2019-01564 - PhD Position F/M Dexterous Interaction in Virtual Reality using High-Density Electrotactile Feedback

Type de contrat : CDI de la fonction publique
Niveau de diplôme exigé : Bac à 5 ou équivalent
Autre diplôme apprécié : Master en Computer Science or equivalent
Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

Inria, the French national research Institute for the digital sciences, promotes scientific excellence and technology transfer to maximise its impact. It employs 2,400 people. Its 200 agile project teams, generally with academic partners, involve more than 3,000 scientists in meeting the challenges of computer science and mathematics, often at the interface of other disciplines. Inria works with many companies and has assisted in the creation of over 160 startups. It strives to meet the challenges of the digital transformation of science, society and the economy.

Conteste et attous du poste

This PhD position is formed under the EU H2020 ICT 25 TACTILITY project. Tactility aims at creating a new generation of smart electrotactile systems able to adapt to the user, application scenarios, and use conditions. Such electrotactile 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 electrotactile 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 electrotactile 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 electrotactile feedback to provide natural user interfaces (NUIs). 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 electrotactile 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 [1, 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 simplifications 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 interactions [10]. The second objective is to push forward the state of the art to create efficient and realistic hand simulation methods able to deliver the required end-to-end latency. We envision the design of simplified models able to deliver realistic interactions. The proposed models will have to match the distribution of the electrotactile pads and fit their specifications. In addition, hand-object interaction, where a real hand sinks into virtual objects due to the lack of real physical constraints, is a fundamental problem for hand-based interactions [11]. Interpretation contributes to artifacts such as a “sticking object,” when exaggerated finger motions are required for release, degrading release performance and subjective experience and contributing to fatigue. Current methods for hand-object interpretations mainly address systems without haptic feedback or consider only the use of low-density vibro-tactile gloves. In addition to propose novel hand simulation methods, the PhD candidate will have to re-assess existing methods to handle hand-object interpretations to identify and improve the most suitable ones for providing increased immersion and user experience.

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 immersion and user experience.

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 Sanz Fernando / ferran.argelaguet@inria.fr

A propos d’Inria

Inria, the national institute for research devoted to sciences of the digital, promotes excellence scientific and the transfers to have the major impact. It employs 2400 persons. Its 200 projects agiles, in general communes with des partenaires académiques, impliquent plus de 3000 scientifiques for relever les défis des sciences informatiques et mathématiques, souvent à l’interface d’autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 startup. 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

Please submit online : your resume, cover letter and letters of recommendation eventually

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.

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interactions. Thus, formal evaluations of the designed systems would be required to assess the suitability of the designed interactions.

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