NUMERICAL SIMULATION OF MOVING BOUNDARY PROBLEMS WITH THE NEW EULERAN METHOD

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ABSTRACT

A new pressure-based algorithm is developed and applied to compute incompressible flows with moving boundaries. In this paper results of testing and application of the developed numerical algorithm are presented. The testing results show good agreement with experimental data, analytical solution and other calculations. The numerical results of solving several complex industrial problems with free surface are presented.

Incompressible flows with moving boundaries are widespread in the natural phenomena and technological processes. Examples of such flows can be found in any industrial applications. From the practical point of view the most important of them are flow with free surface and moving solid bodies. The numerical simulation of the such problem it is very important to designing and optimization various devices.

For this purpose a numerical algorithm based on Reynolds-averaged Navie-Stocks equations discretized by means of the finite volume method was developed. The iterative velocity-pressure coupling for incompressible flows is realized via SIMPLE-C procedure on a collocated grid arrangement. For the closure of Reynolds averaged equations the two-layer k-ω Menter model of turbulence are used. For solving free surface flows we used widely known VOF method [1]. The validation of numerical method was carried out on a water dam break problem (2D and 3D cases), sloshing of water in an oscillating tank, problem of entry and emersion circular cylinder in the water, and many others. Numerical experiments have shown that the quality numerical results essentially depend on a discretisation scheme of transfer equation of liquid phase in a cell. So in the paper various convective schemes have been considered.

Highly-effective algorithm for solving of unsteady incompressible flow with moving boundaries was realized. A number of test problems were solved. The results of test calculations are in good agreement with experimental data. The algorithm was successfully applied for a several application problems. According to the results, suggestions which allow essential increasing efficiency of the equipment and technological processes were made.

References

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