

Development and Evaluation of Novel Interactions with Kinesthetic Feedback in VR

Encadrants :

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Structure :

Ville : Rennes

Désignation de l'établissement : Laboratoire

Nom de l'établissement : INRIA

Équipe : Rainbow/Hybrid

Keywords: Virtual reality, Haptics, Kinesthetic cues, Proprioception, Simulation, Fan-based interactions

Context:

Virtual reality (VR) has the benefits of transporting the user through novel immersive environments. Yet, discrepancies between what the user visually perceives and what the user physically experiences can lead to motion sickness – especially linked to the users' proprioception: their perception and awareness of our own body parts positions and movements. In these regards, we propose in this internship to investigate the development of a navigation task through novel interactions – potentially using mobile interfaces providing kinesthetic feedback to the users' head [1, 2] or body parts [3, 4]. The global idea is to provide a believable navigation for simulation rooms in VR – e.g. simulating extreme sports (such as bungyjumping, paragliding etc) or flight simulation [5]. The internship will consist in drawing novel navigation techniques using new types of environment-initiated interactions.

The student will be in charge of leading experiments for quantifying both the kinesthetic rendering on a perceptual perspective and the applied forces on a mechanical perspective. The student will have to understand the challenges behind pHRI – *physical Human-Robot Interaction* – to define novel interactions techniques using robotized mobile interfaces. The student will first have to conduct physical simulations of the mobile interfaces with virtual users, prior to evaluate interactions with real participants. Depending on the advances of the internship, the student will potentially work with a swarm of mobile interfaces [6].

Detailed Description:

During this placement, the intern will have to:

- Design novel physical interactions using mobile platforms following pHRI recommendations,
- Design the associated VR scenes on Unity,
- Design an experiment for fan-based interactions,
- Conduct an experiment with a panel of participants and analyse the results,
- Participate in the writing of a scientific article.

Qualifications: The candidate must be following a Master in Computing, HCI, or Robotics. He/She must show good computing skills (C, C#, Python) and must be eager to work with Virtual environments and Unity and Robotised interfaces.

References:

- [1] Gugenheimer et al., *GyroVR: Simulating Inertia in Virtual Reality using Head Worn Flywheels*, 2016
- [2] Günther et al, *PneumoVolley: Pressure-based Haptic Feedback on the Head through Pneumatic Actuation*, 2020
- [3] Ye et al., *Pull-Ups: Enhancing Suspension Activities in Virtual Reality with Body-Scale Kinesthetic Force Feedback*, 2019
- [4] Cheng et al., *Haptic Turk: a Motion Platform Based on People*, 2014
- [5] Costes et al., *The "Kinesthetic HMD": Enhancing Self-Motion Sensations in VR with Head-Based Force Feedback*, 2021
- [6] Tsykunov et al., *WiredSwarm: High Resolution Haptic Feedback Provided by a Swarm of Drones to the User's Fingers for VR interaction*, 2019