

Ph.D. thesis scholarship offer (4 years) – ÉTS (Montreal, Canada)

Probabilistic modeling by finite elements of the acoustic response of the outer ear excited by impulse industrial noise

A Ph.D. thesis funding for a period of 48 months ((CAD)\$23,000/year) is offered.

Location: The Ph.D. will be carried out at the École de Technologie Supérieure de Montréal (ÉTS) within a dynamic, multidisciplinary and internationally recognized research team in the field of hearing protection. Located in the heart of Montreal, the ÉTS campus is easily accessible by bike or public transit. Often described as an attractive mix of North American and European culture, Montreal, since 2016, has consistently ranked as the best student city in North America according to Quacquerilli Symonds.

Research team: The student will have access to the ICAR laboratory (<http://gram.etsmtl.ca/equipment/>), at the cutting edge of technology where experimental infrastructures, offices, meeting rooms, spaces for relaxation and exchanges are grouped together, promoting collaborative work. The thesis will be co-supervised by Dr. Franck Sgard from the IRSST, associate professor at ÉTS, and Prof. O. Doutres from ÉTS.

Context : The selection of a hearing protector, the last bastion to protect against exposure to noise, is mainly based on the acoustic attenuation it can provide. While knowledge on the attenuation of hearing protectors for continuous noise has progressed in recent years, that on attenuation for industrial impulse noise is less advanced both in terms of metrology and in terms of modeling. A model relaxing the limits of existing models and allowing for a better understanding of the transmission of waves in the ear/protector system with a view in particular to improving the design of protectors and the methods for measuring their performance against impulse noise is lacking. Recent progress made on the numerical modeling of hearing protection for continuous noises and the increasing use in other applications of the Bayesian formalism integrating all the uncertainties of the problem, make it possible to consider the development of such a model. It is in this perspective of designing a probabilistic model by finite elements (FE) of the acoustic response of the auditory canals of a human head, equipped or not with a protector, excited by impulse industrial noises and including all the transmission paths through tissues, that a research program is proposed. This research program is divided into four specific objectives: OS1) Model the acoustic response of the unprotected ear; OS2) Model the acoustic response of hearing protectors; OS3) Model the acoustic response of the ear coupled to a protector; OS4) Exploit FE models to understand the mechanisms of sound transmission in the earcanal open or occluded by a protector, taking into account uncertainties.

Subject of the Ph.D. project: This topic tackles the specific objectives OS1 and OS4 and consists in developing a probabilistic model by FE of the acoustic response of the open earcanal for excitation by industrial impulse noise taking into account the transmission paths through the head. The model will be calibrated/validated in a Bayesian framework against measurements on the human subject from which the head model is reconstructed and will be used to study the mechanisms of sound transmission in the open earcanal.

Main tasks : In addition to carrying out his/her doctoral project in compliance with the rules of research ethics, the student will contribute to the writing of deliverables (e.g., articles, presentations, reports) and will be encouraged to present his/her work at international scientific conferences.

Candidate profile: This project includes both modeling and experimental aspects. The candidate must have the equivalent of a master's degree in engineering or physics. A background in acoustics, finite element modeling, mathematics (probabilities, statistics), design, measurement and Matlab programming is recommended. Skills in image analysis and processing and knowledge of human anatomy would be a plus. He/she must (i) be able to communicate in French and/or English, both orally and in writing (ii) enjoy working in a team and (iii) know how to meet deadlines.

Start date: To be defined (estimated date December 2022-February 2023).

Status in Canada: Be a Canadian citizen, resident or have a valid permit from Immigration, Refugees and Citizenship Canada (IRCC) to carry out studies in Quebec.

Contact: Send resume + cover letter to Franck Sgard (Franck.Sgard@irsst.qc.ca) before **October 15, 2022**