

Abstract Submitted
for the SES05 Meeting of
The American Physical Society

Radial oscillation of a gas bubble in a fluid as a problem in canonical perturbation theory JAMES STEPHENS, University of Southern Mississippi — The oscillation of a gas bubble in a fluid is of interest in many areas of physics and technology. Lord Rayleigh treated the pressure developed in the collapse of cavitation bubbles and developed an expression for the collapse period. Minnaert developed a harmonic oscillator approximation to bubble oscillation in his study of the sound produced by running water. Oscillating bubbles are important to oceanographers studying the sound spectrum produced by water waves, geophysicists employing air guns as acoustic probes, mechanical engineers concerned with erosion of turbine blades, and military engineers concerned with the acoustic signatures developed by the propeller screws of ships and submarines. For the oceanographer, Minnaert's approximation is useful, for the latter two examples, Lord Rayleigh's analysis is appropriate. On the one hand, a bubble can be treated as a harmonic oscillator in the small amplitude regime, whereas even in the relatively moderate pressure regime characteristic of air guns the oscillation is strongly nonlinear and amplitude dependent. Is it possible to develop an analytic approximation that affords insight into the behavior of a bubble beyond the harmonic approximation of Minnaert? In this spirit, the free radial oscillation of a gas bubble in a fluid is treated as a problem in canonical perturbation theory. Several orders of the expansion are determined in order to explore the dependence of the oscillation frequency with bubble amplitude. The expansion to second order is inverted to express the time dependence of the oscillation.

James Stephens
University of Southern Mississippi

Date submitted: 29 Sep 2005

Electronic form version 1.4