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Direct Numerical Simulation of Turbulent Flow in a Wavy Channel Using an Efficient, Novel, Spectral Method LUO WANG, KOSTAS HOUSIADAS, University of Delaware, PETER WAPPEROM, Virginia Tech, ANTONY BERIS, University of Delaware — A spectrally preconditioned biconjugate gradient algorithm has been developed to perform efficiently Direct Numerical Simulations (DNS) of Newtonian turbulent flow in a wavy channel. A transformation involving the shear direction only is applied to map the wavy geometry into a rectangular one so that a spectral approximation can be applied. DNS of Newtonian turbulent flow over a single sinusoidal wavy wall has been investigated at with the amplitude, wavelength of the undulation equal to 0.1, 2, respectively, based on the halfwidth of the channel. A fully implicit second order time integration scheme has been used with dealiasing along the periodic directions for all the non-linear terms using an influence matrix method to ensure the satisfaction of the divergence-free velocity condition (Housiadas and Beris 2004). The initial guess has been developed from the turbulent velocity profile obtained for a straight channel through the intermediate use of a pseudoconformal orthogonal coordinate system. The numerical results are compared against the experimental results reported in the literature (Hudson 1993). The influence of the wave amplitude on the structure of the turbulence is going to be discussed.

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