Abstract Submitted
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A coarse-grid-projection acceleration method for finite-element incompressible flow computations 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, FIN LAB TEAM[1] — Coarse grid projection (CGP) methodology provides a framework for accelerating computations by performing some part of the computation on a coarsened grid. We apply the CGP to pressure projection methods for finite element-based incompressible flow simulations. Based on it, the predicted velocity field data is restricted to a coarsened grid, the pressure is determined by solving the Poisson equation on the coarse grid, and the resulting data are prolonged to the preset fine grid. The contributions of the CGP method to the pressure correction technique are twofold: first, it substantially lessens the computational cost devoted to the Poisson equation, which is the most time-consuming part of the simulation process. Second, it preserves the accuracy of the velocity field. The velocity and pressure spaces are approximated by Galerkin spectral element using piecewise linear basis functions. A restriction operator is designed so that fine data are directly injected into the coarse grid. The Laplacian and divergence matrices are driven by taking inner products of coarse grid shape functions. Linear interpolation is implemented to construct a prolongation operator. A study of the data accuracy and the CPU time for the CGP-based versus non-CGP computations is presented.

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