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Author: Dr. Marco Mulser
OHB System AG, Germany

Mr. Thomas Sedlmaier
OHB System AG - Oberpfaffenhofen, Germany
Mr. Alexander Kuisl
OHB System AG - Oberpfaffenhofen, Germany
Mr. Christoph Pobel
OHB System AG - Oberpfaffenhofen, Germany
Dr. Eike Volkmann
OHB System AG, Germany
Mr. Michael Lippert
Fraunhofer Research Institution for Additive Manufacturing Technologies IAPT, Germany
Dr. Martina Meisnar
European Space Agency (ESA/ECSAT), United Kingdom
Dr. Laurent Pambaguian
European Space Agency (ESA), The Netherlands

INTEGRATED TWIN-MIRROR MADE BY ADDITIVE MANUFACTURING

Abstract

Many studies that address Additive Manufacturing (AM) have shown that the technology provides benefits as an alternative to conventional manufacturing methods. AM offers a unique design freedom and new opportunities to manufacture complex-shaped structural and functional parts. Performance gain through functional integration, reduction of interfaces of an assembly, mass reduction and cost savings are the main drivers for considering AM in spacecraft design.

OHB recently developed an AM design approach for an Integrated Twin-Mirror (ITM). It is based on the same requirements as for the conventional mirror design for a high-resolution imaging spectrometer of the FLEX mission. The mission's purpose is to monitor the photosynthetic activity and plant stress by mapping the vegetation fluorescence. The twin-mirror combines two separate spherical mirror surfaces on the same structural body. The motivation to use AM is to reduce mass and thermal capacity to limit stresses on the flexures. In addition, lower thermal gradients will increase the instrument's optical performance.

The ITM was designed and manufactured in aluminum by Laser Powder Bed Fusion (L-PBF). The design integrates a lattice structure into the part, outside of the two functional surfaces. The mass of the mirror was reduced by 40% compared to the already light-weighted conventional design. The analytical verification shows that the surface form error was reduced compared to the original design for all relevant load cases. The stress in the lattice structure and the interface flexures under random loads is well below the relevant stress limits.

OHB's successful topology optimization and design workflow is presented. The approach to implement lattice structures for light-weighting is highlighted. Key challenges during manufacturing and post-processing including precision machining and surface finishing are discussed. An outlook is given on AM process and prototype verification using the recently published ECSS-Q-ST-70-80C as a baseline.