A CASE STUDY: KEEPING NASA'S IBEX ON TRACK

AGI PARTNERS REDUCE MISSION RISK & OPERATIONAL IMPACT

Challenge:

1) NASA's IBEX mission is characterized by an orbit highly perturbed by lunar gravity which must avoid re-entry and long shadows

2) The IBEX Flight Dynamics Team needed to identify a final orbit that:
   – Has a desirable perigee history over six months
   – Has no shadow durations that are excessive

3) Engineers wanted to re-plan final orbit "on the fly"

Solution:

1) All pre-mission planning and operations performed with STK/Astrogator and MS Excel

2) All pre-mission and operational navigation planning performed with ODTK

3) All operational tracking and maneuver reconstruction performed with ODTK and STK/Astrogator external scripts, allowing for rapid prototyping and development

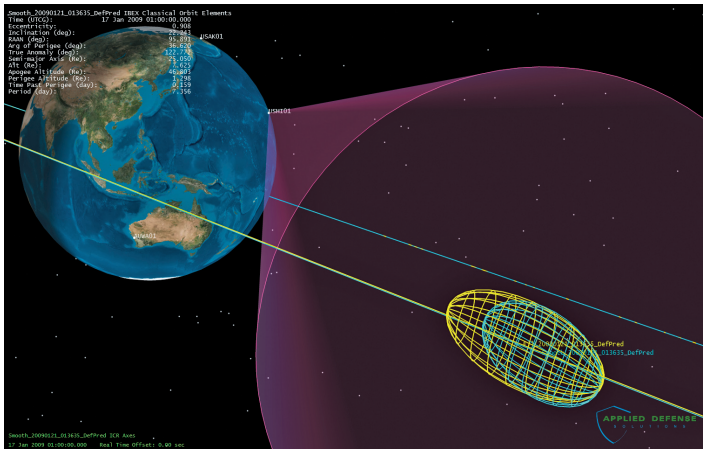
Results:

1) Stability and flexibility of platform allowed risk mitigation via Monte Carlo analysis

2) Mission duration extended twice during operations

3) Re-planned ascent and final orbit during operations

A small NASA spacecraft is on a two-year mission to give scientists their first map of the edge of our solar system, and AGI business partners are designing this satellite's unique trajectory. Applied Defense Solutions (ADS) of Fulton, MD, along with Mike Loucks of Space Exploration Engineering, are responsible for flight dynamics for the Interstellar Boundary Explorer (IBEX) satellite. The team is working with Southwest Research Institute (SwRI) to design and model the sometimes "chaotic" trajectory associated with this critical mission. AGI's STK/Astrogator served as the sole mission-planning tool and Orbit Determination Tool Kit is being used for orbit determination. These tools allowed operators to completely re-plan the mission several times after launch in order to accommodate additional requirements from the science team.



ADS is using AGI's Orbit Determination Tool Kit and STK/Astrogator software to determine orbit error analysis for the NASA IBEX mission.

IBEX was launched on Oct. 19, 2008, on an L-1011 that took a Pegasus rocket to 40,000 ft. The Pegasus rocket then fired its own rockets to propel it and the IBEX spacecraft into space. New and innovative technologies such as AGI's have dramatically reduced the manpower, hardware and cost required to fly the satellite. With NASA's tight budgets, these decreased flight operations costs allow customers to invest more heavily in the mission's science. "If we had to, we could fly this bird with a laptop and an aircard from a coffee shop on the corner," said ADS president Ryan Frederic.

IBEX's orbit has an apogee of 50 Earth Radii (~319,000 km) which allows the satellite to spend most of its time above the Earth's magnetosphere. "This trajectory is very unique and exhibits some of the phenomena associated with the mathematical definition of 'chaos;' this will really test the limits of currently available technologies," says John Carrico, ADS' principal astrodynamics specialist. Using ODTK's ability to calculate a physically realistic uncertainty, the team used the output covariance from ODTK as the input to Monte Carlo algorithms that call STK/Astrogator. Combined with maneuver performance estimates, this orbit error analysis was able to reduce mission risk and operational impact on the science team by demonstrating that mission requirements would be met over the life of the mission. Using AGI tools, the IBEX Flight Dynamics Team successfully extended the mission duration twice during operations and completely re-planned the ascent and final orbit.

Learn more at ***ibex.swri.edu***. Info on ADS and SEE: ***agi.com/bp***.

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