SPACE DEBRIS SYMPOSIUM (A6)
Space Surveillance, Legal Aspects and Space Debris Modelling (5)

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MODELING HYPERVELOCITY IMPACT OF DEBRIS PARTICLES ON SPACE STRUCTURES

Abstract

Space activity of the mankind generated a great amount of orbital debris; i.e. manmade objects and their fragments launched into Space, inactive at nowadays and not serving any useful purpose. Those objects sizing from hundreds of microns up to decimeters, traveling at orbital velocities, remaining in orbits for many years and numbering billions formed a new media named "space debris" and became a serious hazard to space flights. Thus this media wherein the space satellites operate nowadays should be taken into account, and its impact on the durability of space missions should be evaluated as it can be now or in the near future comparable with the role of reliability of the technical systems. That turns to be of a tremendous importance for developing the systems containing constellations of low Earth orbiting satellites as a space segment. Developing the concepts of such systems it is necessary to take into consideration the Space debris environment the systems will operate in. The speed of the strike of an objects placed on LEO and element of space debris might be 15 km per second. The recent developments including collision of constellation satellite with space objects testify that. To build a model of space debris evolution it is important to consider two interrelated questions which deal with processes of debris reproduction as a result of different break-ups and high –speed collisions on LEO. A great number of codes were recently created to solve problems of high-speed collisions, but it takes to much time to solve a single collision problem, which prevents from their application to simulation of the evolution of space debris population. To execute simple estimations there exist empirical formulas derived from experiments. However, those formulas operate only short range of parameters. The aim of this work is to develop simplified model of space debris particle collision on solid structures, which would provide closed form solution formulas for determining crater depth, radius and ejected mass being functions of impactor mass, speed and material of both impactor and target. The model will be verified with results of experiments. The authors wish to acknowledge the support by Russian Foundation for Basic Research (Grant 09-08-000396).