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Amplification of disturbances generated by localized body forces in channel flows of viscoelastic fluids GOKUL HARIHARAN, Department of Chemical Engineering and Materials Science, University of Minnesota, MIHAILO JOVANOVIC, Ming Hsieh Department of Electrical Engineering, University of Southern California, SATISH KUMAR, Department of Chemical Engineering and Materials Science, University of Minnesota — The study of non-modal amplification of distributed body forces in channel flows of viscoelastic fluids has provided useful insight into the mechanisms that may govern the initial stages of transition to elastic turbulence. However, distributed body forces are not easy to implement in experiments and there is a need to examine amplification of localized body forces. In this work, we use the linearized governing equations to examine such amplification in plane Poiseuille flow of FENE-CR fluids. We first identify the location at which the impulsive excitations experience the largest amplification and then analyze the energy of the fluctuations and resulting flow structures. For both a Newtonian fluid at high Reynolds number and a viscoelastic fluid at low Reynolds number, the largest amplification occurs for disturbances that are located near the channel wall. Analysis of the energy evolution shows that the localized point force directed in the spanwise direction has the largest impact and that the streamwise velocity is most affected. For viscoelastic fluids we observe the development of vortical structures away from the source of impulsive excitation, a feature absent in Newtonian fluids that may provide a mechanism for the initial stages of transition to elastic turbulence.

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