

Domain decomposition methods in FreeFEM with `ffddm`

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The idea behind `ffddm` is to simplify the use of parallel solvers in the open source finite element software FreeFEM. The `ffddm` framework is entirely written in the FreeFEM language. Thanks to `ffddm`, FreeFEM users have access to high-level functionalities for specifying and solving their finite element problems in parallel using scalable two-level Schwarz domain decomposition methods. The coarse space correction can be built either from a coarse mesh or using the GenEO (Generalized Eigenvalue in the Overlap) approach [1]. One can also use `ffddm` for learning and prototyping domain decomposition methods without compromising efficiency. The presentation includes numerical experiments for diffusion, elasticity and wave propagation problems [2]. In particular, large scale experiments illustrate the use of multilevel methods for the iterative solution of the coarse problem when it gets too large. This is a joint work with Frédéric Nataf, Pierre Jolivet and Frédéric Hecht. Numerical results are obtained using HPC resources from GENCI-CINES (Grant 2017- A0020607330).

[1] Spillane, N. and Dolean, V. and Hauret, P. and Nataf, F. and Pechstein, C. and Scheichl, R. Abstract Robust Coarse Spaces for Systems of PDEs via Generalized Eigenproblems in the Overlap. Numerische Mathematik, 2014.

[2] M. Bonazzoli, and V. Dolean, and I. G. Graham and E. A. Spence and P.-H. Tournier Domain decomposition preconditioning for the high-frequency time- harmonic Maxwell equations with absorption. Mathematics of Computation, 2019.

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