SYNTHETIC-APERTURE RADAR IMAGING AND WAVEFORM DESIGN FOR DISPERSIVE MEDIA

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ABSTRACT

In this dissertation we develop a method for synthetic-aperture radar (SAR) imaging through a dispersive medium and we provide a method to obtain the optimal waveform design for imaging.

We consider the case when the sensor and scatterers are embedded in a homogeneous dispersive material, and the scene to be imaged lies on a known surface. We use a linearized (Born) scalar scattering model, and allow the flight path of the radar antenna to be an arbitrary smooth curve.

We formulate our filtered back-projection imaging algorithm in a statistical framework where the measurements are polluted with thermal noise. We assume that we have prior knowledge about the power-spectral densities of the scene and the noise.

We test our algorithms when the scene consists of point-like scatterers located on the ground. The position of the targets is well resolved when the target-to-noise ration is relatively small. For relatively large noise levels, the position of the targets are still well resolved employing the optimal waveform as an input signal in the reconstruction algorithm.

We show the results of simulations in which the dispersive material is modeled with the Fung-Ulaby equations for leafy vegetation. However, the method is also applicable to other dielectric materials where the dispersion is considered relevant in a frequency range of the transmitted signals.