

SPACE DEBRIS SYMPOSIUM (A6)
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A NOVEL RECYCLING CONCEPT FOR SPACE DEBRIS MITIGATION

Abstract

In this work a novel concept of space debris mitigation technique is assessed. The main idea beyond this analysis derives from the consideration that many subsystems could be used after the mission end of life. The studied model involves the analysis of the effects on the space debris long-term growth of a new spacecraft design concept voted to the exploitation of reusable subsystems left on orbit by decayed missions and its economic effects on the future spacecraft design costs. This analysis is differentiated in two main areas, i.e. Engineering and the Economics and business studies. Particularly in the Engineering study the effects of different subsystem exploitation, in terms of reusable on-orbit mass, in different scenarios has been analyzed. The scenarios involve analysis of different representative missions for the different orbital region, i.e. Earth-observation, GNSS and telecommunication respectively of LEO, MEO and GEO region, and the results will show which is the long-term effect on the space debris population growth and which is the reused mass fraction that could produce a remarkable effects on the space debris global mass. Referring to the economics and business part of this research, the Space debris evolution is a typical example of production externalities as well as space congestion is a typical example of the so called tragedy of the commons, a very severe one considering that in this case the E. Ostrom solution cannot be applied. Despite that, environmental economic research on this topic is rare and our study's aim is to fill this gap. Our aim is twofold, first we asses a series regression analysis in order to establish the historical economics determinant of space debris time evolution. This is needed in order to identify the main economic cause of debris growth and to describe synthetically how the congestion is produced. Second we would like to understand if recycling sub system can mitigate the externality. We consider exploiting reusable subsystems as a change in the debris production technology in we try to evaluate its impact on congestion. Lastly, an impact analysis of the proposed model on the spacecraft costs from the design to the on-orbit assembly for the different scenarios will be provided.