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SPACE DEBRIS SYMPOSIUM (A6)
(joint session with Space Security Committee): Policy, Legal, Institutional and Economic Aspects of Space Debris Detection, Mitigation and Removal (8)

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COST AND RISK ASSESSMENT FOR SPACECRAFT OPERATION DECISIONS CAUSED BY THE SPACE DEBRIS ENVIRONMENT

Abstract

The presence and creation of debris due to human operations in orbit is an ongoing problem. It is recognized that the continuation of current trends in launches and long orbital lifetimes of satellites will only increase the density of debris in both the low Earth orbit (LEO) and geosynchronous (GEO) regimes. This has fostered the increased use of passivation techniques to avoid on-orbit break-ups, as well as the mitigation guidelines of the 25-year lifetime rule for LEO and the minimum 235 km graveyard orbit above GEO. Active debris removal (ADR) has also been suggested and widely studied as a possible method for reducing debris density in all regimes. However, ADR could be expensive and challenging technically, economically, and politically. Further, most existing studies focus on generating information only and forecasting mean growth of the debris population over centuries. Such studies are often much too long-term to be relevant to today's investors and policy makers.

This paper will attempt to better define the space debris problem in terms of the diverse set of costs associated with operating in the present debris environment. Specifically, a mapping of debris-induced economic impacts on operational decision making is proposed that will help to better determine when it is more advantageous to:

- make no changes to current operations activities
- increase tracking capabilities to allow satellites to weave through the debris field
- create more stringent mitigation guidelines
- begin active debris remediation

This decision making framework will be applied to both LEO and GEO regimes since they are heavily populated and of importance to many interests, as well as to a range of spacecraft architectures ranging from inexpensive small satellites to large, expensive or operationally critical spacecraft. The primary inputs to cost function are:

- Financial: spacecraft lifetime reduction due to increased maneuvers, down-time due to increased maneuvers, insurance
- Environmental: increase in conjunction events, cost due to a collision in a particular orbit regime
- Operational: tracking, analysis of conjunctions, COLA maneuvering

- Geopolitical: who is responsible for a collision, who performs maneuver, enforcement of mitigation techniques, creation of ADR systems

These inputs will be discussed and their importance will be classified depending upon the user of the information (commercial, military, scientific). A case study will be presented to demonstrate how such considerations affect an operator today, as well as in the future.