Conceiving new acoustic metamaterials with bubbles

Research internship (2024)

Laboratory: Laboratoire Interdisciplinaire de Physique (LIPhy), Grenoble, France
Supervisor: Dr. Dorian Bouchet

Project description

Air bubbles in water are excellent acoustic resonators. Their ability to strongly interact with acoustic waves has led to the development of acoustic metamaterials made of bubbles, for instance in order to turn acoustic reflectors into perfect absorbers [1].

In this project, the main objective will be to **conceive a new kind of acoustic metamaterial using a structured cloud of bubbles**. On the conceptual side, in order to understand the collective emission properties of bubbles, the project will be based on the analogy that can be made between acoustic experiments involving resonating bubbles and quantum optics experiments involving cold atoms [2]. On the experimental side, the project will benefit from the unique expertise at LIPhy to trap air bubbles in cages that are fabricated using 3D printing technology [3]. Finally, in order to conceive acoustic metamaterials with optimal properties, the project will involve employing powerful tools developed by the deep-learning community, such as efficient optimizers based on automatic differentiation.

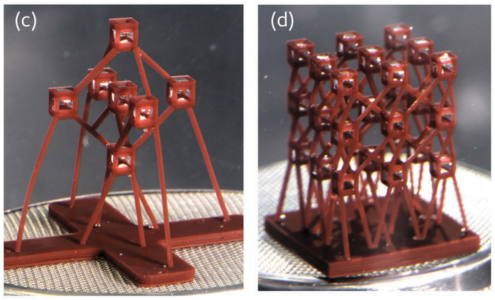

Fig. 1: Example of bubble-based structures that are built using 3D printing. Extracted from [3].

At an initial stage, the project will involve understanding the dynamics of two bubbles, using numerical simulations and experimental measurements. At a later stage, collective emission in more complex systems made of clouds of bubbles will be investigated in simulations and experiments.

Profile of the candidate

This project can be carried out as a M2 internship, or as part of Graduate Schools requirements. Candidates with academic backgrounds in physics or engineering are expected. Specific skills in numerical modeling (Python, Matlab,...) will be a strong advantage for the project.

For further information

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References:
[1] V. Leroy *et al.*, Physical Review B 91, 020301 (2015)
[2] D. Bouchet and R. Carminati, JOSA A 36, 186-195 (2019)
[3] T. Combriat *et al.*, Soft Matter 16, 2829-2835 (2020)