Paper ID: 59218
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18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Modeling and Risk Analysis (2)

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DEVELOPMENT OF A FIRST PRINCIPLES APPROACH TO QUANTIFY AND ASSESS IN-ORBIT RISK

Abstract

The arrival of new and innovative space systems, such as large constellations, comprising hundreds or even thousands of satellites, as well as in-orbit servicing missions proposing multiple spacecraft visitations, manoeuvres and orbital activities, pose significant regulatory challenges. This is true not only from a policy perspective but also a technical one. Under the 1972 Space Liabilities Convention, the licensing nation is ultimately responsible for any unexpected events in orbit, such as collisions or explosions that are caused by that nation's licensed spacecraft. Hence it is imperative that the risks associated with licensing new and novel missions are quantified and understood.

To meet this need, the UK Space Agency is currently developing a new in-house risk assessment capability, with the goal of better understanding both the likelihood of events in orbit, as well as both the environmental and financial consequences of such events. A key aim will be to ensure that these new capabilities are underpinned with first-principles physics models and understanding, combined with high-fidelity data and validated thoroughly through-out.

This briefing aims to detail the approaches developed to quantify in-orbit mission risk, illustrating how the modelling effort can be separated into likelihood and impact, and how the two can be brought together to define an overall risk. A description of the current models in development, following a strategy of parallel advancement of multiple models of varying fidelity, is detailed. In addition, preliminary results are provided and assessed for relevant mission profiles of interest to the UK. A discussion on how the output of these models and the development of appropriate risk metrics can be used to inform licensing decisions. Finally, a development schedule for the capability over the next few years is discussed.