Paper ID: 77220
oral

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

Author: Dr. Ryo Higuchi
University of Tokyo, Japan, higuchi@aastr.t.u-tokyo.ac.jp

Dr. Tomohiro Yokozeki
University of Tokyo, Japan, yokozeki@aastr.t.u-tokyo.ac.jp
Prof. Takahira Aoki
Tokyo University , Japan, aoki@aastr.t.u-tokyo.ac.jp

ANALYSIS OF OUT-OF-PLANE THERMAL DEFORMATION OF THE ULTRALIGHT PHASED ARRAY ANTENNA

Abstract

This study aims to scrutinize the feasibility of an antenna structure made of an ultrathin plate of CFRP mounted with multiple antenna patches and strips. This structure is designed for an ultralight antenna for a preliminary radar satellite with a 30 m class phased array antenna as a midway target for future solar power satellites. Of particular interest is the issue of out-of-plane thermal deformation, which arises due to variations in the coefficients of thermal expansion among the various constituents of the antenna structure. This deformation poses a critical challenge in ensuring that the flatness requirement for electromagnetic performance is met. This study treats this thermal deformation as a generalized eigenstrain problem and develops a theoretical model using Eshelby's equivalent inclusion method and Mori-Tanaka's mean-field method within the framework of classical lamination theory. This study further investigates the impact of the in-plane geometry, alignment, and layered structure of the antenna components on the overall deformation of the antenna structure, with the aim of deriving design guidelines. On the basis of the results obtained, the optimized layered structure is examined to determine its effectiveness in suppressing thermal deformation.