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DEBRIS REMOVAL PROTOTYPE (DERP)

Abstract

We propose a mission concept, which aims to establish a supernational organisation with the purpose of streamlining debris containment. We propose our Debris Removal Prototype (DeRP), an autonomous debris deorbiting satellite and its mission to demonstrate not only autonomous and safe deorbiting of debris but also to assess how such an organisation might be feasible - modelled after municipal waste management services.

Debris poses a direct threat to continued access to space. An international coordinated debris management initiative is of crucial importance to contain the situation. Space traffic and finance management pertaining to debris management require extensive infrastructure in addition to potentially countless international cooperative agreements. We weigh on these and other implications of coordinating debris management efforts in the paper.

Designed to operate at altitudes between 400 and 1600 km, DeRP features standard satellite subsystems. We opted for Ion propulsion on account of its efficiency and restartability. A single 6 degrees of freedom grabbing unit is fitted for debris handling. LiDAR is used for debris localization. This debris metadata is forwarded to partner open debris tracking solutions. The flight plan is to rendezvous with a selected target debris. After reorienting, a retrograde deorbit burn is conducted. Once the perigee altitude allows a shorter deorbit process, DeRP detaches from target debris to conduct a prograde burn and reestablish a stable orbit. Executing these manoeuvres close to apogee, DeRP has time to disengage from the debris and reestablish a stable orbit. DeRP's mission plan consists of a series of rendezvous, deorbit, re-orbit sequences. A key design goal is to reduce the accumulation of debris over time. This is why we adopt a focus on improving the state of the art in the craft mass versus deorbited debris mass ratio. We envision a small fleet of DeRP satellites in Low Earth Orbit working to contain the debris situation with an organisation in charge of managing traffic as well as selecting target debris for DeRP(s) to deorbit.

As the feasibility of a debris removal mission depends on the scalability and cost of the system, we estimated the satellite cost based on existing COTS solutions which amounted to 13 million USD. In addition to this, additional resources are required for launch, production, testing and integration. A further breakdown of costs will be presented in the paper.