Internship position on
"HapticMic: Studying the Persuasive Effects of Haptics during Speech-Based Interactions"

Environment

The work will be carried out at **IRISA-Inria Rennes** as part of the HYBRID team (https://team.inria.fr/hybrid/), which is internationally recognized for its scientific activity as well as for technology transfer experience in the field of virtual reality, 3D interaction, haptic feedback, and human-machine interaction.

Inria is the main French research institution focusing on computer science and applied mathematics, employing 3900 researchers and engineers in 10 research centers.

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

Vibrotactile feedback is directly related to sound. When we speak, we make our body vibrate. At a concert, we feel vibratory feedback if we get close to a speaker. Vibrations seem to be an interesting way to emphasize sound feedback. Persuasive speech is broadly used in verbal communication, for instance in meetings, advertisements, informal discussions among friends, etc. Being able to modulate speaker leadership or persuasion in a collaborative environment could be of interest to increase inclusivity (e.g. of shy participants) or to solve conflicts. Previous studies have suggested that leadership is influenced by visual feedback. Very recently, we conducted two experiments where participants embody a first-person avatar attending a virtual meeting in immersive VR. Results showed that vibrotactile-reinforced speech can significantly improve the perceived co-presence but also the persuasiveness and leadership of the haptically-augmented agent.

Figure. In a previous work, we investigated whether reinforcing speech with vibrotactile feedback displayed in users' hand could improve perceived persuasion, leadership, and co-presence when users listen to agents (left) or when users talk to agents (right) in VR [Saint-Aubert et al., IEEE VR (2023)].

The objective of this research work is to **design and evaluate a haptic-enabled microphone, able to reinforce speech in real-time through vibrotactile feedback.**

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

- Development of the HapticMic: endow a standard microphone of haptic capabilities, so as to enable to reinforce the speech with vibrotactile feedback at runtime.
- Evaluation in Virtual Reality: design and evaluate the effect of speaking through the HapticMic during an immersive VR speech-interaction with virtual avatars in terms of perceived persuasion, leadership, and co-presence.
- Evaluation in the real world: design and evaluate the effect of speaking through the HapticMic during a real speech-interaction with other humans in terms of perceived persuasion, leadership, and co-presence.

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

J. Saint-Aubert, F. Argelaguet, M. J.-M. Macé, C. Pacchierotti, A. Amedi, A. Lécuyer. Persuasive Vibrations: Effects of Speech-Based Vibrations on Persuasion, Leadership, and Co-Presence During Verbal Communication in VR. IEEE VR 2023 - Virtual Reality. [PDF]

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).

Advisors and contact

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How to apply

Contact Justine Saint-Aubert at justine.saint-aubert@inria.fr, providing

- Complete Curriculum Vitae (CV)
- Transcript of record

- Short letter of motivation (1 page)
- Name of one or two references, e.g., a Professor you worked with.

Internship position on
"Wearable haptics for augmenting tangible objects in Augmented Reality (AR)"

Environment

The work will be carried out at **IRISA-CNRS 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.

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Topic

Augmented Reality (AR) integrates virtual content into our real-world surroundings, giving the illusion of one unique environment. Virtual object manipulation is critical for useful and effective AR usage, such as in medical applications, training, or entertainment. However, **there still exist several issues that affect manipulation in AR**, degrading the overall user experience. **One of the most important limitation is the lack of haptic feedback**, despite being proven to significantly improve both the manipulation performance and the user's experience during manipulation in VR and AR. The lack of haptic sensations is due to multiple reasons, including the degradation of the tracking performance when using, e.g., wearable haptic interfaces, and the resulting mismatch between the pose of the user's hand and that of its avatar representation in the AR environment.

The objective of this research work is to **design and evaluate (wearable) haptic approaches to augment tangible objects during AR manipulation**, e.g., alter the haptic perception of a tangible object through additional wearable haptic stimuli.

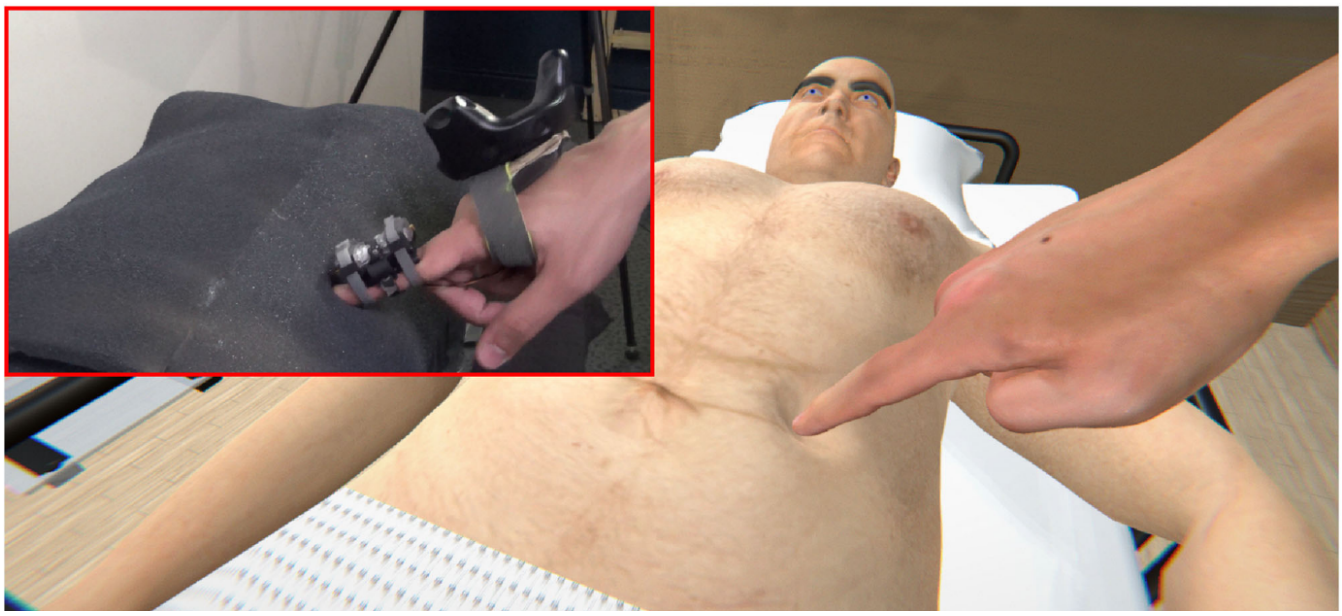

Figure. Mock-up example from [Salazar et al. IEEE Trans. Haptics, 2020]. A human user, wearing a wearable haptic device on the finger, interacts with a tangible object that resembles the abdomen of a virtual human patient. Providing timely tactile stimuli via the wearable haptic device, we can alter the stiffness and shape perception of passive tangible objects. For example, in the context of medical palpation, we can simulate the presence of a tender body part or of a small bump representing a cyst.

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

- Wearable haptic interface: mechatronic development of a wearable haptic interface suitable for use in AR, considering the right type of haptic sensation (pressure, skin stretch, vibration) as well as its placement (fingertip, palm, wrist).
- Haptic rendering: design a haptic rendering algorithm to provide suitable sensations during AR manipulation, so as to dynamically alter the how objects feel.
- Evaluation in optical see-through AR (OST-AR): carry out a human subjects study to evaluate the effectiveness and viability of the proposed rendering interfaces and techniques during OST-AR manipulation.

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

– Maisto, Maurizio, et al. "Evaluation of wearable haptic systems for the fingers in augmented reality applications." *IEEE Trans. haptics* 10.4 (2017): 511-522.

- Asano, Shuhei, Shogo Okamoto, and Yoji Yamada. "Vibrotactile stimulation to increase and decrease texture roughness." *IEEE Trans. Human-Machine Systems* 45.3 (2014): 393-398.
- Salazar, Steeven Villa, et al. "Altering the stiffness, friction, and shape perception of tangible objects in virtual reality using wearable haptics." *IEEE Trans. haptics* 13.1 (2020): 167-174.

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 550 EUR/month).

Advisors and contact

Claudio Pacchierotti
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How to apply

Contact Claudio Pacchierotti at claudio.pacchierotti@irisa.fr, providing

- Complete Curriculum Vitae (CV)
- Transcript of record
- Short letter of motivation (1 page)
- Name of one or two references, e.g., a Professor you worked with.

Internship position on
"Mixed Reality (MR) for heterogeneous multi-robot systems"

Environment

The work will be carried out at **IRISA-CNRS 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. The position is open within the **French project MULTISHARED,** which aims at advancing the state-of-the-art in multi-robot autonomy and human-multi-robot interaction for allowing a human operator to intuitively control the coordinated motion of multi-robot groups.

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Topic

Teams of coordinated robots have been successfully used in a plethora of different applications, including disaster response, exploration, patrolling, and surveillance. Multi-robot systems are able to perform actions according to the perception of the single robot and understanding of the environment, as the team (physically) interacts with it. The ensemble of these abilities of sensing, interpreting, modeling, predicting, and interacting with the physical world are concrete applications for Artificial Intelligence (AI) tools and methodologies.

However, when multiple robots are involved, it is unclear how to provide spatially accurate and efficient information to a (leader) human user, who either control the team from a remote (and secure) location or moves in the same environment as the robots. In this respect, Mixed and Augmented reality can be used to provide the human user with additional information about the target environment and task, reconstructing (part of) it from the information provided by the robotic team. By enhancing the world with virtual information, the user is allowed to provide additional feedback to the robots, that can

elaborate those information using sensors and cameras in a complete agnostic way with respect to the environment they move in.

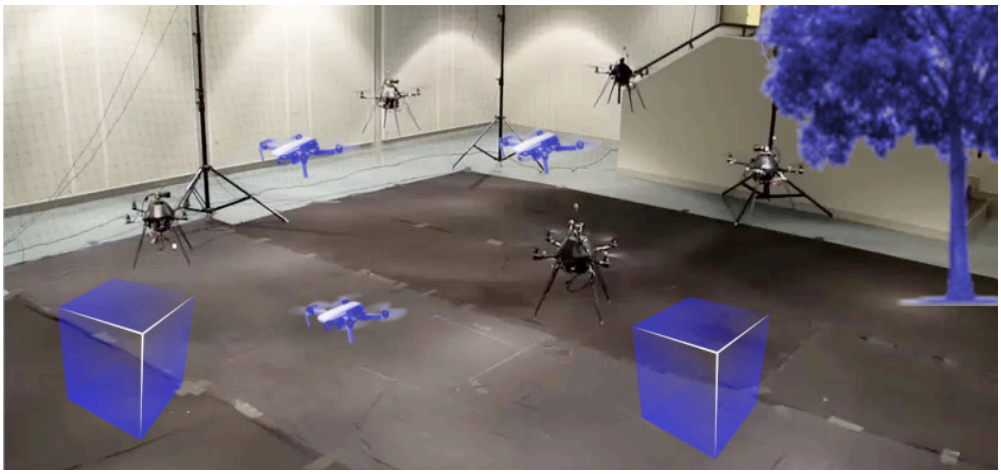

Figure 1. A flight arena augmented with additional virtual content.

The objective of this work is to **design and deploy a mixed-reality system able to agnostically treat real and virtual robots**, as well as provide feedback information to the user about the status of the robots. Imagine a human user, moving in the same environment of a team of coordinated drones; he or she can see directly some of the drones, while those who are not visible are shown through AR rendering. Moreover, virtual content can be added to the real world to show additional relevant details, such as the location of targets.

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

- Raw camera data manipulation: modify (3d) camera raw data to include virtual object from the drone point of view.
- Vision techniques: implement computer vision techniques to superimpose virtual content using an Optical see-through (OST) Augmented Reality system.
- Experimental evaluation: Evaluate the proposed MR techniques in multi-robot urban search & rescue scenarios, in which heterogeneous teams composed of humans as well as grounded and aerial robots move in the same environment to complete a common task. Virtual content augmenting the environment provides the human user with situational and spatial information regarding the part of the team which is not directly visible to him.

Requirements

- B.Sc. degree in computer science or related fields;
- Experience in Python/C#, Unity3D, Computer Vision, drones;
- Excellent scientific curiosity, motivation, and ability to work independently.

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).

Advisors and contact
Claudio Pacchierotti
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Antonio Marino
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How to apply
Contact Claudio Pacchierotti at claudio.pacchierotti@irisa.fr, providing

- Complete Curriculum Vitae (CV)
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Internship position on
"Immersive Virtual Reality (VR) multi-sensory User Interface (UI) for controlling multi-robot systems at the microscale"

Environment

The work will be carried out at **IRISA-CNRS 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. The position is open in the framework of the **collaborative European project RĔGO** (rego-project.eu), which aims at developing an innovative set of AI-powered, microsized, untethered, stimuli-responsive swarms of robots.

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Topic

Information feedback during the teleoperation of microrobotic systems is of course fundamental, enabling the human user to understand what is happening in the remote environment. An example of visual feedback commonly provided during the teleoperation of such systems is shown in Figure 1: two microrobots are controlled in 3D, providing the user with the front and side views of the environment as captured by the cameras.

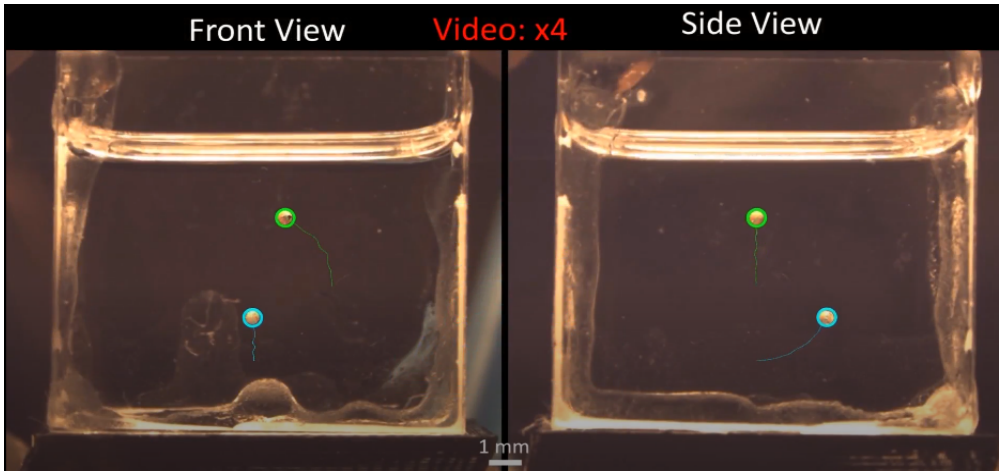

Figure 1. Front and side views of the microscopic environment during the independent control of two micro-robots. [Ongaro et al. IEEE Trans. Robotics (2018)].

Input information regarding, e.g., where the robot should move is usually provided by simply clicking on the screen to indicate the target reference positions. While this approach is widely employed, and it provides all the necessary information to drive the robots, it does not enable an intuitive control and visualization of the robots and their environment.

The objective of this research work is to **design and evaluate a series of immersive Virtual Reality (VR) User Interfaces (UI) for controlling multi-robot systems at the microscale in an intuitive and natural way**, as well as providing feedback information to the user about the status of the robots and the current task.

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

- 3-dimensional virtual scenario: create a VR volumetric representation of the small-scale environment from multiple standard 2D camera views.
- User-immersive interaction: study how to immerse and navigate the human operator inside the abovementioned environment so as to enable an intuitive understanding of the pose and movements of the robots.
- Input techniques: design and evaluate an appropriate user interface and input paradigm to enable a human operator to intuitively control the motion of the robots within the immersive virtual scenario.
- Feedback techniques: design and evaluate visuo-haptic rendering approaches to provide the user with information regarding the status of the robots with respect to the provided inputs.

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

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).

Advisors and contact

Claudio Pacchierotti
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