Paper ID: 30042
student

SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Risk Analysis (2)

Author: Ms. Cristina De Persis
Trinity College, Ireland

Prof. Simon Wilson
Trinity College Dublin, Ireland

A RISK ASSESSMENT TOOL FOR HIGHLY ENERGETIC BREAK-UP EVENTS DURING THE ATMOSPHERIC RE-ENTRY.

Abstract

Many spacecraft end their life through destructive re-entry, particularly those in low Earth orbits. Re-entering from Earth to space, they shatter into pieces that can either burn as encounter friction with the atmosphere along their descent, or fall to the ground.

Deterministic tools have been designed in order to predict how the fragmentation process occurs and much effort is still being made to improve their accuracy. It is not surprising if we think that even a small fragment coming from space could pose a threat to people and assets if its impact on the Earth's surface is not where it is not supposed to land. It's probably fair to say it's certainly very low on the list of things that could kill you but, if it did happen, it would have very large consequences for the space industry.

The severe consequence of such an event results in the need to analyze all the possible re-entry cases, particularly if one considers that the number of re-entries, controlled and uncontrolled, will probably increase over the next few years.

A weak point of most existing re-entry analysis tools is the lack of a proper modeling of the fragmentation that can occur during the atmospheric re-entry, particularly when caused by an explosion. We faced the challenge to develop a model aimed to fill this gap.

Our tool is a statistical tool including two models specifically built for the characterization of the fragments generated by a highly-energetic explosion during atmospheric re-entry, and the assessment of the probability for an such explosion to occur during the re-entry. Both models have been developed through the application of Bayesian inference methods. Relying on Bayesian techniques, expertise and data collection can be incorporated in an appropriate way in the same model and, given the flexibility of the Bayesian framework, the model can be easily updated and improved as new data are gathered over time. Optimistically more and more observations will be available over time, due to an increasing interest in this context.

This is a problem where real data are scarce but physical knowledge is extensive, even if many uncertainties are involved: this is what makes Bayesian statistics perfectly suitable to this type of problem.