



**Offer #2025-08836**

## **Post-Doctoral Research Visit F/M Postdoc in data-driven modelling and simulation of dense crowds**

**Contract type :** Fixed-term contract

**Level of qualifications required :** PhD or equivalent

**Fonction :** Post-Doctoral Research Visit

### **About the research centre or Inria department**

The Inria Centre at the University of Rennes is one of Inria's nine centres and is home to more than thirty research teams. It is a major and well-recognized player in the field of digital science. The centre is at the heart of a rich ecosystem of R&D and innovation, involving highly innovative SMEs, large industrial groups, competitiveness clusters, research and higher education institutions, excellence laboratories, and a technological research institute.

### **Context**

This postdoctoral position is part of the Inria International Relations Department's (DRI) annual postdoctoral recruitment campaign.

The postdoc will be based in the VirtUs team at the Inria Centre at the University of Rennes. Frequent and/or long stays will also be planned in the Virtual Environment and Computer Graphics (VECG) group at UCL in London.

The postdoc will be supervised jointly by He Wang (UCL) and Julien Pettré (Inria).

The Inria Centre at Rennes University is one of Inria's eight centres and has more than thirty research teams. The Inria Centre is a major and recognized player in the

field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc. The VirtUs team has around 25 members, including 7 permanent researchers. The team is internationally recognized for its work in the fields of graphic animation and virtual reality. Crowd simulation and the study of collective human behavior is one of its major research themes.

Founded in 1826 in the heart of London, UCL is London's leading multidisciplinary university, with more than 18,000 staff and 51,000 students from over 150 different countries. UCL consistently demonstrates research power and impact at the highest level and is fortunate to educate students of impressive talent and ambition from around the world. The VECG group investigates fundamentals and applications that enrich human experience of digital content. The group's research spans capture, modelling and display of a multisensory world, and involves hardware, algorithms and human-centred approaches.

Travel fees between UCL and Inria will be covered.

## Assignment

### Context:

This postdoctoral research focuses on the modelling and simulation of dense human crowds, i.e. crowds in which social and physical interactions between individuals are mixed. The study of the behaviour of dense crowds is an important issue in terms of crowd management and accident prevention. Simulation of dense crowds is an essential part of these studies, but modelling the physical interactions between individuals still poses many unexplored challenges. The proposed postdoctoral program aims to make significant progress in this direction, and more specifically, the research on dense crowds will spawn new classes of Artificial Intelligence models.

To explore this area, the VirtUs team has a unique set of field data that captures the behaviour of dense crowds as observed at music festivals. The dataset includes videos of the crowd at festivals, a few manually checked tracked trajectories of individuals in the crowd, as well as automatically tracked trajectories of a large number of people in the image. The dataset also includes full-body motion capture for equipped participants in the crowd. As a continuation of recent work on modelling dense crowds, this postdoc aims to exploit the existing dataset for modeling and simulation purposes.

### Objectives

The main goal of the postdoc is to establish new approaches to crowd simulation that are capable of learning new crowd dynamics based on their video observation, and to establish new crowd analysis methods based on simulation to improve the understanding of dense crowd behaviours.

The main activity of the postdoc will be

- To explore new crowd data representations for machine learning approaches to crowd simulation
- To explore new models for data-driven crowd simulation
- To explore new metrics for the evaluation of crowd simulation and comparison with real-world data.

The postdoc is open in terms of approaches and paradigms for crowd simulation, including trajectory prediction using generative models, or imitation of crowd behaviour using reinforcement learning approaches. Candidates may establish their own approach in discussion with the management team.

## Outcomes

We will aim to publish the results of this research in the best conferences and journals in the field, including IEEE CVPR or ACM SIGGRAPH, ACM TOG.

The postdoc opens up the possibility of applying for permanent research positions in the VirtUs team at the Inria centre at the University of Rennes.

## Bibliography

Chatagnon, T., Olivier, A. H., Hoyet, L., Pettré, J., & Pontonnier, C. (2025). Classification of first recovery steps after quiet standing following external perturbation from different directions. *Journal of Biomechanics*, 112639.

van Toll, W., Braga, C., Solenthaler, B., & Pettré, J. (2020, October). Extreme-density crowd simulation: combining agents with smoothed particle hydrodynamics. In *Proceedings of the 13th ACM SIGGRAPH Conference on Motion, Interaction and Games* (pp. 1-10).

Gomez-Nogales, G., Prieto-Martin, M., Romero, C., Comino-Trinidad, M., Ramon-Prieto, P., Olivier, A. H., ... & Casas, D. (2024). Resolving Collisions in Dense 3D Crowd Animations. *ACM Transactions on Graphics*, 43(5), 1-14.

He, F., Yue, J., Zhu, J., Seyfried, A., Casas, D., Pettré, J., & Wang, H. (2025). Learning Extremely High Density Crowds as Active Matters. *arXiv preprint arXiv:2503.12168*.

Sundararaman, R., De Almeida Braga, C., Marchand, E., & Pettre, J. (2021). Tracking pedestrian heads in dense crowd. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 3865-3875).

Dang, H. T., Gaudou, B., & Verstaevel, N. (2024). A literature review of dense crowd simulation. *Simulation Modelling Practice and Theory*, 102955.

Van Toll, W., & Pettré, J. (2021, May). Algorithms for microscopic crowd simulation: Advancements in the 2010s. In *Computer Graphics Forum* (Vol. 40, No. 2, pp. 731-754).

## Main activities

Main activities (5 maximum) :

- Propose solutions for automatic modelling of dense crowds based on data
- Coding / developping
- Analysis, evaluation of results
- Bibliographics studies

## Skills

Technical skills and level required :

- Deep learning
- Simulation
- C++

Languages :

- English

Relational skills :

- good capabilities to work in a collaborative environment

## Benefits package

- 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

## Remuneration

Monthly gross salary from 2 788 euros.

## General Information

- **Theme/Domain** : Interaction and visualization  
Scientific computing (BAP E)
- **Town/city** : Rennes
- **Inria Center** : [Centre Inria de l'Université de Rennes](#)
- **Starting date** : 2025-11-01
- **Duration of contract** : 2 years
- **Deadline to apply** : 2025-06-22

## Contacts

- **Inria Team** : [VIRTUS](#)
- **Recruiter** :  
Pettre Julien / [julien.pettre@inria.fr](mailto:julien.pettre@inria.fr)

## About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

## The keys to success

We are looking for candidates who are highly motivated by the research topic and who have demonstrated solid research activity during their PhD. The candidate will have a strong background in automatic modelling and/or machine learning and/or generative models and/or reinforcement learning. He/she will have a research activity in the fields of computer vision or graphic animation in relation to the modelling of human behaviour or character animation.

**Candidacy to this position is undergoing the following eligibility criteria:**

Candidates for postdoctoral positions are recruited after the end of their Ph.D. or after a first postdoctoral period: for the candidates who obtained their Ph.D. in the Northern hemisphere, the date of the Ph.D. defense shall be later than September,1 2022; in the Southern hemisphere, later than April,1 2022.

In order to encourage mobility, the postdoctoral position must take place in a scientific environment that is truly different from that of the Ph.D. (and, if applicable, from the job held since the Ph.D.); particular attention is thus paid to French or international candidates who obtained their doctorate abroad.

**To apply, please provide the following documents:**

- Detailed CV with a description of the PhD and a complete list of publications with the two most significant ones highlighted
- Motivation letter from the candidate
- 2 letters of recommendations

Applicants should send their applications through the web platform or directly to [julien.pettre@inria.fr](mailto:julien.pettre@inria.fr) and [he\\_wang@ucl.ac.uk](mailto:he_wang@ucl.ac.uk)

**Warning :** you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

## **Instruction to apply**

Please submit your CV, cover letter, and any recommendations online

**Defence Security :**

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

**Recruitment Policy :**

As part of its diversity policy, all Inria positions are accessible to people with disabilities.