2018-01191 - PhD Position F/M Support of the Interactive Visual Exploration and Classification of Temporal Development in 3D Datasets using the Example of Cell Division Data

Contract type : Public service fixed-term contract
Level of qualifications required : Graduate degree or equivalent
Fonction : PhD Position

About the research centre or Inria department

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: data 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 31 teams, the 100 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.

Context

In this PhD project within the computer science domains of visualization and human-computer interaction (HCI) we want to investigate how to best support the visual exploration of temporal developments of biologic organisms. In a collaboration between Inria and Inra, we want to analyze segmented 3D datasets of plant embryos which have developed up to, at least, the 8th stage of cell division (256 cells; the datasets are roughly of size 300x300x100 voxels). In the project we want to investigate visualization techniques and interactive tools to classify cell types based on their shape, identify sister cells that originated from a single cell in the previous division stage, and thus construct a tree of cell division history from only a single 3D microscopy image.

Assignment

For a better knowledge of the proposed research subject :

https://www.aviz.fr/wiki/uploads/Research/2016_INRA-INRIA_internship.pdf

Main activities

For this purpose we need to combine several visualization and interaction techniques. In particular, the biologists need to be able to focus on a local neighborhood in the dataset to assess shapes and potential divisions, for example by using abstraction techniques from illustrative visualization. In addition, we need to be able to interact both with the 3D dataset as well as with the abstract data such as the inheritance tree or data about the shared surface between two adjacent cells. We also want to be able to visualize a progression of the classified cell division history to assess if the proposed division tree is plausible.

In addition to analyzing single datasets independently, we also want to exploit existing classifications for the annotation of new datasets. In particular, we not only want to be able to compare datasets with each other but also to employ machine learning techniques that allow us to assist the biologists by identifying similar situations and by suggesting potential division patterns based on the local segmented geometry. This suggestion should also provide a certain level of confidence such that the biologist can make use of the suggestion or decide differently if needed. The use of machine learning should also allow us to classify and analyze mutant embryos in which the cell division does not follow a normal path.

Ultimately, we thus want to investigate several important research questions within the scope of this proposed PhD work which are highly relevant to visualization and HCI: (1) how can we best combine both 3D and standard 2D interaction techniques for essentially time-dependent data that has both 3D and 2D aspects, (2) how can we use abstraction to allow the biologists to concentrate on local 3D neighborhoods, without losing the context of the entire dataset, (3) how can we best visualize alternative decision trees such that different potential division histories can be analyzed and compared to each other, and (4) how can we make use of machine learning techniques to support the interactive data analysis, without taking the human out of the loop.

Skills

- Highly motivated student who has completed a MSc or equivalent degree in computer graphics, visualization, HCI, or related computer science topics,
- Experience with software development, in C++ and/or Java,
- Experience in modern computer graphics (GPU) and/or visualization programming,
- Experience in the use of machine learning algorithms,
- Able to communicate on a regular basis with supervisors and end-users,
- Distribute time between the two labs (details negotiable),
- Receptive to directions and feedback from supervisors, and
- Able to clearly and concisely communicate in English in written and spoken form.

Benefits package

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave

General Information

- **Theme/Domain :** Interaction and visualization
  Scientific computing (BAP E)
- **Town/city :** PALAISEAU
- **Inria Center :** CRI Saclay - Île-de-France
- **Starting date :** 2019-09-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2019-08-31

Contacts

- **Inria Team :** AVIZ
- **PhD Supervisor :**
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About Inria

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.

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.

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.

- Flexible working hours
- Sports facilities

Remuneration

Monthly gross salary : 1st and 2nd year, 1.982 euros

Monthly gross salary : 3rd year, 1.982 euros