ACOUSTICS2008/1708
Equilibrium state of a multi-size bubble population in a liquid

Svetlana Kovinskaya
Mechmath LLC, 14530 Bluebird Trail, Prior Lake, MN 55372, USA

A propagation of a linear pressure wave in the liquid with multi-size bubble population is investigated. The wave in the bubbly mixture is modeled as wave in the waveguide interacting with distributed resonators having different resonance frequencies. Each bubble sub-population has the frequency range of effective influence on the wave propagation. This range is started from the resonance frequency of the individual bubble and ended in dependency on the partial void fraction of this sub-population. Mutual influence of sub-populations leads to additional sound attenuation that in essence is a Landau damping. The dispersive equation for the propagating wave lets introduce a criterion for the equilibrium state of the bubbly mixture with multi-size bubble population. The equilibrium distribution which meets this criterion is found analytically. It is shown that the equilibrium distribution is an exact result from the resonant acoustical absorption theory. This theory is employed to find the bubble distribution from measured attenuation of the acoustical wave with assumption that only resonating bubbles contribute attenuation at the frequency of their resonance (neglecting off-resonance contributions). The deviation from the equilibrium contributes Landau damping into the resonant absorption. A dependency of Landau damping on the bubble size distribution is presented.