MAINTAINING AURA'S FROZEN ORBIT AND MEAN LOCAL TIME (MLT) REQUIREMENTS WHILE PERFORMING ROUTINE ORBIT MAINTENANCE MANEUVERS CONTAINING AN ORBIT NORMAL DELTA-V COMPONENT

Megan R. Johnson [(1)], Jeremy D. Petersen [(2)]
[(1)(2)]*Flight Dynamics Analyst, a.i. solutions, Inc., 10001 Derekwood Lane, Lanham, MD. 20706*
[(1)]*megan.johnson@ai-solutions.com*, [(2)]*jeremy.petersen@ai-solutions.com*

Keywords: *Aura, Earth Observing System (EOS), Afternoon Constellation, Mean Local Time, Frozen Orbit*

The Earth Observing System (EOS) Afternoon constellation consists of five member missions (GCOM-W1, Aqua, CALIPSO, CloudSat, and Aura), each of which maintain a frozen, sun-synchronous orbit with a 16-day repeating ground track that follows the Worldwide Reference System-2 (WRS-2). Aura, as well as each constellation member, routinely performs drag make up (DMU) maneuvers in order to compensate for semi-major axis (SMA) decay due to atmospheric drag. These DMUs are historically performed at an argument of latitude that will maintain the frozen orbit requirements, eccentricity and argument of perigee. In addition to maintaining these orbit properties, each mission is required to maintain their MLT relative to the Aqua mission in order to create a desirable along track separation among the constellation members necessary to facilitate science collection coordination and maintain mission safety.

Under nominal science operations for Aura, the propulsion system is oriented such that the resultant thrust vector is aligned 13.493 degrees away from the velocity vector along the yaw axis. When performing traditional slewed-DMUs, the spacecraft performs a yaw slew to align the thrust vector in the appropriate direction. Recently a new DMU maneuver operations scheme was implemented for Aura alleviating the need for the 13.493 degree yaw slew. The benefits of no-slew operations include decreased flight operations complexity and required communications coverage during maneuvers, reduced flight operations man hours, reduced loss of science data collection per maneuver, and increased predictability and robustness of maneuver modeling from minimized slew-induced attitude errors before, during, and after each maneuver.

The focus of this investigation is to assess the impact of no-slew DMU maneuver operations on both Aura's Mean Local Time at the Ascending Node (MLTAN) and frozen orbit. By modifying a copy of the operational lifetime simulation to incorporate no-slew DMUs, long term effects of the new maneuver strategy become apparent.

No-slew DMUs incur cross track acceleration which has short-term and long-term impacts to MLTAN based on changes to inclination and Right Ascension of the Ascending Node (RAAN). The investigation found that alternating maneuvers at the North and South Poles (a mirror pole maneuver strategy) would alleviate drift in MLTAN. This scheme works by cancelling out changes in the RAAN induced by the out-of-plane acceleration imparted during the no-slew DMU. Additionally, maneuvers at the North and South poles were studied in particular because they imparted the least amount of inclination change to the orbit, and therefore reduced the effects on the MLTAN critical for maintaining the proper sun-synchronous orbit.

Furthermore, continued investigation analyzed the ability to maintain both MLTAN and frozen orbit requirements by using a modified mirror pole maneuver strategy which includes frozen

*

orbit maintenance maneuvers each year. Maintaining a frozen orbit is important for both science and constellation safety by maintaining the relative altitude of the satellite above the Earth constant from orbit to orbit. Mirror pole maneuvers used to maintain MLTAN deleteriously affect the frozen orbit and would eventually lead to mission requirement violations if not controlled. This analysis determined that it is possible to perform both mirror pole paired maneuvers and frozen orbit maneuvers in a hybrid maneuver scheme that maintains Aura's frozen orbit properties, MLT, and along-track separation between Aura and the constellation members.

*