NUMERICAL MULTISCALE METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS POSED IN DOMAINS WITH ROUGH BOUNDARIES

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There is an extensive literature dealing with numerical aspects of PDEs posed on domains with rough boundaries, see for instance the work of Barrenechea, Le Tallec, and Valentin [1]. Imposing effective boundary conditions, a.k.a. wall laws, is the preferred way to avoid (expensive) discretizations of intricate boundaries. The trouble is that this was done only for "periodic" boundaries, to the best of my knowledge.

In this work, I propose a novel Finite Element scheme that overcomes this barrier. The analysis is still restricted to periodic boundaries, but the method itself is more general.

As in the Multiscale Finite Element Method [2], the basis functions are local (element-wise) solutions of the original problem, and, "capturing" the local features of the problem, upscales the information into the global formulation. After the basis functions are defined, the numerical solution is found by using the Galerkin method.

References

[1] Gabriel R. Barrenechea, Patrick Le Tallec, and Frédéric Valentin, *New wall laws for the unsteady incompressible Navier-Stokes equations on rough domains*, M2AN Math. Model. Numer. Anal. **36** (2002), no. 2, 177–203.MR1906814 (2003k:76104)

[2] Thomas Y. Hou and Xiao-Hui Wu, *A multiscale finite element method for elliptic problems in composite materials and porous media*, J. Comput. Phys. **134** (1997), no. 1, 169–189.MR1455261 (98e:73132)

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