DIGITAL BEAMFORMING SAR (DBSAR) FOR BIOMASS ESTIMATION

Rafael Rincon [1], K. Jon Ranson [1], and Guoqing Sun [2]
[1] NASA/Goddard Space Flight Center, Greenbelt MD 20771
[2] University of Maryland, College Park, MD 20742, USA

This paper will discuss ongoing research efforts at NASA/Goddard Space Flight Center (GSFC) seeking to demonstrate biomass retrievals using digital beamforming SAR techniques. DBSAR is a state-of-the-art multimode radar system designed for the development, implementation, and testing advanced radar applications (Fig. 1). The system combines phased-array architecture, reconfigurable hardware, and on-board processing in order to enable new remote sensing capabilities in support of Earth science and planetary applications [1] [2]. DBSAR's is capable of synthesizes multiple antenna beams simultaneously over a large field of view permitting the implementation of SAR imaging techniques (Fig. 2).

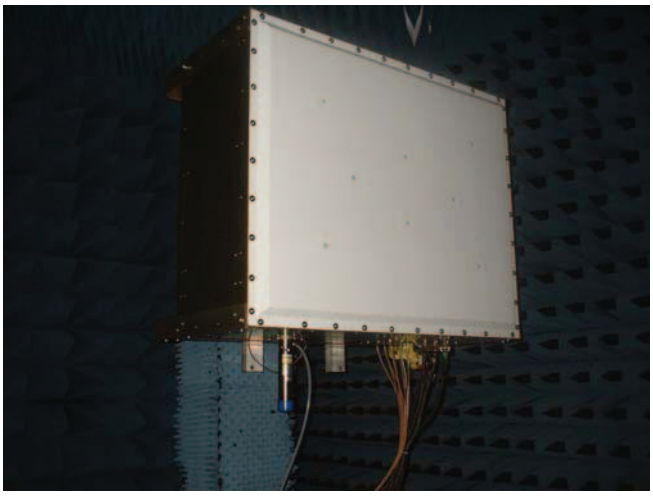

Figure 1 DBSAR's in GSFC's anechoic chamber. Instrument dimensions: 1.2 m x 1 m x 0.5 m.

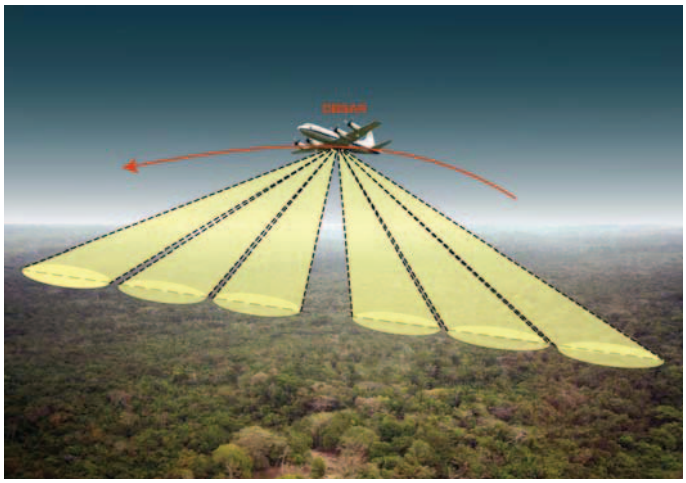

Figure 2 DBSAR beamforming imaging enables multi-beam SAR measurements across a wide swath.

The ongoing efforts are intended to develop data processing capability and algorithm development for the retrieval of forest parameters from DBSAR single and multi polarization data, and to provide information on optimal SAR frequency, polarization and operation modes for various scientific purposes. The effort involves developing image formation and calibration algorithms, conducting flight campaigns on board the NASA P3 over forest areas, and retrieving key biomass parameters.

Our study seeks to implement several SAR algorithms (e.g., Range-Doppler, Chirp Scaling, etc…), and evaluate them in detail with DBSAR data in order to identify the ones best suited to meet science driven requirements. We will also develop robust motion correction, calibration, and geolocation procedures that will yield high quality SAR images and accurate estimates of scientific parameters. We will also configure and programmed a dedicated off-line processor for the implementation and testing of the SAR algorithms with DBSAR data, and with data available from other airborne and spaceborne systems for validation purposes.

DBSAR's science capability will be demonstrated by analyzing its polarimetric data and extracting important biomass parameters relevant to Ecosystems and the carbon cycle. This is a high priority science issue as NASA prepares for the DESDynI mission. Radar backscatter models and algorithms for forest classification and parameters retrieval that have been developed by GSFC scientists [3-5] will be used for this purpose.

The study will also investigate DBSAR's polarimetric InSAR measurement capability for biomass applications such as canopy height estimation, and fusion of lidar and InSAR data. During this study, we will perform precision repeat-pass flight lines on the P3 aircraft over forests in order to generate interferometric phase maps. These techniques will also be applicable to other areas of science such as surface deformation and ice dynamics.

This paper will discuss the project in more detail, describe milestones achieve, and present results.

References

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