

Radar Interferometric Imaging using the Maximum Entropy Method for the Case of Point Targets

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The radar interferometry technique was first used at the Jicamarca Radio Observatory by Woodman (1971) for measuring the inclination of geomagnetic field. Since then, this technique has been successfully developed for imaging ionospheric plasma irregularities phenomena (Farley 1981; Kudeki 1987; Hysell 1996; etc.). With this technique, we can obtain the spatial and temporal (image) information of objects at the same time. We explore practical methods to achieve both fine spatial and temporary resolutions for radar imaging of meteor (point target) events. The basic mathematical description of radar interferometric imaging is the linear Fourier transform relationship (Woodman 1997). The complex visibility measurement from one interferometer baseline is a Fourier component of the objects brightness distribution. However, since the observed visibility data (the Fourier coefficients) from radar interferometry is necessarily incomplete and noisy, in most cases the directly linear inversion is not sufficient to obtain the desired resolution of objects. We need non-linear inversion techniques to remove “ringing” effects and obtain details that are not revealed using linear inversion techniques. Among the non-linear inversion techniques, the maximum entropy method has been widely used in many fields (e.g., radio astronomy, etc.) to reconstruct images of objects. According to the comparisons between maximum entropy method and other conventional inversion methods (CLEAN, etc.) from many papers, we believe maximum entropy method is an optimal choice to achieve satisfactory reconstructions from incomplete and noisy data. Therefore, for meteor head-echoes modeling purposes, a discrete linear radar interferometric signal model is derived, and a maximum entropy image reconstruction method based on Newton-Raphson technique is applied to point targets. Its advantages and limitations are discussed.