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Reduction of turbulent skin-friction drag by oscillating discs
DANIEL WISE, PIERRE RICCO, None — A new drag-reduction method, based on the active technique proposed by Ricco & Hahn (2013), i.e. steadily rotating flush-mounted discs, is studied by DNS. The effect of sinusoidally oscillating discs on the turbulent channel-flow drag is investigated at $Re_\tau = 180$, based on the friction velocity of the stationary-wall case and the half channel height. A parametric investigation on the disc diameter, tip velocity and oscillation period yielded a maximum drag reduction of 18.5%. Regions of net power saved, calculated by considering the power spent to enforce the disc motion against the viscous resistance of the fluid, are found to reach up to 6.5% for low disc tip velocities. Significantly, the characteristic time-scale for the oscillating disc forcing is double that for the steadily rotating discs, representing a further step towards industrial implementation. The oscillating disc forcing, similar to the steadily rotating disc forcing, creates streamwise-elongated structures between the discs. These structures - largely unaffected by the periodic wall forcing and persisting throughout the entire period of the oscillation - are the main contributor to the additional Reynolds stresses term created by the disc forcing, and are important for the drag reduction mechanism.

Daniel Wise
None

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