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Numerical Modeling of 3-D Dynamics of Ultrasound Contrast Agent Microbubbles Using the Boundary Integral Method MICHAEL CALVISI, Department of Mechanical and Aerospace Engineering, University of Colorado, Colorado Springs, KAWA MANMI, QIANXI WANG, School of Mathematics, University of Birmingham — Ultrasound contrast agents (UCAs) are microbubbles stabilized with a shell typically of lipid, polymer, or protein and are emerging as a unique tool for noninvasive therapies ranging from gene delivery to tumor ablation. The nonspherical dynamics of contrast agents are thought to play an important role in both diagnostic and therapeutic applications, for example, causing the emission of subharmonic frequency components and enhancing the uptake of therapeutic agents across cell membranes and tissue interfaces. A three-dimensional model for nonspherical contrast agent dynamics based on the boundary integral method is presented. The effects of the encapsulating shell are approximated by adapting Hoff's model for thin-shell, spherical contrast agents to the nonspherical case. A high-quality mesh of the bubble surface is maintained by implementing a hybrid approach of the Lagrangian method and elastic mesh technique. Numerical analyses for the dynamics of UCAs in an infinite liquid and near a rigid wall are performed in parameter regimes of clinical relevance. The results show that the presence of a coating significantly reduces the oscillation amplitude and period, increases the ultrasound pressure amplitude required to incite jetting, and reduces the jet width and velocity.

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