

Inverse Problems Network Meeting 3

Thursday, 26th April 2018 - Friday, 27th April 2018

Centre for Inverse Problems, UCL

Abstract of Talk

DOMAIN-DECOMPOSITION PRECONDITIONING FOR LINEAR FREQUENCY DOMAIN WAVE PROBLEMS

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There is currently large research interest in finding optimal 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 material coefficients, and come with theorems rigorously justifying their behaviour.

Such problems occur regularly as the forward problem in practical inverse problems. For example the heterogeneous Helmholtz equation (and the corresponding frequency domain elastic wave equation) arise in seismic imaging (“full waveform inversion”).

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 the “shifted Laplacian” preconditioner involving multigrid).

The overall philosophy is to use, as much as possible, PDE theory of the underlying boundary-value problems to tackle this linear-algebra problem of developing fast solvers and to use the flexibility of domain decomposition methods in order to choose subdomain solvers which are suitable for solving wave propagation problems.

The work on Helmholtz is joint with 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/Cote d’Azur), and Pierre-Henri Tournier (Paris 6).