

# STK Software and ODTK-Based Flight Dynamics System Take LADEE to the Moon

## From the Earth to the Moon with STK

**THE VIEW FROM THE GROUND:** Space Exploration Engineering (SEE) and Applied Defense Solutions (ADS) needed a flight-dynamics system (FDS) for LADEE that supports trajectory design, maneuver planning, and orbit determination—as well as provide acquisition data and product generation. ADS has used AGI products to operate more than 20 military, NASA and commercial spacecraft—including IBEX, LCROSS, and the Radiation Belt Storm Probes. As AGI software has proven successful in so many missions and is in use at most centers; the LADEE team felt confident using it for their FDS for trajectory design, maneuver planning and orbit determination—as well as acquisition data and product generation.

**REACHING FOR THE STARS:** Space Exploration Engineering (SEE) and Applied Defense Solutions (ADS) built an FDS based on AGI's STK Astrogator and Orbit Determination Tool Kit (ODTK) software—already proven on various NASA, commercial, and military deep-space missions. The team used STK and STK SatPro for all acquisition data and product generation—including pointing products, constraints, and eclipses. These products let them plan all attitude maneuvers for the entire mission—as well as the attitude constraint violation checks to ensure the Sun does not enter the star trackers' field of view.

At the same time, they used the orbit-propagation capabilities of Astrogator to plan maneuvers—using phasing orbits to target arrival. Astrogator helped engineers plan acquisition maneuvers to enter lunar orbit, lower LADEE's orbit for science collection, and perform orbit station keeping. AGI's Orbit Determination Tool Kit (ODTK) allowed the team to perform orbit determination for the entire mission—from launch and early operations to cislunar phasing loops and lunar orbit.



On September 7, 2013; NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) spacecraft launched from Wallops Flight Facility on a mission to orbit the Moon. Engineers designed the craft to gather detailed information about both the structure and composition of the thin lunar atmosphere and to determine whether dust is being lofted into the lunar sky.

**STK IS A GO FOR LAUNCH:** Reusing proven software shortened development, streamlined testing, and helped reduce technical risk. AGI software's widespread acceptance also enabled easy collaboration among team members and other NASA centers. ADS and SEE built the LADEE FDS in close coordination with NASA Ames Research Center to support multiple mission rehearsals and operations simultaneously. This makes the system mission-independent. They factored-in orbit analyst decision points in advance and tailored the system—built to support multiple mission rehearsals and operations simultaneously—to operational workflows. Consultants from AGI also worked closely with the LADEE team to ensure that the lunar gravity field met requirements before launch.