3D simulation considering surface condition of wall in particle method

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ABSTRACT

We have experimentally observed the forms of splash caused by spheres diving into water, where the spheres are made of hydro-gel or acrylic resin[1].

The experimental results have shown that the splash by the hydro-gel sphere has formed the crown-type one, whereas the acrylic sphere formed the column-type one despite the same experimental condition. This means that the surface condition of wall gives the important influence on the flow around an object, and thus we should take it into acount in the numerical simulation of the FSI.

In the most of the FSI studies, however, the wall of the solid or the structures is assumed to be as non-slip in the numerical simulation, which is not a realistic assumption.

We propose in this paper, focusing on the treatments of the interface between the solid and the fluid, the calculation methods for the slip effect on the surface of a slimy material.

First, as an engineering model to express the slimy surface, the slip ratio, which is the reduction ratio of the shear stress near a solid wall obtained through the experiment, is introduced in the shear term of the Navier-Stokes equation. Second, the effect of the electric attractive/repulsive force observed in acrylic resin is introduced into the Navier-Stokes equation as the external force.

The splash patterns calculated with the proposed models and the 3D large scale parallel computing are in good agreement with the experimental results.

REFERENCES

[1] M. Yokoyama, Y. Kubota, K. Kikuchi, G. Yagawa, and O. Mochizuki, “Some remarks on surface conditions of solid body plunging into water with particle method” *Advanced Modeling and Simulation in Engineering Sciences*, Vol. 1(1), pp.1-14 (2014).