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Nonlinear Dynamics in Viscoelastic Jets[1] TRUSHANT MAJMUDAR, MATTHIEU VARAGNAT, GARETH MCKINLEY, Massachusetts Institute of Technology — Instabilities in free surface continuous jets of non-Newtonian fluids, although relevant for many industrial processes, remain poorly understood in terms of fundamental fluid dynamics. Inviscid, and viscous Newtonian jets have been studied in considerable detail, both theoretically and experimentally. Instability in viscous jets leads to regular periodic coiling of the jet, which exhibits a non-trivial frequency dependence with the height of the fall. Here we present a systematic study of the effect of viscoelasticity on the dynamics of continuous jets of worm-like micellar surfactant solutions of varying viscosities and elasticities. We observe complex nonlinear spatio-temporal dynamics of the jet, and uncover a transition from periodic to quasi-periodic to a multi-frequency, broad-spectrum dynamics. Beyond this regime, the jet dynamics smoothly crosses over to exhibit the "leaping shampoo" or the Kaye effect. We examine different dynamical regimes in terms of scaling variables, which depend on the geometry (dimensionless height), kinematics (dimensionless flow rate), and the fluid properties (elasto-gravity number) and present a regime map of the dynamics of the jet in terms of these dimensionless variables.

[1]Procter and Gamble

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