A VHF/UHF Dual-Band Dual-Polarized Microstrip Array

J. Huang, Y. Rahmat-Samii* and M. Moghaddam

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California, USA 91109

* University of California, Los Angeles
Los Angeles, California 90095-1594
USA

In order to address a key science goal of understanding the global water and energy cycle, JPL/NASA is investigating a space-borne Synthetic Aperture Radar (SAR) to operate simultaneously at two frequency bands, UHF (435 MHz) and VHF (tentatively, 118 MHz), for vegetation and deep soil moisture detection. The simultaneous use of UHF and VHF radar frequencies will enable the characterization of a substantial vegetation layer and subsurface soil moisture down to 2-meter depth or more. This soil moisture radar will be extremely useful for global water resource management. In addition, it can provide valuable information on hydrological, ecological, and bio-geo-chemical processes.

The above radar calls for an antenna to generate fan-shaped beams with radiating effective apertures of 30m by 3m for the UHF band and 30m by 11m for the VHF band. The antenna system selected for development is a 30m deployable mesh reflector with center-fed co-located dual linear arrays. The two linear arrays are of the stacked patch design with six UHF square patches (each 32 cm in dimension) situated on top of three VHF square patches (each 115 cm in dimension). The overall feed array dimension is about 380cm x 130cm x 6cm with the VHF patches designed using a 5cm thick honeycomb substrate and the UHF patches using a 1cm thick honeycomb substrate. The calculated bandwidth of the VHF patch is about 2 MHz, while that for the UHF patch is about 5 MHz (The requirement is 1 MHz bandwidth for both frequencies, stemming from SAR range resolution requirements). The UHF patches, stacked on top of the VHF patches, are fed by microstrip lines and coax cables, and are independent from the VHF feed lines. Because the UHF and VHF frequencies are separated far apart from each other, a single feed system used for both sets of patches through parasitic coupling is not feasible. To accommodate two independent feed systems, a square hole of 12 cm in dimension is designed at the center of each VHF patch and this hole is electrically shorted at its four walls to the ground plane. A set of coax cables can be brought up through this hole to feed the UHF patches without disturbing the VHF radiation performance. The calculated radiation patterns, input VSWR and port isolation using Moment Method (Ensemble software tool) have all shown good results and will be presented during the symposium. This work has demonstrated the feasibility of using microstrip patch elements at the very low frequency band of VHF in a co-located, independently fed, dual-band stacked-patch array antenna.

* This work was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.