RadSTAR L-Band Imaging Scatterometer: Performance Assessment

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RadSTAR is an instrument development program aimed at combining a radiometer and a scatterometer system into a highly compact configuration that uses a single, electronically scanned antenna to provide co-located and simultaneous measurements of emission and backscatter for airborne and spaceborne applications [1]. The program was designed to map soil moisture and ocean salinity, both important components of the water cycle, and to map sea ice density and thickness, an important factor in ocean-atmosphere heat exchange in Polar Regions. The accuracy in estimation of these and a number of other Earth science parameters can be greatly enhanced by providing the co-aligned radar/radiometer microwave measurements. For instance, radiometer estimates of soil moisture from soil emission are affected by emission from vegetation, and from the roughness of the surface. Complementary measurements using the scatterometer can be used to evaluate the vegetation and surface roughness effects. Hence, the combined observations can provide an improved estimate. As with soil moisture, the ocean salinity is a function of the microwave emission from the sea surface temperature (SST) and sea roughness. There, the addition of radar backscatter measurements of sea roughness enables the correction of the emissivity and provide more accurate estimates of ocean salinity. Similar arguments can be made for other important Earth science parameters.

The L-band Imaging Scatterometer (LIS), recently developed at NASA/Goddard Space Flight Center as part of the RadSTAR initiative, is an airborne imaging radar that combines phased array technology and digital beam forming techniques for the measurement of important scientific parameters [2]. LIS was designed for joint operation with the existing NASA Electrically Steered Thinned Array Radiometer (ESTAR) instruments for the remote sensing of soil moisture and ocean salinity [3]. The radar employs a real-time processor capable of synthesizing multiple, low sidelobe beams over a scan range of +/-50 degrees. One of the unique features of this system is the capability of synthesizing beams that match the spatial resolution of the ESTAR instrument. LIS was flight tested for the first time in May 2006 when it flew on board of the NASA P3 aircraft over areas on the Delmarva Peninsula, in the state of Virginia. Subsequent steps towards demonstrating the RadSTAR concept took place in January 2007 when LIS was flown along with the ESTAR-1D system.

This paper discusses the RadSTAR program, the radar system design, calibration, and digital beamforming techniques, and presents preliminary analysis of the data collected during the test flights. The data sets obtained during the flights and during the radar calibration in the anechoic chamber are also employed to asses the performance of the radar. The paper also discusses the Digital Beamforming Synthetic Aperture Radar (DBSAR) processor, a real-time processor recently developed for the LIS instrument which enables beam synthesis, fine resolutions, and large swaths.

REFERENCES

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