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ALIGNMENT MECHANISM AND SYSTEM CONCEPT OF A SCALABLE DEPLOYABLE ULTRA-LIGHTWEIGHT SPACE TELESCOPE FOR A 1U CUBESAT DEMONSTRATOR

Abstract

The goal of the Optical Coatings Ultra Lightweight Robust Spacecraft Structures (OCULUS) project is to develop a high-quality metallization process for surface modification of high precise carbon fiber reinforced plastics (CFRP) structures. As a joint research project between the Institute of Space Systems at Technical University of Braunschweig, Invent GmbH and the Fraunhofer Institute for Surface Engineering and Thin Films (IST) the technology enables the construction of space-suitable, lightweight and cost-effective refractors, which allows a drastic mass reduction of mirrors in the application for space telescopes. The state-of-the-art of conventional telescopes operated on ground as well as in space uses mirror materials with high density, such as metal or ceramics, which are the main contributor to overall system mass. The aperture diameter is proportional to the optical performance of the system and is limited by the launcher. A mass reduction and deployment of mirror segments can increase the performance of such a system. Within the OCULUS project the mirror mass can be reduced by a minimum of 80This paper introduces a detailed overview of the demonstrator design with special focus on the mechanism that deploys and aligns the primary and secondary mirror. A design trade-off will be summarized and the dependencies of the mechanical positioning mechanism will be discussed. Followed by a description of the optical system, the internal working process and autonomous control to align the mirror. This leads to the detailed design of the deployment and alignment mechanism with respect to the other satellite subsystems as well as the overall volume-, mass- and energy-budget. The positioning accuracy and resulting optical performance of the space telescope for Earth observation will be estimated. In addition a testing environment to proof the shown concept and assess the optical system and its alignment accuracy is proposed. Concluding a conceptual design to demonstrate the functionality of the deployment mechanism independently of alignment mechanism in microgravity tests is derived.