

Astrogator is used for interactive spacecraft maneuvers and trajectory design.

Mission Control Sequence

The Mission Control Sequence (MCS) defines your overall space mission. The MCS functions as a graphical programming language, in which mission segments dictate how Astrogator calculates the trajectory of the spacecraft. Available segments:

- Initial State
- Launch
- Follow
- Maneuver
- Propagate
- Hold
- Update
- Sequence
- Backward Sequence
- Target Sequence
- Return
- Stop

Maneuvers

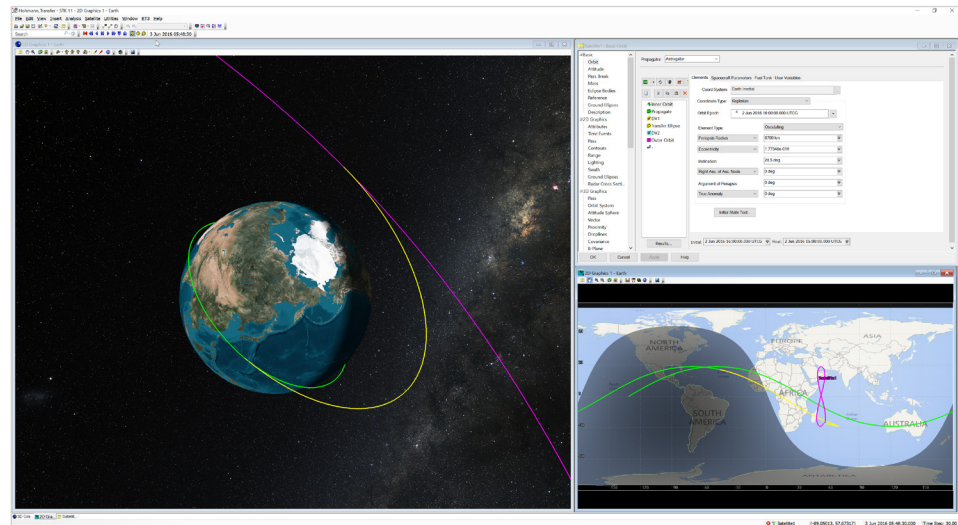
Impulsive maneuver. Calculates a new state vector by adding the defined delta-V vector to the velocity of the final state of the previous segment, adding this new state to the ephemeris, and passing it to the next segment.

Finite maneuver. Effectively a propagate segment with thrust specified by particular engine and steering models.

Optimal finite maneuver. Collocation-based trajectory optimization mechanism to produce finite maneuvers with optimal steering. Option supports low-thrust trajectory optimization problems.

Target Sequence

A Target Sequence is a structural element that can be used to define maneuvers and propagations in terms of the goals they are intended to achieve. Targeting sequences are controlled through profiles that come in three forms: search, segment configuration, and scripting tool.



High-fidelity orbit propagation

Astrogator’s flight-proven algorithms include:

- Force models for third-body effect
- Solar radiation pressure
- Atmospheric drag
- Geopotential models
- Thermal pressure and albedo
- Solid and ocean tides
- A broad set of numerical integrators

Search profiles

Search profiles are used to define goals and modify variables to achieve them.

Differential corrector. The differential corrector profile targets specific values, defined as independent variables. The target sequence changes the value of independent variables as needed to achieve the goal defined by the dependent variables using a root-finding algorithm:

- Newton-Raphson method
- Secant method

SNOPT Optimizer. The SNOPT Optimizer search profile uses the general purpose, large-scale, nonlinear programming solver SNOPT (Sparse Nonlinear OPTimizer) to achieve a certain goal, represented by a cost function and a set of constraint functions. SNOPT uses a Sequential Quadratic Programming (SQP) algorithm to iteratively modify a set of decision variables or controls to find a feasible, optimum solution. You can supply the exhaustive set of SNOPT algorithm options through the Astrogator interface and access a detailed log file for post-solution analysis.

IPOPT Optimizer. The IPOPT Optimizer profile uses the large-scale nonlinear programming solver IPOPT (Interior Point OPTimizer) to minimize or maximize a certain cost function in the presence of constraints. IPOPT implements an interior-point, line-search filter method, and is capable handling sparse optimization problems with up to millions of variables and constraints. You can supply the exhaustive set of IPOPT algorithm options through the Astrogator interface and access a detailed log file for post-solution analysis.

Plugins. You can define plugins to implement search algorithms that are not included in Astrogator.

Segment configuration profiles

These profiles change segments within the target sequence.

- Change Maneuver Type
- Change Propagator
- Change Return Segment
- Change Stop Segment
- Change Stopping Condition State
- Run Target Sequence Once
- Seed Finite Maneuver

Scripting tool profiles

A scripting profile can function as either:

- A search profile
- Segment configuration profile

The profile will execute the script it contains each time that the profile is run.

Automatic sequences

Automatic Sequences can be assigned to Propagate and Maneuver (Finite) segments, and function as subroutines by executing in response to specified stopping conditions of those segments.

Component technology

Astrogator includes a component browser and editor for selecting and customizing:

- Calculation objects
- Central bodies
- Constraints
- Custom functions
- Engine models
- MCS segments
- Power sources
- Propagator functions
- Propagators
- Stopping conditions
- Thruster sets

You can also:

- Create unique components for use in building mission control sequences using The Vector Geometry Tool in STK Analysis Workbench.
- Use components as target and stop values, and as the basis for reports.

Spacecraft configuration

In an Initial State, Launch, or Follow segment, you can define the fuel tank and other spacecraft physical values using the Spacecraft Parameters and Fuel Tank tabs.

In addition, most of these properties can be modified at a later point in the space mission scenario in an Update segment.

Scripting tool

The Scripting tool is a utility within Astrogator that allows you to write scripts in JScript, VBScript, or MATLAB that will interact with object attributes, calculation object components, and custom-defined parameters to perform a variety of functions to augment the logic of the Mission Control Sequence.

Design tool library

Lambert Solver. Set initial and final states based on STK objects or central bodies, use specialized options to define departure and arrival conditions, and export an Astrogator sequence based on the resulting Lambert solution.

Closed-loop maneuver control

Model closed-loop propulsion systems and maneuver control laws to analyze missions that include near-field rendezvous, proximity operations, station-keeping, planetary landing, and formation flying.

Analyze fuel requirements, thruster duty cycles, and control-law stability/robustness, among others.

Multiple views of space missions

View a mission or a mission segment from as many perspectives and distances as your screen allows.

- Display multiple 3D views of the mission.
- View spacecraft trajectories in inertial, fixed or any user-defined frame.
- Monitor spacecraft during successive calculation iterations of the targeter in 3D for critical insight into the targeting solution.

Formation flying

Astrogator models multiple spacecraft flying in formation, thus permitting you to analyze and calculate complex maneuvers that support formation-flying activities, such as imaging, satellite maintenance missions, gravity field determination, and constellation maintenance.

User variables

Astrogator is capable of incorporating additional variables during propagate and finite maneuver segments. Within Astrogator, these variables are called “user variables” and are defined in the MCS Options window. These variables are carried through the MCS with the rest of the spacecraft state, and are saved at each time step as part of the ephemeris.

Astrogator reports

In addition to Astrogator specific report styles available through the Report & Graph Manager, Astrogator can generate three special reports that provide information about the execution of MCS segments:

- MCS Segment Summary
- Astrogator Log File
- Differential Corrector Log