Title: Optimized Schwarz preconditioners for finite difference and finite element acoustic simulations

Abstract: Frequency-domain Full Waveform Inversion (FWI) of long-offset node data can be designed with a few discrete frequencies hence allowing for compact volume of data to be managed. However, 3D frequency-domain seismic modeling is challenging since it requires solving a large and sparse indefinite linear system per frequency with multiple right-hand sides (RHS). Direct solvers are very efficient to process multiple RHS but may suffer from limited scalability for very large problems, while iterative methods equipped with a domain decomposition preconditioner can provide a suitable alternative to process large computational domains for sparse node acquisition.
We investigate the domain decomposition preconditioner based on the optimized restricted additive Schwarz (ORAS) method, where a Robin or Perfectly-Matched Layer (PML) condition is implemented at the subdomain boundaries.
The accuracy, computational cost and scalability of the method are assessed against several realistic benchmarks. For the discretization, we compare a compact wavelength-adaptive 27-point finite-difference stencil with a P${}_3$ finite-element method on h-adaptive tetrahedral mesh. The scalability of the method, the block processing of multiple RHS and the straightforward implementation of attenuation, which further improves the convergence of the solver, make the method a versatile forward engine for large-scale 3D FWI applications from sparse node data sets.