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Aspect ratio effects in turbulent duct flows studied with DNS R. VINUESA, IIT, Chicago, A. NOORANI, KTH, Stockholm, A. LOZANO-DURÁN, U. Politecnica de Madrid, P. SCHLATTER, KTH, Stockholm, P. FISCHER, Argonne National Lab, Chicago, H. NAGIB, IIT, Chicago — Three-dimensional effects present in turbulent duct flows, i.e., side-wall boundary layers and secondary motions, are studied by means of direct numerical simulations (DNS). The spectral element code Nek5000, developed by Fischer *et. al.* (2008), is used to compute turbulent duct flows with aspect ratios 1 and 3 in streamwise-periodic boxes of length $25h$ (long enough to capture the longest streamwise structures). The total number of grid points is 28 and 62 million respectively, and the inflow conditions were adjusted iteratively in order to keep the same bulk Reynolds number at the centerplane ($Re_{b,c} = 2800$) in both cases. Spanwise variations in wall shear, mean-flow profiles and turbulence statistics were analyzed with aspect ratio, and also compared with the 2D channel. The simulations were started from a laminar duct profile, and transition to turbulence was triggered by means of trip-forcing in the wall-normal direction, applied at the two horizontal walls. In addition, we developed a convergence criterion aimed at assessing the necessary averaging time T_A for converged statistics. We find that econdary motions present in duct flows require longer averaging times and the total shear-stress profile is not necessarily linear.

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