Paper ID: 64390
oral

19th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Operations in Space Debris Environment, Situational Awareness - SSA (7)

Author: Mr. Toby Harris
Astroscale Pte. LTD, United Kingdom

Dr. Jason Forshaw
Astroscale Ltd, United Kingdom
Mr. Andrea Puppa
Astroscale Ltd, United Kingdom
Mr. MICHAEL LINDSAY
Astroscale Pte. LTD, Japan

SPACE SITUATIONAL AWARENESS (SSA) AND ORBITAL COORDINATION ACTIVITIES FOR SAFE RENDEZVOUS AND PROXIMITY OPERATIONS (RPO) EXPLORED THROUGH THE ELSA-D MISSION

Abstract

Astroscale's ELSA-d mission, the world's first commercial demonstration of an end-of-life (EOL) capability is be used to demonstrate the core technologies necessary for debris docking and removal. The uniqueness of the mission objectives provides an exclusive opportunity to explore both the Space Situational Awareness (SSA) demands as well as the associated operational safety and orbital coordination aspects of Rendezvous and Proximity Operation (RPO) missions.

The ELSA-d mission consists of two spacecraft, a servicer and a client, stacked together during launch and orbit insertion. The servicer is equipped with proximity rendezvous technologies and a magnetic docking mechanism, while the client has a ferromagnetic plate which enables the docking. The servicer will repeatedly release and dock with the client in a series of technical demonstrations proving the capability to find and dock with debris. Demonstrations include client search, client inspection, client rendezvous, and both non-tumbling and tumbling docking. ELSA-d itself is to be launched into a 550km sun-synchronous orbit.

Because of the controlled nature of this specific mission - Astroscale has direct command and control of both spacecraft - ground-truth instrumented data, including accurate time-dependent state-vectors and spacecraft dynamics, are readily available. This enables evaluation of the use of SSA services during the key phases of the mission. This paper seeks to assess SSA requirements including orbit propagation and determination of both spacecraft, attitude analysis (state and evolution rate), approach analysis and collision avoidance. By evaluating these needs, both during and post-mission, it is hoped that a better understanding of what services are either essential or desirable for future RPO missions, whether they be Active Debris Removal (ADR), EOL, In-orbit Inspection or Life Extension (LEX).

As well as assessing SSA needs, ELSA-d also offers the prospect of considering how operational safety aspects of RPO missions can or should be performed. The complexity of the mission activities in an increasingly congested orbital environment requires that coordination between operators and SSA service providers is paramount to safe operations. This paper seeks to reflect on these experiences with ELSA-d and consider where improvements in coordination and operational safety practices can be made.