Abstract Submitted
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Traveling wave solutions of large-scale structures in turbulent channel flow at $Re_\tau = 1000$.[1] YONGYUN HWANG, Department of Aeronautics, Imperial College London, ASHLEY WILLIS, School of Mathematics and Statistics, University of Sheffield, CARLO COSSU, Institut de Mcanique des Fluides de Toulouse — Recently, a set of stationary invariant solutions for the large-scale structures in turbulent Couette flow was computed at $Re_\tau \simeq 128$ using an over-damped LES with the Smagorinsky model which accounts the effect of the surrounding small-scale motions (Rawat et al., 2015, J. Fluid Mech., 782:515). In this talk, we show that this approach can be extended to $Re_\tau \simeq 1000$ in turbulent channel flow, towards the regime where the large-scale structures in the form of very-large-scale motions (long streaky motions) and large-scale motions (short vortical structures) energetically emerge. We demonstrate that a set of invariant solutions in the form of a traveling wave can be computed from simulations of the self-sustaining large-scale structures in the minimal unit with midplane reflection symmetry. By approximating the surrounding small scales with an artificially elevated Smagorinsky constant, a set of equilibrium states are found, labelled upper- and lower-branch according to their related wall shear stress. In particular, we will show that the upper-branch equilibrium state is a reasonable proxy for the spatial structure and the turbulent statistics of the self-sustaining large-scale structures.

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