Piezoelectric Control for Surface Haptics

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Haptic technologies are systems that enable users to physically interact with virtual objects through the sense of *touch*. Beyond enhancing immersion in virtual contexts, these technologies contribute to sustainability by reducing the need for physical prototypes, enabling safe and resource-efficient training, and supporting remote work and teleoperation. By lowering material waste, reducing energy consumption, and improving access to education and healthcare, haptic devices address key environmental challenges while promoting inclusiveness, health, and safety.

The device under study is a '*Surface haptic device*' that creates texture illusions through ultrasonic vibrations. The illusions are created because ultrasonic vibration reduces the surface friction. Thus, a sensation of 'softness' increases with the vibration amplitude. These vibrations are controlled in closed loop, using vector control on piezoelectric actuators.

Figure 1. Ultrasonic surface haptic devices and in-house prototype testing

Objective

This lecture will address the main applications of the technology, its working principles, and basics of how haptic devices are prototyped in-house [1]. Finally, we will discover how Energetic Macroscopic Representation (EMR) [2] can be used to model, simulate and control the vibration amplitude of the device in real-time [3] in small microcontrollers for portable applications. A simulation session is proposed, so the dynamic model can be implemented and simulated using EMR/ Matlab-Simulink®

Key words

Haptic, Ultrasound, Vector Control, Energetic Macroscopic Representation

References

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