Space Vehicles Directorate

Stay One Step Ahead In Space

Automated Navigation and Guidance Experiment for Local Space (ANGELS)

Purpose:

The Automated Navigation and Guidance Experiment for Local Space (ANGELS) program is managed by the Air Force Research Laboratory's Space Vehicles Directorate, Kirtland AFB, NM. As part of Air Force Research Laboratory's research in advanced Space Situational Awareness (SSA), the ANGELS program examines techniques for providing a clearer picture of the environment around our vital space assets.

Rigorous research and development has been conducted to ensure that the satellite can perform safe automated spacecraft operations above Geosynchronous Earth Orbit (GEO). AFRL is employing a layered strategy that combines system design, testing, mission design, procedures and flight operations discipline to ensure safety. Prior to the start of experimental operations, AFRL will calibrate various spacecraft subsystems and verify navigation capabilities.

ANGELS will evaluate SSA techniques in a limited region around its Delta-4 launch vehicle upper stage several hundred kilometers above GEO, testing maneuvering concepts around the rocket body. The vehicle will begin experiments approximately 50 km away from the up-per stage and cautiously progress over several months to tests within several kilometers. As part of the research effort, ANGELS will explore increased levels of automation in mission planning and execution to enable more timely, safe, and complex operations with a reduced operations footprint. AFRL engineers will maintain positive control of the spacecraft throughout the automation experiments with ground commanded authorization to proceed points, ensuring a

"man-in-the-loop" throughout the experiment. The Air Force will use the results to evolve the ability of future systems to responsively perform SSA from a modest but safe distance.

Features:

The ANGELS spacecraft hosts an SSA sensor payload to evaluate techniques for detection, tracking, and characterizing of space objects, as well as, attribution of actions in space. Additional payloads that aid spacecraft operations include a GPS system for GEO and high performance accelerometers. The GPS system uses advanced algorithms from NASA to receive GPS side lobe signals and generate near continuous navigation solutions. The high performance accelerometers precisely measure small spacecraft accelerations for enhanced guidance and navigation. Additional sensor technologies for safe relative navigation will also be tested. The experimental on board vehicle safety system explores methods for dramatically reducing the probability of collision with other space objects in an increasingly congested space environment.
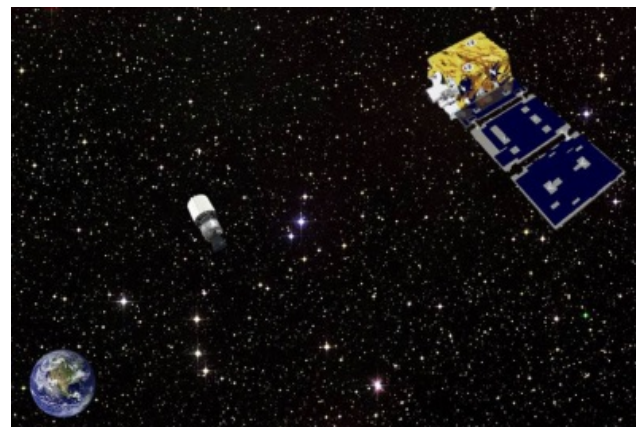
Background:

The current ANGELS program began in 2007, focused on meeting the country's need to improve methods for monitoring an increasingly contested space environment. The research and development effort resulted in the current microsatellite design that achieves a high level of safety and experiment flexibility.

Orbital Sciences Corporation of Dulles, Virginia, is the project's prime contractor responsible for overall system design and development. ATA Aerospace of Albuquerque, New Mexico is the project's integration and test contractor and provides essential satellite operations support. Payload providers include Moog Broad Reach Engineering of Tempe, Arizona, NASA Goddard, ATA Aerospace, MIT/Lincoln Laboratory and Science Applications International Corporation (SAIC) of San Diego, California.

Launch integration and flight operations of the ANGELS spacecraft are performed in partnership with the Department of Defense (DoD) Space Test Program (STP), Kirtland AFB, New Mexico. The ANGELS spacecraft was launched in July 2014 as a secondary payload on the AFSPC-4 mission, and it has 1 year of experiments planned.

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