Numerical Computation of Added Mass of 2D Object in Unsteady Flow between Walls

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ABSTRACT

The added mass of an object partially or fully submerged in an unsteady flow has been of interest to researchers for many years, and objects of simple geometry such as circular cylinders and spheres have been extensively investigated for added mass in unbounded domain. However, there are very limited researches that an object in the flow is located near the wall(s) or even within a tube, where the viscosity plays additional important role.

This paper presents numerical computations employing the finite volume method for viscous, turbulent and unsteady flow around an object moving near the walls or inside a tube. In order to simulate the effects of unsteady motion of the object, a dynamic mesh of layering is utilized. It is well known that the drag increases drastically when an object is in the flow within a bounded domain, compared to that in an unbounded domain. The total force exerted on the object increases further when it moves with acceleration, and the force is known to consist of actual drag and added mass; however, it is yet unclear how to determine the added mass from the total force.

This study aims to determine the added mass by simulating the force exerted on an accelerating object between walls. The motion of the object in a liquid is imposed by a unidirectional gravitational acceleration. The preliminary results show that more than 90% of the total force is caused by the added mass due to the acceleration.

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