2019-01616 - Doctorant F/H Supporting Collaborative 3D Modeling through Augmented-Reality Spaces

Type de contrat : CDD de la fonction publique
Niveau de diplôme exigé : Bac + 5 ou équivalent
Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

Located at the heart of the main national research and higher education cluster, member of the Université Paris Saclay, a major actor in the French Investments for the Future Programme (Idex, LabEx, IRT, Equipex) and partner of the main establishments present on the plateau, the centre is particularly active in three major areas of research and knowledge: safety, security and reliability; modelling, simulation and optimisation (with priority given to energy).

The 450 researchers and engineers from Inria and its partners who work in the research centre’s 28 teams, the 60 research support staff members, the high-level equipment at their disposal (image walls, high-performance computing clusters, sensor networks), and the privileged relationships with prestigious industrial partners, all make Inria Saclay Île-de-France a key research centre in the local landscape and one that is oriented towards Europe and the world.

Contexte et atouts du poste

Current digital fabrication tools still rely on traditional CAD software, where a great part of the creation process takes place in front of a computer screen. Unfortunately, this process does not capture the way design teams work on highly creative projects, where concepts evolve through parallel representations, which include sketches on paper and low-cost physical prototypes before they reach their final detailed form. Recently, we have developed material-based sensing technologies that allow synchronizing the physical and digital representation of a model. As the modeler works on a physical prototype, the system streams the artist’s physical changes to its digital representation in a 3D CAD environment. Another designer can then refine the details of the model in front of a computer. Unfortunately, such technologies are imprecise and hard to deploy, while interaction between collaborators is still difficult. We have further studied remote scenarios where concepts evolve through parallel representations, which include sketches on paper and low-cost physical prototypes before they reach their final detailed form.

The goal of the Ph.D. thesis is to investigate how alternative digital (or physical) representations can enhance collaborative modeling. We are especially interested in collaboration scenarios where each participant (e.g., the architect or the modeler) has potentially a different design role and task. This direction requires virtual views adapted to the expertise and design perspective of each collaborator. It further requires interactive tools that adapt well to the scope of a design task: sketching capabilities are more important in the early phases of a design process; annotation and multiple parallel views better support design iteration and collaboration; while precision is crucial for producing high-fidelity models. Likewise, some input devices (e.g., mouse and specialized pens) are effective for precise editing, while other modalities (e.g., touch, gaze, and free-hand gestures) can be more appropriate when collaborators navigate through design alternatives and communicate ideas.

Mission confiée

The thesis will examine augmented-reality (AR) technologies (e.g., based on HoloLens and/or Meta AR handsets), focusing on how the 3D representations they support can be integrated into traditional design tools, either digital or physical. We envision the following main directions:

1. Explore AR techniques that help collaborators coordinate their actions when working on the same virtual model, effectively communicate design ideas, and avoid conflicts. A main challenge is how to adapt the view of each collaborator in way that it reflects her or his expertise and design perspective.

2. Investigate how to support collaborative design through parallel model representations. Some recent work has studied techniques for sharing views in Virtual-Reality environments. However, this approach does not generalize to AR environments where collaborators share a common physical space. In such scenarios, taking into account and further encouraging natural body cues, such as gaze and gestures, can be important. To this end, we need to design techniques that provide links among representations, highlight differences, and help designers evaluate their outcomes and make decisions.

Principales activités

During the thesis, the student will explore solutions with design experts, develop novel technologies, and experimentally evaluate them with users. The research topic will be adapted based on the interests and skills of the student.

References
Compétences
We are looking for students who are enthusiastic about AR technology and research in Human-Computer Interaction. The candidate is expected to have solid programming skills, and ideally, previous experience with C# or related programming languages (Java or C++). A background in computer graphics and 3D modeling will be a plus. The candidate must have good knowledge of English (reading, writing, and oral). Knowledge of French is not required.

Avantages
- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération
Monthly gross salary (1st and 2nd year) : 1.982 euros, (3rd year) : 2.085 euros