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

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MASTER-2009 FUTURE LAUNCH AND EVENT TRENDS

**Abstract**

MASTER (Meteoroid and Space Debris Terrestrial Environment Reference) is the European reference model for all objects greater than 1 $\mu$m in Earth orbit. The 2009 release is based on the reference population from May 1, 2009. For the analysis of the future space debris environment and the effectivity of distinct mitigation measures, such as passivation and end-of-life disposal, MASTER provides future populations which have been generated using the DELTA (Debris Environment Long Term Analysis) tool. DELTA uses the MASTER-2009 reference population as input and allows the future forecasting of all major debris sources by using a fast, analytical orbit propagator. For this purpose a derivation of future launch rates as well as event rates including solid rocket motor firings and fragmentations by explosions is required. The current paper presents the derivation which was used for MASTER-2005 and compares the propagated results from 2005 with real data obtained from 2006 through 2009. The propagated annual rate of 69 launches in MASTER-2005 is slightly above the real data. According to the DISCOS Database a total of 486 launches were performed between May 1, 2001 and May 1, 2009 resulting in a real annual launch rate of 61. The reasons for this difference are investigated considering alternative concepts for the launch rate derivation, e.g. the individual launch rate estimation for each country. The rationale behind choosing a similar launch rate estimation process in MASTER-2009 compared to MASTER-2005 will be explained. The paper also includes the analysis and revision of future SRM firings as well as fragmentation events. Fragmentation events are caused by explosions or collisions. The annual explosion rates increased form 4.5 in MASTER-2005 to 5.6 in MASTER-2009. Collision analysis is based on the initial population and is performed during propagation. For MASTER-2009 this resulted in 14.7 annual events compared to 13 annual events in 2005, respectively. The reason for this increase is subject of this paper.