NEW ADVANCES ON MULTISCALE HYBRID-MIXED METHODS

DIEGO PAREDES AND FRÉDÉRIC VALENTIN

Abstract. The Multiscale Hybrid-Mixed method (or MHM for short), a finite element method, was presented in 2013 for solving the Laplace equation with a highly oscillatory permeability coefficient. This method appears as an attractive "divide-and-conquer" option to handle multiscale problems by naturally merging the effects of multiple scales to provide solutions with high-order precision on coarse meshes. The underlying upscaling procedure transfers to a set of basis functions the responsibility of achieving high orders of accuracy at scales smaller than the coarse mesh. The upscaling is built inside the general framework of hybridization, in which the continuity of the solution is relaxed a priori and imposed weakly through the action of Lagrange multipliers. This procedure characterizes the unknowns as the solutions of local problems with boundary conditions driven by the multipliers. The computation of local problems is embedded in the upscaling procedure, with local computations being completely independent and thus fitting naturally with parallel computation facilities. Since our first work, this methodology was extended for several problems, and new theoretical and computational features have been developed as a consequence. In this talk, we discuss some of these advances focusing on new discretization strategies its accuracy and computational performance.

Keywords: finite element method, multiscale method

Mathematics Subject Classifications (2010): 65C20, 65M12, 65Y20

References

[1] C. Harder, D. Paredes and F. Valentin A family of multiscale hybrid-mixed finite element methods for the Darcy equation with rough coefficients. *Journal of Computation Physics*, Vol. 245, pp. 107-130, 2013.

[2] C. Harder, D. Paredes, and F. Valentin On a multiscale hybrid-mixed method for advective-reactive dominated problems with heterogenous coefficients. *SIAM Multiscale Model. and Simul.*, Vol. 13, No. 2, pp. 491–518, 2015.

[3] S. Lanteri, D. Paredes, C. Scheid, and F. Valentin The Multiscale Hybrid-Mixed method for the Maxwell Equations in Heterogeneous Media *SIAM Multiscale Model. and Simul.*, Vol. 16, No. 4, pp. 1648-1683, 2018.

Pontificia Universidad Católica de Valparaíso
E-mail address: diego.paredes@pucv.cl

Laboratório Nacional de Computação Científica
E-mail address: valentin@lncc.br