Finally, due to the complementarity of both objectives, an iterative design process will be employed. It strives to meet the challenges of the digital transformation of science, society and the economy.

**Contexte et atouts du poste**

This PhD position is framed under the EU H2020 ICT 25 TACTILITY project. Tactility aims at creating a new generation of smart electro-tactile systems able to adapt to the user, application scenarios, and use conditions. Such electro-tactile interfaces will provide high-density stimulation for delivering natural-like sensations. The ability to generate localized tactile feedback will change the way we interact with virtual reality content. Users will be able to feel the physical properties of virtual objects (e.g., roughness, stiffness) supporting a wide variety of natural interactions and information retrieval. Such technology will allow the design of algorithms for real-time rendering of high-fidelity electro-tactile stimuli to the user. One of the main hypothesis of Tactility is that it is possible to improve the feeling of immersion and embodiment by leveraging a multimodal approach, i.e., by integrating electro-tactile stimuli with visual and auditory information. TACTILITY is based on a highly interdisciplinary approach. Experts from fields such as computer science, electrical/electronic engineering, psychology and neuroscience are involved.

The PhD candidate will join the Inria's Hybrid team (https://team.inria.fr/hybrid), internationally recognized in the virtual reality and haptic research fields. Currently, the team is composed by more than 30 members working in topics related to virtual reality, augmented reality, physical simulation, haptics and human computer interaction.

**Mission confiée**

Haptic devices commonly used in virtual reality are unfit for precise dexterous manipulation. As of today, the only systems capable of doing so are cumbersome and costly multi-finger devices such as active exoskeletons. Alternatively, the use of tactile feedback could allow the user to gather additional information from the virtual environment. Such information can be used for exploratory purposes (e.g., feel a soft or a bumpy surface) or for interaction purposes (e.g., enable the precise and realistic grasping of a virtual object [1,2]). Other research groups have tried to add haptic feedback to interfaces based on hand tracking by developing their own haptic displays. Technologies based on ultrasound [3, 4], air streams [5], and pin-matrix [6] allow interaction with a bare hand, but they are too complex to scale to large workspaces. The main goal of this PhD is to take advantage of a new generation of electro tactile gloves in order to enable dexterous manipulation in virtual reality.

**Principales activités**

The first objective is to create novel interaction methods leveraging electro-tactile feedback to provide natural user interfaces (NIUs). The ability to provide high-density localized tactile feedback to the user's hand will enable an increased awareness of the actions performed supporting precise and complex dexterous manipulations of virtual objects. In addition, to provide localised contact feedback, we will investigate how electro-tactile feedback can be modulated to increase the range of tactile sensations that can be elicited. Immersion and interaction are key components in any VR experience, with several factors that define the grade of this immersion. So far these have been characterized only in scenarios with no or crude tactile feedback [7, 8]. The technology proposed in Tactility will allow complex, compelling, and accurately-timed tactile feedback.

However, grasping and dexterous virtual object manipulation are complex tasks that require appropriate models of hand and contact mechanics to be simulated in real time. The complexity of the human hand requires the use of simulations during physical simulation, which can generate unrealistic interactions, breaking the user's immersion. Existing methods have focused on hand interactions involving a reduced number of fingers [9] or computationally expensive for bimanual purposes (e.g., feel a so, or a bumpy surface) or for interaction purposes (e.g., enable the precise and realistic grasping of a virtual object [1,2]). Other research groups have tried to add haptic feedback to interfaces based on hand tracking by developing their own haptic displays. Technologies based on ultrasound [3, 4], air streams [5], and pin-matrix [6] allow interaction with a bare hand, but they are too complex to scale to large workspaces. The main goal of this PhD is to take advantage of a new generation of electro tactile gloves in order to enable dexterous manipulation in virtual reality.

Finally, due to the complementarity of both objectives, an iterative design process will be employed. In particular, the interaction process is tightly coupled to a perception-action loop. In such context, the user's perception of the visual and tactile stimuli would strongly influence/drive his/her interactions. Thus, formal evaluations of the designed systems would be required to assess the suitability of the designed interactions.

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**Informations générales**

- **Thème/Domaine :** Interaction et visualisation
- **Ville :** Rennes
- **Centre Inria :** CRI Rennes - Bretagne Atlantique
- **Date de prise de fonction souhaitée :** 2019-10-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2019-06-16

**Contacts**

- **Equipe Inria :** HYBRID
- **Directeur de thèse :** Argelaguet San Fernando / ferran.argelaguet@inria.fr

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**A propos d'Inria**

Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques ou mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L'Institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

**Consignes pour postuler**


**Sécurité défense**

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

**Politique de recrutement**

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

**Attention**

Les candidatures doivent être déposées en ligne sur le site Inria.

Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.
Bibliography


Compétences

The candidate must have a master degree (or equivalent), with a preference in virtual reality or computer graphics. In addition, the candidate should be comfortable with as much following items as possible:

- Background in computer graphics and physical simulation.
- Experience in 3D/VR applications (e.g. Unity3D).
- Experience in evaluation methods and controlled users studies.
- Good knowledge in programming languages.
- Good spoken and written English.
- Good communication skills. This PhD is framed under a larger project, thus the candidate would have to interact with other members of the project and assist to the project meetings.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs

Rémunération

Monthly gross salary amounting to 1 982 euros for the first and second years and 2 085 euros for the third year.