

## 2019-01513 - Post-Doctoral Research Visit F/M Delaunay triangulations of hyperbolic (2, 4, 6)-surfaces [s]

**Type de contrat :** CDD de la fonction publique  
**Niveau de diplôme exigé :** Thèse ou équivalent  
**Fonction :** Post-Doctorant

### Contexte et atouts du poste

#### Team

Gamble, INRIA Nancy - Grand Est, Loria <http://gamble.inria.fr>

#### Contacts

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### Mission confiée

#### Context

Tesselations of space from repeating motifs have a long and involved history in mathematics, art, engineering, and natural sciences. The mathematical literature has traditionally focused on patterns in Euclidean spaces but the role of hyperbolic geometry in the natural sciences is increasingly recognized. From a theoretical point of view, discrete differential geometry, a field that provides a basis for a theoretical analysis of discrete objects that recovers the rich theory of their smooth counterparts, treats discrete surfaces as triangular meshes. It is desirable to assume that the triangulation is Delaunay, as many things, such as the discrete Laplacian, become much simpler to compute and to interpret. As a result, Delaunay triangulations have become a central tool in the theoretical study of discrete surfaces.

Delaunay triangulations in Euclidean space have been extensively studied throughout the 20th century and are still a very active research topic. Their mathematical and algorithmic properties are by now well understood (see e.g., a survey book [AKL13]). Considering their importance, it is surprising how little is known about geometric algorithms to robustly compute Delaunay triangulations for hyperbolic surfaces, even relatively simple ones. Recent progress has led to an algorithm for one of the simplest hyperbolic surfaces, the Bolza surface, which is related to the triangle group (2, 3, 8) [BTV16, IT17]. However, the extension to general hyperbolic surfaces remains elusive.

The Computational Geometry Algorithms Library [CGAL](http://CGAL.org), developed within an Open Source Project, has facilitated the use of geometric algorithms in applications in an unprecedented way. The library offers several triangulation packages, including the recent package for the Bolza surface [IT19].

### Informations générales

- **Thème/Domaine :** Algorithmique, calcul formel et cryptologie
- **Ville :** Villers-lès-Nancy
- **Centre Inria :** CRI Nancy - Grand Est
- **Date de prise de fonction souhaitée :** 2019-10-01
- **Durée de contrat :** 1 an, 4 mois
- **Date limite pour postuler :** 2019-06-05

### Contacts

- **Equipe Inria :** GAMBLE
- **Recruteur :**  
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### A propos d'Inria

Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques et mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

### L'essentiel pour réussir

#### Application deadline

May 30, 2019

#### How to apply

Upload your file on [jobs.inria.fr](http://jobs.inria.fr) in a single pdf or zip file, and send it as well by email to the contact persons. Your file should contain the following documents:

- CV including a description of your research activities (2 pages max) and a short description of what you consider to be your best contributions and why (1 page max and 3 contributions max); the contributions could be theoretical or practical. Web links to the contributions should be provided. Include also a brief description of your scientific and career projects, and your scientific positioning regarding the proposed subject.
- The report(s) from your PhD external reviewer(s), if applicable.
- If you haven't defended yet, the list of expected members of your PhD committee (if known) and the expected date of defense (the defense, not the manuscript submission).

In addition, at least one recommendation letter from your PhD advisor should be sent directly by their author(s) to the contact persons.

Applications are to be sent as soon as possible.

## Principales activités

### Objectives

Hyperbolic surfaces exhibiting the symmetries of the (2, 4, 6) triangle group are ubiquitous in nature, where they appear as triply-periodic minimal surfaces [ES15]. The aim of this project is to propose and analyze effective algorithms to compute triangulations of such surfaces. Fundamental questions must be addressed to establish the mathematical foundations used to describe triangulations in these spaces. To ensure that our results are as relevant and applicable as they can be, we will focus on recent and active research problems in the natural sciences as test cases for our theory. We plan to make the designed algorithms available for practical use as a new CGAL package.

## References

[AKL13] Franz Aurenhammer, Rolf Klein, and Der-Tsai Lee. Voronoi Diagrams and Delaunay Triangulations. World Scientific, 2013.

[BTV16] Mikhail Bogdanov, Monique Teillaud, and Gert Vegter. Delaunay triangulations on orientable surfaces of low genus. In Proceedings of the Thirty-second International Symposium on Computational Geometry, pages 20:1–20:17, 2016.

[ES15] Myfanwy E. Evans and Gerd E. Schroöder-Turk. In a material world: Hyperbolic geometry in biological materials. Asia Pacific Mathematics Newsletter, 5(2):21–30, 2015.

[IT17] Iordan Jordanov and Monique Teillaud. Implementing Delaunay triangulations of the Bolza surface. In Proceedings of the Thirty-third International Symposium on Computational Geometry, pages 44:1–44:15, 2017.

[IT19] Iordan Jordanov and Monique Teillaud. 2D periodic hyperbolic triangulations. In CGAL User and Reference Manual. CGAL Editorial Board, 4.14 edition, 2019.

## Compétences

### Required qualifications

PhD thesis in Mathematics or Computer Science, and strong interest for the other discipline

### Language

English is requested

## Avantages

- 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

## Rémunération

Salary: 2653€ gross/month

## Consignes pour postuler

### Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

### Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

**Attention:** Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.