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Causal analysis of self-sustaining processes in the log-layer of wall-bounded turbulence[1] ADRIAN LOZANO-DURAN, HYUNJI JANE BAE, Stanford University, MIGUEL P. ENCINAR, Universidad Politecnica de Madrid — Despite the large amount of information provided by direct numerical simulations of turbulent flows, the underlying dynamics remain elusive even in the most simple and canonical configurations. Most standard methods used to investigate turbulence do not provide a clear causal inference between events, which is necessary to determine this dynamics, particularly in self-sustaning processes. In the present work, we examine the causal interactions between streaks and rolls in the logarithmic layer of minimal turbulent channel flow. Causality between structures is assessed in a non-intrusive manner by transfer entropy, i.e., how much the uncertainty of one structure is reduced by knowing the past states of the others. Streaks are represented by the first Fourier modes of the streamwise velocity, while rolls are defined by the wall-normal and spanwise velocities. The results show that the process is mainly unidirectional rather than cyclic, and that the log-layer motions are sustained by extracting energy from the mean shear, which controls the dynamics and time-scales. The well-known lift-up effect is shown to be not a key ingredient in the causal network between shear, streaks and rolls.

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