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An Accelerated Markov Chain Monte Carlo Sampling Scheme for an Inverse Scattering Problem with Partial Measurement

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We consider the inverse scattering problem of reconstructing the shape of a sound-soft target placed in homogeneous background media, given only the diagonal entries of the multi-static response (MSR) matrix. The diagonal entries correspond to monostatic far-field data. We develop a reconstruction scheme based on Markov Chain Monte Carlo (MCMC) sampling. We accelerate the MCMC sampling scheme by three parallel steps of preprocessing: optimizing the radius and center of the initial disk for MCMC iteration and the directions for shape deformation. In particular, we rigorously derive a simple integral form of the shape derivative of the MSR matrix, and thereby, we find every direction of shape deformation such that small shape perturbation in the direction makes non-vanishing leading order difference in the diagonal part of the MSR matrix. Numerical simulation shows that our MCMC method is efficient and stable with respect to noise when the target is small compared to the wavelength, or its shape is close to a disk. This is a joint work with Sangwoo Kang and Mikyoung Lim.