Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

New multi-scale causality analysis of streak-roll interactions in wall-bounded turbulence[1] X. SAN LIANG, Nanjing Institute of Meteorology, ADRIAN LOZANO-DURAN, Center for Turbulence Research, Stanford University
— An important observation in nonlinear dynamical systems in general, and turbulent flows in particular, is that, as time goes on, the correlation between two events may be lost and re-emerge. How the causality evolves between them is hence of particular interest. Using a newly developed rigorous causality analysis based on the information transfer, we have examined the causality evolution between the streaks and rolls within the wall-bounded turbulence of a channel flow model with doubly periodic boundaries. The streaks are represented with the low principal component modes of the streamwise velocity U, while the rolls are reflected in the spanwise velocity W and vertical velocity V. It is found that the causal relation mainly occurs between the lower U modes, i.e., the streak structures, and V and W. For U and V, the causality is almost one-way, i.e., from the streaks to V, and that from the first two U modes (domain modes hereafter) dominates. In contrast, no causal relation has been identified between the domain modes and W. The W-U causality is between W and the non-domain lower U modes, which are mutually causal, though the influence from the latter to the former dominates.

[1]Funded by the Center for Turbulence Research Summer Program

Adrian Lozano-Duran
Center for Turbulence Research, Stanford University

Date submitted: 01 Aug 2016 Electronic form version 1.4