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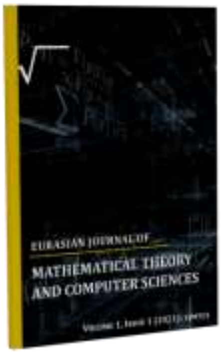

TWO-STEP IMPLICIT PISMAN-RICKFORD SCHEME FOR SOLVING THE LAPLACE EQUATION

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ABSTRACT

An analysis was made of determining the stationary temperature field in a solid body. For this, the Peaceman-Rickford finite-difference scheme is used [1]. To solve the elliptic equation, a two-step finite-difference scheme is used.

Introduction: The Laplace equations is a model equation for elliptic partial differential equations. In the Cartesian coordinate system, the two-dimensional Laplace equation has the form

$$\frac{\partial^2 U}{\partial x^2} + \frac{\partial^2 U}{\partial y^2} = 0 \qquad (1)$$

Some important problems are solved using an elliptic partial differential equation. Problems of calculating subsonic irrotational (potential) gas flow and determining the stationary temperature field in a solid body. Numerical method Consider the problem of temperature propagation in a pipe. In this case, equation (1) will take the following form

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0 \qquad (2)$$

Let us now turn to the study of the two-step finite difference Peaceman-Rickford scheme for solving the Laplace equation.

Step1.

$$T_{i,j}^{n+1/2} = T_{i,j}^{n} + \rho_n(\partial^2{}_x T_{i,j}^{n+1/2} + \partial^2{}_y T_{i,j}^{n})$$

Step2.

$$T_{i,j}^{n+1} = T_{i,j}^{n+1/2} + \rho_n(\partial^2{}_x T_{i,j}^{n+1/2} + \partial^2{}_y T_{i,j}^{n+1})$$

where $\partial^2{}_x T_{i,j}^{n+1/2}, \partial^2{}_y T_{i,j}^{n}$ and $\partial^2{}_y T_{i,j}^{n+1}$ are expressed as follows

$$\partial^2{}_x T_{i,j}^{n+1/2} = \frac{T_{i+1j}^{n+1/2} - 2T_{i,j}^{n+1/2} + T^{n+1/2}{}_{i-1,j}}{\Delta x^2}$$

$$\partial^2{}_y T_{i,j}^{n+1} = \frac{T_{i,j+1}^{n+1} - 2T_{i,j}^{n+1} + T^{n+1}{}_{i,j-1}}{\Delta y^2}$$

$$\partial^2{}_y T_{i,j}^{n} = \frac{T_{i,j+1}^{n} - 2T_{i,j}^{n} + T^{n}{}_{i,j-1}}{\Delta y^2}$$

Calculation result.
Figure 1. The result of the implicit Peaceman-Rickford method is displayed. 1. The Peaceman-Rickford method.

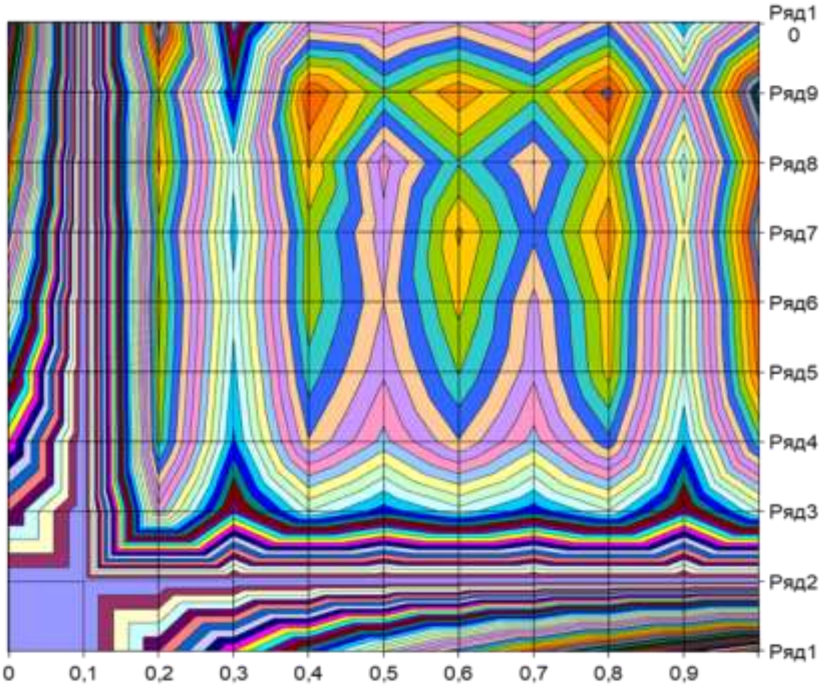

Fig1.

Conclusion. As a result of the calculation, it is shown that the distribution of temperature in a solid. It can be seen that, on the lower layers of the pipe, the temperature propagates in an irrotational flow.

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