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# Numerical Solution to Stokes Equations on the block structured adaptive mesh refinement approach including matrices representation

Hector D. Ceniceros[†], Alexandre M. Roma[‡], Catalina M. Rúa[*]

[†] UCSB Santa Barbara - California, USA
[‡] USP - São Paulo, SP
[*] UdeNar, San Juan de Pasto, Colombia

**Resumo**

The present work has been motivated by the study of incompressible flows at low Reynolds numbers. In the limit, as the Reynolds number approaches to zero, the dynamics of the system is modeled by the steady Stokes equations. An adaptive version of Uzawa Method using the Biconjugate gradient stabilized method and some matrices representation are proposed to solve those equations with Dirichlet boundary conditions on locally refined grids [1]- [2]. Adaptive mesh refinements increase locally the resolution of the method to improve accuracy at low computational cost and the matrices allow us to use preconditioners [4].

A finite difference approach is used for the discretization of the fluid velocity in a staggered fashion and Uzawa Method is employed to handle the pressure-velocity coupling in primitive variables [3]. To solve the resulting set of algebraic equations, the matrix representing the discretization on the adaptive grid is built and the related linear system solved by PETSc (Portable, Extensible Toolkit for Scientific Computation, *www.mcs.anl.gov/petsc*) library.

We are interesting in give the numerical results to impose problems and test several methods with suitable preconditioners to solve some linear systems.

## Referências

[1] Berger, M. J.; Colella, P. *Local Adaptive Mesh Refinement for shock hydrodynamics*. Journal of Computational physics 82, 64-84 (1989).

[2] Kim, S.D. *Uzawa algorithms for coupled Stokes equations from the optimal control problem.* CALCOLO 46, 37-47 (2009).

[3] Klein, H. D.; Leal, L. G.; Garcia-Cervera, C. J. and Ceniceros H. D.; *Computational studies of the shear flow behaviour of a model for nematic liquid crystalline polymers.* ANZIAM J. 46, C210-C244, (2005).

[4] Pletzer, A.; Jamroz B.; Crockettv R.; Sides, S. *Compact cell;centered discretization stencils at fine-coarse block structured grid interfaces.* Journal of Computational physics 260, 25-36, (2014).