2018-00597 - PhD Position - Simulation of random geometric structures [5]

Level of qualifications required: Graduate degree or equivalent
Other valued qualifications: MSc in computer science or mathematics.
Fonction: PhD Position

Context

Team
Gamble, INRIA Nancy Grand-Est, gamble.loria.fr

Contacts
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This PhD position is funded by ANR ASPAG.

Assignment

Context
The complexity of geometric algorithms is often expressed in terms of the input size and sometimes of the output size, but the behavior of these algorithms may depend drastically on the geometric distribution of the input. The difference between the best-case and the worst-case can be important. An alternative is to analyze these algorithms under the hypothesis of a probabilistic distribution of the data. When the input is a point set, an easy probabilistic hypothesis is to consider that points are independently distributed under some law (Poisson distribution, uniform distribution...), unfortunately this hypothesis of independence may be unsuitable for several applications.

The use of non-independent distribution is very difficult to analyze theoretically, thus having access to simulations of practical instances would be of tremendous help to guide the intuition and to lead to reasonable conjectures. Unfortunately, the generation of useful random instances is a difficult question in itself. We plan to attack three specific questions, as described below: simulation of geometric structures, of conditioned structures, and of dependent point sets.

Main activities

Project description
The goal of this research is to design and realize tools for the generation of several random geometric objects. These tools will be used to benchmark geometric algorithms and to establish new probability conjectures.

The thesis will address the following questions:
- Sparse structures. One of the general frameworks we will consider is that of sparse structures, for which typically only a vanishing proportion of the pointset is part of the output. Problems of this kind abound: in convex hulls, in power diagrams, or when computing the boundary of a union of objects, it is very likely that the vast majority of the input data has no influence on the computed structure. Our goal is to design algorithms of random generation with a near-linear running time in the output size.
- Partial structures. In some other situations, it may be the case that even if all the input participates in the definition of the output, only a part of the output is relevant. Examples of this kind of situation include paths in Delaunay triangulations: either intrinsic (shortest paths) or defined through a pathfinding algorithm.

General Information

Theme/Domain: Algorithmics, Computer Algebra and Cryptology
Town/city: Villers-lès-Nancy
Inria Center: CRI Nancy - Grand Est
Starting date: 2018-10-01
Duration of contract: 3 years
Deadline to apply: 2018-05-01

Contacts

Inria Team: GAMBLE
Recruiter: Devillers Olivier / olivier.devillers@inria.fr

The keys to success

Application deadline

May 1st, 2018
(Midnight Paris time)

How to apply

Upload your file on jobs.inria.fr in a single pdf or zip file, and send it as well by email to olivier.devillers@inria.fr.

Your file should contain the following documents:
- Your CV.
- A cover/motivation letter describing your interest in this topic.
- A short (max one page) description of your Master thesis (or equivalent) or of the work in progress if not yet completed.
- Your degree certificates and transcripts for Bachelor and Master (or the last 5 years).
- Master thesis (or equivalent) if it is already completed and publications if any (it is not expected that you have any). Only the web links to these documents are preferable, if possible.

In addition, one recommendation letter from the person who supervises(d) your Master thesis (or research project or internship) should be sent directly by his/her author to olivier.devillers@inria.fr.
- **Conditioned structures.** A closely related—but fundamentally different—open question is the design of algorithms that simulate random objects conditional on the occurrence of some rare event, e.g., for points in convex position, portions of tessellations in the neighborhood of exceptional locations, and conditioned geometric networks.

Simulations will be coded and distributed using CGAL.

More details at https://members.loria.fr/Olivier.Devillers/these-aspag.pdf

**Skills**

Knowledge involved:

- mathematical aspects (probability)
- algorithmic aspects
- C++ (templates, etc)

**Language**

French or English.

**Benefits package**

- Subsidised catering service
- Partially-reimbursed public transport
- French courses

**Remuneration**


Monthly salary after taxes: around 1596,05€ for 1st and 2nd year. 1678,99€ for 3rd year. (medical insurance included).