MSCA Horizon Europe PhD position in Structural Acoustics at INSA Lyon/UTS Sydney

https://euraxess.ec.europa.eu/jobs/71401#job-information

1. General Information

Name of the position	**Structural Acoustics**
Foreseen date of enrolment	1 October 2023
Position is funded by	• COFUND, Marie Skłodowska-Curie Actions (MSCA), Horizon Europe, European Union • Institut National des Sciences Appliquées de Lyon (INSA-L) • University of Technology Sydney (UTS)
Research Host	Institut National des Sciences Appliquées de Lyon
PhD awarding institutions	Institut National des Sciences Appliquées de Lyon & University of Technology Sydney
Locations	Primary: Lyon, France Secondary: Sydney, Australia
Supervisors	A/Prof. Laurent Maxit (INSA-L) and Dr. Mahmoud Karimi (UTS)
Group of discipline	Mechanical engineering, Physics, Vibrations, Acoustics
Deadline for applications	11 April 2023

2. Research topics (only one of these projects will be funded. The candidate must choose one of these projects)

Project 1: *Vibroacoustic Response of a Curved Surface Excited by a Turbulent Flow*
It is common for the structures of marine vessels, and other engineering structures, to include complex geometries such as curved surfaces. The relative motion between the vessel and water produces a turbulent boundary layer (TBL) that surrounds the vessel surface. The curvature of the surface changes the characteristics of the boundary layer as it moves around the surface. The pressure field beneath the boundary layer also excites the structure and causes vibrations; a part of the noise due to the vibrations of the vessel is radiated to the far field and partially transmitted into the vessel. The aim of this project is to dramatically improve our understanding of the interaction

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between turbulent boundary layers and curved structures and to understand vibroacoustic responses of these structures in turbulent flow. The project comprises three major phases: 1. Development of a numerical model for describing the spatial variations of the TBL over a curved surface: In previous studies a homogeneous TBL has been considered in the vibroacoustic calculations. Recent preliminary work on the subarea decomposition technique has shown promising results for analysing a non-homogeneous TBL on panels. This approach will be extended here to the study of a curved surface for the first time. 2. Development of theoretical models for sound radiated from a curved surface exited by a TBL: The technique developed in task 1 will then be integrated with the uncorrelated wall plane wave-finite element method. In this hybrid method, the wall pressure field will be synthesized using the uncorrelated wall plane wave technique and different realisations of the WPF will be applied as deterministic loads to a fully coupled structural-acoustic solver. 3. Measurement of sound radiation from a curved surface under a TBL excitation in a wind tunnel: There is very limited experimental data on the sound radiated by a curved structure in turbulent flow, and so validating predictions against measurements in a wind tunnel provides a more favourable environment for investigating new phenomena for curved surfaces. In this task to characterise the boundary layer on the curved surface and investigate the radiated noise from a curved surface, experiments will be carried out at a wind tunnel.

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Research Fields: Mechanical engineering, Vibrations, Acoustics, Numerical and analytical modelling, Experimental analysis

Project 2: *Noise Radiated from a Cylindrical Shell in Shallow Water Environment*

Modelling noise radiated from an underwater vehicle is very important in many naval applications. These vehicles are often modelled as a submerged cylindrical shell in deep water (free field). In shallow water acoustics (waveguide), as opposed to deep water acoustics, one must often consider how the sound interacts with the surface and the bottom. The free surface boundary is perhaps the easier to understand and comprehend of the two boundaries, yet it is still far from being trivial. The ocean floor poses an even greater obstacle since, in shallow water, the water column sound speed profiles frequently exhibit downward refraction, making the bottom a nearly inevitable boundary condition for sound propagation. Along with an irregular bathymetry, sub-bottom inclusions, and variable materials, the bottom also exhibits a surface roughness profile similar to that seen in sea surface scattering. Research on the vibroacoustics of cylindrical shells in shallow water is rare and most researchers have modelled the shell near either a perfect free surface or a rigid sea floor. Very recently, the noise radiated form a cylindrical shell was analytically modelled in a perfect acoustic waveguide (i.e. free surface and sea bottom are assumed as pressure release and rigid boundary conditions, respectively). The current PhD study will investigate the vibroacoustics of a cylindrical shell in more realistic shallow water environment. In particular, the effects of sea surface/bottom roughness, surface waves, elasticity of the sea bottom and its material properties on the noise radiated from a cylindrical shell in shallow water will be examined. The project will aim to provide an analytical model of this complex system if possible. However, semi-analytical, numerical and hybrid models may need to be considered due to the complexity of the model. The numerical model will then be employed to shed light on physical phenomena of the acoustic waves' propagation from a vibrating shell in shallow water environment.

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Project 3: *Control of the noise radiated from stiffened cylindrical shells using acoustic black hole and locally resonant metamaterial*
The control of noise radiated from stiffened thin shells like the fuselage of an aircraft or the pressure hull of a submarine is of prime importance for industries. The thin shell is generally stiffened regularly by internal frames in order to resist to static loads keeping the structure as light as possible. However, it is well known that the periodic arrangement of these internal frames induces propagation of Bloch-Floquet waves in the structure which increases the radiation efficiency of the shell. In this thesis, we propose to study two innovative means to reduce the noise radiated by stiffened cylindrical shells: 1. <u>Embedding acoustic black holes (ABHs) in the internal frames:</u> An ABH is a passive and lightweight device for the control of noise and vibrations. It basically consists of a retarding wave guideline that slows down impinging waves and concentrates them at the ABH centre, where energy gets dissipated by means of viscoelastic materials. 2. <u>Attaching locally resonant metamaterials (LRMs) to the internal frames:</u> LRM involve periodically or randomly arranged resonators which are designed to manipulate waves in targeted frequency ranges, which are called band gaps. The two concepts can then be mixed to optimize the radiated noise reduction in the whole frequency range of interest. To date most researches on ABH and LRM have focused on the control of the vibration and sound radiation from academic structures like beams, plates and cylinders. This work will study the efficiency of these devices in the presence of a thin vibrating structure exhibiting Bloch-Floquet waves which are induced by the periodic arrangement of the stiffeners. In the first step, analytical and numerical models will be developed to analysis the physical phenomena involved when the stiffened shell is coupled to these devices. In the second step, parametric analyses will be performed to find the optimal parameters and design to reduce the radiated noise for realistic configurations. Finally, the most promising designs will be investigated experimentally in the lab.
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Research Fields: Mechanical engineering, Vibrations, Acoustics, Numerical and analytical modelling, Experimental analysis.

3. Eligibility criteria

Applicants must fulfill ALL the following minimum eligibility criteria at the date of the call deadline (11 April 2023):

1. MSCA Early-stage Researcher rule: Applicants must have not yet been awarded a doctoral degree. Researchers who have successfully defended their doctoral thesis but who have not yet formally been awarded the doctoral degree will NOT be considered eligible to apply.

2. MSCA Mobility rule: **<u>Applicants may not have resided or carried out their main activity (work, studies, etc.) in France for more than 12 months in the 3 years immediately before the call deadline (i.e., since 11 April 2020).</u>** Time spent as part of a procedure for obtaining refugee status under the Geneva Convention (1951 Refugee Convention and the 1967 Protocol), compulsory national service and/or short stays such as holidays are not taken into account.

3. MSCA Employment rule: Applicants may not be already permanently employed by the chosen Research Host at the time of call deadline.

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4. Minimum level of studies: Applicants must meet the academic criteria for admission to the doctoral programs at both the French and the Australian enrolling universities.

5. English proficiency*: Applicants must have a demonstrable C1 level of English (both speaking and in writing).

4. Employment Benefits and Conditions

INSA Lyon offers a 36-months full-time work contract (with the option to extend up to a maximum of 42 months) with 2 months of probation period and 35 working hours per week.

The remuneration, in line with the European Commission rules for Marie Skłodowska-Curie grant holders, will consist of a gross annual salary of 28,800 EUR. Of this amount, the estimated net salary to be perceived by the Researcher is 1,928 EUR per month. However, the definite amount to be received by the Researcher is subject to national tax legislation.

Benefits include

- The candidate will have access to the numerical and experimental facilities of the two laboratories involved in the project:
  - Laboratory of Vibration and Acoustics of INSA Lyon;
  - UTS Tech Lab which is a multidisciplinary research facility with a variety of laboratories and research teams working across engineering and the computer sciences.
- Tuition fees exemption at both PhD awarding institutions.
- Yearly travel allowance to cover flights and accommodation for participating in AUFRANDE events.
- 10,000 EUR allowance to cover flights and living expenses for 12 months in Australia (which may be taken in several blocks over the period of the employment term as best suits the needs of the researcher).
- 25 days paid holiday leave.
- 112 days maternity leave.
- 28 days paternity leave.

5. PhD enrolment

Successful candidates for this position will be enrolled by the following institutions and must comply with their specific entry requirements, in addition to AUFRANDE's conditions. Only one project among the 3 proposed will be achieved by the candidate.

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INSA Lyon

Applicants mut hold a national Master's degree or another qualification conferring the status of Master (5 years of higher education).

More information: https://www.insa-lyon.fr/en/formation-doctorale

University of Technology Sydney (UTS)

Applicants must have completed a UTS recognised master's by research or bachelor honours degree with first class or second class / division 1 honours, or an equivalent or higher qualification, or submitted other evidence of general and professional qualifications that demonstrates potential to pursue graduate research studies.

The English proficiency requirement for international students or local applicants with international qualifications is: Academic IELTS: 7.0 overall with a writing score of 7.0; or TOEFL: internet based: 94-101 overall with a writing score of 27; or AE6: Pass; or PTE: 65-72 overall with a writing score of 65; or C1A/C2P: 185-190 overall with a writing score of 185.

More information: https://www.uts.edu.au/research-and-teaching/graduate-research/future-research-students/application-essentials

6– Information contacts and how to apply

For further information on the research projects, contact Laurent Maxit (Laurent.maxit@insa-lyon.fr) and Mahmoud Karimi (Mahmoud.Karimi@uts.edu.au)

For further information on the AUFRANDE (Australia-France Network of Doctoral Excellence) project and to apply https://aufrande.eu/

IMPORTANT REMINDER: Following the MSCA Horizon-Europe rule, applicants may not have resided or carried out their main activity (work, studies, etc.) in France for more than 12 months in the 3 years immediately before the call deadline (i.e., since 11 April 2020)

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