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ECONOMIC VALUATION OF ACTIVE SPACE DEBRIS REMOVAL

Abstract

This paper contributes to the evaluation of the benefits of active space debris removal, or alternatively to the discussion of the costs of "doing nothing" (i.e. costs of not removing space debris).
The literature usually defines the costs of "doing nothing" by the average expected costs of the assets, that were damaged in a catastrophic collision (see, for example, Levin and Carroll (2012)).
However, besides the costs of the damaged assets, catastrophic collision entails some economic lost value (e.g., lost surpluses in the related markets, lost return from the alternative use of the resources spent on the reconstruction of the damaged asset etc.). To the best of our knowledge this economic value is not sufficiently studied in the literature.

In the current paper we evaluate the lost (expected) value in the satellite-based service market that arises as a result of a catastrophic collision.

Our model is based on the idea that the number of satellites held by a company is a choice of the company itself. The company may decide to have some spare capacity (the examples of such companies include Iridium, Oneweb) or to operate a single satellite. The firm's own choice implies that this decision comes from some optimization problem.
We formalize the choice of the company regarding the number of the satellites it operates. The solution to the optimization problem allows to express the company's profit as a function of the probability of collisions (p) and the satellite costs, construction plus launching (C). This model allows expressing a lower bound for the surplus in the satellite-based service market via the observable variables p and C.

We demonstrate that the destruction of K (K is greater or equal to 1) satellites leads to loss in the (expected) surplus from service provision. This loss greatly exceeds $C \cdot K$ (i.e. the costs needed to reconstruct the destroyed assets).
In other words, the costs of "doing nothing" are much higher than the ones generally considered in the literature.

Reference:
Levin, Eugene M., and Joseph A. Carroll."The Cost of Future Collisions in LEO."White Paper, February 28 (2012).