



Offre n°2024-07758

## PhD Position F/M Learning to Translate Freehand Design Drawings into Parametric CAD Programs

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

### A propos du centre ou de la direction fonctionnelle

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 regional 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.

### Contexte et atouts du poste

This Ph.D. is funded by a joint ANR-NSF grant, in collaboration with Daniel Ritchie from Brown University

#### Context and Objective

Computer Aided Design (CAD) is a multi-billion dollar industry responsible for the digital design of almost all manufactured goods. It leverages parametric modeling, which allows dimensions of a design to be changed, facilitating physically-based optimization and design re-mixing by non-experts. But CAD's potential is diminished by the difficulty of creating parametric models: in addition to mastering design principles, professionals must learn complex CAD software interfaces.

To promote effective modeling strategies and creative flow, design educators advocate freehand drawing as a preliminary step to parametric modeling. Unfortunately, CAD systems do not understand these drawings, so designers must re-create their entire design using complex CAD software. Can we automatically convert freehand drawings to parametric CAD models? Sketch-based modeling techniques do not produce parametric CAD programs [1]; classic CAD reverse-engineering techniques cannot handle drawings as input [2]; the newer field of visual program induction is promising but has been demonstrated only on simple shapes and programs [3]. By leveraging the visual vocabulary shared by drawing and CAD modeling, we will develop a system to translate from the natural language of drawing to the formal language of CAD.

#### References

[1] Symmetry-driven 3D Reconstruction from Concept Sketches. Felix Hähnlein, Yulia Gryaditskaya, Alla Sheffer, Adrien Bousseau. SIGGRAPH 2022.

[2] InverseCSG: automatic conversion of 3D models to CSG trees. T. Du, J. Inala, Y. Pu, A. Spielberg, A. Schulz, D. Rus, A. Solar-Lezama, W. Matusik. ACM Trans. on Graphics (SIGGRAPH Asia) 2018.

[3] Neurosymbolic Models for Computer Graphics. Daniel Ritchie, Paul Guerrero, R. Kenny Jones, Niloy Mitra, Adriana Schulz, Karl D. D. Willis, and Jiajun Wu. Eurographics 2023 STAR.

### Mission confiée

To handle drawings as input, we will treat them as timestamped sequences of strokes, allowing us to cast the problem as one of machine translation from drawing stroke sequences to CAD program token sequences. We observe that drawing strokes are grouped into coherent drawing operations that are correlated with CAD modeling strategies (e.g. first drawing construction lines and simple primitives shapes, then refining). We propose to extract these drawing operations as an intermediate representation, which helps disambiguate between the (potentially infinitely) many programs which can represent a single shape. Performing this extraction and then producing CAD programs are complex search problems; we will leverage novel deep neural networks to guide the search.

### Principales activités

We will first create a dataset to study how designers draw parametric shapes. To do this, we will collect existing parametric shapes from public datasets and hire professional designers to draw these shapes

We will then develop a drawing analysis algorithm in order to identify the lines of a drawing which correspond to the same 3D parametric operation, then recognize this operation and deduce its parameters.

Finally, we will develop a program synthesis method which will combine all the estimated information (input design, recognized 3D operations, estimated parameters) and which will generate a valid program

### Compétences

The candidate must have experience in Python programming. Past experience in implementing 3D modeling or 3D analysis algorithms is a plus.

### 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 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

Duration: 36 months

Location: Sophia Antipolis, France

Gross Salary per month: 2100€ brut per month (year 1 & 2) and 2190€ brut per month (year 3)

### Informations générales

- **Thème/Domaine** : Interaction et visualisation  
Ingénierie logicielle (BAP E)
- **Ville** : Sophia Antipolis
- **Centre Inria** : [Centre Inria d'Université Côte d'Azur](#)
- **Date de prise de fonction souhaitée** : 2024-10-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2024-07-05

### Contacts

- **Équipe Inria** : [GRAPHDECO](#)

- **Directeur de thèse :**  
Bousseau Adrien / [Adrien.Bousseau@inria.fr](mailto:Adrien.Bousseau@inria.fr)

## A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 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

The successful candidate should have knowledge in computer graphics and/or computer vision and be interested in 3D modeling and related topics (geometry processing, numerical optimization, machine learning).

**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.

## 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.