The Influence of Solid Rocket Motor Retro-Burns on the Space Debris Environment

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The ESA space debris population model MASTER (Meteoroid and Space Debris Terrestrial Environment Reference) considers firings of solid rocket motors (SRM) as a debris source with the associated generation of slag and dust particles. The resulting slag and dust population is a major contribution to the sub-millimetre size debris environment in Earth orbit. The current model version, MASTER-2005, is based on the simulation of 1,076 orbital SRM firings which contributed to the long-term debris environment. A comparison of the modelled flux with impact data from returned surfaces shows that the shape and quantity of the modelled SRM dust distribution matches that of recent Hubble Space Telescope (HST) solar array measurements very well. However, the absolute flux level for dust is under-predicted for some of the analysed Long Duration Exposure Facility (LDEF) surfaces. This points into the direction of some past SRM firings not included in the current event database. The most suitable candidates for these firings are the large number of SRM retro-burns of return capsules. Objects released by those firings have highly eccentric orbits with perigees in the lower regions of the atmosphere. Thus, they produce no long-term effect on the debris environment. However, a large number of those firings during the on-orbit time frame of LDEF might lead to an increase of the dust population for some of the LDEF surfaces. In this paper, the influence of SRM retro-burns on the short- and long-term debris environment is analysed. The existing firing database is updated with gathered information of some 800 Russian retro-firings. Each firing is simulated with the MASTER population generation module. The resulting population is compared against the existing background population of SRM slag and dust particles in terms of spatial density and flux predictions.