Two-dimensional analysis of local dynamics near pinch-off of viscoelastic filaments

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The study of filament formation and breakup has great importance in applications such as ink-jet printing, DNA micro-arraying etc. Liquids used in these applications commonly contain dissolved polymer and hence are viscoelastic. Thus, viscoelasticity must be included in models to analyze this phenomenon. Universal and self-similar behaviors have been shown to exist in the region of pinch-off for Newtonian filaments breaking in a medium of lower viscosity [1, 2]. Similar studies have been carried out for viscoelastic liquids, but under the simplifying assumption that the filaments are slender, and hence the governing equations are one-dimensional [3, 4]. This approximation is not accurate when the axial curvature is significant, and when interface folding occurs. We present here full 2D axisymmetric numerical calculations, and scaling analysis of pinching viscoelastic filaments. The fluid viscoelasticity is accounted through the conformation tensor [5]; the equations of the flow are solved with the DEVSS-TG/SUPG finite element method [6, 7] coupled with elliptic mesh generation.

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