Reduced order modeling inversion of mono static data in a multi-scattering environment

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Abstract: The data-driven reduced order models (ROMs) have recently emerged as an efficient tool for the solution of the inverse scattering problems with applications to seismic and sonar imaging. One specification of this approach is that it requires the full square multiple-output/multiple-input (MIMO) matrix valued transfer function as data for multidimensional problems. The synthetic aperture radar (SAR), however, is limited to single input/single output (SISO) measurements corresponding to the diagonal of the matrix transfer function. Here we present a ROM based Lippmann-Schwinger approach overcoming this drawback. The ROMs are constructed to match the data for each source-receiver pair separately, and these are used to construct internal solutions for the corresponding source using only the data-driven Gramian. Efficiency of the proposed approach is demonstrated on 2D and 2.5D (3D propagation and 2D reflectors) numerical examples. The new algorithm not only suppresses multiple echoes seen in the Born imaging, but also takes advantage of illumination by them of some back sides of the reflectors, improving the quality of their mapping.

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