High-accuracy simulation of free surface flows near finite-time singularities

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Motivated by applications such as ink jet printing, drop-by-drop manufacturing, sprays, and chemical separations, we study the dynamics of breakup and coalescence through high-accuracy simulation, theory, and experiment. In this talk, I will highlight our group's work on accurately capturing the fluid dynamics that takes place in the vicinity of finite-time singularities. The primary focus of the talk will be on simulations of the breakup of surfactant-covered filaments where I will pay special attention to the pinch-off singularity. I will also summarize some of our recent work on the pre- and post-coalescence singularities that arise when two drops or bubbles are driven together and made to merge into one.