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Acoustic streaming in resonant viscous microfluidic systems
PEDER SKAFTE-PEDERSEN, HENRIK BRUUS, MIC - Department of Micro and Nanotechnology, Technical University of Denmark — Within the field of lab-on-a-chip systems large efforts are devoted to the development of onchip tools for particle handling and mixing in viscosity-dominated microflows. One technology involves ultrasound with frequencies in the MHz range, which leads to wavelengths of the order of $10^{-4} - 10^{-3}$ m suitable for mm-sized microchambers. Due to the nonlinearity of the governing acoustofluidic equations, second-order effects will induce steady forces to fluids and suspended particles through the effects known as acoustic streaming and acoustic radiation pressure. We present the basic perturbation approach for treating these effects in systems at resonance, where the amplitudes are maximized. The first-order eigenmodes are used as source terms for the time-averaged viscous second-order equations. The theory is applied to explain experimental results on aqueous microbead solutions in silicon-glass microchips [1].

[1] S. M. Hagsäter, T. Glasdam Jensen, H. Bruus and J. P. Kutter.
Acoustic resonances in microfluidic chips: full-image micro-PIV experiments and numerical simulations. Lab Chip, 2007, DOI: 10.1039/b704864e.

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