Numerical and experimental study on splash formation with consideration of the surface condition of solid wall

M. Yokoyama*, K.Murotani†, O. Mochizuki†† and G. Yagawa†††

* School of Information Science, Meisei University, 2-1-1 Hodokubo, Hino, Tokyo, Japan
Correspondig auther, E-mail: masao.yokoyama@meisei-u.ac.jp

†School of Engineering, University of Tokyo 7-3-1 Hongou, Bunkyou, Tokyo, Japan

†† Faculty of Engineering, Toyo University, 2100 Kujirai, Kawagoe, Saitama, Japan

††† Nuclear Safety Research Association, 5-18-7 Shinbashi, Minatoku, Tokyo, Japan

ABSTRACT

The purpose of the present paper is to propose a method to simulate the splash formation taking account of the surface condition of the solid plunging into water.

Usually, the boundary condition between the solid and the fluid is supposed to be "no-slip" in the simulation of the fluid structure interaction (FSI). We discuss in this paper, however, that the above no-slip condition in the simulation is not always valid.

First, we have experimentally studied the patterns of splashes caused by different spheres diving into water, showing that the splash by the hydro-gel sphere is the crown-type one, whereas the acrylic sphere creates the column-type one despite the same experimental condition[1]. This means that the surface condition of the solid wall gives the important effect on the flow around an object, meanig that we should take it into acount in the numerical simulation of the FSI and the assumption of the interface to be "no-slip" in the numerical simulation may cause an unrealistic result.

Regarding the numerical models, we propose two diffrent methods of MPS method. 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 type force observed in the acrylic resin is introduced into the Navier-Stokes equation as the external force.

The splash patterns calculated with the above 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 Modelling and Simulation in Engineering Sciences*, Vol. 1(1), pp.1-14 (2014).