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

Master project, 2025-2026

— Efficient Haptic Interface —

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Context

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.

With the advent of high speed communication systems, supported by many action like 6G, "tactile internet", industry 5.0, more remote communication will be developed to control robots in the next generation factories [1], or democratize communication between people which goes beyond speech and sight. However, this evolution will require more motors, more electric devices and more batteries leading to more pressure on resources. This is why, it is important to reduce the footprint of the new devices, and find sustainable solutions to create haptic feedback

Objective

The objective of the master thesis is to find solution to produce efficient tactile feedback, by reducing the global power consumption of the device. A first approach will be to harvest energy from user's gesture [2,3] in order to become self powered. Control loops will be evaluated to change the force-speed relation with the haptic device.

Figure 1 Haptic Gloves

Work steps

1. Bibliographic research (Energy harvesting, tactile, force/speed in condition of passive touch) 2. Evaluation of PVDF material in tactile actuator [2] 3. Design proposal 4. Evaluation

Key word

Haptic, Energy Harvesting, Control

References

[1] https://www.aboutamazon.com/news/operations/amazon-vulcan-robot-pick-stow-touch accessed on 3 sept 2025
[2] Cédric, Lapeyronie, et al. "Piezoelectric polymer characterization setup for active energy harvesting." Polymers for Advanced Technologies 36.1 (2025): e70056

[3] Diana Angelica Torres Guzman, Betty Lemaire-Semail. Energy-Based Model Representation for Design and Optimization of Piezoelectric Energy Harvesting Systems. *The 26th European Conference on Power Electronics and Applications*, 2025, Paris, France.