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Reducing spin-up time for DNS and LES of turbulent channel flow[1] KURT NELSON, OLIVER FRINGER, Stanford Univ — In DNS or LES of turbulent channel flow, significant computational resources are wasted on simulation of flow evolution as it approaches statistical equilibrium. Although the driving pressure gradient that produces the desired time-averaged bottom stress is known a-priori, during flow spin-up this pressure gradient is typically not in balance with the time-averaged bottom stress, leading to flow acceleration beyond the target velocity which can significantly prolong the time to reach statistical equilibrium. Through DNS of turbulent channel flow with Re_τ =500, we present a method that ensures a time invariant volume-averaged streamwise velocity. While the method eliminates spin-up time related to approaching the target volume-averaged velocity, spin-up time is still needed for the turbulence to reach statistical equilibrium. To this end, we study the evolution of the turbulence in response to different initial velocity profiles and initial random perturbations and show that initialization with a laminar velocity profile significantly reduces spin-up time because the linear distribution of vertical shear triggers turbulence faster than it would with a log-law velocity profile.

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