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Numerical Simulation of Fluid-Structure Interaction on Wedge Slamming Impact by Using Particle Method

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Abstract : The slamming impact problem has a very important engineering background. For seaplane landing, recycling for the satellite re-entry capsule, and the impact load of the bow in the adverse sea conditions, the slamming problem always plays the important role. Due to its strong nonlinear effect, however, it seems to be not easy to obtain the accurate simulation results. Combined with the strong interaction between the fluid field and the elastic structure, the difficulty for the simulation leads to a new level for challenging. This paper presents a fully Lagrangian coupled solver for simulations of fluid-structure interactions, which is based on the Moving Particle Semi-implicit (MPS) method to solve the governing equations corresponding to incompressible flows as well as elastic structures. The developed solver is verified by reproducing the high velocity impact loads of deformable thin wedges with two different materials such as aluminum and steel on water entry. The present simulation results are compared with analytical solution derived using the hydrodynamic Wagner model and linear theory by Wan.

Keywords : fluid-structure interaction, moving particle semi-implicit (MPS) method, elastic structure, incompressible flow, wedge slamming impact
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