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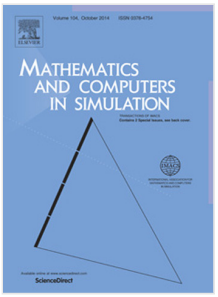

Efficient methods for solving the Stokes problem with slip boundary conditions

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Abstract

The paper deals with the Stokes flow with the threshold slip boundary conditions. A finite element approximation of the problem leads to the minimization of a non-differentiable energy functional subject to two linear equality constraints: the impermeability condition on the slip part of the boundary and the incompressibility of the fluid. Eliminating the velocity components, one gets the smooth dual functional in terms of three Lagrange multipliers. The first Lagrange multiplier regularizes the problem. Its components are subject to simple bounds. The other two Lagrange multipliers treat the impermeability and the incompressibility conditions. The last Lagrange multiplier represents the pressure in the whole domain. The solution to the dual problem is computed by an active set strategy and a path-following variant of the interior-point method. Numerical experiments illustrate computational efficiency.

Keywords: Stokes problem, slip boundary condition, active-set algorithm, interior-point method

1. Introduction

Observing a fluid flow along a solid impermeable wall, one can observe in some applications a non-zero tangential velocity of the fluid that may depend on a material of the wall or its shape. Such behaviour of the fluid is usually simulated by slip boundary conditions used for modelling the blood flow, the

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