Experimental Validation of an Endfire SAR Ambiguity Function

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In this work we present a theoretical analysis along with experimental validation of an endfire synthetic aperture radar (SAR) ambiguity function model. A mathematical model is established in the continuous and discrete time domains and is subsequently used to numerically compute the ambiguity function in order to illustrate the fundamental radial resolution available. In this work the test configuration implemented to experimentally validate the endfire SAR ambiguity function model is described in detail. The measured ambiguity function is obtained by coherently adding the predetected signal reflected from the surface of a corner cube reflector. The resulting improvement in radial resolution relative to a field aperture radar is analyzed and discussed.

The synthetic aperture radar (SAR) technique provides significant improvements in spatial resolution over conventional single aperture monostatic or bistatic radars at the cost of increased signal processing complexity. The SAR mode of operation studied in this work is a forward or endfire imaging mode with respect to the motion of the radar platform.

In this work we study the response of a forward looking SAR system on a very slow moving (i.e. zero doppler velocity) platform by analyzing its ambiguity function. The moving platform of interest is ice-melting cryobot designed for penetration of the Europan ice sheet on a future Jovian mission. A slow moving platform allows a very long integration time for coherent averaging of reflected signals, thereby relaxing the time and doppler constraints on the radar processor.

The exploration of both terrestrial and extraterrestrial glaciers and potential subglacial bodies of water is a challenging task that has been shown to be able to be facilitated by the use of an ice penetrating cryobot. The endfire SAR concept described herein is a critical design innovation for the obstacle avoidance system on such a vehicle

This presentation will focus on: (1) Formulation of the endfire SAR ambiguity function and numerical simulation and (2) Test configuration to exactly measure the endfire SAR ambiguity function for comparison simulated results.