The Generic Sensor Model (GSM) is a collection of core software components (classes) used as the foundation for developing radar simulation models.
Generic Sensor Model (GSM)

OVERVIEW

- Model Description
- Operating Modes
  - Stand-Alone
  - System-of-Systems
- Model Components
- Model Flow
- Model Flexibility
  - Extensibility
  - Changeable Components
  - System Adjustable Parameters
- Analyses
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**MODEL UTILITY**

- Scenario Testing
- Algorithm Testing and Comparison
- Interoperability Evaluation
- Mission Planning
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**FEATURES**

- Event Driven
- Parameter Based
- Scalable
- Modular
- Extensible - Uses Object Oriented Design (C++ based)
- Can Incorporate Tactical Software
- Can be Incorporated into system-of-systems environment (High Level Architecture (HLA) interface)
- Fidelity - configurable from low to high
- Unclassified
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**COMPONENTS**

- HLA Interface
- Beam Scheduling
- Ray Trace Beam Propagation
- Detection Processing
- Tracking
- Cueing
- Communications
- Data Logging
- Dynamic Environment (Atmosphere, Weather, clutter)
- Terrain maps (DTED)
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**OPERATING MODES**

**Stand-Alone Mode**
- All inputs via XML and data files
- All outputs to log files
- Operates on a single Windows™-based platform

**System-of-Systems Mode**
- HLA federated configuration
- Operates in Lockheed Martin’s Integrated Missile Defense Testbed (IMDT)
Integrated Missile Defense Testbed (IMDT™)

IMDT Addresses All Phases of BMDS Mission

1. Plan the Battle – Integrated Defense Planner (IDP)
2. Fight the Battle – IMDT Federation
3. Assess the Battle – Post-Simulation Analyses

IMDT Provides Accurate BMD Planning, Performance And Evaluation Support
**Integrated Missile Defense Testbed (IMDT™)**

**IMDT Federation**

- **Distributed high-fidelity system-of-systems modeling and simulation testbed for BMD**
- **HLA and the GV-Net™ allow distribution of the simulation models to their developers’ (subject matter experts’) locations**
- **Includes sensor, weapon systems, communications, and C2BMC high-fidelity models. System controller, analysis suite, and visualization.**
Generic Sensor Model (GSM)

IMDT™ Distributed Network

GVNet™
Generic Sensor Model (GSM)

Generic Sensor Model Transmit Event Flow

[Diagram of a flowchart showing the transmit event flow process]
Generic Sensor Model (GSM)

Generic Sensor Model Event Processing
Generic Sensor Model (GSM)

Generic Sensor Model Components

- **Physics-Based Components**
  - Beam scheduling
  - Beam propagating
  - Signal calculations
  - Tracking

- **Effects-Based Components**
  - Measured state
  - Single-scan correlation
  - Multi-scan correlation
Generic Sensor Model (GSM)

Generic Sensor Model Components

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Generic Sensor Model (GSM)

**Generic Sensor Model Components**

**Flexibility and Extensibility**

- **Beam Scheduler**
  - Phase / Rotate
  - Phase / Phase
  - Phase / Phase / Rotate
  - Track Filter
- **Kalman Filter**
  - Interacting Multi-Model (IMM)
  - Non-Linear Ballistic Model
- **Model Extensions**
  - External Cue
  - IFF
Generic Sensor Model (GSM)

**Generic Sensor Model Parameter Examples**

- **Sensor**
  - Transmitter – power, duty cycle, …
  - Antenna – size, element count, …

- **Waveforms**
  - Selection
  - Beam Parameters – frequency, bandwidth, …

- **Tracker Characteristics**
  - Initial Conditions – weights, …
  - Operating Parameters – time constants, …

- **Threats**
  - Number
  - Characteristics
  - Trajectories
**Generic Sensor Model Analyses**

- **Component Performance Analyses**
  - Detections – SNR, $P_D$, ...
  - Tracker – initiate track, drop track, ...

- **Algorithm Analyses**
  - Baseline updates
  - Extended functionality

- **Mission Planning**
  - Assumption verification
  - Parameter development

- **Scenario Analyses**
  - Targets – number, location, type, ...
  - Assets - number, location, type, ...
  - Communications – latency, availability, ...
Generic Sensor Model Analysis Examples

- Stand-Alone Operating Mode
  - Performance assessment
    - Track initiation
    - Coverage
    - Detection probability
  - Enhanced/Modified Capability evaluation
    - Tracking
- System-of-Systems Operating Mode
  - Interoperability
Stand-Alone Mode Performance

Example

- **Individual missiles launched throughout the region of interest**
- **Missiles impact one of two cities (white, pink)**
- **Radar at a specified location**

**NOTE:** All data are notional.
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Stand-Alone Mode Enhanced Capability

Example

- \textbf{N Monte-Carlo runs using Tracker 1}
- \textbf{N Monte-Carlo runs using Tracker 2}
- \textbf{Evaluate}
  - Probability of track initiation
  - Track initiation time
  - Track duration
  - Track drop time
  - Track quality
  - ...

\textbf{NOTE: All data are notional.}
Interoperability Video

NOTE: All data are notional.
**Summary**

- **Generic Sensor Model (GSM) provides a flexible, extensible framework for instantiating sensor models**
  - Object-Oriented design
  - Parametrically driven
  - Stand-Alone mode
  - Federated mode

- **Integrated Missile Defense Testbed (IMDT) provides a distributed system-of-systems environment**
  - High-Level Architecture (HLA)
  - Global Vision Network (GV-Net™)
  - Addresses all phases of the BMD mission
    - Plan the Battle
    - Fight the Battle
    - Assess the Battle