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

Master project, 2020-2021

— VibroLoc: Localized Vibrotactile Stimulation by remote Actuators —

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Context

The control of vibration is essential in order to achieve performance improvements in systems. It can help to reduce the drag forces of a propeller [1] for instance or reduce the noise emission of a motor [2]. Conversely, new applications can emerge from the control vibration of a plate. Tactile stimulators for instance create localized and calibrated vibrations in order to give a user the illusion of touching a button. Applied to smartphones and tablets, this technique can help people to use them when not looking at them, if they are visually impaired or if they are driving a car for example.

When excited by an actuator, a plate undergoes a deformation that can be decomposed into several vibration modes. By adjusting the amplitude and phase of the modes, it is possible to create a deformation pattern. In the L2EP, we exploit this technique in order to create our tactile stimulator and it has been developed by E. Enferad [3] and A. Kaci [4] in their PhD. Hence, the actuator operates "at a distance" which is an advantage: we can place actuators at the periphery of a glass plate, and obtain a deformation in its middle. However, the main issue is to accurately adjust the actuators' voltage, in order to create the modal distribution required to generate the calculated deformation.

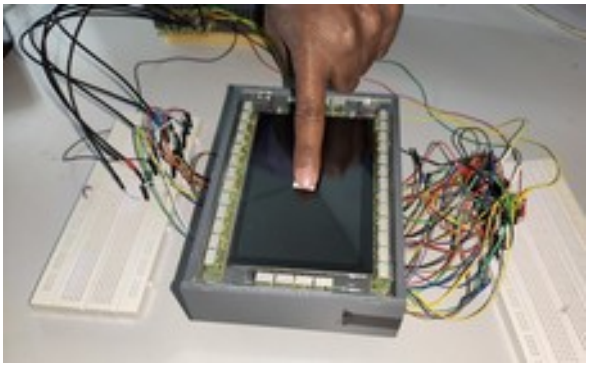

figure 1: An experimental Device at L2EP which can control the vibration of a plate in the middle with actuators placed at the periphery. The user feels like a button click with an appropriate control.

In this work, a closed loop control of the vibration will be achieved. The methodology will follow what has been described in [5]. The main advantage is that the vibration control is then analogous to the torque control of an AC Machine: Park transform is used, and the variables are constant in steady state.

Objectives

Based on an existing plate and its numerical model, simulations of the control will be conducted. We have already achieved the simulation of the closed loop control of vibration, but with a limited number of modes (2 maximum). In this project, the simulation will take more modes into account for the closed loop (10 minimum) achieving a significant leap towards the multi-modal control.
Experimental work will be carried out on a test bench that is being built. The controllers will be implemented into a DSP, following a methodology already presented. The comparison between simulated and experimental results will confirm the methodology.
Finally, tactile pattern associated with a "Psychophysical Study" will be proposed in order to measure the performances of the tactile stimulator.

Key word

Ultrasonic transducer, mechatronic, vector control

References

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