Offer #2023-06349

PhD Position F/M Inverse Control of Erosion Simulation

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria centre at Université Côte d'Azur includes 37 research teams and 8 support services. The centre's staff (about 500 people) is made up of scientists of different nationalities, engineers, technicians and administrative staff. The teams are mainly located on the university campuses of Sophia Antipolis and Nice as well as Montpellier, in close collaboration with research and higher education laboratories and establishments (Université Côte d'Azur, CNRS, INRAE, INSERM ...), but also with the regiona economic players.

With a presence in the fields of computational neuroscience and biology, data science and modeling, software engineering and certification, as well as collaborative robotics, the Inria Centre at Université Côte d'Azur is a major player in terms of scientific excellence through its results and collaborations at both European and international levels.

Context

The Ph.D. is part of the ANR JCJC project INVTERRA, which seeks to model physically plausible and editable terrains for computer graphics environments.

The thesis will handle the main scientific challenges of the project: the definition of the erosion processes, their neural representation, and the inversion of control parameters.

The project will be led in collaboration with other research groups with expertise in terrain or geology and will include travels for visits or conferences.

Assignment

Terrains in computer graphics are either procedural (result from a mathematical formulation or process), simulation-based (solution of a geology-derived differential equation), or by-example (copy or learned from real data). Simulation is often chosen for global geological consistency, while example-based provides fine-grained realism. In this project, we propose to combine both to reach both local and global plausibility, and ease edition as a by-product. The key idea is to use by-example technics in the space of the parameters of the simulation.

The thesis will be separated into three main projects:

1) Propose a generic, fast, and differentiable representation for terrain that allows easy inversion.

While direct outcomes will be to accelerate erosion simulation and implement further erosion processes not yet seen in computer graphics (e.g., debris flow, alluvial deposition), this project will also serve as the basis for the following tasks that require a fast and differentiable terrain generator.

2) Inverse erosion parameters

This is the core of the Ph.D.: given a real terrain, what are the erosion parameters that lead the erosion simulation to that terrain? This task will be solved using classical optimization and benefit from geology-derived regularization. The results will be exemplified by fluvial erosion laws and thoroughly validated on terrains known to exhibit fluvial features.

3) Generic erosion laws

The previous project focused on a well-defined fluvial erosion law, which encompasses many, but not all terrains on Earth. Instead of tackling, the infeasible task of inverting all possible erosion models, we propose to infer a learned erosion function from real data and untangle the erosion from the parameterization.

Main activities

The Ph.D. student follows a typical research methodology, that includes:

- Exploration and analysis of the state of the art

- Research and prototyping

- Writing publications, and presenting the results at conferences

- Managing collaborations (assisted by the supervisor)

- Integration within the local research team

- Training and obligations from the doctoral school

Skills

Knowledge of terrain modeling in computer graphics, physically based simulation, optimization, and learning.

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 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
- Contribution to mutual insurance (subject to conditions)

Remuneration

Duration: 36 months
Location: Sophia Antipolis, France
Gross Salary per month: 2051€ brut per month (year 1 & 2) and 2158€ brut per month (year 3)

General Information

- **Theme/Domain :** Interaction and visualization
  Scientific computing (BAP E)
- **Town/city :** Sophia Antipolis
- **Inria Center :** Centre Inria d'Université Côte d'Azur
- **Starting date :** 2023-10-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2023-06-23

Contacts

- **Inria Team :** GRAPHDECO
- **PhD Supervisor :**
  Cordonnier Guillaume / guillaume.cordonnier@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

not guaranteed.

Instruction to apply

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.