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TOWARDS FLIGHT QUALIFICATION OF AN ADDITIVELY MANUFACTURED NANOSATELLITE COMPONENT

Abstract

Fraunhofer EMI currently designs, builds and tests a MWIR payload for a 12U nanosatellite. The mission is called ERNST (Experimental Spacecraft based on Nanosatellite Technology) and its main goal is to evaluate the utility of a nanosatellite mission for scientific and military purposes. The satellite bus is based on CubeSat components where possible and its main payload is an advanced MWIR camera. As spacecraft weight remains to be a main mission driver for space missions Fraunhofer EMI decided to take advantage of weight saving topology optimization algorithms in order to reduce the mass of secondary satellite structures. The optimized part (optical bench) integrates different functionalities and components of the optical system. Main design drivers for the topology optimization are considered to be vibration loads during the launch period as well as thermal loads emerging from the temperature conditions in space. The structure will be designed by combining both vibrational and thermal loads into the optimization model. Furthermore, the optimization model was extended in order to aim for a defined position of the center of gravity of the overall satellite. To have preferably low design limitations in the numerical optimization process, where material is only placed at necessary areas, Additive Manufacturing (AM) can offer a solution. The significant advantage using AM exists in the design freedom with almost no design restriction compared to conventional manufacturing methods. Selective Laser Melting as one of many AM-Methods will be used to manufacture the optimized structure based on a high strength aluminum alloy (SCALMALLOY ©). With the ultimate goal in mind to qualify the additive manufactured part, this work will present a post processing concept for the optical bench as well as experimental data of Eigen-frequencies, the sinus response and random-response. In addition to that, the experimental determined thermal behavior of the optical bench will be presented.