



# MuSES™

## EO/IR Signature Prediction Software



Truck rendered in NearIR

### Principal Features

#### Complete Thermal Analysis

- Multi-bounce Radiation
- Solid, Planar, Cylindrical & Spherical Conduction
- Convection, 1D Fluid Streams
- Import CFD Results
- Natural Environments
- Ballistic & Standard Glass

#### EO/IR Signature Prediction

- Multiband Radiance & Apparent Temperature Prediction
- BRDF Rendering
- Terrain and Sky Reflection
- Spectral Paint Surfaces & Camouflage Texturing
- Faceted Backgrounds
- Integrated Plume Module
- Hyperspectral Rendering Module

#### Target Backgrounds

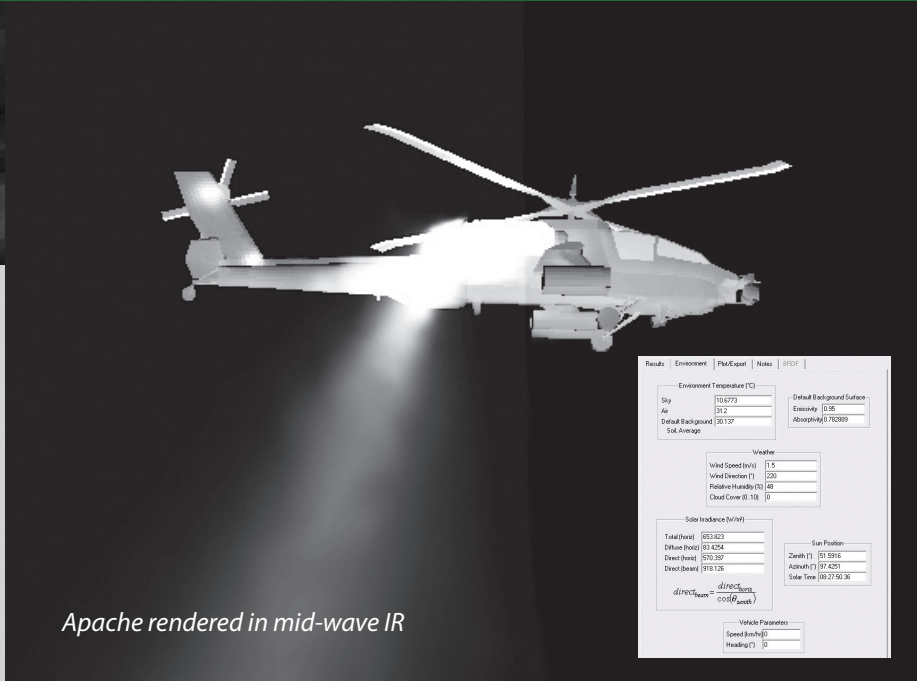
- Faceted Terrain Backgrounds
- Library of Terrains, Foliage, etc.
- First Principles Multi-Layer Backgrounds
- MODTRAN for Atmospheric and Variable Sky
- Texture and Assigned Backgrounds

#### Benefits

- Integrated Thermal & EO/IR Solutions
- Faster Product Development
- Interfaced to Scene Simulators

#### Common Applications

- LO Design Analysis
- Signature Optimization
- Integration with Scene Simulators
- Probability of Detection
- Survivability / Hit Avoidance



Apache rendered in mid-wave IR

## The Leader in EO/IR Signature

MuSES (Multi-Service Electro-optic Signature) is an advanced thermal and infrared signature prediction program from ThermoAnalytics. MuSES will let the infrared analyst or specialist perform complete thermal modeling and infrared signature prediction within an integrated easy-to-use interface.

#### Benchmark Speed & Accuracy

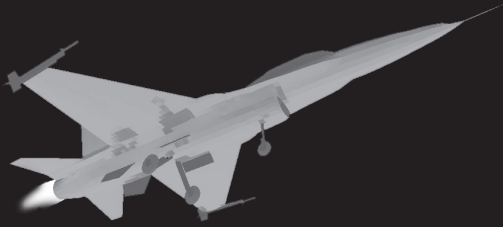
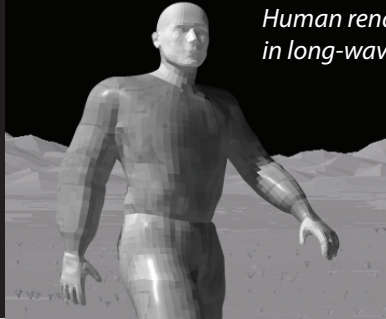
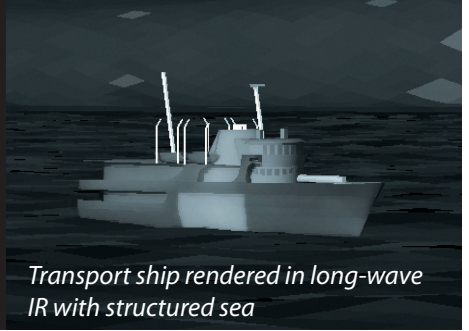
MuSES's highly-optimized algorithms handle even the most complex EO/IR questions. Written entirely in C++, MuSES maintains speed and cross-platform compatibility across Windows, Linux, and Unix computers.

#### Realistic Natural Environment

Natural environments are supported through weather data files and solar loading based on global position. MuSES can also use atmospheric data from MODTRAN. Multi-bounce solar radiation is automatically calculated including greenhouse effects from solar radiation transmitted through glass. Faceted terrains provide full target-background interactions, including reflections and shadowing.

#### Near-IR Module

The Near-IR Module extends the effective sensor band range in MuSES and supports four environmental sources of radiance across the near-IR waveband: lunar glow, atmospheric glow, skyshine, and urban glow.

*F-16 rendered in mid-wave IR**Human rendered in long-wave IR**Transport ship rendered in long-wave IR with structured sea*

## MuSES Features

### Advanced Rendering Module

- Multi-Bounce BRDF model
- BRDF per pixel rendering
- Sub-pixel oversampling

### Near-IR Module

- Includes four environmental sources: lunar and atmospheric glow, skyshine, and urban glow
- Simulation of night vision systems
- Survivability and probability of detection in low-light engagements

### Complex Multilayer Parts

- Planar, cylindrical and spherical with up to 25 layers
- Mixed solid, air, vacuum, or transparent layers
- Multilayer conduction rules and links

### Air Targets

- MODTRAN atmospheric attenuation
- Variable sky background model
- Custom atmospheric profiles

### Human Thermal + Effectiveness

- Accurate human physiological models
- Multi-layer clothing database
- Local sensation and comfort model output

### Battery Thermal Module

- Perform coupled thermal-electrical analysis
- Transient charging and discharging cycles
- Analysis of individual cells, battery packs, and vehicle systems

### Solid Conduction

- Support for 3D solid and shell conduction
- Temperature dependent properties
- Internal imposed heat rates
- Clipping plane display of internal temperatures

## Total Thermal Solutions

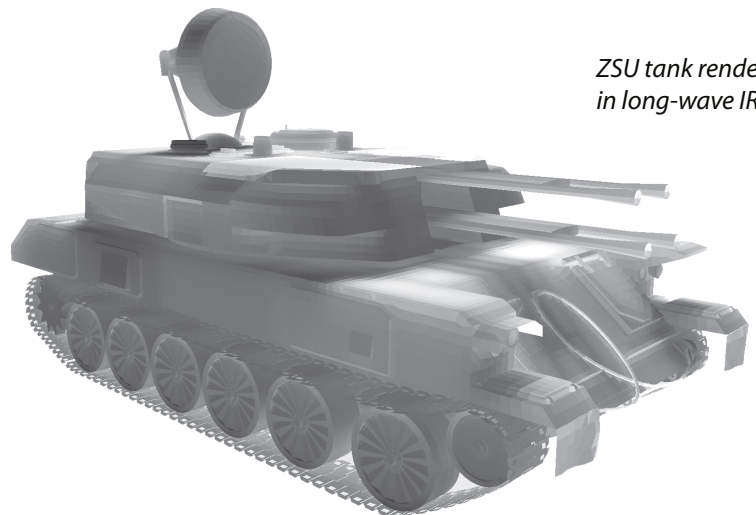
**Predict Signature Data** – The EO/IR Signature post-processor displays physical temperatures, in-band radiances and apparent temperatures for every element or facet. Running the BRDF solver allows the user to predict target and background specular radiance images into a pixelized format.

**Improve Your Design** – Import your model geometry and change designs with ease. Manipulate the geometry within MuSES to optimize heat management and understand IR signatures relative to a time-varying environment or operating conditions.

**Utilize Faceted First Principle Backgrounds** – To predict accurate target-background contrast levels, MuSES fully supports faceted backgrounds. Create or import a faceted terrain and apply one or multiple background types to your geometry. Calculate accurate temperature/signature solutions—including full target background interactions.

**Integrate with CFD** – Seamless integration with CFD air flow results provides increased accuracy for convection.

**Integrated Plume Module Available** – Incorporate plume radiance into your BRDF renderings for total signature analysis. Licensed separately.

*ZSU tank rendered in long-wave IR*