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Acceleration of incremental-pressure-correction incompressible flow computations using a coarse-grid projection method ALI KASHEFI, Engineering Science and Mechanics Program, Department of Biomedical Engineering and Mechanics, Virginia Tech, ANNE STAPLES, Associate Professor, Engineering Science and Mechanics Program, Department of Biomedical Engineering and Mechanics, Virginia Tech — Coarse grid projection (CGP) methodology is a novel multigrid method for systems involving decoupled nonlinear evolution equations and linear elliptic equations. The nonlinear equations are solved on a fine grid and the linear equations are solved on a corresponding coarsened grid. Mapping functions transfer data between the two grids. Here we propose a version of CGP for incompressible flow computations using incremental pressure correction methods, called IFEi-CGP (implicit-time-integration, finite-element, incremental coarse grid projection). Incremental pressure correction schemes solve Poisson's equation for an intermediate variable and not the pressure itself. This fact contributes to IFEi-CGP's efficiency in two ways. First, IFEi-CGP preserves the velocity field accuracy even for a high level of pressure field grid coarsening and thus significant speedup is achieved. Second, because incremental schemes reduce the errors that arise from boundaries with artificial homogenous Neumann conditions, CGP generates undamped flows for simulations with velocity Dirichlet boundary conditions. Comparisons of the data accuracy and CPU times for the incremental-CGP versus non-incremental-CGP computations are presented.

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