

SHAPE OPTIMIZATION IN STOKES PROBLEMS WITH STICK-SLIP BOUNDARY CONDITIONS

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Abstract

This contribution addresses the numerical solution of shape optimization problems in fluid mechanics, formulated as the Stokes problem with Navier-Tresca stick-slip boundary conditions. In these problems, the objective is to minimize a composite function that depends on the shape of the domain boundary. To evaluate the objective for a given boundary shape, it is necessary to solve the so-called state problem, which, in this context, is the Stokes problem with Navier-Tresca stick-slip boundary conditions. The composite function in question is typically nondifferentiable because of the nonlinear nature of the boundary conditions imposed. As a result, the considered problem is thus described as a nonsmooth optimization problem, requiring specialized numerical techniques. For such nonsmooth optimization problems, traditional smooth gradient-based optimization algorithms are often inadequate. Therefore, we employ the bundle trust method, which is well-suited for nonsmooth optimization. This method operates iteratively and, at each step, requires evaluating the objective function and computing an arbitrary subgradient from the generalized gradient. In our implementation, we approximate this subgradient numerically.

The aim of the contribution is to present methods for solving shape optimization problems for Stokes problems with stick-slip conditions and to present some numerical experiments.