

Compressibility Effects and Sound Propagation in Turbulent Channel Flow

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Large-Eddy Simulations of supersonic channel flow and the advection of a passive scalar oscillating at the walls are presented. A new and non-local scaling of the wall co-ordinate is proposed, which yields significant improvement of the scaling of the mean velocity and temperature profiles with respect to the van Driest transformation. With this scaling, the spanwise correlations of the velocity fluctuations collapse at least up to Mach 2, with indication of a preferential streak spacing of about 120 of the proposed wall units. In the quasi-incompressible regime, the oscillating passive scalar obeys the laminar Stokes law at high driving frequencies and exhibits increasing wall shear at decreasing frequency in agreement with experimental and numerical results in pulsating shear flows. However, the established albeit controversial subrange of reduced shear is not recovered with this linearized scalar approach.

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