Alpines

JJL

Internship for Master 2
in Applied Mathematics

Domain decomposition for boundary integral formulations of wave propagation

Context This internship will focus on Domain Decomposition Methods (DDM) in the context of scalar wave propagation. It remains challenging to propose efficient DDM for high or even moderate frequency propagation problems. In the case of piecewise homogeneous propagation media, a natural idea consists in proposing a DDM built on top of a boundary integral formulation of the problem.

Boundary integral formulations consist in rewriting (a priori) volumic PDEs as equivalent equations posed only on the boundary of the computational domain. Although more complecated than volumic formulations of PDEs, integral formulations give rise to much less dispersive numerical methods. But still very little is known about DDM involving boundary integral operators.

Objectives The goal of this project is to investigate the performance of standard DDM in the context of so-called multi-trace boundary integral formulations, in 2D geometrical configurations. Here we shall focus on the local Multi-Trace Formulation (local MTF) introduced in [1]. The internship will start with a bibliographical work on boundary integral formulations of harmonic wave propagation and domain decomposition. Depending on the candidate, he shall then either conduct numerical experiments applying classical DDM (LU,Jacobi, Gauss-Seidel, GMRES) to the local MTF, or focus on the theoretical spectral analysis of the iteration operators associated to various DDM applied to simple problems.

Candidate profile The candidate should have a solid background on the numerical analysis of elliptic PDEs (variational theory of the laplacian, Lax-Milgram theorem, finite element method) and some programming experience, ideally in C++.

Practical information

Location: Jacques-Louis Lions Laboratory, Univ. Paris 6.
Duration: 5 month.

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Possible continuation of this work as a Ph.D. thesis a candidate providing satisfactory commitment for the present internship may be offered a PhD fellowship funded by ICS (Institut du Calcul Scientifique).

References

[1] R. Hiptmair & C. Jerez-Hanckes, *Multiple traces boundary integral formulation for Helmholtz transmission problems*, *Adv. Comput. Math.*, 37(1):39–91, 2012.