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ELSA-D: A CASE STUDY OF ADR MISSION OPERATIONAL PRACTICE

**Abstract**

Since the beginning of the space era, the amount of debris generated in low Earth orbit has been steadily increasing. Founded in 2013, Astroscale's vision is to secure safe and sustainable development of space for the benefit of future generations. Astroscale is developing innovative and scalable solutions across the spectrum of on-orbit servicing missions, including specifically End of Life and Active Debris Removal (ADR) services, to mitigate the growing and hazardous build-up of debris in space.

The ELSA-d (End of Life Services by Astroscale-demonstration) mission is due to launch in March 2021. ELSA-d will demonstrate technologies for Rendezvous and Proximity Operations (RPO) by launching a servicer satellite ( 175 kg) attached to a small client satellite ( 17 kg), which will then repeatedly dock and undock in orbit in order to mature key technologies and capabilities. The servicer is 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.

This paper will focus on ELSA-d operational practise. The paper starts by briefly introducing the mission and reviewing the key ground segment products including MCS (Mission Control System), MPS (Mission Planning System), FDS (Flight Dynamics System), Mission Simulator. The paper will discuss the use of the National In-orbit Control Centre, embedded in the Satellite Applications Catapult, and developed by a consortium including Astroscale (prime), Catapult, RHEA, GMV, CGI. Details of the operations centre will be provided showing the way in which the centre has been specially crafted for ADR/IOS (In-orbit Servicing) operations.

Finally, the paper will talk through the key demonstrations undertaken by ELSA-d since launch and any operational best-practise that can be fed back to the community. ELSA-d remains the world's first

mission to go through the key CONOPS of a full ADR service, including client search, client inspection, client rendezvous, and both non-tumbling and tumbling docking. Thus, ELSA-d is a pioneering development in ADR/IOS operations, which will be a benchmark for future RPO missions.