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OPERATIONAL PROGRESS UPDATE ON THE ELSA-D DEBRIS REMOVAL MISSION

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 launched on March 22, 2021. ELSA-d will demonstrate technologies for Rendezvous and Proximity Operations (RPO) with a servicer satellite (175 kg) attached to a small client satellite (17 kg), which will then repeatedly dock and undock on orbit 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.

On August 25, 2021, ELSA-d demonstrated its first successful undocking and docking between the servicer and client. The client was separated a short distance from the servicer for the first time and captured to validate the magnetic capture system. During the release and capture period, Astroscale's Mission Operations and Ground Segment teams checked out and calibrated the rendezvous sensors and verified relevant ground system infrastructure and operational procedures. On January 25, 2022, the ELSA-d servicer spacecraft successfully released its client spacecraft and began autonomous relative navigation, maintaining a constant and safe distance from the client spacecraft for several hours, over multiple orbits, as designed.

The paper will talk through the key demonstrations undertaken by ELSA-d since launch including any operational best-practice that can be fed back to the community and planning for upcoming demonstrations. ELSA-d has plans to be 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 and On-orbit Servicing (OOS) operations.

Keywords: end-of-life, active debris removal, on-orbit servicing, ELSA-d, operations, ground segment, rendezvous proximity operations