IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

Author: Mr. Jason Shore
Surrey Space Centre - University of Surrey, United Kingdom

Prof.Dr. Guglielmo Aglietti
Surrey Space Centre, University of Surrey, United Kingdom
Mr. Roy Blows
Surrey Space Centre - University of Surrey, United Kingdom
Dr. Andrew Viquerat
Surrey Space Centre, University of Surrey, United Kingdom
Dr. Guy Richardson
SSTL, United Kingdom
Mr. David Gooding
Surrey Satellite Technology Ltd (SSTL), United Kingdom

DESIGN, ANALYSIS AND TESTING OF A NOVEL DEPLOYABLE TELESCOPE FOR EARTH OBSERVATION USING SMALL SATELLITES

Abstract

The Surrey Space Centre (SSC) and Surrey Satellite Technology Ltd (SSTL) have collaborated in a Centre for Earth Observation Instrumentation (CEOI) project to design a deployable Cassegrain telescope. Deployable structures have proved very successful in the past decades for deployment of sensors and solar panels, to name a few. Therefore, attention has naturally turned to incorporating deployable structures into more complex space systems. Optical telescopes are currently flown with a fixed focal length, set by the desired magnification, which limits their use to larger satellites. Incorporating a deployable system, to extend to the fixed length from a smaller volume, could open the door for smaller satellites to carry larger optical telescopes, making Earth observation more accessible for research and businesses.

The aim of this project was to increase the capability of small satellites for Earth observation by demonstrating a proof of concept breadboard and development model of a deployable Cassegrain telescope. The design uses three concentric carbon fibre barrels deployed into lockout stops by three leadscrew sets equi-spaced around the barrels. This paper will provide an overview of the design, analysis and test campaign for this deployable optical system.

Demonstration and validation of the design was completed on two fronts, analysis and test. The requirements can be simplified to deployment repeatability, structural performance and thermal stability. The deployment repeatability was physically tested using an aluminium test rig and suspended digital test indicators. The structural performance was first modelled using finite element (FE) software then experimentally using a suspended mini-shaker. Finally, the thermal stability of the system was investigated using FE and validated experimentally, using an autocollimator, reference tube and thermal chamber.

The deployment results for both the breadboard and development models show that the system can reliably deploy to less than 0.25mm. The first mode of the development model is predicted to be 94Hz from FE and has been experimentally measured to be 86Hz, with both FE results and experiment showing similar response curves. The FE results of thermal loading show the design to be compliant with the requirements.

This work has shown that it is possible to design a deployable Cassegrain telescope to meet the requirements of an Earth observation telescope. Work is set to continue to show that the flight model

will have a first modal frequency above 100Hz, as is currently predicted, and to undertake further testing moving towards a full structural qualification model in 2020.