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Analysis of the vibration environment induced on spacecraft components by hypervelocity impact¹

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This paper reports the result achieved within the study “Spacecraft Disturbances from Hypervelocity Impact”, performed by CISAS and Thales-Alenia Space Italia under European Space Agency contract. The research project investigated the perturbations produced on spacecraft internal components as a consequence of hypervelocity impacts of micrometeoroids and orbital debris on the external walls of the vehicle. Objective of the study was: (i) to set-up a general numerical /experimental procedure to investigate the vibration induced by hypervelocity impact, (ii) to analyze the GOCE mission in order to assess whether the vibration environment induced by the impact of orbital debris and micrometeoroids could jeopardize the mission. The research project was conducted both experimentally and numerically, performing a large number of impact tests on GOCE-like structural configurations and extrapolating the experimental results via numerical simulations based on hydrocode calculations, finite element and statistical energy analysis. As a result, a database was established which correlates the impact conditions in the experimental range (0.6 to 2.3 mm projectiles at 2.5 to 5 km/s) with the shock spectra on selected locations on various types of structural models. The main outcomes of the study are: (i) a wide database reporting acceleration values on a wide range of impact conditions, (ii) a general numerical methodology to investigate disturbances induced by space debris and micrometeoroids on general satellite structures.

¹This work has been conducted in the frame of the ESA contract “Spacecraft Disturbances from hypervelocity impact”