

Domain-decomposition preconditioning for frequency-domain wave problems

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Abstract: There is currently large research interest in finding optimal-in-time solvers for finite-element discretisations of frequency-domain wave problems, such as the Helmholtz and time-harmonic Maxwell equations, when the frequency is large. Ideally such solvers should also have good parallel scaling properties, be robust to heterogeneities in the material coefficients and come with theorems rigorously justifying their behaviour.

A common approach to this problem is trying to find good preconditioners to use when solving the linear systems with (F)GMRES. This talk will be about preconditioners built using

- (i) variants of classical additive-Schwarz domain-decomposition methods, and
- (ii) artificial absorption (similar to in the “shifted Laplacian” preconditioner involving multigrid).

The overall philosophy is to use PDE theory of the underlying boundary-value problems to tackle this linear-algebra problem of developing fast solvers.

The work on Helmholtz is joint with Ivan Graham (Bath), Eero Vainikko (Tartu), and Jun Zou (Chinese University of Hong Kong). The work on Maxwell is joint with Marcella Bonazzoli (Paris 6), Victorita Dolean (Strathclyde/Côte d’Azur), Ivan Graham (Bath), and Pierre-Henri Tournier (Paris 6).