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SMART ON-ORBIT SERVICER MISSION FOR GIVING LIFE TO DEFUNCT SATELLITES IN GRAVEYARD ORBIT

Abstract

Toronto Metropolitan University's Space Systems Dynamics and Control Laboratory is working on a Smart On-Orbit Servicer (SOOS) mission for giving life to defunct satellites in a graveyard orbit by providing station-keeping and pointing control capabilities. SOOS spacecraft carries a pack of attitude and orbit control (AOCS) modules; each AOCS module is planned to be supplied to each defunct satellite to make it operational. The SOOS mission involves six phases: I) Launch of SOOS spacecraft into GEO transfer orbit, II) Orbital maneuvering of SOOS spacecraft for rendezvous with a defunct satellite in the graveyard orbit, III) Rendezvous and docking of SOOS spacecraft with the defunct satellite, IV) Orbital maneuvering of the combined SOOS and defunct spacecraft to the designated GEO orbit location, V) Attachment of the AOCS module to the defunct satellite and its recommissioning, and VI) Detachment of SOOS spacecraft from the (now) operational satellite to a modified Phase II: orbital manoeuvring of SOOS spacecraft from GEO to the graveyard orbit to bring life to another defunct satellite. A survey of defunct satellites in a graveyard orbit is carried out to determine the number of defunct satellites that can be made operational. Next, the optimal number of AOCS modules to be carried by SOOS spacecraft is obtained based on onboard fuel requirements to make the selected defunct satellites operational. Phases 2 and 4 involve optimal fuel transfer orbits including Hohmann transfer orbits. Phase 3 is the most critical phase of the mission, and the intelligent attitude and orbit control system onboard SOOS-1 includes a vision system coupled with deep reinforcement learning-based autonomous navigation and control to provide fully autonomous rendezvous and docking operations. Finally, the numerical simulation results show the feasibility of the proposed SOOS mission.