Paper ID: 16774
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SPACE DEBRIS SYMPOSIUM (A6)
Political, legal, Institutional and Economic Aspects of Space Debris Mitigation and Removal (8)

Author: Mr. Jerome Pearson
Star Technology and Research, Inc., United States

Dr. Eugene Levin
Star Technology and Research, Inc., United States
Mr. Joseph Carroll
Tether Applications, Inc., United States

THE LONG-TERM COST OF DEBRIS REMOVAL FROM LEO

Abstract

It is commonly accepted now that large debris objects, such as derelict satellites and rocket bodies, should be removed from LEO to prevent or at least reduce the frequency of new catastrophic collisions. Such collisions can produce hundreds of thousands of debris fragments in the centimeter range ("shrapnel") that are hard to track, but could be long-lived and lethal to operational spacecraft. Different technologies are being proposed and developed for debris removal. While it is important to begin the process of debris removal in the near future, it is not less important to assess the sustainability and long-term implications of the proposed debris removal campaigns. In this presentation, we first review and compare the estimated costs of running debris removal campaigns using different technologies. We then describe a high-level statistical model of shrapnel production and use it to evaluate the average cost of a catastrophic collision as the statistically expected loss due to the damage to operational satellites and loss of their functions as a result of future collisions in LEO. The model is phenomenological and based on the two most relevant empirical data points, the Fengyun-1C and Cosmos-Iridium events. Using this model, we have found that the primary loss occurs not in the catastrophic collision itself, but within a decade after the collision, when a piece of untracked shrapnel produced in that collision hits a high value asset. It could be a "hidden" loss, because it may be hard to determine the true reason for the asset failure. Knowing the average anticipated loss resulting from future catastrophic collisions, we estimate the annual insurance premium that could be reasonably associated with coverage of the losses from such events. This could be treated as a gauge for rationality of the financial burdens of different debris removal campaigns. We then review and compare the long-term financial commitments required by different debris removal campaigns and touch upon the question of the exit strategies and a transition to a low-cost self-regulating regime in the future after the bulk of the large legacy debris is removed from LEO.