Conformal Array of Log-Periodic Folded Slot Antennas for an Endfire Obstacle Avoidance SAR on a Cryobot

Srikumar Sandeep[(1)], A. J. Gasiewski* [(1)]
(1) University of Colorado, Boulder

We present the antenna design and simulation results for an obstacle avoidance endfire Synthetic Aperture Radar (SAR). The SAR will be used on an ice-penetrating cryobot to deploy realistic astrobiology science payloads through ice caps of substantial thickness. The antenna consists of four conformal Log Periodic Folded Slot Arrays (LPFSA) on a cylindrical surface. An array of LPFSAs (J.L. Volakis, Antenna Engineering Handbook, Fourth edition) offer several advantages for this system. Each LPFSA is a broadband antenna which is required for short radar range resolution. In addition, the end fire radiation characteristics of the LPFSA are essential for forward obstacle avoidance. Finally, LPFSAs offer the distinct advantage of conformal mounting on the cylindrical body of the cryobot. Multiple LPFSAs are required for steerable squinting of the beam off the vehicle axis and rotation of the beam main lobe around the vehicle axis. Such steerability is achieved by proper phasing of the four LPFSA arrays.

Each LPFSAs on the hollow cylindrical surface will generate travelling waves both on the inner and outer regions of the cylinder. The waves internal to the cylinder need to be attenuated for improved antenna performance. Damping of internal waves is achieved by using iron-loaded epoxy absorbers (e.g., Emerson & Cuming MF-124) inside the cylinder. It should be noted that since the antenna is embedded in ice, the simulation is be performed with ice as the background media. A center frequency of operation of 610 MHz with a bandwidth of 20% is achieved.

The talk will present the overall mechanical and electrical design of the antenna with emphasis on the effects of the following parameters on the antenna performance: 1) absorber thickness and absorber material 2) inner dielectric and outer ceramic coatings 3) number of dipoles and other geometrical characteristics such as slot width and expansion ratio, 4) presence of a thin layer of liquid water on the antenna surface (this layer is between the antenna surface and ice background media).