LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

Université de Lille

L2EP Laboratoire d'électrotechnique et d'électronique de puissance de Lille

Master project, 2023 – 2024

Energy conversion in a distributed actuators vibrating structure

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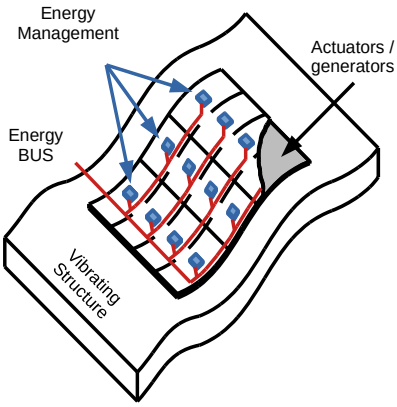
Context

The L2EP is involved in two scientific projects that both use distributed actuators on a vibrating structure. The HASAMé project aim is to create localized vibrations on a surface in order to induce tactile stimulation on a user fingertip. Funded by the ANR, it explores new ways to create the next generation of Human Computer Interfaces that can simulate button click on flat touchscreens [1]. The other project is COMASYS and is funded by the University of Lille. Within this project, we collaborate with researchers from the *UMET* (Unité Matériaux et Transformations - UMR CNRS 8207) laboratory to create flexible power sources that can extract energy from ambient vibration.
Distributing the actuation over the surface is known to be able to focus vibration at specific point [2], and few examples of this arrangement for energy harvesting applications have been investigated [3]. With this master thesis, we want a control methodology that can be efficient for both use cases.



Objective

The actuators are coupled on the same surface, and therefore, they collaborate to excite the vibration, or to damp it in order to extract and convert the mechanical energy. As a result, each contribution can be coherently added to the others, or, conversely, it can negatively interfere with the other actuators and kill their effort. The objective of the thesis is to propose local energy management rules (i.e. that act on each actuator independently), that guarantee the system's global stability and optimize the energy scavenging. Hence, not only the actuators are distributed, but also the control.
This control will be deduced by the inversion of the Energetic Macroscopic Representation. The performances in for the vibration control and the energy harvesting will be evaluated.

Work steps

1 Bibliography on the subject
2 Model of the structure, after measurements
3 Study of the global stability
4 Application by simulation.

Keyword

Energy harvesting, mechatronic, active vibration control.

References

[1] P Garcia, F Giraud, B Lemaire-Semail, M Rupin, A Kaci Control of an ultrasonic haptic interface for button simulation Sensors and Actuators A: Physical 342, 113624 (2022)
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[3] MM Khattak, C Sugino, A Erturk Concurrent vibration attenuation and low-power electricity generation in a locally resonant metastructure Journal of Intelligent Material Systems and Structures 33 (15), 1990-1999 (2020)