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NISAR S-SAR System Performance Optimization with DBF

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NASA-ISRO Synthetic Aperture Radar (NISAR) is a dual-band SAR modelled around the SweepSAR concept for which JPL/NASA is developing L-band SAR subsystems and SAC/ISRO is contributing S-band SAR subsystems. S-Band SAR payload consists of an array of primary RF antenna feed elements for dual polarization, connected to dedicated TR Modules. An unfurlable reflector antenna would be deployed to focus the RF beam from the primary antenna feed array to ground, and vice-versa. The radar backscatter, reflected from the secondary reflector, "sweeps" across the primary antenna feed array. A novel approach (NISAR-DBF) processes the sweeping backscatter to generate a single data stream corresponding to a wide swath.

In NISAR, each T/R Module is assigned a dedicated digital channel which is activated based on pre-calculated data reception time instances corresponding to the sweeping backscatter on the primary RF feed array, thereby generating multiple time-overlapped data-streams from adjacent channels. Receive channels are activated base on Scan-On-Receive concept. NISAR-DBF differs from conventional DBF in that the phase profiles of individual primary RF elements are fixed. Instead, the phase is equalized digitally after acquisition of data, to compensate for the effects of total antenna phase. Data from time-overlapped channels are combined to maximize gain and SNR. Various performance parameters were evaluated from simulations of all science modes of NISAR which showed significant performance improvement compared to data from individual channels through the entire swath.

This paper discusses the implementation of NISAR-DBF algorithm and the analysis of simulated performance parameters.

Keywords: SweepSAR, NISAR, DBF, imaging radar, system optimization