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2D SIMULATION OF a FREE-FLOATING STRUCTURE MOTIONS IN WAVES OF a FLAPPING-TYPE WAVEMAKER

[roozbeh . panahi   ]

[Mehdi . Shafieefar   ]

Abstract
A numerical model to simulate motions of a free-floating structure in a wave tank is proposed based on finite volume discretisation. This is developed by implementing an overlapping mesh system consisting of three meshes. Two of them follow wavemaker's paddle forced motions as well as structure's free motions in waves. The last one which is a fixed mesh also covers the whole domain while it is responsible for meshes inter connections. By simulating a flapping-type wavemaker and recording three degrees of freedom of motions of a structure in front the generated waves using developed software, it is now obvious that the algorithm is capable of simulating other wavemakers as well as different hydrodynamic aspects of such problems.

Keywords: Overlapping Mesh, Fluid-Structure Interaction, Finite Volume, Wavemaker

1-INTRODUCTION

Along with extensive progresses in computational facilities, numerical hydrodynamics brings indispensable tools to deal with detailed assessment of marine infrastructures performance during their design and just before their construction. For example, in order to decide about implementing a floating breakwater for a distinct region, it would be a good chance if one could simply investigate all its hydrodynamic aspects under the specific wave pattern of the area. Experimental study is somehow useless in this regard, because it is very expensive. This is due to necessities to construct different models as well as to conduct many sets of experiments in order to have such an optimum arrangement of geometry and size, while keeping economic limits.

Such a fluid-structure interaction problem generally includes motions of a structure in the context of a free surface flow. Regarding difficulties in complete simulation of such a problem, there are always some assumptions in developing related codes. In other words, with a simple cost-benefit analysis, one can decide about the accuracy level and generality of its code according to range of encountered problems in this area.

In this study, a free rigid structure motions are simulated under a wavy environment of viscous incompressible fluids generated by a flapping-type wavemaker. To cope with different parts of the problem decisions have to be made about numerical algorithm details. All governing equations are discretised using finite volume method. A fractional step method is implemented to represent the flow field [1]. Also, a volume fraction transport equation is used to simulate free surface [1]. In order to handle bodies; floating structure and wavemaker paddle; an overlapping mesh system is used [2] among a wide variety of choices [3, 4]. Coupling these parts results in the final algorithm as will be introduced in the paper.

After developing code, a regular wave is generated using the flapping-type wavemaker in the computational domain. Meanwhile, all motions of the structure are recorded based on solving