TECHNICAL COMPARISON OF MOTION STRATEGIES IN FINITE VOLUME SIMULATION OF MARINE STRUCTURES HYDRODYNAMIC

Roozbeh Panahi **Mehdi Shafieefar**

roozbeh_panahi@yahoo.com ***shafiee@modares.ac.ir***

ABSTRACT

A number of motion strategies to handle fluid flow involving moving bodies have been appeared over the last two decades. They are frequently used in marine applications together with finite volume discretization as in the case of authors under development software. An appropriate choice among such strategies strongly helps to catch desired code capable of meeting all requirements while keeping the computational effort at an acceptable level.

In this paper, such strategies are briefly discussed in six categories and assessed based on common necessities in the area of marine structure hydrodynamic problems. Finally, some results are presented using two different motion strategies in the under development software. Body-attached mesh is implemented to calculate a three dimensional (3D) barge resistance in a two degree of freedom (2-DoF) steady forward motion and also overlapping mesh to investigate a 2D cylinder slamming in a 1-DoF free falling.

KEYWORDS: motion strategy, finite volume discretization, interfacial flow, marine structures, hydrodynamics

INTRODUCTION

The numerical solving of a mathematical model which describes the fluid flow, known as Computational Fluid Dynamics (CFD), is nowadays increasingly becoming a design tool in various parts of industrial product development. Numerous examples include flow around a car or an offshore structure or flow in an internal combustion engine, etc. This is a field of large expansion mainly due to the progress in computer technologies and the computational algorithms. Such an approach reduces costs, eliminates restrictions in data gathering, proposes full-scale studies and facilitates applying model geometrical changes in comparison to that of experiment while gives reliable results in many cases.

Fluid-structure interaction in sea environment is an important topic among marine structures related problems, which should be investigated in early design stages. Maneuverability of ships in restricted areas as well as harbors and channels, which results in modifying infrastructures, is a good example of such investigations. Dynamic positioning of platforms is another subject in this domain, which needs a complete model of structure's hydrodynamic behavior to forecast its motions due to wind, wave and current and consequently required loads to narrows its swing circle. All such problems have two main components which are:

- fluid and flow
- structure and motions

One must specifically decide about all aspects of these components by keeping all initial assumptions consistent with encountered problems, sea Table 1.

A regular marine environment can be depicted by below characteristics about its governing fluids (water and air) and flow:

- without surface tension
- homogeneous properties
- without suspended particles
- incompressible