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SPACEBORNE LARGE-SCALE MEMBRANE PHASED ARRAY DEFORMATION COMPENSATION FOR BEAMFORMING

Abstract

Spaceborne large-scale membrane phased arrays promise wide application potentials with increased aperture and reduced launch storage volume. But it also introduces technical challenges such as deformation which affects relative positions of radiating elements and consequently beamforming performance due to lack of structure rigidity.

A novel scheme aimed at compensating deformation and improving array directivity, gain, and sidelobe suppression was presented with conceptual description and simulation verification. With embedded clusters of Fiber Bragg Gating (FBG) sensors in polymeric membrane substrate of phased array, deformation and vibration caused by space environment and vehicle maneuver can be estimated to compensate phase deviation of radiation units due to twist and curving. The compensation process begins with curvature extracted from FBG sensor measurement which is wavelength shift. Membrane surface deformation and vibration can be reconstructed based on those curvature. Once array surface geometry is recognized, radiation elements phase delay variation which deteriorates beamforming ability can be compensated.

Simulations was utilized to test the procedure and various design parameters such as sensor accuracy and distribution as well as reconstruction algorithms were compared. Satisfactory results can be find by improved beamforming performance. The method proposed suits the trend of developing larger and lighter space phased arrays.