SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

Author: Mr. Jan Hupfer
Fraunhofer EMI, Germany

Mr. Robin Putzar
Fraunhofer EMI, Germany
Mr. Matthieu David
Airbus DS GmbH, Germany
Ms. Gwenaëlle Aridon
Airbus Defence and Space SAS, France
Mr. Bernard Gergonne
Airbus Defence and Space SAS, France
Dr. Frank Schäfer
Fraunhofer EMI, Germany
Mr. Claude Cougnet
France

EVALUATION OF ENHANCED SHIELDING CONFIGURATIONS AGAINST HYPERVELOCITY PARTICLE IMPACTS FOR FUTURE UNMANNED SPACECRAFT

Abstract

Space debris is a growing problem for unmanned spacecraft. State-of-the-art satellites are typically designed to withstand most impacts with particles not exceeding 0.1 cm in diameter. Large debris, exceeding 10 cm, can be detected and avoided using evasive manoeuvres. Objects from 0.1-10 cm, however, can neither be tracked nor ignored and therefore they pose a serious threat to current and future missions. As the particle population in Earth orbit is expected to increase, future spacecraft will require enhanced protection against particle impact to ensure reliable operation during the specified spacecraft lifetime.

As part of the EU funded FP7 research project ReVuS (Reducing the Vulnerability of Space systems), the configurations typically found on board unmanned spacecraft with respect to particle impacts were identified. In a second step, potential enhancements to those typical configurations to increase the robustness against particle impacts were identified. These enhancements include e.g. additional protective layers made from Aluminium, Kevlar, Nextel, stainless steel mesh and ceramics. Based on the results of a preliminary test campaign (including approx. 30 screening hypervelocity impact tests), enhanced shielding configurations were developed. The ballistic limit of five such enhanced configurations was determined at 7 km/s during a second test campaign. Finally, analyses were performed to evaluate the protection gain and impact (e.g. with respect to mass) of the enhanced configurations on future spacecraft.

This paper describes the enhanced shielding configurations, the hypervelocity impact test campaigns (including test rationale, test plan and test results) and presents the results of the analyses performed.