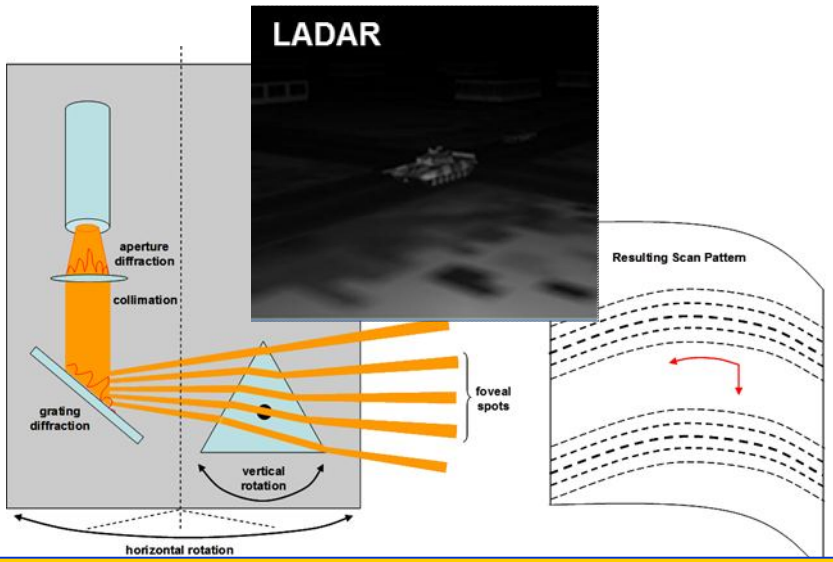


Features

- Material and atmospheric science based physical property assignments of the scene elements: 3D objects, vehicles, terrain and atmosphere
- Fast transient thermal models for accurate surface temperatures reactive to changes in atmosphere/ weather and dynamic states
- Physics-based, spectral signature calculations for UV, VIS, NIR, SWIR, MWIR, LWIR, FLIR, and RF frequencies.
- Various Fidelity vs. Performance Modes
- Accurate, fast Modtran/Radtran-based atmospherics for realistic scattering, transmittance and path radiance
- Supports standard open database formats such as OpenFlight and Terrapage
- Extensible, flexible development SDK

Scalable Fidelity/Performance

All modes use 32-bit floating point GPU processing for signatures and atmospherics, with frame rate performance ranging from about 1 Hz for full spectral rendering into a 32-bit float frame buffer to real-time 60-200 Hz for fast passband rendering to a standard 8-24 bit integer frame buffer.



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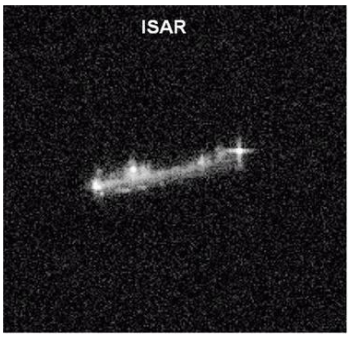
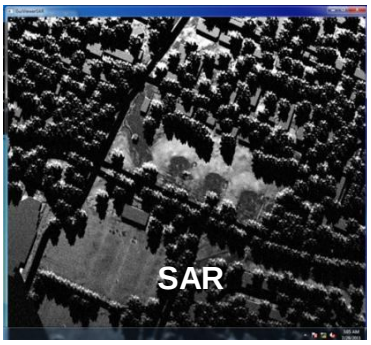
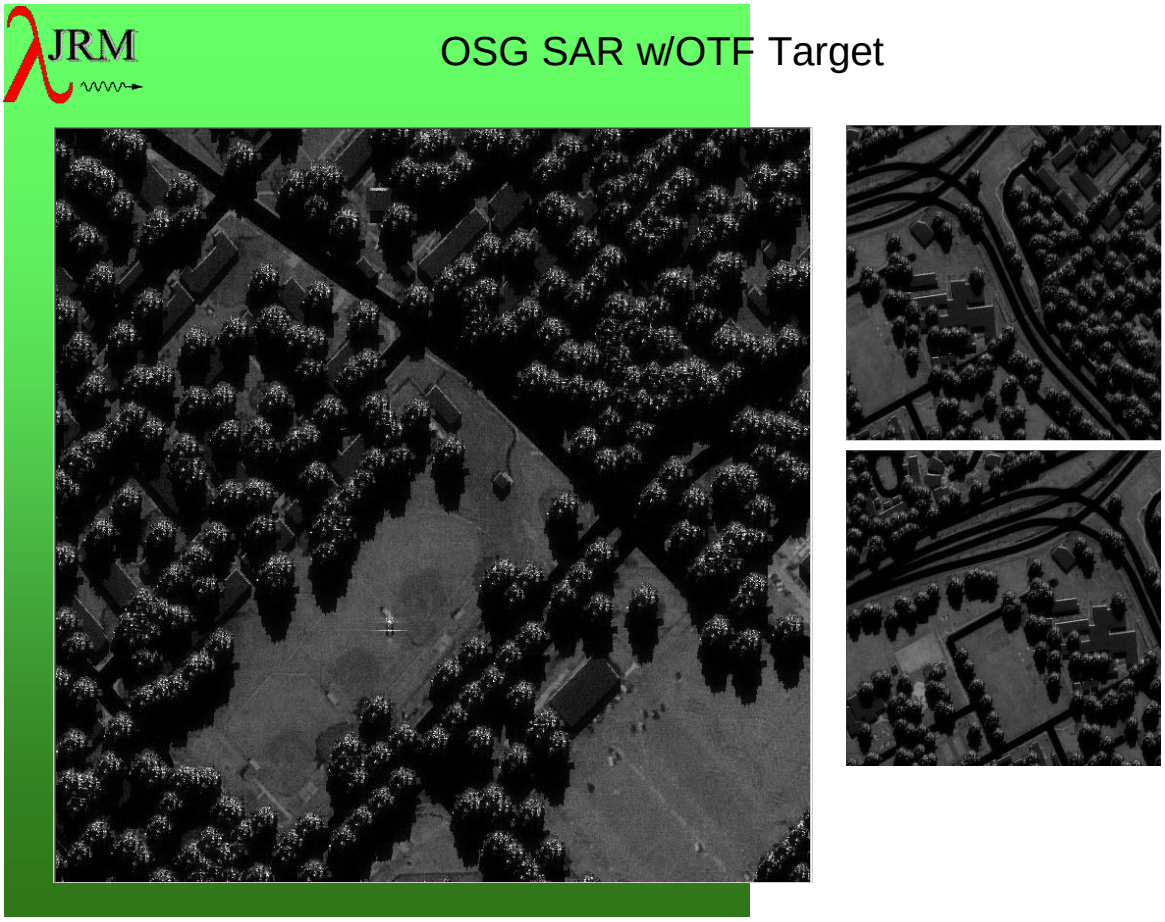
JRM

OSG Sensor Viewer (OSV) *Radar Mode Support*

OSV now features Radar Mode support, including Synthetic Aperture Radar (SAR) mode, Inverse Synthetic Aperture Radar (ISAR) and scanning modes like Wide-Area Scan (WAS). JRM is adding support for future radar modes like weather radar, ground-beam mapping, etc …







The general specifications for SAR/ISAR radar mode support are provided below.

Performance: 1-10Hz depending on scene complexity. OSV SAR runs on-the-fly (OTF) in real-time typically at 1Hz.

OSG Sensor Viewer (OSV) *Radar Mode Support*

Sensor Correlation: Correlated with EO/IR. Switchable between SAR mode, and EO/IR sensor modes (US, Visible CCD, NIR, SWIR, MWIR, LWIR and arbitrary sensor passband). OSV SAR runs fully correlated with the other OSV sensor modes for EO/IR (ie NVG, MWIR, LWIR) because it is built into the same physics-based sensor rendering software and runs on the same physical-property terrain and target database.

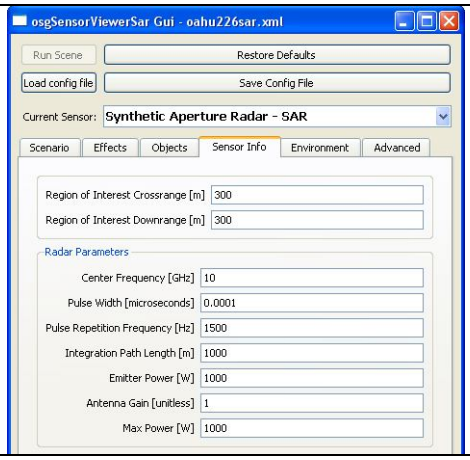
Resolution: Arbitrary. OSV SAR can support arbitrary SAR resolutions up to the resolution of the database RGB textures.

Signature Effects: OSV SAR uses on-the-fly (OTF) physics-based signatures from a single material-property encoded 3D database of terrain, cultural features, atmosphere and targets. Real-time effects include:

- SAR Shadows
- Leading edge brightness
- Down-range/Cross-range resolution effects
- RF path attenuation and absorption noise
- Target RF signatures from user data (user RCS or SC tables or JRM default)
- Target simulated in-phase returns (for resonance and nulls)
- Polarization.
- Terrain Ulaby-Dobson RF signatures from JRM material library

Sensor Controls: OSV SAR provides control over the following sensor inputs

Frequency (Ghz)
Pulse Width (u-secs)
Pulse Repetition Frequency-PRF (Hz)
Integration Path Length (m)
Transmitter Power (W) and Max Power (W)
Antenna Gain



Frequency Ranges: OSV SAR supports the following bands

- ✓ L-band : 1-2 GHz
- ✓ S-band: 2-4 GHz
- ✓ C-band : 4-8 GHz
- ✓ X-band : 8-12 Ghz
- ✓ Ku-band : 12-18 GHz
- ✓ Ka-band : 30-40 GHz
- ✓ W-band : 90-100 GHz

For more details, please contact:

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