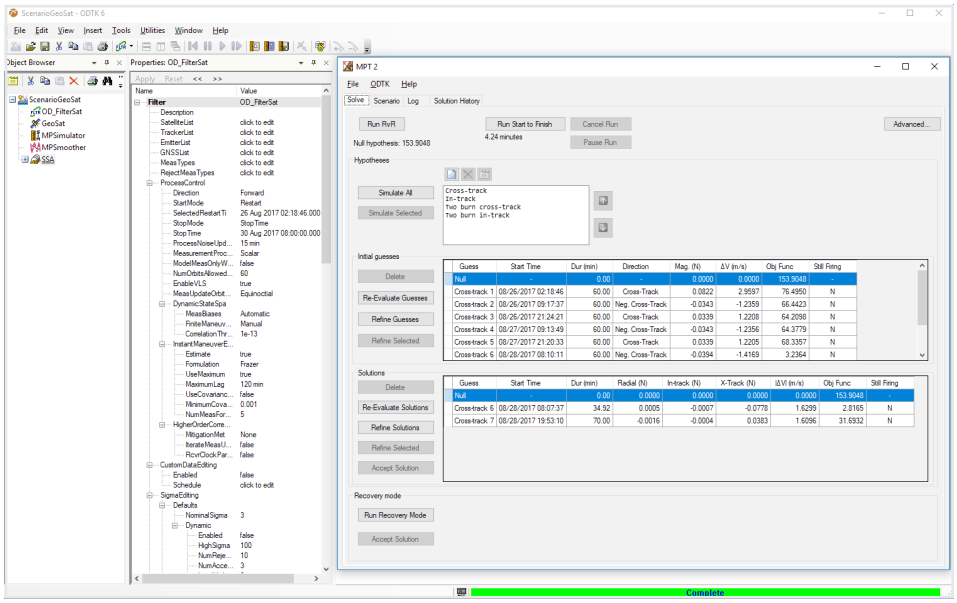
MANEUVER PROCESSING TOOL

Maneuver Processing Tool (MPT) is an ODTK module that automatically characterizes non-cooperative maneuvers

MPT enables orbit analysts who encounter non-cooperative maneuvers to quickly solve for the maneuver characteristics, maintaining track custody of the space object and informing operations.

MPT contains the same maneuver processing engine as the SSA Software Suite, including its patented intellectual property.



Processing maneuvers

MPT guides you through the following maneuver processing steps:

Residual vs. reference and bad data detection

MPT computes the residuals of the "no maneuver solution", or null hypothesis, and analyzes the residuals to remove bad data.

Pattern recognition

MPT postulates configurable maneuver hypotheses with ODTK's simulator. Both single-burn and two-burn hypotheses are available, with options to specify and solve for cant angles. An auto-correlation function compares the simulated residuals of the hypotheses to the actual residuals to find an initial guess for the maneuver center time and burn duration.

Objective function evaluation

MPT evaluates each maneuver guess with an objective function that considers the filter/smoother position and velocity consistencies, the weighted residual interval RMS, and the count of rejected residuals. By considering this set of metrics, the objective function is sensitive to both large errors – where the residuals are not acceptable, and small errors – where the residuals may be acceptable but the filter/smoother consistency is not acceptable.

Null hypothesis evaluation

MPT also computes the objective function with no maneuver, the null hypothesis, to use as a comparison against the objective function values of the maneuver solutions.

Solution refinement

Initial maneuver guesses from the pattern recognition step are refined with a Nelder-Mead algorithm to optimize their objective function value. The refinement step optimizes the maneuver center, duration, and thrust magnitude and direction.

The refinement step can also use maneuvers already in the ODTK scenario as an initial guess, without having to run the pattern recognition step on those maneuvers.

Recovery mode

If no solutions have acceptable objective function values, MPT enters recovery mode.

In recovery mode, the maneuver start and stop times and the thrust uncertainty are adjusted until an acceptable recovery solution - a solution that brings the number of rejected residuals to within an acceptable value and the Filter/Smoother consistency within an acceptable range - is found.

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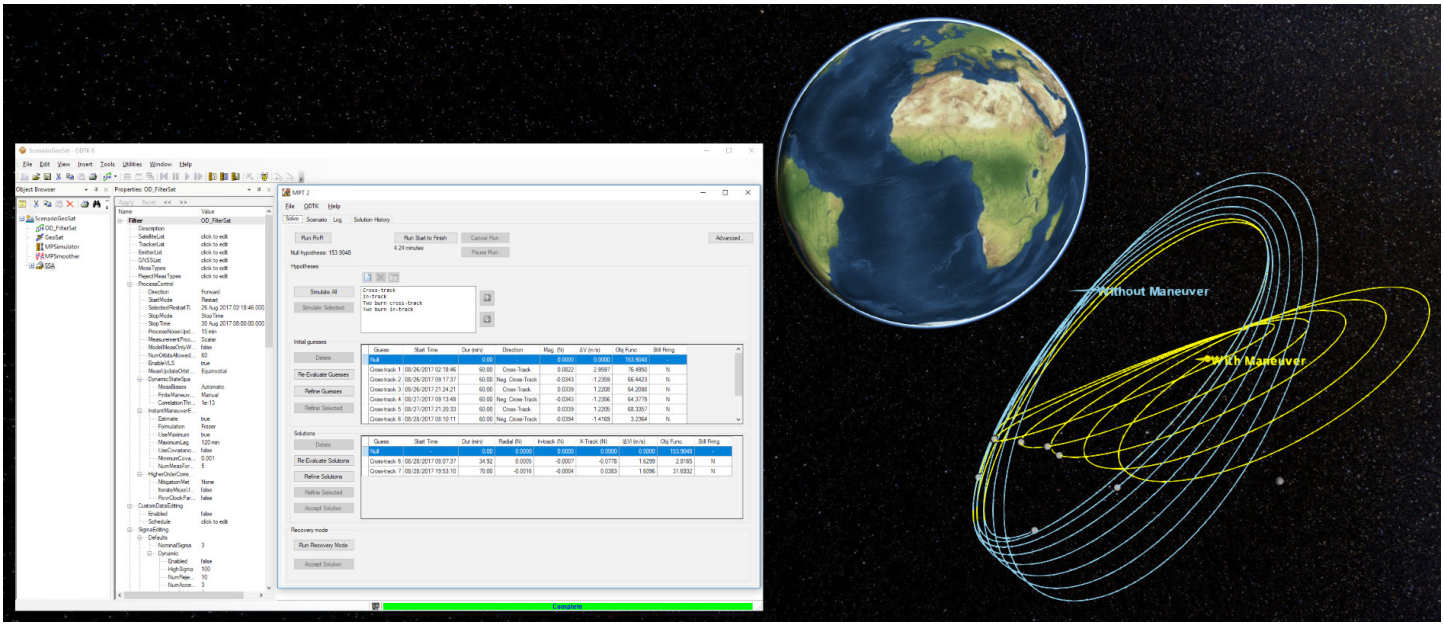

Auto-run capability

MPT can automatically run the maneuver processing steps in an auto-run. The auto-run maximizes performance by skipping hypotheses if the first ones it considers have high correlation metrics and yield acceptable solutions.

Re-evaluating solutions and solution history

When more tracking data is available, MPT can re-evaluate and refine existing solutions against the new data in the extended analysis span. A solution history tab keeps track of each solution as the analysis span changes. If a solution gets worse in the presence of new data – perhaps because another maneuver occurred – the previous solution can be restored.

Parallelization

MPT can evaluate potential maneuver solutions in parallel for improved runtime. Users can control the number of cores available to MPT. MPT can also use an STK Scalability Coordinator if one is available.

Algorithm control and feedback

MPT offers full control of the algorithm through an advanced panel. Settings are saved with the ODTK scenario.

While MPT is running a Log window gives details of each iteration of the process, to give insight into how well solutions are converging.