Abstract Submitted
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Dynamic K-L analysis of coherent structures based on DNS of turbulent Newtonian and viscoelastic flows[1] GAURAB SAMANTA, ANTONY BERIS, University of Delaware, ROBERT HANDLER, Naval Research laboratory, Washington, KOSTAS HOUSIADAS, University of the Aegean, Samos, Greece — Direct Numerical Simulation (DNS) data of a Newtonian and a viscoelastic turbulent channel flow is analyzed here through a projection of a time sequence of velocity fields into a set of Karhunen-Loeve (K-L) modes, large enough to contain, on the average, more than 90% of the fluctuating turbulence energy. The enhanced importance of large coherent structures in viscoelastic turbulent flows is exploited here, using K-L modes dynamically, to gain further quantitative insights into the behavior of the overall flow dynamics. A representational entropy is used in conjunction with fluctuating kinetic energy to show that viscoelastic turbulent flow is better organized than in the Newtonian limit. Dynamic correlations of pairs of K-L coefficients are used to quantify time scales that show an unsystematic increase with viscoelasticity. Calculating these correlations for K-L modes corresponding to different wavenumbers in the principal flow direction, in a moving frame of reference, allows us to detect coherent flow structures, their mean convective velocity, and locate turbulent events. Dependence of Newtonian case data on mesh-resolution, domain size and time-step of integration is investigated.

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