A CASE STUDY: STK PROVIDES KEY RISK REDUCTION FOR NASA'S KEPLER MISSION

BALL AEROSPACE SELECTS AGI PRODUCTS FOR TRAJECTORY MODELING AND ANALYSIS

Solution | Space Missions

Challenge:
The NASA Kepler mission flight segment design and fabrication team at Ball Aerospace & Technologies Corp. needed to ensure that during long-term return, the ejected photometer dust cover (DC) doesn't strike the flight segment (FS) and cause severe damage.

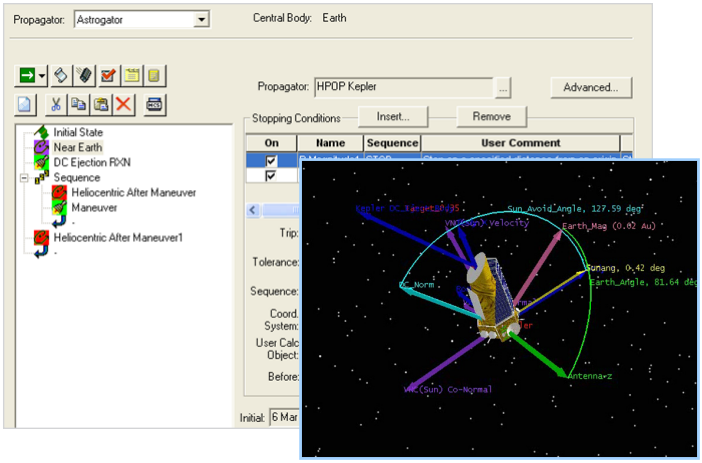
Solution:
Ball selected STK as the standard trajectory modeling and analysis tool because of its ease-of-use, flexibility, visualization capabilities, accuracy and familiarity.

Results:
STK provided key risk reduction for the dust cover ejection problem through its ability to help fine-tune DC trajectory estimates validated against customer solutions, fast and inexpensive optimization and Monte Carlo analysis and simple verification of results via 3D visualization.

NASA's Kepler Mission, launched in March 2009, uses a highly sensitive photometer to help search for Earth-sized planets in or near a habitable zone of solar-like stars. The flight segment design and fabrication team at Ball Aerospace & Technologies Corp. needed to ensure that during long-term return, the ejected photometer dust cover (DC) – which is neither small, nor light – doesn't strike the flight segment (FS) and cause severe damage. Ball selected STK as the standard trajectory modeling and analysis tool because of its ease-of-use, flexibility, visualization capabilities, accuracy and familiarity to analysts. Ultimately, STK reduced the cost and time to address this important mission design concern via three main capabilities:

- Fine-tuning DC trajectory estimates during independent validation with customer solutions lowered risk of errors
- STK/Analyzer greatly reduced time and cost of optimization and Monte Carlo analysis
- 3D visualization provided simple visual verification.

The dust cover issue required Ball to determine the release attitude to maximize FS-to-DC distance over the mission duration while meeting power, telecommunication and Sun-avoidance constraints. The validity of the solution also needed to be tested against three variables: DC ejection direction and velocity, DC surface properties and DC release date. Ball



employed STK/Professional Edition, STK/Astrogator, STK/Chains and STK/Analyzer. In particular, STK/Astrogator provided unique features to tailor deep space analysis and validate results from NASA JPL Navigation Team's MONTE Tool:

- Propagator selection, math models, bodies and planetary ephemeris
- Transitions between spheres of influence
- Modeling reaction wheel desaturation events as a loop
- Solar radiation pressure

After tailoring STK/Astrogator to match JPL inputs, the final result was a "highly accurate STK trajectory model," said Chris Zeller, senior systems engineer at Ball. STK's Vector Geometry Tool validated antenna, star tracker and photometer field-of-view constraints. STK/Analyzer generated carpet plots to optimize release directions and investigated the sensitivity of the DC-FS range to variations in parameters. "This reduced the risk that inaccuracy in any one parameter could throw us 'off the cliff,'" Zeller said.

In all, AGI products allowed efficient analysis of a complex problem, ultimately saving time and money for the customer. In addition to the DC ejection event, Ball has used STK for a variety of Kepler mission analyses, including power estimates, telecom range and angles for duration of mission; initial acquisition timing and angles; Deep Space Network station view periods; quarterly roll window optimization; and commissioning attitudes verification. Watch Zeller's 2010 AGI UC Tour presentation at uc.agi.com.

GENERAL INFO & SALES
Phone: 1.800.220.4785 | 1.610.981.8000
E-mail: info@agi.com