

A Simulation and Animation Toolbox to Study Human Crowds in eXtended Reality

Type d'offre : Ingénieur-e de recherche (CDD)

Lieu de travail : Inria, équipe VirtUs, Rennes

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Contexte projets : Travaux menés notamment dans le cadre des projets ANR-FNR PEAR, France 2030 JUNN, et Horizon TimeScale

Context

The VirtUs team at Inria has, over more than a decade, developed a recognised expertise in the simulation and animation of virtual crowds, combining agent-based crowd modelling, character animation, and perceptual evaluation to produce large-scale virtual populations that behave and move convincingly. This expertise is embodied in a set of software tools — including the open-source crowd simulation engine Umans — that are continuously extended and reused across the team's research projects, each of which brings its own requirements and use-cases.

Two projects currently illustrate this diversity. The ANR-FNR project PEAR investigates how realistic virtual crowds can be deployed on-site through Augmented Reality (AR), so that organisers of large-scale events — music festivals, sporting ceremonies, urban celebrations — can move beyond desk-based planning and experience crowd situations directly, from within a virtually populated version of their event site. The France 2030 project JUNN, on digital twins, relies on the same underlying crowd simulation capabilities to populate high-fidelity virtual replicas of real environments. To support these projects, the Virtus team has a need to consolidate some of its existing software, develop novel functionalities, and extend its scope of usability (e.g., real-time execution on AR hardware).

This engineer position aims to address these issues: consolidating the team's crowd simulation software into a coherent, maintainable and reusable toolbox, contributing to the development of a number of functionalities to edit in real-time simulation trajectories to dedicated operational contexts, and contributing to porting these components to run in eXtended Reality (XR) to support use-cases developed in the team's current projects.

Missions

The recruited candidate will work in collaboration with other engineers and PhD students, and contribute to the following missions depending on their own expertise; we therefore recommend that interested candidates apply even if they do not have expertise in all these areas as we are looking for motivated candidates that can bring their expertise to the general context of these projects.

Missions will include:

- Auditing and consolidating the team's existing crowd simulation and animation frameworks (simulation core, character animation, rendering) — improving its modularity, interoperability, documentation and test coverage, so that it can be reliably reused and extended across projects.
- Developing tools to edit and modify simulated trajectories and crowd data — e.g., reshaping simulated paths, adjusting local density or flow patterns, or directly editing individual trajectories — so that the populated crowds can be fine-tuned to match conditions observed in the field (from video recordings, sensor data, or other observations collected during real situations).
- Porting and optimising this consolidated framework to run at interactive frame rates on XR systems (in particular AR head-mounted displays), including dynamic quality adaptation mechanisms that adjust character appearance and animation quality to GPU and memory constraints on XR hardware.
- Defining and implementing clean, well-documented interfaces between the crowd simulation toolbox and the applications that build on it — in particular the AR crowd authoring and animation prototypes developed within PEAR, and the population of digital-twin environments within JUNN — so that new projects can integrate the toolbox with minimal friction.

- Providing ongoing technical support to the PhD students and researchers of the team relying on the toolbox, and contributing to its open-source release in line with the team's open-science practices.

Requirements for candidacy

- Strong software engineering skills (C++ and/or C# recommended), with an interest in software architecture and maintainable codebase design
- Experience with real-time 3D engines (Unreal Engine would be best); prior XR development experience would be a plus
- Interest in or prior experience with computer animation, crowd simulation, robotics, or signal processing
- Ability to support and collaborate with multiple research projects and users with different technical needs
- Proficiency in English (orally and in writing) to interact with the different international project partners

Keywords

Crowd simulation; Software consolidation; Augmented Reality; Digital twins.