OPTIMAL APERTURE SYNTHESIS RADAR IMAGING

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Radar imaging techniques have been used to investigate coherent backscatter from ionospheric plasma irregularities at Jicamarca and elsewhere for more than ten years. Radar targets of interest include irregularities produced by equatorial spread *F*, the equatorial electrojet, 150-km echoes, meteor trails, and mesospheric echoes. The sought after images are related to spaced-receiver data through an integral transform, but direct inversion is generally impractical. Optimal inversion of the data is instead performed using information theory and Bayesian statistics to utilize all available a priori and a posteriori information. The most important constraint on the images, other than the radar data themselves, is the fact that images are positive semidefinite. The reduces substantially the space of possible solutions to be considered. Regularization of the data using an entropy-based metric enforces this constraint while also favoring images with a high likelihood of occurrence. There is also a presumption that the images are, in some sense, smooth. Finally, images are expected to be consistent with the data only to the degree required by the confidence limits of the data. The imaging algorithm used at Jicamarca (called MaxEnt), derived from radio astronomy, implements the principles outlined above. It was improved recently by 1) incorporating the antenna radiation pattern in the a priori probability and 2) estimating and including the full error covariance matrix in the constraints. The new algorithm will be tested using new 28-baseline electrojet data from Jicamarca and compared with less computationally intensive algorithms useful in real-time applications. Methods of validating the images will be discussed.

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