Internship position on
“Smart pressure materials for a hand-held haptic interface”

Environment

The work will be carried out at **IRISA-INSA in Rennes** as part of the Rainbow team (https://team.inria.fr/rainbow/), which is internationally recognized for its scientific activity as well as for technology transfer experience in the field of shared control, multi-robots, haptics, sensor-based control, visual tracking, and visual servoing.

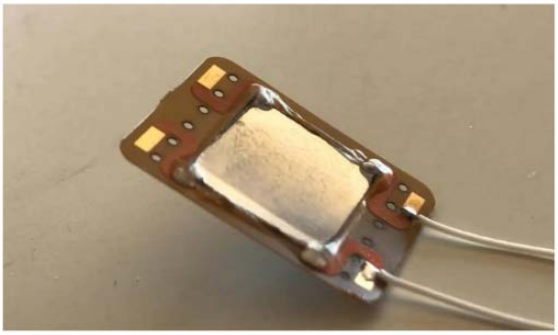
Founded in 1966, **INSA Rennes** is the largest engineering school in Brittany. INSA Rennes ranks among the top post-baccalaureate engineering schools in France. A member of the INSA Group, France's leading network of public engineering schools, INSA Rennes is recognized for its training and scientific research.

Rennes in a lively city in the north-west part of France, capital of the Britanny region. Located 90 minutes from Paris and less than one hour from the sea, **Rennes was named as the leading French city in Europe for “quality of life”** in 2020 and has the highest satisfaction rate among its inhabitants (source: European Commission).

Topic

In the dynamic landscape of virtual reality (VR), the quest for better immersion has led to the integration of sophisticated feedback mechanisms, with **pressure and vibrotactile feedback emerging as transformative components.** Unlike traditional haptic feedback, combining pressure and vibrotactile feedback through the same actuation mechanism delve deeper into the realm of tactile sensations, adding layers of realism and responsiveness to virtual experiences. Pressure feedback introduces a dynamic dimension by simulating the sense of resistance or force against the user's interactions. Imagine the tangible sensation of pressing a virtual button, feeling the subtle resistance akin to pushing a physical object. Complementing pressure feedback, vibrotactile feedback engages users through subtle vibrations, replicating the textures and surfaces encountered in the digital realm. Recent haptic actuators leverage the use of smart flexible materials, such as **electroactive polymer actuators**, to be able to **provide both soft pressure and sustained vibrations through the same end-effector in a compact and flexible package.** Leveraging a collaboration with the electronics company KEMET, we have the unique possibility of testing this technology for VR interaction.

The objective of this research work is to **design a hand-held haptic interface integrating electroactive polymer technology to provide pressure and vibration sensations** as well as **evaluate it in a Virtual Reality scenario.**



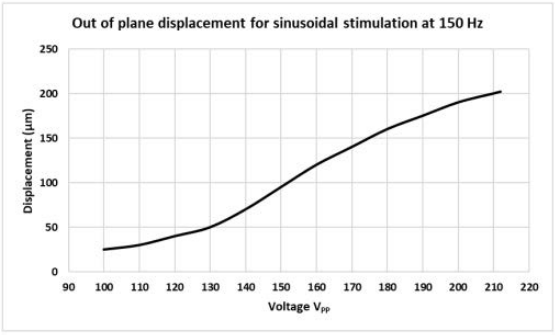


Figure. Advancing virtual touch: Electroactive polymer actuators (left) can seamlessly translating digital experiences into palpable haptic sensations, providing pressure and vibrotactile sensation in a flexible and comfortable package. Our objective is to integrate this technology into a hand-held haptic interface for VR interactions (right).

The work will address the following points, tuned according on the expertise and interests of the student:

- Design of the haptic interface: mechatronic development of a hand-held interface suitable for use in VR, integrating electroactive polymer actuator technology.
- Haptic rendering: design a haptic rendering algorithm to provide suitable pressure and vibrotactile sensations during VR interaction.
- Human-subjects evaluation: carry out a human subjects study to evaluate the effectiveness and viability of the proposed rendering interface and techniques in an immersive VR scenario.

Requirements

- B.Sc. degree in computer science or related fields;
- Experience in C/C++/C# , Unity3D, VR/AR tools, human-robot interaction;
- Excellent scientific curiosity, motivation, and ability to work independently.

References

- Cabaret, Pierre-Antoine, et al. "Does multi-actuator vibrotactile feedback within tangible objects enrich VR manipulation?." IEEE Transactions on Visualization and Computer Graphics (2023).
- Lacôte, Inès, et al. "Investigating the Haptic Perception of Directional Information Within a Handle." IEEE Transactions on Haptics (2023).
- Yang, Tae-Heon, et al. "Recent advances and opportunities of active materials for haptic technologies in virtual and augmented reality." Advanced Functional Materials 31.39 (2021): 2008831.
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Duration

5-6 months

Benefits and Salary

According to French laws (e.g., subsidized meals, partial reimbursement of public transport costs, flexible organization of working hours, insurance, gratification salary of about 650 EUR/month).

Advisors and contact

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How to apply

Contact Pierre-Antoine Cabaret at pierre-antoine.cabaret@irisa.fr providing

- Complete Curriculum Vitae (CV)
- Transcript of record