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AUTONOMOUS NAVIGATION: OPTICAL STATE ACQUISITION SYSTEMS FOR LUNAR AND INTERPLANETARY SMALL SATELLITES

Abstract

The total shift of focus and dependence from ground-based architectures to reliable on-board autonomous systems is a prime necessity for navigation of small satellites, if they are to venture beyond Earth. Navigation systems would need to provide higher accuracy levels, generally constrained by stringent transfer trajectories. Research on autonomous navigation by Spaceflight Dynamics division at SRM University, considered an articulated navigation technique with goal to maximize accuracy in both orbiting and cruise phases of the mission. Optical navigation is considered as primary navigation method for orbiting profile phases, while Milli-Second X-Ray Pulsar based navigation for the cruise phase. The navigation methods are theoretically investigated in Lunar WSB transfer trajectory, which is being considered in the mission design for SRMSAT-2, a student designed lunar orbiter. Use of optical navigation is a developed concept and furthering its use to account for versatility to minimize hardware requirements by using same optical hardware in all the orbiting or close approach phases is important. In the paper, with respect to a small satellite lunar orbiter mission, star occultation method is considered and the performance is evaluated in comparison to other optical navigation techniques. This basis of selection is justified with truth model simulation and observability analysis with a scope of improvement using landmark tracking. Primary attention in the work is given to maximizing the state acquisition accuracy to improve independence and reliability of the navigation system. The hardware layout for achieving reasonable orbit determination accuracy is then laid down.