Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Effects of bubble size distributions on acoustics of dilute bubbly liquids[1] KEITA ANDO, TIM COLONIUS, CHRISTOPHER BRENNEN, California Institute of Technology — We examine the acoustic properties of dilute bubbly liquids whose equilibrium bubble radius is widely scattered. First, we rigorously derive a continuum model for the mixture using an ensemble averaging technique. In computations of the averaged equations for polydisperse bubbles, there is a need to evaluate moments of the distribution of initial bubble radius, which are computationally prohibitive. For the case of impulsive pressure forcing, it is mathematically shown that inviscid bubble oscillations reach a statistical equilibrium and lead to time-invariant values of the moments due to phase cancellations amongst the different-sized bubbles. At statistical equilibrium, the moments can be computed using the period-averaged radius instead of the instantaneous one. The period-averaged formula enables us to substantially reduce the numerical effort associated with bubble size distributions. Based on the continuum model with the period-averaged formula, we solve linear wave propagation in the mixture and compare the results to the theory of Commander and Prosperetti (1989) to demonstrate the usefulness of the present model. We also show that distributions of bubble sizes effectively smooth out a rapid change of phase velocity and a sharp maximum of attenuation observed around resonance in the case of monodisperse bubbles.

[1]Supported by ONR Grant N00014-06-1-0730.

Keita Ando
California Institute of Technology

Date submitted: 05 Aug 2008

Electronic form version 1.4