Project 1: Investigating acoustic metamaterials for ultrasonic engineering

Supervisory Team

Prof James Windmill & Dr Joseph Jackson
Centre for Ultrasonic Engineering, University of Strathclyde

Background and motivation

For the past two decades, there has been significant research into understanding and using the unusual physics that happens when waves interact with structured matter. Advances in microfabrication have allowed the creation of materials whose geometric scales are on the order, or smaller, than the wavelength of both light and sound, and this has formed the basis of the study of metamaterials. Acoustic metamaterials control sound waves in unusual ways, and are capable of acoustic absorption, cloaking and waveguiding that supersedes traditional approaches.

What will you do?

This project aims to investigate how work on audio frequency metamaterials at the University of Strathclyde can be scaled to achieve acoustic metamaterials that function with ultrasound. The Strathclyde work models, creates and measures metamaterials that use locally resonant features to create the necessary acoustic properties, on a scale much smaller than the wavelength of sound. The project will first review existing acoustic metamaterials, including those designed at Strathclyde and in other labs worldwide. Then, using existing mathematical models and knowledge from the Strathclyde metamaterials design process, the project will investigate the design of ultrasound metamaterials. The new theoretical concepts produced in the project will be used as the basis to fabricate working acoustic and ultrasonic metamaterials using high resolution 3D printing techniques developed in the supervisory team's research group in Strathclyde. These new metamaterial designs will then be measured acoustically, for comparison with the theoretical model results. Experimental characterisation of the new metamaterials will take place within a sound-proof room in Strathclyde. The final goal of the project is to develop the design requirements for future ultrasonic metamaterials. The intern will be supported through these various stages, working closely with their research team.

Working from Home

Should laboratory access be restricted due to the ongoing pandemic, the project can continue as a theoretical description of printable metamaterial designs and through simulation, which can be done from home with virtual access to the university's computing facilities. Proposed designs of materials could also be printed and tested by laboratory staff who have had continued access through the pandemic, and thus results can still be gathered.

Required skills and experience

Candidates should have an interest in acoustics and/or ultrasound, and the use of sound engineering in consumer and industrial applications. Some programming experience is useful, and experience with Matlab is desirable but not essential. Any experience with CAD software and 3D printing is beneficial but not required. Candidates can come from any degree background, which furnishes them with the required skill-set outlined above. Candidates should have strong interpersonal skills and enjoy working as part of a team.