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On the numerical method for solving a hypersingular integral equation with the computation of the solution gradient

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Аннотация:
We consider a linear integral equation, which arises when solving the Neumann boundary value problem for the Laplace equation with the representation of the solution in the form of a double layer potential, with a hypersingular integral treated in the sense of Hadamard finite value. We consider the case in which the exterior or interior problem is solved in a domain whose boundary is a closed smooth surface and the integral equation is written over that surface. A numerical scheme for solving the integral equation is constructed with the use of quadrature formulas of the type of the method of discrete singularities with a regularization for the use of an irregular grid. We prove the convergence, uniform over the grid points, of the numerical solutions to the exact solution of the hypersingular equation and, in addition, the uniform convergence of the values of the approximate finite-difference derivative operator on the numerical solution to the values on the projection of the exact solution onto the subspace of grid functions with nodes at the collocation points.