SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Concepts (6)

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COBRA ACTIVE DEBRIS REMOVAL CONCEPT

Abstract

The COBRA concept is an active debris removal system which relies on contactless technology to modify the orbit of a space debris object. A demonstration mission aims to imparting a ΔV of 50 m/s on a 100 kg space debris object. Momentum is imparted on the debris object using the exhaust plume of a monopropellant hydrazine propulsion system. The COBRA concept was proposed as a solution to one of the challenges issued by ESA within the framework of the SysNova competition. The mission can be performed at low cost using a modified payload module on an otherwise standard satellite platform. The Iridium Next platform has been selected. This platform is designed for operations in LEO at 800 km and only minimal modifications are required. The debris removal equipment can be hosted in the payload bay and the chaser spacecraft can be launched on the Dnepr or the Vega launch vehicle. The utilization of a "mass produced" platform allows the realization of the COBRA satellite in a short time frame. The main research topics were the momentum exchange, mission analysis and mission design. Work on the momentum exchange included a literature review of methods and models for plume impingement and the development of a Monte Carlo plume impingement model. Mission analysis involved an analytical evaluation of the ΔV required to cover all mission phases. Mission design focused on adapting the payload module of the Iridium Next bus for rendezvous and debris pushing operations. In addition an operational concept, a mission timeline and a preliminary design of the GNC system were generated. The study has identified that the satellite hardware can be composed of commercial of the shelf elements, and that the main technology development needs lie in the development and testing of a high-fidelity plume impingement model and the on-board GNC software for performing the rendezvous and proximity operations, including the debris pushing. This paper will discuss the impact of the momentum transfer efficiency on the system performance. It is found that the momentum transfer efficiency needs to be better than 5%. A general overview of the mission concept covering the main research topics will be presented. It will be shown that the demonstration mission is feasible in the near-term by using a standard platform and focusing the development effort on two key areas, the momentum transfer mechanism and the on-board GNC software.