18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Post Mission Disposal and Space Debris Removal (1) (5)

Author: Mr. Chris Blackerby
ASTROSCALE JAPAN Inc., Japan

Mr. Seita Iizuka
ASTROSCALE JAPAN Inc., Japan
Dr. Jason Forshaw
Astroscale Ltd, United Kingdom
Mr. Mike Lindsay
Astroscale Pte. LTD, Japan
Mr. Nobu Okada
Astroscale Pte. LTD, Singapore, Republic of

LAUNCH OF THE WORLD'S FIRST COMMERCIAL ADR MISSION: ELSA-D

Abstract

The rise of large commercial satellite constellations in low-Earth orbit (LEO) will lead to an increase in the number of objects in key orbits and will raise the risk of potential collision. Systematic spacecraft end-of-life management strategies assuring post-mission disposal (PMD) are required to maintain the utility of key LEO assets.

The novel End-of-Life Services by Astroscale demonstration (ELSA-d) mission promises to be a major step forward in proving technol-ogy necessary for rendezvous and proximity operation (RPO), capture, and removal of orbital debris. The ELSA-d mission, which due to launch in 2020, will demonstrate key technologies and procedures for the rendezvous, capture, and eventual de-orbit of a piece of debris.

ELSA-d will consist of two satellites launched together – a servicing satellite that will perform the RPO and capture capabilities and a small client satellite that will serve as a model for a piece of orbital debris. After launching together, the two satellites will repeatedly separate and dock in orbit, each time showcasing a different capability that will be applicable to the commercial market. The servicing satellite will be equipped with rendezvous guidance, navigation, and control (GNC) technologies and a magnetic docking mechanism, whereas the client has a docking plate (DP) which enables it to be captured.

Undertaking RPO in space, is far more operationally complex than a regular Earth-observation or communications satellite – ELSA-d will demonstrate semi-autonomous capture of both non-tumbling and tumbling clients, the latter being novel in the space environ-ment. This complexity means a comprehensive and specialised approach is needed for functional testing of RPO sequences. This paper will explore the testing methodologies used at the system and subsystem level, including simulation, SILS (software-in-loop), HILS (hardware-in-loop). A specialised testbed facility for testing our magnetic capture system will also be presented.

Finally, the paper will explore the final Assembly, Integration and Test (AIT) and Environmental Test (EVT) campaigns before the satel-lite is shipped for launch. The paper continues the satellite's journey through launch preparation, launch, and initial LEOP and opera-tions, before the paper concludes with initial experimental results from the mission.

ELSA-d will be the world's first commercial demonstration of Active Debris Removal (ADR) which demonstrates the core operational phases of a realistic ADR mission: client search, rendezvous, capture and de-orbit. The capabilities stemming from ELSA-d will lead to safe and effective solutions to maintain a sustainable global space environment and thus accessibility of LEO in the future.