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The Prominent Role of the Upstream Conditions on the Large-scale Motions of a Turbulent Channel Flow LUCIANO CASTILLO, SURANGA DHARMARATHNE, Purdue University, MURAT TUTKUN, University of Oslo, NICHOLAS HUTCHINS, The University of Melbourne — In this study we investigate how upstream perturbations in a turbulent channel flow impact the downstream flow evolution, especially the large-scale motions. Direct numerical simulations were carried out at a friction Reynolds number, $Re_\tau = 394$. Spanwise varying inlet blowing perturbations were imposed at $1\pi h$ from the inlet. The flow field is decomposed into its constituent scales using proper orthogonal decomposition. The large-scale motions and the small-scale motions of the flow field are separated at a cut-off mode number, M_c. The cut-off mode number is defined as the number of the mode at which the fraction of energy recovered is 55%. It is found that Reynolds stresses are increased due to blowing perturbations and large-scale motions are responsible for more than 70% of the increase of the streamwise component of Reynolds normal stress. Surprisingly, 90% of Reynolds shear stress is due to the energy augmentation of large-scale motions. It is shown that inlet perturbations impact the downstream flow by means of the LSM.

Suranga Dharmarathne
Purdue University

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