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# Numerical Simulation of Waves Interaction with a Free Floating Body by MPS Method

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**Abstract :** In recent decades, a variety of floating structures have played a crucial role in ocean and marine engineering, such as ships, offshore platforms, floating breakwaters, fish farms, floating airports, etc. It is common for floating structures to suffer from loadings under waves, and the responses of the structures mounted in marine environments have a significant relation to the wave impacts. The interaction between surface waves and floating structures is one of the important issues in ship or marine structure design to increase performance and efficiency. With the progress of computational fluid dynamics, a number of numerical models based on the NS equations in the time domain have been developed to explore the above problem, such as the finite difference method or the finite volume method. Those traditional numerical simulation techniques for moving bodies are grid-based, which may encounter some difficulties when treating a large free surface deformation and a moving boundary. In these models, the moving structures in a Lagrangian formulation need to be appropriately described in grids, and the special treatment of the moving boundary is inevitable. Nevertheless, in the mesh-based models, the movement of the grid near the structure or the communication between the moving Lagrangian structure and Eulerian meshes will increase the algorithm complexity. Fortunately, these challenges can be avoided by the meshless particle methods. In the present study, a moving particle semi-implicit model is explored for the numerical simulation of fluid–structure interaction with surface flows, especially for coupling of fluid and moving rigid body. The equivalent momentum transfer method is proposed and derived for the coupling of fluid and rigid moving body. The structure is discretized into a group of solid particles, which are assumed as fluid particles involved in solving the NS equation altogether with the surrounding fluid particles. The momentum conservation is ensured by the transfer from those fluid particles to the corresponding solid particles. Then, the position of the solid particles is updated to keep the initial shape of the structure. Using the proposed method, the motions of a free-floating body in regular waves are numerically studied. The wave surface evaluation and the dynamic response of the floating body are presented. There is good agreement when the numerical results, such as the sway, heave, and roll of the floating body, are compared with the experimental and other numerical data. It is demonstrated that the presented MPS model is effective for the numerical simulation of fluid-structure interaction.

**Keywords :** floating body, fluid structure interaction, MPS, particle method, waves
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