Fast pseudo-spectral method for multidimensional boundary-value problems and its applications

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Numerical method for solving one-, two- and three-dimensional boundary-value problems for the nonlinear elliptic equations is described. The method is based on application of Chebyshev approximations and on new way of forming and solving the systems of linear equations after discretization of the original differential problem. The estimates of the number of operations ($O(N^{d+1})$) and of the memory consumptions ($O(N^d)$) are proved, where N is the number of collocation nodes along one direction, d is the dimension of problem. A posteriori estimates of the approximation and round-off errors are derived. Numerical tests are performed to show the correspondence of theoretical estimates and practice. The proposed method is used for numerical simulation of polymer fluid flows and for computation and optimal design of composite lattice shells (Russian anisogrid).