Basic operators method extension for some 3D stationary astrophysical problems

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Support operator method (Samarskii's method, operator-difference method) has proven itself well in 2D numerical simulations of astrophysical problems. The idea of operator approach consists of inclusion of boundary conditions in finite difference form into the grid analogue of solving problem and formulation of the finite difference problem as operator equation. The finite difference operators are constructed in the way to fulfill corresponding relations between continuous operators (for instance, div(rot)=0, div is conjugated to -grad; div(grad) is self-conjugated etc.). The approach allows obtaining completely conservative finite difference schemes. The matrix which corresponds to the self-conjugated operator is symmetrical and can be inversed efficiently by modern iteration methods. We extended this method for three dimensional case. 3D grid analogues for continuous differential operators using a cell-node approximation were obtained. A test problem for calculation of spatial Newtonian gravitational potential was solved. The stationary heat transfer equation in spherical layer with Dirichlet boundary condition on the inner surface and third type boundary condition on the outer one was calculated. Some model results for anisotropic nonlinear heat transfer equation in neutron star outer crusts are shown.

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