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Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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DISPLACEMENT MEASUREMENTS OF A PARABOLIC REFLECTOR BY HOLOGRAPHIC INTERFEROMETRY IN THE LONG-WAVELENGTH INFRARED

Abstract

Deformation metrology of complex shape space structure and reflectors is a recurrent problem addressed by ESA. Consequently, suitable measurement techniques have to be developed and validated to support relevant on-ground qualification and verification testing.

Holographic techniques in the visible wavelengths are common for measuring the surface displacement of object. However the short wavelength induces high stability criteria which are so severe that they often prevent the measurement of large space structures under good conditions.

We propose to use a wavelength longer than the usual visible ones to render such holographic displacement measurement techniques less sensitive to external perturbations. For this we consider CO2 laser emitting at 10.6 m which correspond to the long-wavelength infrared spectrum (LWIR).

The most important element for performing holography is to use an adequate recording medium. However no convincing holographic recording media exists in LWIR and we decided to investigate the possibility of electronic hologram recording, such as electronic speckle pattern interferometry (ESPI). This possibility is feasible nowadays thanks to various thermal imaging technologies such has uncooled microbolometers sensors commonly found in thermographic cameras.

In this study, we analyze how it is possible to measure surface displacement of specular objects which do not produce speckle, using speckle interferometry by the mean of a scattering diffuser. We show results of measurements of the rotation of a plane mirror. We applied the phase-shifting technique for quantitative measurements and the results are correlated to counter measurements. We finally present the application of the ESPI technique at LWIR for measuring displacements of a large parabolic reflector.