An investigation on transient flow behaviour in pulsating channel flows

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Abstract

DNS has been used to investigate the transient behaviour of turbulence for the pulsating flows. An in-house DNS/LES code, CHAPSim, has been adopted and used for the study. Simulations have been performed for channel flow at Reynolds number of Re_m=2800, where Reynolds number is based on the time-averaged bulk velocity and channel half-height. A wide range of pulsating frequencies and amplitudes has been simulated. Turbulence statistics and detailed flow behaviour are examined. Where possible, the simulations are validated against the physical experiments.

The preliminarily results show strong similarity between the pulsating and accelerating/decelerating flow for the behaviour of turbulence in the transient period. The transient development of the flow is characterised by a two-stage process resembling *pre-transition* and *transition* stages of boundary layer bypass transition (laminar-turbulent) and corresponding stages reported, in the literature, for the individual accelerating/decelerating (turbulent-turbulent) flows. The elongated low- and high-speed streaks are exhibited during the early stages of the transition. This is reflected into immediate but gradual response of the streamwise fluctuating velocities in the near-wall region while it remains almost unchanged in the core region. The wall-normal and spanwise components remain also approximately unchanged during the pre-transition stage and until the onset of transition when the fluctuating velocities and the Reynolds stress exhibit rapid changes.