Doctoral thesis offer (Ph.D.)

Vibratory and vibro-acoustic behavior of lightweight metastructures with enhanced performance over a wide frequency range

***Key words**: vibration, dynamics, damping, vibro-acoustics, acoustic radiation, metastructures, microperforated structures,*

Reducing the weight of structures is a significant economic and environmental challenge for many industries, including the transport sector. Reducing the mass of a transport structure means lower energy consumption and less environmental pollution. However, it is often accompanied by a deterioration in their vibratory and vibro-acoustic properties.

Recent research has shown that it is possible to lighten a structure while achieving interesting vibratory and vibro-acoustic properties, for example by periodically removing material from a structure [1] (see Fig. 1a)) or by micro-perforating it [2] (see Fig. 1b)). These solutions are promising; however, they are not effective over a wide frequency range.

The objective of this PhD is therefore to develop new lightweight structures with enhanced vibratory and vibro-acoustic properties, effective over a wide frequency range - from low to high frequencies. The PhD comprises the following five interdependent parts:

1) Development of an analytical vibratory and vibro-acoustic model
2) Numerical validation of the model
3) Parametric analysis of the vibratory and vibro-acoustic effects that can be obtained
4) Optimization of parameters, design and manufacture of prototypes (beams and plates)
5) Vibration and vibro-acoustic measurements on prototypes

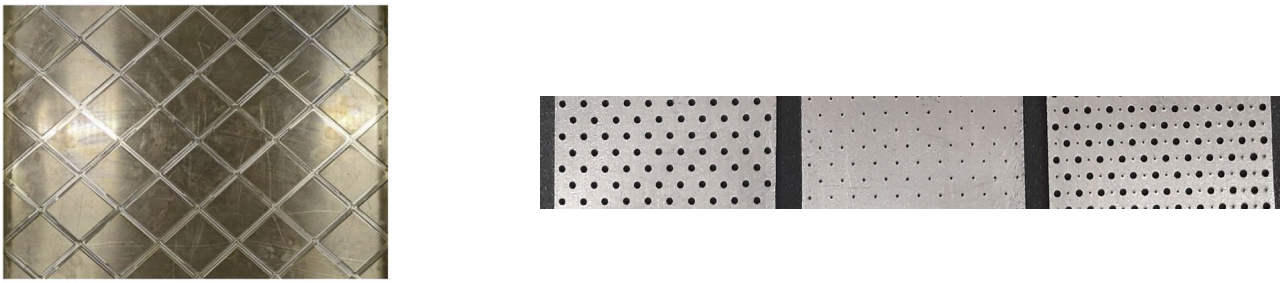

Figure 1 – a) Left – Periodic material removal, b) Right – Microperforated structures

This research work will be carried out mainly within the GRAM group of the ICAR laboratory at the École de technologie supérieure de Montréal (part of the Université du Québec), under the direction of Pr. Thomas Dupont. This project will be carried out in close collaboration with Université de Sherbrooke under the direction of Pr. Olivier Robin. The PhD will also be done in partnership with Université de Bourgogne Europe de Bourgogne (France). The candidate should have good skills in vibration and structural dynamics. Knowledge of material acoustics and vibro-acoustics of structures would also be appreciated.

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Références: [1] González, V., Robin, O., & Meruane, V. (2024). Band gap generation in cantilever beams through periodic material removal. Transactions of the Canadian Society for Mechanical Engineering.
[2] Gallerand, L., Legrand M., Dupont T. et Leclaire, P. (2022). Vibration and damping analysis of a thin finite-size microperforated plate. Journal of Sound and Vibration, 541:117295.