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Direct Numerical Simulation of Drag Reduction in Turbulent Pipe Flow with Spanwise Wall Oscillation Using a Spectral Element Method ANDREW DUGGLEBY, KENNETH BALL, Virginia Polytechnic Institute and State University — Results of a direct numerical simulation of turbulent pipe flow with spanwise wall oscillation, using NEK5000, a spectral element Navier-Stokes solver, are presented. The polar-cylindrical coordinate singularity at the pipe axis is avoided by solving the flow in Cartesian coordinates with a stadium-like element cross-section. Near the center of the pipe, a Cartesian configuration is used, while near the wall, the elements are mapped to a polar configuration. Each element uses 10th order Legendre Lagrangian interpolants in each direction, with a local Jacobi/Conjugate Gradient solver and a global Schwarz Multigrid solver. Validation with previous DNS and experiments is performed for $Re_\tau = 180$ using 960 elements and a length of 10 R, and the drag reduction studies are performed at $Re_\tau = 150$ using 2560 elements and a length of 20 R. Comparisons will also be made with previous DNS and drag reduction studies. Results showing better correlation with experiments using a spectral method compared to a 2nd order finite difference radial discretizations will be presented.

Andrew Duggleby
Virginia Polytechnic Institute and State University

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