Paper ID: 34273
oral
student

14TH IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Space Debris Removal Concepts (6)

Author: Mr. Houman Hakima
University of Toronto Institute for Aerospace Studies, Canada

Prof. M. Reza Emami
University of Toronto, Canada

DEBRIS DETUMBLERS: A NEW APPROACH TO ACTIVE DEBRIS REMOVAL

Abstract

Since the launch of the first artificial satellite, i.e., Sputnik in 1957, several thousand man-made objects have been launched into the Earth orbits, great majority of which remained in their orbit despite the termination of their mission. A number of viable solutions have been suggested in the research community for actively removing the orbital debris, some of which require the capturing of the debris, while others are contactless methods. A challenging aspect of capturing an orbital debris using any method is due to the tumbling motion of the debris. A majority of the suggested methods require zero or very low rates of debris attitude to perform successfully, or need to follow a synchronization phase with the debris before the capturing and removal operation. This is technically costly and challenging, if not infeasible. This paper proposes an alternative approach to orbital debris removal, which can make various state-of-the-art methods of active debris removal perform at lower costs and risks. The approach utilizes one or more detumbler platforms, in the form of miniaturized cubesats, which are de-signed to be lunched from the remover spacecraft, attach to the target debris, and reduce its attitude rate to zero using the onboard attitude determination sensors and control actuators. The paper outlines the operation of debris detumblers. The conceptual design of such platforms is also presented, based on the one- to three-unit cubesat bus and commercial off-the-shelf technologies. Orbital insertion, rendezvous and attachment maneuvers are also discussed. Finally, through simulations the performance of the proposed approach is compared with that of some well-studied methods in various scenarios using several catalogued debris, based on performance metrics such as delta-v, operation time, trajectory simplicity, total thrust, etc.