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Detection of anomalies in radio tomography of asteroids: source count and forward errors

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Abstract

The purpose of this study was to advance numerical methods for radio tomography in which asteroid's internal electric permittivity distribution is to be recovered from radio frequency data gathered by an orbiter. The focus was on signal generation via multiple sources (transponders) providing one potential, or even essential, scenario to be implemented in a challenging *in situ* measurement environment and within tight payload limits. As a novel feature, the effects of forward errors including noise and *a priori* uncertainty of the forward (data) simulation were examined through a combination of the iterative alternating sequential (IAS) inverse algorithm and finite-difference time-domain (FDTD) simulation of time evolution data. Single and multiple source scenarios were compared in two-dimensional localization of permittivity anomalies. Three different anomaly strengths and four levels of total noise were tested. Results suggest, among other things, that multiple sources can be necessary to obtain appropriate results, for example, to distinguish three separate anomalies with permittivity less or equal than half of the background value, relevant in recovery of internal cavities.

Keywords: Asteroids; Radio tomography; IAS algorithm; FDTD method; Multiple sources; Forward errors.

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