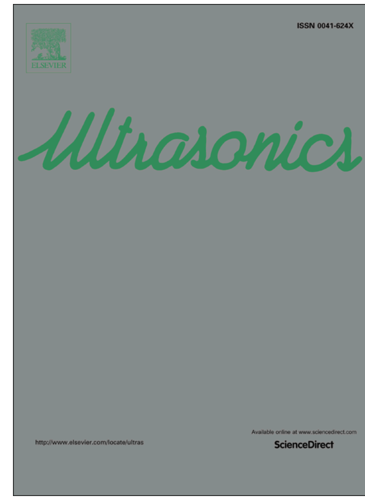
Accepted Manuscript



Dynamics of two interacting bubbles in a nonspherical ultrasound field

Jinfu Liang, Xun Wang, Jing Yang, Lunxun Gong

PII: S0041-624X(16)30312-2
DOI: http://dx.doi.org/10.1016/j.ultras.2016.11.012
Reference: ULTRAS 5415

To appear in: *Ultrasonics*

Received Date: 26 February 2016
Accepted Date: 20 November 2016

Please cite this article as: J. Liang, X. Wang, J. Yang, L. Gong, Dynamics of two interacting bubbles in a nonspherical ultrasound field, *Ultrasonics* (2016), doi: http://dx.doi.org/10.1016/j.ultras.2016.11.012

Dynamics of two interacting bubbles in a nonspherical ultrasound field

Jinfu Liang[a], Xun Wang[b], Jing Yang[b], Lunxun Gong[a]

[a]*School of Physics and Electronic Science, Guizhou Normal University, Guiyang 550001, China*
[b]*The Key Laboratory of Modern Acoustics, Ministry of Education, Institution of Acoustics, Nanjing University, Nanjing 210093, China*

Abstract

In this paper, we present and analyse a model of the oscillations of a pair of gas bubbles driven by nonspherical ultrasound. We derived our model based on the perturbation and potential flow theories and use it to study three cases of oscillation of two bubbles under driving ultrasound with different initial phases, different separation distances between the bubbles and different sound pressure amplitudes. For the driving ultrasound with different initial phases, we obtain the in-phase and anti-phase radial pulsations of the bubbles in incompressible liquid. We also study the effect of the secondary Bjerknes force on the oscillation of bubbles separated by different relative distances. Lastly, we analyse the ratio of a nonspherical to a spherical partial quantity, and the results show that the bubbles survive longer with decreases in both the pressure amplitude of nonspherical ultrasound and the initial bubbles radii.

Keywords: Nonspherical ultrasound field, Cavitation bubbles, Dynamics

1. Introduction

Acoustic cavitation, a phenomenon that forms some individual micro-sized gas bubbles, is generated in liquid irradiated with ultrasound waves of sufficiently intensity [1] . In the cavitation process, each bubble expands and then quickly collapses. Sometimes the phenomenon of light emission can be generated during bubble collapse, which is known as sononluminescence, due to high temperature and pressure [2, 3]. The dynamics of cavitation bubbles represent the foundation of sonochemistry and sonoluminescence. However, the dynamics of two cavitation bubbles remains an interesting question for study in the physics and acoustical communities.

Researchers have investigated the dynamics of two bubbles driven by ultrasound both theoretically and experimentally. For example, in early studies, V. F. K. Bjerknes [4] and C. A. Bjerknes [5] studied the mutual force between two pulsating gas bubbles in a liquid. This mutual force, today called the secondary Bjerknes force, can cause the bubbles to either attract or repel each other. The magnitude of the force between two bubbles has been found to be proportional to the inverse square of the separation distance between them. Recently, Barbat et al. [6] observed experimentally that two bubbles can undergo stable, periodic translational motion. Fujikawa et al. [7] theoretically investigated the interaction between two nonspherical cavitation bubbles in liquid. Doinikov [8] found that two bubbles can maintain a fixed separation distance and form a stable bound pair due

*Corresponding author
Email address: liang.shi2007@163.com (Jinfu Liang)