

Worst-case Launch Vehicle Stage Separation Analysis

This paper is dedicated to the development of a multi-body separation model and to its combination with worst-case simulation methods towards an integrated tool for the verification and validation of launch vehicle stage separation mechanics. The simulator is implemented using SimMechanics, MathWorks' physical modelling suite, and based on the Constraint Force Equation (CFE) framework, which has been previously applied to stage separation simulations. Worst-case problems targeting the analysis of different system requirements (e.g., angular deviation rate or relative translational velocity) are then formulated and applied to the release of the Intermediate eXperimental Vehicle (IXV) model, ESA's re-entry demonstration spacecraft, as a case-study. Given the outcomes of this study, it is expectable that the worst-case stage separation simulator is able to be directly integrated with different vehicle models, potentially featuring a higher number of dispersed properties, as well as with end-to-end launch vehicle trajectory simulation tools.