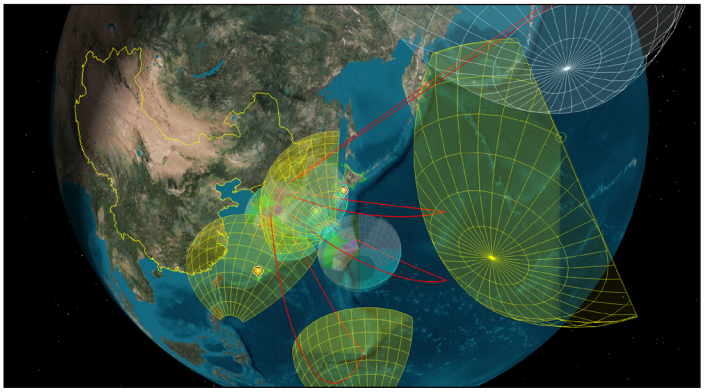
Ansys

MISSION

STK Missile Tool Kit

Simulate powered missile flight trajectories, intercept engagements, and defense system performance.

Missile Modeling Tool (MMT)



MMT is a high-fidelity missile flight path generator that creates multiple stage missile trajectories, battle engagement scenarios, and space launches that can be exported to STK for analysis and visualization. MMT includes:

World map. Used to visualize missile flights defined for the current project.

Export manager. Used to export missile object ephemeris and attitude profiles to STK (missile stages, complete flight profiles and targets).

Missile flights. Defined using the basic elements of the defined or selected missile system along with the launch site and targets.

Space launches. Analyze and visualize space launch vehicle flight paths based on the 3-DOF propagator with pitch programs suitable for satellite insertion.

Visualization of Missile Systems. Provides realistic:

- 3D models of each missile system.
- Visualization of your missile flight, including stage separation and firing, shroud removal, PBV maneuvers, and RV deployments.

Missile database. Contains missile models (booster and payload parameters) from three sources:

- Representative models installed with MMT
- Models designed and exported using Missile Design Tool (MDT)
- Adversary Capabilities Document (ACD) models designed by the Missile Defense Agency (MDA) for current and future missile systems

Accurate trajectory simulation. Simulates boost, midcourse, and terminal phases of ballistic trajectories with detailed models of gravity, atmospheric drag, guidance, PBV maneuvers, and RV deployment.

All flight trajectories are generated with a 4th order Runge-Kutta integration algorithm. The state vector and derivative computations change with the state of the missile. (e.g., thrust, drag, and gravity modeled during boost; but only drag and gravity during reentry).

Launch and target sites. Defined by manually specifying location properties or by using an object in the current STK scenario.

Interceptor engagements. Simulates and analyzes engagement scenarios including aircraft, missile, or satellite targets. Using the database of representative interceptors or a custom interceptor specification, MMT provides kinematic feasibility assessments of one-to-one engagements.

Interceptor performance curves tool. Used to evaluate the performance of interceptors using two fly-out curves on two plots. The fly-out curves consist of “range vs. altitude” and “time vs. velocity” plots of all acceptable flights. Time-of-flight contours for the maximum range flights can also be included.

Debris modeling.

- Post-intercept debris modeling. Select debris pieces by number, mass, length; export to STK for further analysis.
- Predefined debris modeling. Model individual debris pieces from a user-specified file.

Battery editor. Interceptor systems are modeled as batteries, which are defined as one or more interceptors of the same type in a single operating area. There are two sources of interceptor models used by MMT:

- Representative models installed with MMT
- Models designed and exported using MDT

Target grid generator. Used to create target trajectories that you can use in MMT analysis cases.

Analysis case editor. Analysis cases are comprised of an intercept battery, targets, and sensors. These components are linked to the analysis case from intercept batteries and target grids defined in MMT and from missile and sensor objects in the STK scenario.

Use the editor or a wizard to walk you through the process of creating one of the following analysis case types for a particular missile or space flight, or intercept engagement:

- Defended-area footprint
- Guaranteed defended-area footprint
- Guaranteed launch-area denied
- Guaranteed operating area
- Launch-area denied
- One versus many
- Operating area

Timelines. View timelines of the analysis cases in the current project.

/ Missile Design Tool (MDT)

Create complete system-level performance models of ballistic missiles, interceptors, and space launch vehicles that can be imported into:

- MMT, where their trajectories can be accurately modeled.
- STK, for analysis and visualization.

3D model view. MDT displays an interactive, 3D model of the components, including stages, as the model is being designed.

Stage editor. Used to define the following properties of each stage of the model:

Propulsion. Linear thrust curve or thrust table methods, including Vernier propulsion modeling for ballistic missiles and strap-on engine modeling for space launch vehicles.

Dimensions and mass. Dimensions, mass, mass jettisons, and ballistic coefficient.

Separation. Velocity parameters that move the exhausted stage away from the remaining model.

Guidance. MDT provides eight guidance modes for ballistic missiles and one each for interceptors and space launch vehicles:

- Fixed
- Pitch Profile
- Quadratic Pitch Profile
- Thrust Terminating, Variable Loft
- In-plane Pitch Maneuver
- Out-of-Plane Yaw Maneuver
- Variable Launch Angle
- Fixed Pitch Profile with Aero Extension
- Initial Missile Pitchover

Payloads. Define payloads carried by missiles, interceptors, and space launch vehicles:

- Post-Boost Vehicle (PBV)
- ransfer Stage
- Reentry Vehicle (RV)
- LV Payload
- Kill Vehicle
- Penetration aids (penAids)
- Shroud

Thermal properties. Define thermal properties for a missile, interceptor, or space launch vehicle that can be analyzed using STK EOIR. You can define EOIR shape properties in three categories:

- Missile components
- Plume
- PenAids and other objects

Performance plots. Plot Windows display plots of performance characteristics of the model. There are five plots that can be viewed:

- Altitude vs. Range
- Velocity vs. Time
- Range vs. Time
- Altitude vs. Time
- FPA vs. Time

Aerodynamic calculations. These calculations are based on the geometry of the model, including its frontal area, length, and the angles of the inter-stages. The algorithms work by combining wave drag, base drag, and viscous drag increments.

- Drag coefficients can be entered manually, computed by MDT, or loaded from a file.
- The model's PBV, RVs, and last spent stage can have specific 6DOF aerodynamics properties defined.

Mass properties. Define specific mass compositions for model components.

/ Missile Conversion Tool (MCT)

MCT converts trajectory data from other simulations into missile system objects for STK scenarios. MCT provides a generic file converter for custom simulations. MCT is compatible with:

- STAMP (Strategic and Theater Attack Modeling Process)
- BMRD (Ballistic Missile Reference Document)
- Any input format where the data is columnar ASCII text for custom simulations

Integration with custom applications.
MMT features application programming interfaces for MMT, MDT, and MCT:

- **MCTScript**. An XML-based, command line tool that is used to transform precomputed trajectory files into STK missile objects.
- **mdtapi utility**. Used to call MDT from a batch program, script, or other application.
- **IFT.exe utility**. Used to call MMT from a batch program, script, or other application that bypasses the MMT graphical user interface.

Learn more
agi.com