

Adaptive Just-in-time Collision Avoidance via Targeted Dust Cloud Deployment from Orbital Platforms

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Approach

- Develop relationships between dust properties, deployment, dispersion, and probabilistic remediation effectiveness using uncertainty propagation tools.
- Develop a pseudo-catalog of test collisions for evaluation of constellation designs. Perform genetic constellation optimization to characterize constellations on performance Pareto front.
- Analyze architectures on Pareto front, and develop an end-to-end simulation tool for tasking, targeting, and cost analysis of proposed designs.

Research Goals

- Goal: Develop an adaptive, rapid-response orbital debris remediation technology using on-orbit assets to release dust clouds targeted at debris to prevent predicted collisions.
- Improved Just-in-time Collision Avoidance (JCA) relative to previously-proposed JCA methods based on sub-orbital, dust plumes launched on demand into the path of debris:
 - Faster response, less human-in-the-loop complexity, more adaptability.
 - Entry TRL 1; basic principles formulated for similar JCA ideas.
 - Exit TRL 2; feasibility and benefit analysis. Some work toward TRL 3; identification and verification of key parameters.

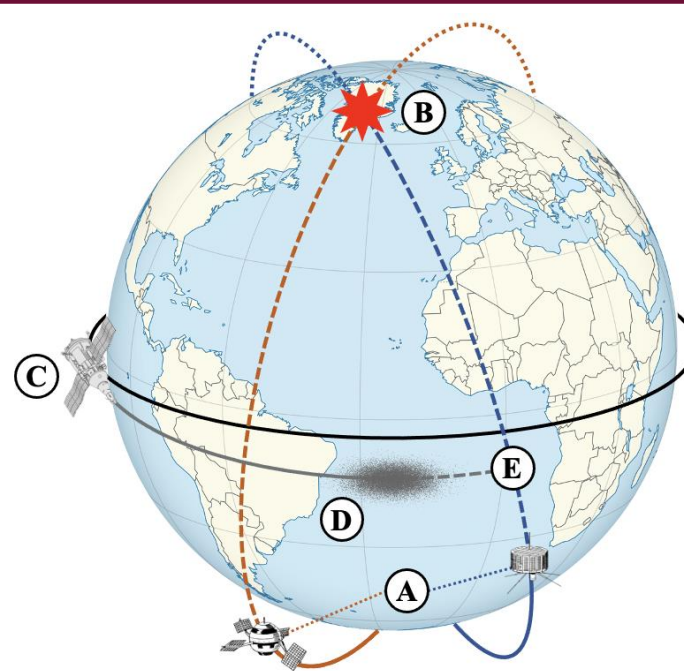


Figure 2. Concept of Operations. Two debris objects (A) are projected to have a close approach or collision (B). In response, an on-orbit platform (C) deploys a dust cloud (D) which disperses to intercept and nudge one of the objects (E), adjusting its orbit to prevent the collision.

Potential Impact

- Understanding of feasibility, performance, and scaling laws for this space-based dust JCA method.
- Preliminary design parameters for a rapid and adaptive collision response system with guaranteed risk return and flexible scaling.
- Greatly-improved understanding of a non-traditional orbital debris remediation technology that can provide fast-response capability and support other remediations.
- Open-access simulation tool for the proposed JCA system, helping to guide next-step development of this technology.