Iterative Method for Solving Non-Linear Navier-Stokes Equations in Complex Domains Taking Into Account Boundary Conditions with Uniform Accuracy

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Abstract: In this report the Navier-Stokes equations describing the motion of viscous incompressible fluid in a bounded domain is considered. Method of fictitious domains is applied for approximate solution of the problem taking into account boundary conditions with uniform accuracy. The original problem is reduced to solving an auxiliary problem corresponding to the method of fictitious domains.

A theorem on the existence of the generalized solution to the auxiliary problem is proved. In addition, the convergence of the solution of the auxiliary problem to the solution of the original problem is proved.

Next, a difference scheme of the second order of approximation is constructed for the auxiliary problem. For a numerical solution of this difference problem, a special iterative method is constructed that determines approximate solutions on the boundary with uniform accuracy for a limited number of arithmetic operations.

To develop a new numerical implementation algorithm, the idea of the fictitious unknowns method with a two-step iterative process and a method for solving the Poisson difference equation in a square with the right-hand side different from zero only at nodes that are a distance of the order of the grid distance from a given piecewise smooth curve are used.

Keywords: method of fictitious domains, Navier-Stokes equations, numerical solution, auxiliary problem, convergence.

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