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Full Waveform Inversion of Seismic Input Motions at a Domain Reduction Method Boundary in a PML-truncated domain

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A new inverse modeling is investigated for reconstructing seismic input motions propagating into a domain surrounded by a domain reduction method (DRM) boundary from limited seismic measurement data. The non-convolutional second-order complex-frequency-shifted perfectly matched layers (CFS-PML) is employed to truncate a two-dimensional semi-infinite domain of a plane-strain setting, and the DRM is utilized to model seismic input motions coming from the outside domain of the CFS-PML. A partial differential equation (PDE)-constrained optimization method aims at minimizing a misfit between measured motions at sensors on the surface induced by targeted incident waves (or equivalent effective forces on a DRM boundary) and their reconstructed counterparts induced by estimated effective forces.

The numerical results show that the targeted effective forces can be accurately reconstructed. It is observed that the wave responses in a structure and soils in the domain induced by the targeted effective forces are in excellent agreement with those by the reconstructed ones. Therefore, the presented method can help engineers to replay seismic responses of structures and soils from limited seismic measurement data and estimate the impact of earthquake waves on infrastructures.