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Shaidurov, Vladimir, Institute of Computational Modelling of Russian Academy of Sciences, Krasnoyarsk, Russia

Cascade finite element methods for weakly nonlinear elliptic equations

Dirichlet problem is considered for a weakly nonlinear elliptic equations of second order. Implementation of standard finite-element method with piecewise linear elements on triangles results in a system of nonlinear algebraic equations. To solve it, a cascade organization of conjugate-gradient method is used on sequence of nested grids and gives a simple version of multigrid without preconditioning and projection onto coarser grids. Cascade algorithm begins at a comparatively coarse grid where algebraic system is solved with sufficient accuracy. At each finer grid, nonlinear system is linearized by Newton method with "frozen derivative" and is approximately solved by conjugate-gradient method. It is proved that this algorithm has the optimal exponent at number of unknowns in computational complexity.