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Dynamics of microbubbles targeted to surfaces: numerical and experimental modelling

Richard Manasseh[a], Edward Payne[b] and Andrew Ooi[b]
[a]CSIRO, Fluid Dynamics Group, PO Box 56, Highett, VIC 3190 Melbourne, Australia
[b]University of Melbourne, Department of Mechanical & Manufacturing Engineering, Parkville, VIC 3010 Melbourne, Australia

Numerical calculations and illustrative experiments are presented on the volumetric oscillations of microbubbles on and near surfaces.
There is a considerable theoretical and experimental literature on the acoustic interactions of bubbles. In the present study, the surface was represented by a mirror-image bubble and the nonlinear frequency response calculated by integrating acoustically coupled sets of Rayleigh-Plesset-like equations.
A significant shift was found in the peak nonlinear response frequency of a bubble targeted onto a surface. This effect is increased when other bubbles are nearby on the surface. Owing to the asymmetric influence of the surface, experimental images were dominated by shape-mode instabilities, making optical determination of the peak nonlinear response frequency difficult.
Moreover, it was found that even if bubbles are separated by only a small fraction of the sound wavelength, time delays owing to the finite speed of sound have a surprisingly significant influence. Calculations on the symmetric mode of mutual oscillation showed that the introduction of time delays significantly modified harmonics of the spectrum.