

Research internship proposal 2022

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Unité de recherche : Laboratoire de Mécanique et d'Energétique d'Evry (LMEE)

Lieu d'activités : 40 Rue du Pelvoux, Evry

Sujet du stage : **Topology optimisation for microscale piezoelectric actuators**

Durée du stage : 5 ou 6 mois en 2^{ème} semestre - année universitaire 2022-2023

Modern fabrication technologies have led to an increasing number of miniaturised systems that integrate piezoelectric micro components. Such micro-to-nano scale devices are found in applications such as nano oscillators and resonators, micro biomimetic robots, ultrasonic sensors, etc. Consequently, structure design with optimal vibration properties for microscale piezoelectric components has become an important topic. During this research internship, you will implement a **topology optimisation** approach based on a 2D **finite element** with plane stress assumption and **couple stress elasticity** to deal with structure design of **microscale piezoelectric actuators**.

The project will focus on the influence of **size effect** on the optimised structure topology since material behaviours of microscopic problems present significant dependence on the problem size. Hence, application of higher-order elasticity, for instance the couple stress elasticity, is justified. The project will consider in the first place static load conditions with forces and displacements confined in the plane of the piezoelectric plate. Then, a «power-law» approach (SIMP approach) will be applied to achieve optimised structure design leading to maximised displacement (objective) given a fixed external force (constraint). Particular attention should be drawn to the implementation of the couple stress elasticity model, which requires adaptation of the classical 2D finite element formulation, which by defaults does not satisfy the requirements of higher-order elasticity since higher-order kinematics is involved.

The work will benefit from existing developments on this topic, made through previous efforts led by the research group. Within the scope of this proposal and depending on the progress of the work, you are also expected to consider including multiscale modelling to your topology optimisation framework. The current proposal involves elements of significant scientific value. Publication of a research paper is highly encouraged.

Mots Clefs : **topology optimisation, piezoelectricity, high-order elasticity**

Profil recherché : The ideal candidate is a curious and highly motivated person with confirmed background in solid mechanics and programming skills (Matlab). Good level of writing in English is expected.

Candidates are invited to send your CV to [yu\(dot\)cong \(at\) univ-evry\(dot\)fr](mailto:yu(dot)cong(at)univ-evry(dot)fr)

