Paper ID: 65675
oral

19th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Impact-Induced Mission Effects and Risk Assessments (3)

Author: Dr. Lorenzo Olivieri
CISAS "G. Colombo" - University of Padova, Italy

Dr. Cinzia Giacomuzzo
University of Padova - DII, Italy
Ms. Cristina Duran
Politecnico di Milano, Spain
Mr. Lorenzo Giudici
Politecnico di Milano, Italy
Dr. Camilla Colombo
Politecnico di Milano, Italy
Prof. Alessandro Francesconi
University of Padova - DII/CISAS, Italy

INVESTIGATION OF ENVISAT CATASTROPHIC FRAGMENTATION SCENARIOS

Abstract

ENVISAT is currently one of the largest debris in Low Earth Orbit and it resides in a highly populated orbital zone with higher impact risk. A collision with other satellites or rocket stages could generate and scatter fragments into altitudes occupied by many operational spacecraft, and in the worst case could restrict the access to polar orbits at about 800 km of altitudes. In this context, there is a need to evaluate the contamination of the orbital regions possibly involved by the spread of debris originated after a possible ENVISAT fragmentation. To this aim, this paper presents the results of a campaign of hypervelocity impact simulations with ENVISAT as target, performed with a tool called CSTS (Collision Simulation Tool Solver). The key features of CSTS are the capability of modelling a large variety of collision scenarios involving complex systems such as entire satellites and the possibility to provide statistically accurate results with a computational effort lower than hydrocodes. The simulated collision configurations include two different impacting bodies (small-class 100 kg satellite, defunct rocket stage), two impact position (glancing impact on ENVISAT radiator, collision on the central body), and two impact velocities (1 and 10 km/s). For each impact configuration, fragments area to mass, characteristic lengths, and velocity distributions are reported and the severity of different collision scenarios is discussed. Based on the said distributions, a second part of the paper focuses on debris cloud evolution and its propagation to other orbits in terms of local variation of the space debris density. This is achieved by superimposing the ENVISAT fragments to the ESA MASTER population and computing the evolution though the Starling suite. For each simulated configuration, local distribution peaks are pointed out and the general deterioration trend of the space debris environment is discussed.