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DYNAMIC MODELLING OF SPACE DEBRIS COSTS AND EFFECTS

Abstract

Outer Space, particularly the Low Earth Orbit and the Geostationary Earth Orbit, has become increasingly congested and contested due to space debris. Space debris increases the costs of space operations (arising from increased satellite protection measures, space surveillance, collision avoidance measures and satellite service obstruction). Space debris incidents can affect the functioning of a satellite, thereby obstructing satellite services on Earth such as air transport, healthcare delivery, rescue operations and commercial transactions. This paper explores the use of System Dynamics tools to evaluate the operational and economic costs (direct and indirect) and societal impacts of space debris incidents. System Dynamics is a computer-based simulation method that models interactions among populations of things, events and people.

In general, the problems that arise from space activities are not immediately visible; they unfold over a long period of time. The accumulated effects are difficult to handle especially due to private and national security interests. The trend has been to delay appropriate policies or actions, which results in a feedback effect and a vicious cycle is formed. Also, the actions of space users, both new and old, are sometimes not rational. Such actions generate reactions from other space users. This further increases the complexity of the space environment. System Dynamics is a suitable approach for tackling problems that arise from systems characterised by accumulations/delays, feedbacks and uncertainties, hence its use for this work.