Seminários do Mestrado em MATEMÁTICA

Palestra de abertura do 2º semestre de 2015

Data: 13 de Agosto de 2015
Horário: 14:00
Local: Anfiteatro do DM - UFJF

Título: A Multiscale Mixed Method for Porous Media Flows: Design and Implementation.

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RESUMO

We are concerned with the development of multiscale numerical methods for the efficient simulation of very large reservoir flow problems, such as those occurring in Brazil's oil reserves in the pre-salt layer. These reservoirs are very deep (the depth of typical reservoirs is only a few meters; the pre-salt reservoirs may reach 3 Km in depth). The accurate numerical simulation of such reservoirs presents new research challenges because currently available simulators have been designed to handle considerably smaller reservoirs. Simulators should be able to take advantage of state-of-the-art multi-core hardware to produce fast and accurate numerical results.

In the case of second order elliptic and parabolic equations multiscale procedures have the potential to fit well within the aforementioned computational environments because large computational problems are decomposed in smaller problems that may be efficiently solved in multiple cores.

We discuss the development of a new multiscale mixed method for the fast and accurate approximation of the velocity field in subsurface flows. The new procedure is closely related to a recent work [1] (see also [2], where the domain decomposition procedure used in [1] was proposed), where the Multiscale Mixed Method (MuMM) was introduced. The method of [1] and the work discussed here share some distinctive properties:

- The approximation is locally conservative through the use of mixed finite elements. Discontinuous coefficients and source terms can be considered.
- Three length scales are introduced in the definition of the procedure: the solution is sought in the finest scale; multiscale basis functions are defined in the subdomains associated with the coarsest scale. Flux conservation is directly imposed in an intermediate scale. If the finest and coarsest scales are the same then the new method produces the mixed finite element solution in the finest scale.
- A downscaling procedure ensures local conservation at the finest scale.
- The procedures fit well in heterogeneous processing units (CPU-GPU): all the local problems can be efficiently solved in GPUs. These local problems are relatively small and fit in the GPU memory.

The two procedures differ in that the method presented here has improved computational efficiency because an iterative procedure of the MuMM is replaced by a new algorithm for the clustering of multiscale basis functions. Numerical results will be presented and discussed.

[1] Francisco A., Ginting, V., Pereira, F. and Rigelo, J., Design and implementation of a multiscale mixed method based on a nonoverlapping domain decomposition procedure, Math. Comput. Simul., vol. 99, issue C (2014) 125-138.
[2] Douglas, Jr., J., Paes~Leme, P. J., Roberts, J. E., and Wang, J., A parallel iterative procedure applicable to the approximate solution of second order partial differential equations by mixed finite element methods, Numer. Math., 65 (1993) 95--108.

PUBLICO ALVO

Alunos de graduação e pós-graduação. Palestra será em português

UNIVERSIDADE FEDERAL DE JUIZ DE FORA

Departamento de Matemática

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