Radar Holography using Compressed Sensing for Point Targets

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The scientific community has been interested in observing meteors for decades due to the role of meteoriods in studying space weather, the upper atmosphere of the meteor zone, and various aspects of plasma physics. Meteor events detected by single receiver radar system are usually shown in the Range-Time-Intensity (RTI) plot. While we can not acquire meteor information in the cross-range domain with traditional single-receiver detection methods, the Radar Holography is a good alternative. The mathematical basis of radar holography is the fourier transform relationship[*Woodman*, 1997]. The images of interested targets can be obtained from the scattered electromagnetic field at a finite number of sampling points on the groud (Receiver Array). For point targets, the interested signal is natural sparse and compressible, therefore, by introducing the compressed sensing (CS) concept, we can approximately reconstruct the signal from only a few measurements, which can be less than the number required by the Nyquist-Shannon sampling theorem. However, the sparse approximation based on the CS is a NP-hard optimization problem therefore its solution can not be found easily. It is shown that by satisfying certain reconstruction conditions [*Candes et al.*, 2008], we can approximate the original problem by l_1 norm minimization, which is easily solvable by various algorithms. In this paper, we will apply the CS method to radar holography in the range, doppler frequency and cross-range domain for point targets. For modeling, a discrete linear radar signal mode is derived, and the sparse approximation based on CS has been applied. We demonstrate that this approach can provide satisfied resolution in both the temporal and spatial domain by better limiting usual ringing effect.