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An Eulerian Framework for Numerical Simulations of Cavitating Bubble-Clouds near Viscoelastic Materials[1] JEAN-SEBASTIEN SPRATT, MAURO RODRIGUEZ, SPENCER BRYNGELSON, TIM COLONIUS, California Institute of Technology — Given the broad range of spatio-temporal scales involved, simulating cavitating bubble clouds and their interactions with soft materials is challenging. However, such simulations are necessary to predict many physical phenomena, with particular applications in biomedical engineering. These applications include shock-wave and burst-wave lithotripsy (BWL), histrotripsy, blunt trauma and traumatic brain injury. BWL, a therapy for ablating kidney stones, can entail particularly complex physical processes. This treatment focuses large-amplitude ultrasound waves near the stone to break it up. During therapy, bubble clouds can form and cavitate around the stone, affecting treatment efficacy. Modeling of bubble-cloud–stone–soft-material interactions is required to optimize stone comminution against surrounding soft tissue damage. The open-source solver MFC (Bryngelson et al., Comp. Phys. Comm., 2020) models the bubble cloud cavitation using a phase-averaging sub-grid model, and has been extended to include a hypoelastic Kelvin–Voigt model for linear elastic solids, both fully coupled to the background fluid dynamics. We demonstrate the capabilities of MFC to model BWL.

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