

## PhD Offer

### Programmable Acoustic Metasurfaces

#### General information

**Workplace:** Institut Jean Lamour, University of Lorraine-CNRS, Nancy (France)

**Desired level of education:** Master in Mechanical Engineering, Physics, Wave Physics, Applied Physics, Acoustics, Structural dynamics, Applied Mechanics, or equivalent.

#### PhD subject

In recent decades, the manipulation of acoustic waves to generate controlled three-dimensional wave fields has attracted increasing attention for applications such as medical ultrasound imaging, non-destructive testing, and cell manipulation. Despite their effectiveness, conventional wave-control approaches, such as the gold standard of phased-array transducers, suffer from significant drawbacks, including high cost, electronic complexity, and manufacturing challenges. These limitations have restricted the scalability and broader adoption of such technologies.

In this context, programmable acoustic metasurfaces represent a transformative alternative to existing technologies. Classical metasurfaces have generated high interest thanks to their ability to control waves at deep subwavelength scales, enabling phenomena such as absorption, phase modulation, and amplitude control. However, most existing applications operate only at single frequencies with fixed geometries.

This PhD project proposes the design, realization, and characterization of programmable metasurfaces that allow for the full, dynamic control of acoustic wavefronts. By manipulating the physical geometry or material properties of the unit cells via electromechanical, thermomechanical, or other activation phenomena, this research aims to bridge the gap between static metamaterials and complex active arrays. Our ambitious objective is to develop the requisite technology and explore the fundamental physical principles of active wave control, pushing the boundaries of what is possible with such metasurfaces.

#### Work context

We are seeking for a student to start a research project on programmable acoustic metamaterials both on fundamental and applied aspects. Our group in the Institut Jean Lamour (IJL), Institution belonging to the University of Lorraine and CNRS, develops since many years different research topics related to phononics, metamaterials and metasurfaces.

#### About Institut Jean Lamour

The Institut Jean Lamour (IJL) is a joint research unit (UMR 7198) of CNRS and Université de Lorraine. Focused on materials and processes science and engineering, it covers: materials, physics, acoustics, plasmas, nanomaterials and electronics. It regroups 183 researchers/lecturers, 91 engineers/technicians/administrative staff, and around 150 doctoral students and 25 post-doctoral fellows. Partnerships exist with 150 companies and our research groups collaborate with more than 30 countries throughout the world. Its exceptional instrumental platforms are spread over 4 sites; the main one is located on ARTEM campus in Nancy. The project will be carried out within the "Metamaterials and Phononics" group whose subjects range from acoustic/elastic metamaterials, metasurfaces and phononics to topological and non-Hermitian metamaterials.

#### Application

The application should be addressed to: Julio Iglesias Martínez ([julio.iglesias-martinez@univ-lorraine.fr](mailto:julio.iglesias-martinez@univ-lorraine.fr)) & Mourad Oudich ([mourad.oudich@univ-lorraine.fr](mailto:mourad.oudich@univ-lorraine.fr)).

Application should include: **CV**, **Cover letter**, and **M1/M2 (Master or equivalent) transcripts**.

The PhD student will be affiliated to the C2MP doctoral school (Chemistry - Mechanics - Materials – Physics, <https://doctorat.univ-lorraine.fr/en/doctoral-schools/c2mp/presentation>).