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Karhunen-Loéve analysis of coherent structures in viscoelastic turbulent channel flows GEOFFREY OXBERRY, University of Delaware, ROBERT HANDLER, Naval Research Laboratory, KOSTAS HOUSIADAS, ANTONY BERIS, University of Delaware — Direct numerical simulation data of viscoelastic turbulent channel flows from Housiadas et al. (Phys. Fluids, 17: 035106, 2005) were analyzed by decomposing the dynamic velocity fields into representative time-invariant eigenfunctions using the Karhunen-Loéve technique. Eigenfunctions were evaluated previously as explained in the aforementioned article. The dominant eigenmodes of flows (ranked by energy) display a structure similar to definitions of turbulent vortices in the literature. Therefore, time-dependent analysis of the velocity field in terms of those eigenfunctions allows one to evaluate the long time behavior of large, coherent structures in the flow. The comparison of the viscoelastic data, obtained with the FENE-P model, against results obtained for Newtonian turbulent channel flow allows for a better understanding of the role of viscoelasticity in turbulence modification leading to drag reduction.

Geoffrey Oxberry
University of Delaware

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