An Efficient Two-Level Preconditioner for Multi-Frequency Wave Propagation Problems

Manuel Baumann [1]

We consider wave propagation problems that are modeled in the frequency-domain, and that need to be solved simultaneously for multiple frequencies within a fixed range. For this, a single shift-and-invert preconditioner at a so-called seed frequency is applied. The choice of the seed is crucial for the performance of preconditioned multi-shift GMRES and is closely related to the parameter choice for the Complex Shifted Laplace preconditioner. Based on a classical GMRES convergence bound, we present an optimal seed parameter that purely depends on the original frequency range. The new insight is exploited in a two-level preconditioning strategy: A shifted Neumann preconditioner with minimized spectral radius is additionally applied to multi-shift GMRES. Moreover, we present a reformulation of the multi-shift problem to a matrix equation solved with, for instance, global GMRES. Here, our analysis allows for rotation of the spectrum of the linear operator. Numerical experiments for the time-harmonic elastic wave equation demonstrate the performance of the new preconditioners.

This is joint work with M. B. van Gijzen.

---

[1] Delft University of Technology, Netherlands (m.m.baumann@tudelft.nl)