

Numerical Simulation of the Free Fall Problem

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Abstract: The numerical simulation of the free fall of a solid body in a viscous fluid is a challenging task since it requires computational domains which usually need to be several order of magnitude larger than the solid body in order to avoid the influence of artificial boundaries. Toward an optimal mesh design in that context, we propose a method based on the *weighted* a posteriori error estimation of the finite element approximation of the fluid/body motion. A key ingredient for the proposed approach is the reformulation of the conservation and kinetic equations in the solid frame as well as the implicit treatment of the hydrodynamic forces and torque acting on the solid body in the weak formulation. Informations given by the solution of an adequate dual problem allow to control the discretization error of given functionals. The analysis encompasses the control of the free fall velocity, the orientation of the body, the hydrodynamic force and torque on the body. Numerical experiments for the two dimensional sedimentation problem for symmetric and nonsymmetric bodies validate the method.

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