

DIRECTIONAL COARSENING AND SMOOTHING FOR ANISOTROPIC NAVIER-STOKES PROBLEMS*

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Abstract. Unstructured multigrid techniques for relieving the stiffness associated with high-Reynolds number viscous flow simulations on extremely stretched grids are investigated. One approach consists of employing a semi-coarsening or directional-coarsening technique, based on the directions of strong coupling within the mesh, in order to construct more optimal coarse grid levels. An alternate approach is developed which employs directional implicit smoothing with regular fully coarsened multigrid levels. The directional implicit smoothing is obtained by constructing implicit lines in the unstructured mesh based on the directions of strong coupling. Both approaches yield large increases in convergence rates over the traditional explicit full-coarsening multigrid algorithm. However, maximum benefits are achieved by combining the two approaches in a coupled manner into a single algorithm. An order of magnitude increase in convergence rate over the traditional explicit full-coarsening algorithm is demonstrated, and convergence rates for high-Reynolds number viscous flows which are independent of the grid aspect ratio are obtained.

Key words. multigrid, anisotropic, Navier-Stokes.

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