

# ARTEMIS Team Achieves Unprecedented Mission Design Objectives for Space Flight Mechanics

## STK Astrogator Helps Designers Overcome Numerous Challenges

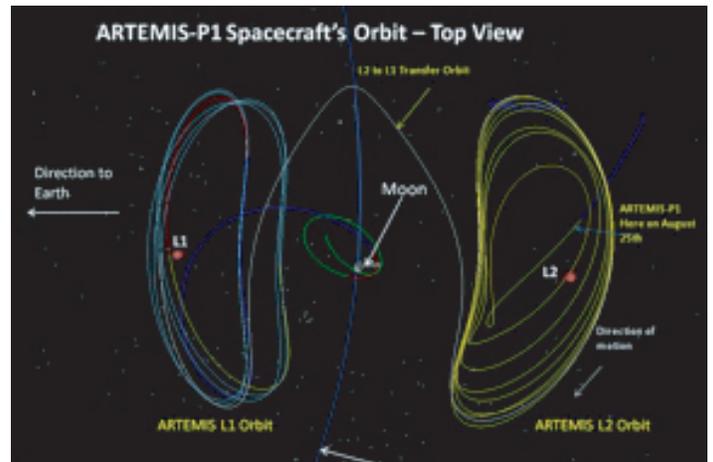
**IMAGINE THE MISSION:** To extend the utility of THEMIS spacecraft, NASA's ARTEMIS mission is making history.

The THEMIS spacecraft launched in 2007 to study Earth's aurora. Upon completing that mission in 2010—and being renamed ARTEMIS P1 and P2—they have recently found a new home around the Moon. Getting there, however, has not been easy due to the age and limited propellant of both spacecraft.

**DESIGN THE MISSION:** NASA engineers used AGI's STK Astrogator to devise a complex series of low-thrust maneuvers and Earth-and-Moon gravity assists. This made ARTEMIS the first mission to achieve Lissajous orbits around the Earth-Moon L1/L2 libration points.

Because NASA had previously used STK Astrogator to design Sun-Earth libration point missions, engineers extended its utility to Earth-moon libration point orbit. STK Astrogator was able to transition from three-body to four-body orbital dynamics.

Using AGI products helped the team overcome a series of challenges that included flying new orbits, minimizing propellant usage for both P1 and P2, and reusing software to heighten fiscal responsibility and enhance mission reliability. This allowed the ARTEMIS mission to break new ground in orbital mechanics—ultimately proving that if you can design it, you can fly it.



ARTEMIS flight dynamics engineers needed to do something they had never done before—design orbits on spacecraft near the end of their design lifetime—and do so on a tight budget. To achieve this, they used STK Astrogator to navigate around Earth-Moon libration points. The software transitioned from three-body to four-body orbital dynamics—ultimately allowing two THEMIS spacecraft to achieve Lissajous orbits around the Earth-Moon L1 and L2 libration points.

**FLY THE MISSION:** Engineers used STK Astrogator to design nearly 100 maneuvers over a two-year timeframe. They modeled impulsive maneuvers in the Earth-moon rotating frame consistent with libration point targets—and then passed impulsive states into operational software for conversion into a finite maneuver. This allowed the team to validate the post-facto finite maneuver parameters to ensure that they achieved their libration point targets. Because software had no models for the Earth-moon rotating frame, STK Astrogator was critical to the planning process. ARTEMIS has broken new ground in orbital mechanics—proving that if you can design it, you can fly it.