Chair: Physics of Fluids group

Cavitation from microcrevices in viscoelastic media

Description

Acoustic cavitation is the formation, oscillation and collapse of bubbles induced by acoustic waves. Researchers have found a plethora of industrial and medical applications for this phenomenon, such as ultrasonic cleaning, sonochemistry, lithotripsy or drug delivery. Usually acoustic cavitation is considered in the context of free bubbles. However, this project focuses on bubbles trapped in small crevices.

As a result of surface tension, such crevices entrap gas bubbles when submerged in a liquid. Upon application of acoustic pressure, these gas pockets start to oscillate. Our team developed a theoretical model that predicts this behaviour for predefined parameters of a liquid medium. Now we turn our interest to cavitation in viscoelastic media.

Your task will be to work with our team on investigation of oscillations of bubbles trapped in small crevices in viscoelastic media. You will use experimental methods such as Laser Doppler Vibrometry (LDV) or Digital Holographic Microscopy (DHM) (Fig. 1) and a developed in-house data processing code to extract information about modes of oscillations of the surface of a gas bubble. Additionally, you will work on development of a model and simulations predicting these oscillations. Note that this is mostly a basic research study that aims to understand the physics behind the phenomenon. However, one practical application of such measurements may be detection of medium's viscoelastic parameters.

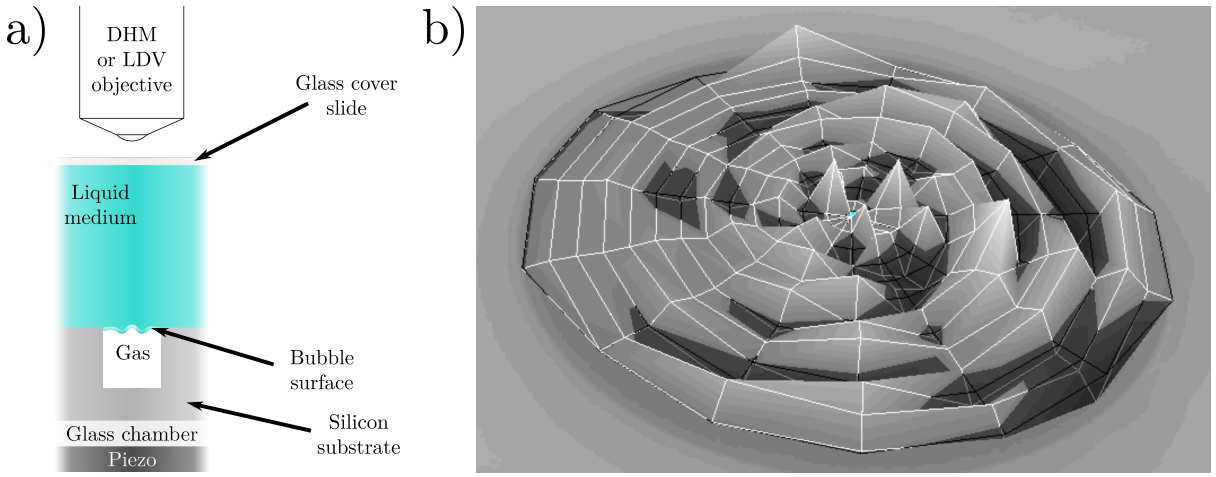

Figure 1: a) Experimental setup to be used in the assignment. b) An example of results obtained using LDV: a frame corresponding to oscillations of a crevice bubble in PDMS, excited at 211.5 kHz.

Assignment

The assignment may consist of (exact scope to be discussed with and adjusted to the candidate):

1. experimental investigation of oscillations of pinned bubbles in viscoelastic media (experiments using LDV/DHM, data processing and analysis using Matlab and/or Python),
2. development of a theoretical model predicting oscillations of crevice bubbles in viscoelastic media,
3. development of simulations predicting the abovementioned phenomenon.

We expect the candidate to have a good background in physics and/or acoustics as well as some experience in programming in Matlab and/or Python.

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