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Space Debris Removal Concepts (6)

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PROJECT MODEL: A CANADIAN SOLUTION FOR ACTIVE DEBRIS REMOVAL

Abstract

The growing issue of space debris in near-Earth orbit is gaining increasing attention and urgency within the international space community. There is a real danger of a "cascading effect" or tipping point being reached, where debris generation rates become self-sustaining and accelerate population growth.

The existing debris population is of primary concern, particularly the larger (¿1000 kg mass) objects which, on a per-object basis, present the most significant risk of adding to the total mass and number of debris objects if they collide with other bodies and fragment.

In mid-2011, the Canadian Space Agency (CSA) commissioned a study into Active Debris Removal (ADR) missions, under its Exploration Core (ExCore) Studies program, to "define the science and technology developments most likely to be required in future space exploration missions of interest to Canada, and assess potential contributions that Canada could make to such missions." Reference debris object targets included spent rocket upper stages, and large, derelict spacecraft.

Our ADR solution is called Project MODEL – the Mission for Orbital Debris ELimination. Project MODEL showcases the application of flight-proven or in-development Canadian technologies, which can be readily applied to an ADR mission with stated goals of being able to remove 2 - 3 large debris objects from Low Earth Orbit per year, over a mission lifetime of 10 years. Such a mission poses great challenges in several key technical areas, including debris object identification and rendezvous, debris object characterization, then grappling and stabilizing a non-cooperative (not designed to be captured) tumbling debris object, and finally lowering and releasing the debris object in a disposal orbit.

COM DEV of Cambridge, Ontario performed the lead system engineering role on the study, with NGC Aerospace of Sherbrooke, Québec providing expertise in orbital rendezvous strategies, Neptec of Kanata, Ontario proposing its flight-proven TriDAR laser-vision system for 3-dimensional debris object spot-cloud imaging and characterization, and ESI Robotics of Toronto, Ontario designing a robotic grappling arm for capture and stabilization operations. The study results were returned to the CSA in 2012, providing a viable mission profile, spacecraft and equipment design using technologies currently available and/or under development in Canada, which can rendezvous with, characterize, grapple, control and de-orbit target debris.

We are pleased to present the results of this study to a large and international audience, to demonstrate Canada's ability and readiness to contribute technologies and expertise to future ADR missions which aim to tackle this urgent issue.