naoe-FOAM-SJTU Solver with Efficient Overset Techniques for Ship Flows and Ocean Engineering Flows

Decheng Wan

State Key Laboratory of Ocean Engineering, School of Naval Architecture, Ocean and Civil Engineering, Shanghai Jiao Tong University, Collaborative Innovation Center for Advanced Ship and Deep-Sea Exploration, Shanghai 200240, China

E-mail: dcwan@sjtu.edu.cn

In this presentation, an in-house CFD solver naoe-FOAM-SJTU based on efficient overset techniques for simulating the complicated viscous flows around ship and ocean structures is introduced. The naoe-FOAM-SJTU solver is developed using the OpenFOAM toolbox and consists of main three special modules of numerical wave tank, 6DOF body motion module and mooring system module. In the numerical wave tank, several wave-makers including piston wave maker, flap wave maker and inlet wave boundary are developed to numerically generate regular waves, irregular waves, directional waves, freak waves, rogue waves, focused waves, etc. An artificial spongy layer is set up at the end of the computation domain to absorb the wave reflection. In the 6DOF body motion module, overset grid method is applied for handling body motion. The main procedure of the overset grid method consists of three steps: projection, hole cutting and fringe-point interpolation. The local body-fit grids are allowed to be arbitrarily embodied into an orthogonal background grid. Therefore the motion of ship and ocean structures in fluid can be treated easily by the overset grid technique without regenerating the mesh. In the mooring system module, three types of mooring lines using taut method, catenary method and piecewise extrapolation method are developed to treat the floating structures. In order to validate the solver, several numerical examples of flows around surface ship (Wigly, KCS, DTMB5415, Catamaran), green water of ship motion in waves, self-propulsion of ship motion, LNG tank sloshing, wave run-up and impact loads on floating platform with mooring system, VIV for risers and VIM for deep-sea platform, as well as wake flows of offshore floating wind turbine are presented.