An Optimal Control Model to Determine Body Forces of Stokes Flow

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Abstract : In this paper, we will determine the external body force distribution with analysis of stokes fluid motion using mathematical modelling and numerical approaching. The body force distribution is regarded as the unknown variable and could be determined by the idea of optimal control theory. The Stokes flow motion and its velocity are generated by given forces in a unit square domain. A regularized objective functional is built to match the numerical result of flow velocity with the generated velocity data. So that the force distribution could be determined by minimizing the value of objective functional, which is also the difference between the numerical and experimental velocity. Then after utilizing the Lagrange multiplier method, some partial differential equations are formulated consisting the optimal control system to solve. Finite element method and conjugate gradient method are used to discretize equations and deduce the iterative expression of target body force to compute the velocity numerically and body force distribution. Programming environment FreeFEM++ supports the implementation of this model.

Keywords : optimal control model, Stokes equation, finite element method, conjugate gradient method

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