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A multi-level adaptive numerical method for nonlinear boundary value problems

Nonlinear boundary value problems occur in many practical applications in science and engineering. Classical iterative methods require a full linearizion of the nonlinear system. Multi-grid full approximation schemes (FAS) require a directional coarsening to significantly improve the rate of convergence for advection diffusion boundary value problems.

This work reports on the development of an efficient multi-level adaptive scheme for solving nonlinear advection-diffusion boundary value problems. A multi-level solver is proposed using the second generation adaptive wavelet collocation method (AWCM). The solver does not calculate explicitly the Jacobian of the nonlinear system. We have verified numerically that the CPU time remains approximately proportional to the number of grid points if the mesh is refined locally to resolve small scale features of the solution.