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Author: Mr. Simon Huembert
German Aerospace Center (DLR), Germany, Simon.Huembert@dlr.de

Mr. Jonas Meth
Student, Germany, meth.jonas@freenet.de
Mr. Markus Echsel
Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Germany, markus.echsel@ipa.fraunhofer.de
Dr. Michael Lengowski
Institute of Space Systems, University of Stuttgart, Germany, lengowsk@irs.uni-stuttgart.de
Dr. Tina Stäbler
German Aerospace Center (DLR), Germany, tina.staebler@dlr.de

ADDITIVE MANUFACTURING OF RADIATION SHIELDING FOR SMALL SATELLITES

Abstract

An increasing demand on reliability in the automotive industry, driven by the development of autonomous driving, has led to a high availability of inexpensive electronics with high potential for space applications. Several of these applications have already been proposed within the NewSpace trend. However, the high-radiation environment inherent to space operations lies outside the automotive hardware development scope and is therefore often the show-stopper for using such electronics for space applications. This work examines the possibility of designing and manufacturing weight- and cost-efficient radiation shielding using additive manufacturing. A printable shielding material, composed of tungsten powder embedded in the high-performance thermoplastic polyether-ether-ketone (PEEK), was developed and used to design a multi-material, multifunctional sandwich structure for local shielding of a representative automotive MEMS sensor. Radiation simulation was used to find the most efficient geometry and distribution of the shielding material. Additionally, the simulation has shown the required amount of shielding material to keep the total ionising dose below the previously tested limits of the sensor. The local shielding realised by additive manufacturing allows a minimal use of tungsten and thereby weight benefits compared to traditional shielding in aluminum boxes. The design will be demonstrated on the University of Stuttgart CubeSat mission, SOURCE, by comparing a shielded and unshielded area of the sandwich. The demonstrated shielding concept can easily be transferred to other hardware and missions and can thereby reduce both weight and cost of future spacecrafts.