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Nonlinear oscillation and interfacial stability of an encapsulated microbubble under dual-frequency ultrasound MICHAEL CALVISI, University of Colorado, Colorado Springs, YUNQIAO LIU, Shanghai Jiao Tong University, QIANXI WANG, University of Birmingham — Encapsulated microbubbles (EMBs) are widely used in medical ultrasound imaging as contrast-enhanced agents. However, the potential damaging effects of violent, collapsing EMBs to cells and tissues in clinical practice have remained a concern. Dual-frequency ultrasound is a promising technique for improving the efficacy and safety of sonography. The EMB system modeled consists of the external liquid, membrane, and internal gases. The microbubble dynamics are simulated using a simple nonlinear interactive theory, considering the compressibility of the internal gas, viscosity of the liquid flow, and elasticity of the membrane. The radial oscillation and interfacial stability of an EMB under single and dual-frequency excitations are compared. The simulation results show that the dual-frequency technique produces larger backscatter pressure at higher harmonics of the primary driving frequency. This enriched acoustic spectrum can enhance blood-tissue contrast and improve sonographic image quality. The results further show that the acoustic pressure threshold associated with the onset of shape instability is greater for dual-frequency driving. This suggests that the dual-frequency technique stabilizes the EMB, thereby improving the efficacy and safety of contrast-enhanced agents.

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