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Dynamics of ultrasound-driven two-dimensional microbubbles
CHENG WANG, BHARGAV RALLABANDI, SASCHA HILGENFELDT, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign — Oscillating microbubbles driven by ultrasound are powerful actuators in microfluidics, with applications including mixing enhancement, particle manipulation, and cell lysis. The bubble dynamics is crucial towards the understanding of steady microstreaming flows. We experimentally characterize the oscillation modes and the frequency response spectrum of oscillating bubbles in 2D, driven by a pressure variation resulting from ultrasound in the range of $1\,\mathrm{kHz} \leq f \leq 100\,\mathrm{kHz}$. Using high-speed imaging, we analyze the oscillation modes of time-resolved bubble interface shapes. We find that (i) distinct, robust resonance patterns occur independent of details of the set-up, (ii) the position and width of the resonance peaks can be understood using an asymptotic theory approach, and (iii) the appearance of streaming flow patterns is governed by the *relative* amplitudes of bubble surface modes (normalized by the volume response). These results enable an understanding of streaming flow control through tuning of the driving frequency, with consequences for practical applications.

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