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Adjoint-based Interfacial Control of Axisymmetric Viscous Drops[1] ALEXANDRU FIKL, DANIEL J. BODONY, Aerospace Department, University of Illinois at Urbana-Champaign — We develop a continuous adjoint formulation for the control of the deformation of a clean, neutrally buoyant droplet in Stokes flow. The focus is on constant surface tension-driven flows, where the interface is deformed with the local fluid velocity. We apply well-known results from the field of shape optimization to rigorously derive the optimality conditions for a wide range of interfacial problems. In the cases of interest, we make use of boundary integral methods as a natural choice for the numerical discretization of the flow variables. In the static case, our methodology is tested on several tracking-type cost functionals, corresponding to classic shape optimization problems. We show agreement with black-box finite difference-based gradients and accurate minimization of the cost functionals. Finally, we show that the methodology also applies to the control of the unsteady droplet deformation, controlled by external forcing in the form of the Capillary number.

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