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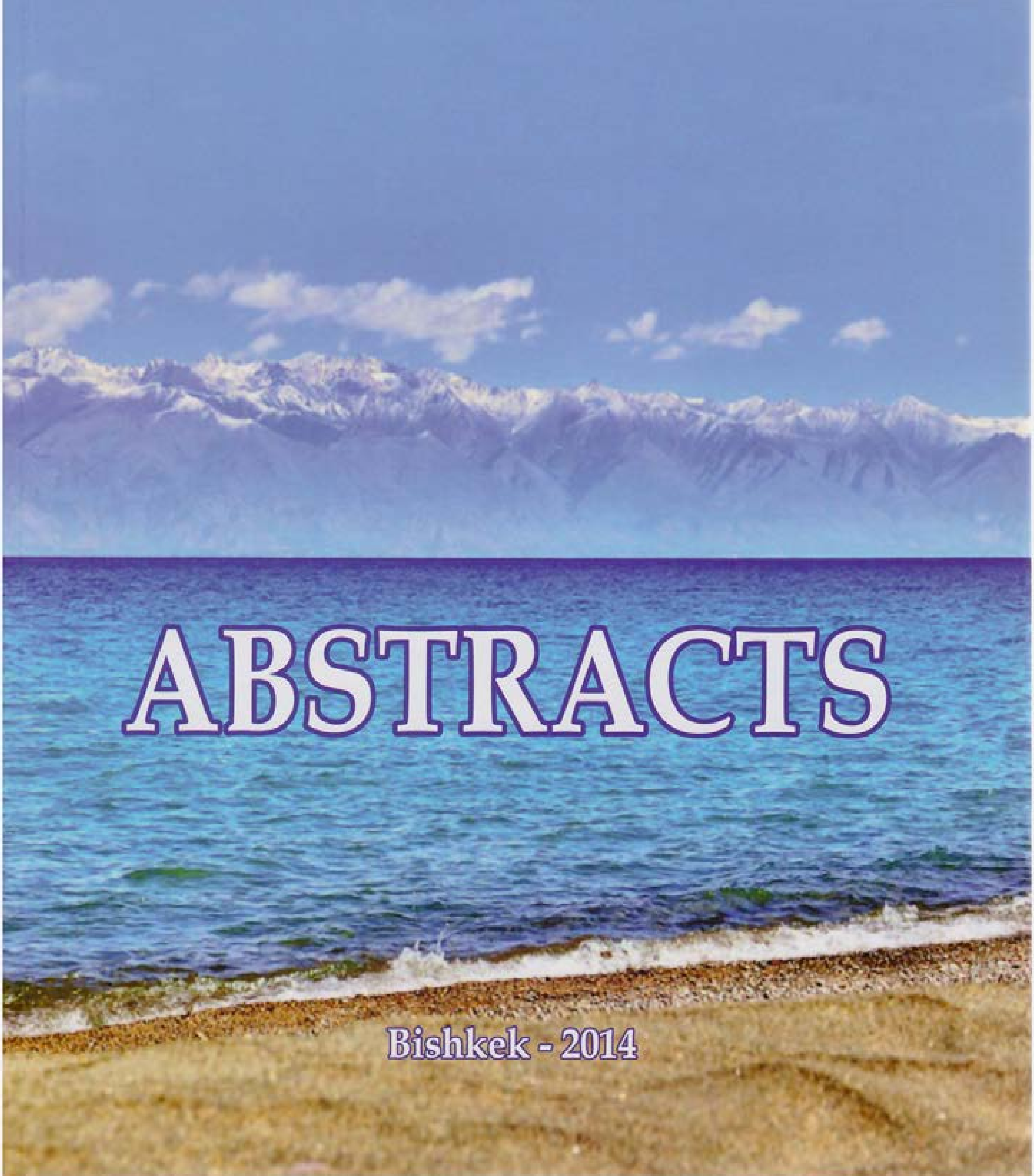

ABSTRACTS

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AN ITERATIVE ALGORITHM FOR NUMERICAL SOLUTION OF HEAT CONVECTION EQUATIONS

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The report focuses on the numerical solution of stationary differential problems in the region $D = \{0 < x_\alpha < 1, \alpha = 1, 2\}$ for two-dimensional heat convection equations can be written in the following form [1]:

$$\left(\omega\frac{\partial\psi}{\partial x_2}\right)_{x_1} - \left(\omega\frac{\partial\psi}{\partial x_1}\right)_{x_2} = \frac{1}{Re}\Delta\omega - \frac{Gr}{Re^2}\frac{\partial\theta}{\partial x_1} + f(x_1, x_2), \tag{1}$$

$$\Delta\psi = \omega, \tag{2}$$

$$\left(\theta\frac{\partial\psi}{\partial x_2}\right)_{x_1} - \left(\theta\frac{\partial\psi}{\partial x_1}\right)_{x_2} = \frac{1}{PrRe}\Delta\theta + g(x_1, x_2), \tag{3}$$

here Pr - Prandtl number, Re - Reynolds number, Gr - Grashof number, Δ - Laplace operator.

Considered an iterative algorithm of the type of variable directions, using by conducting auxiliary function of the vorticity with homogeneous boundary values in the following form:

$$\frac{\omega^{n+\frac{1}{2}} - \omega^n}{\tau} + L_{h,\psi}(\omega^n)\psi^{n+\frac{1}{2}} = \frac{1}{Re}\Delta_h\omega^n - \frac{Gr}{Re^2}\theta^n_{\overset{\circ}{x}_1} + \rho_h\psi^{n+\frac{1}{2}} + f_h, \tag{4}$$

$$\Delta_h\psi^{n+\frac{1}{2}} = \omega^{n+\frac{1}{2}}, \tag{5}$$

$$\frac{\omega^{n+1} - \omega^{n+\frac{1}{2}}}{\tau} = \frac{1}{Re}\Delta_h\left(\omega^{n+1} - \omega^n\right), \tag{6}$$

$$\Delta_h\psi^{n+1} = \omega^{n+1}, \tag{7}$$

$$L_{h,\theta}(\psi^n)\theta^{n+1} = \frac{1}{PrRe}\Delta_h\theta^{n+1} + g_h, \tag{8}$$

here $L_{h,\psi}, L_{h,\theta}$ - symmetric differential operators corresponding to the approximation of the convective terms in the equations of motion and temperature, $\rho_h > 0$.

An iterative algorithm of variational type minimal corrections for implementation of auxiliary non-self-adjoint grid equations was considered [2]. On example of the differential problem with boundary conditions:

$$x_1 = 0, 1;\ 0 \le x_2 \le 1 : \psi = \tfrac{\partial\psi}{\partial x_1} = 0,\ \theta = x_2,$$
$$0 \le x_1 \le 1,\ x_2 = 0 : \psi = \tfrac{\partial\psi}{\partial x_2} = \theta = 0,\ \ 0 \le x_1 \le 1,\ x_2 = 1 : \psi = \tfrac{\partial\psi}{\partial x_2} = \theta = 1,$$

discussion of the calculation result and software implementation details of the algorithm on a multi-processor cluster was conducted.

References

[1] Rouch P. (1980) Vychislitel'naya gidrodinamika. "Mir", Moskva, 616 p.
[2] Samarskiy A.A., Nikolaev E.S. (2004) Metody resheniya setochnykh uravneniy. "Nauka", Moskva, 592 p.

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