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Computation of the Knife-Edge Cusp of a Rising Bubble in a Viscoelastic Fluid[1] RUOBO YOU, HOSSEIN HAJ-HARIRI, University of Virginia — We consider the buoyant rise of an originally-spherical bubble through a viscoelastic fluid. Experiments have demonstrated that the sharp trailing edge could develop a three dimensional cusp of "knife-like" shape under certain conditions (high capillary number, large drop size). In order to understand the complex physics of this phenomenon, we have conducted a linear, three-dimensional temporal stability analysis of a computationally-obtained axisymmetric cusped bubble. The in-house time-accurate code is control-volume based and uses a body-fitted grid. Flux-difference splitting is employed to handle large Deborah numbers. Artificial compressibility is used for time marching. The resulting eigenanalysis shows the only linearly-unstable mode to be the one with azimuthal wavenumber of 2. The eigenvalue is real and the nature of instability is an exchange of stability. Thus an axisymmetric cusp can indeed develop into a knife-like shape. An investigation of the energy production and dissipation for the disturbances shows that the normal pressure gradient of the base-state along the free surface plays an important role in the evolution of the instability.

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