

14TH IAA SYMPOSIUM ON SPACE DEBRIS (A6)  
Interactive Presentations (IP)

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E.DEORBIT – ELEMENTS OF AN ADR MISSION THAT REQUIRE AN  
IN-ORBIT-DEMONSTRATION AND WAYS TO ACHIEVE IT

**Abstract**

The growing number of man-made objects and debris in Low Earth Orbit (LEO) is resulting in an increasing risk of collisions with cascading effects. Studies at NASA and ESA show that the debris environment can be stabilised if in the order of five objects are removed from LEO per year. While the active debris removal (ADR) mission e.deorbit aiming at the controlled de-orbiting of ENVISAT has been studied at ESA for some years, the way forward towards an implementation currently is depending amongst others on the uncertainty if a risk-mitigating In-Orbit Demonstration (IOD) mission should be performed before attempting to remove ENVISAT from orbit or not. OHb System, as one of the industrial primes of the e.deorbit phase B1, investigated if and how this in-orbit demonstration could be performed within the frame of the nominal e.deorbit mission instead of a dedicated IOD mission. Besides the increased total cost also the fact that the delay caused by an additional IOD mission significantly increases the likelihood of a catastrophic collision of ENVISAT in the meantime are driving this investigation. Two different approaches to achieve this goal have been investigated: Either the e.deorbit spacecraft first grapples a smaller debris object in an orbit below ENVISAT, or it could be launched together with a dedicated target object into an elliptic orbit and perform the IOD with this target before proceeding to ENVISAT. The following areas have been identified to provide substantial contribution to the minimization of risks for the e.deorbit mission by an in-orbit demonstration prior to its implementation:

- Forced-motion trajectories
- Communications during forced motion
- Stabilization without previous knowledge of mass, centre-of-mass, and moments of inertia
- Collision avoidance manoeuvres
- Attitude control during de-orbit manoeuvres
- Target release

This paper will present the details and the outcome of this investigation and the implications on the e.deorbit spacecraft.