Center for Fluid Mechanics Seminar

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Dynamical systems models of coherent structures in wall-bounded turbulence

In near-wall regions, turbulent flow is dominated by a few energetic structures. Aubry, Holmes, Lumley, and Stone (JFM 192, 1988) used proper orthogonal decomposition and Galerkin projection to develop low-dimensional dynamical systems models of coherent structures in the turbulent boundary layer. We examine Aubry et al.'s derivation in order to understand the models' lack of predictive accuracy (specifically, the treatment of boundary conditions, mean flow, and unresolved modes) and reformulate the problem for the more tractable case of plane Couette flow. This case shows model accuracy to be limited by the slow convergence of Galerkin projection and eddy-viscosity modeling. Yet numerical results show that the flow's evolution is largely determined by moderately low-dimensional states, suggesting that accurate dynamical systems models are possible, in principle.

Tuesday, January 20, 2004
Barus & Holley, Room 190
4:00pm