Labex MEC "Mechanics And Complexity"

Post-Doctoral position offer

Duration: 1 year

Period: 2017/01 – 2017/12

Location: Marseille, France

Gross salary: from 2423 € to 2843 €/month (€1,950- €2,250 after taxes) depending on qualification and experience

Research project and job description

Title: Optimal Design under Uncertainty of Nonlinear Energy Sinks. Application to Musical Instruments.

Summary & job description: Many phenomena in acoustics and dynamics might exhibit an acute sensitivity to perturbations in initial conditions, loading, and design. In fact, in the case of nonlinear systems, this sensitivity might become so pronounced that responses are discontinuous. The prediction of a dynamic or acoustic behavior must therefore account for uncertainties to understand their effects when propagated through a model or an experiment. This requirement becomes even more critical in the case of the optimal design of a dynamic system. Several methods exist for uncertainty propagation and optimization. However, they are not satisfactory for problems involving discontinuous behaviors and large computational costs associated with repeated calls to a numerical model. Techniques based on classification developed at the University of Arizona alleviate some of these difficulties. These approaches will be used and adapted to study and optimally design systems characterized by a complex dynamic behavior such as nonlinear energy sinks (NES).

NES are used for the passive reduction of vibration amplitude. They can be used, for instance, to mitigate the vibration of civil infrastructures during an earthquake. However, NES are characterized by an activation threshold, which limit their efficiency to specific ranges of excitation. They are also extremely sensitive to uncertainties, including the bi-stable NES developed at LMA, thus making their optimal design very tedious. However, it was recently demonstrated that classification-based techniques might provide an efficient approach to optimally design NES under uncertainty.

The overarching goal of this project is to apply these methods to the design of a damper for string instruments, such as the cello, to remove the "wolf tone". This spurious tone is generated by the coupling between a string and one of the instrument's resonances. To achieve this objective, this study will be divided into simpler tasks enabling a better understanding of the influence of uncertainties on NES efficiency. For instance, at the beginning, simple models such as a cantilever thin plate will be used. These tasks will also provide the candidate with a better familiarity with the methods and tools needed for the completion of the project.

Essential and desired skills: The candidate should hold a PhD (or equivalent) in mechanical engineering or related field and have expertise in the following areas: dynamics (required), uncertainty quantification and optimization (preferred), experimental vibroacoustics (preferred).

Labex team Axis / action / part : Instability, coupling, control / Nonlinear dynamics in acoustics and vibrations / Energy pumping + nonlinear vibrations and musical instruments

Contact:
- Drs. Pierre-Olivier Mattei and Christophe Vergez (LMA, Marseille, mattei,vergez@lma.cnrs-mrs.fr)
- Dr. Samy Missoum (CODES laboratory, Tucson, smissoum@email.arizona.edu).

Location**:** The research will be carried out in the Mechanics and Acoustics Laboratory (LMA), a unit of the National Center for Scientific Research (CNRS), in Marseille, France. The applicant will also have the opportunity to spend, time and budget allowing, up to six months in the Computational Optimal Design of Engineering System (CODES) Laboratory of the Aerospace and Mechanical Engineering Department at the University of Arizona in Tucson, Arizona, USA.

How to apply

Send an application including:

- A detailed CV with a list of publications
- A cover letter
- A list of at least three references able to comment on the application. Please provide the name, title, institution, and email for each reference.

to both these addresses:

Relevant group leaders (mattei,vergez@lma.cnrs-mrs.fr)

Labex management (LabexConseilCoordination@irphe.univ-mrs.fr)