



Offer #2022-05275

PhD Position F/M Self-supervised learning for implicit shape reconstruction

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Other valued qualifications : MSc or equivalent degree in computer science, applied mathematics, computer vision, computer graphics or machine learning.

Fonction : PhD Position

About the research centre or Inria department

The Inria Rennes - Bretagne Atlantique Centre is one of Inria's eight centres and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc

Assignment

Recent years have seen a surge in implicit neural shape representations for modeling 3D objects and scenes within deep learning frameworks. Thanks to their ability to continuously represent detailed shapes with arbitrary topologies in a memory-efficient way, these representations alleviate many of the shortcomings of the traditional alternatives such as polygon meshes, point clouds and voxel grids. In practice, these shape functions are typically multi-layer perceptrons mapping 3D points to occupancy or signed distance values. The zero level set of the inferred field can be rendered differentiably through variants of ray marching and tessellated into explicit meshes with Marching Cubes. Coupling these implicit neural functions with conditioning mechanisms allows generalization across multiple shapes. For instance, combining their inputs with local features generated from additional encoding networks [1,2,3,4] yields single forward pass inference models that can learn 3D reconstruction from various input modalities such as images [5,6] or partial point clouds [1,2,3,4].

These models are commonly trained using dense points sampled near the ground-truth surface. Hence, training them to perform reconstruction from images or point clouds requires typically substantial full 3D supervision that is hard to acquire. With the prospect of alleviating this expensive data dependence, we will explore in this project the extension of self-supervised methods to 3D implicit reconstruction. Existing self-supervised learning techniques in vision focus mostly on holistic 2D recognition tasks [7,8]. Our goal is to design self-supervised learning mechanisms that can reason locally [9] and benefit from inductive biases in 3D euclidean space.

As a primary application, we are interested in developing self-supervised deep learning based methods that can create accurate digital 3D replicas of people [10,11] from minimal input such as a single color image or sparse depth map, monocular color or depth videos, captured with a consumer grade camera. This research will contribute to the democratization of 3D people scanning and telepresence, among other human centered applications.

[1] "Few 'Zero Level Set'-Shot Learning of Shape Signed Distance Functions in Feature Space." ECCV 2022.

[2] "Convolutional occupancy networks." ECCV 2020.

[3] "POCO: Point Convolution for Surface Reconstruction." CVPR 2022

[4] "Shape As Points: A Differentiable Poisson Solver." NeurIPS 2021.

[5] "Disn: Deep implicit surface network for high-quality single-view 3d reconstruction." NeurIPS 2019.

[6] "Sdf-srn: Learning signed distance 3d object reconstruction from static images." NeurIPS 2020.

[7] "A simple framework for contrastive learning of visual representations." PMLR 2020.

[8] "Momentum contrast for unsupervised visual representation learning." CVPR 2020.

[9] "Propagate yourself: Exploring pixel-level consistency for unsupervised visual representation learning." CVPR 2021.

[10] "Pifu: Pixel-aligned implicit function for high-resolution clothed human digitization." ICCV 2019.

[11] "Neural body: Implicit neural representations with structured latent codes for novel view synthesis of dynamic humans." CVPR 2021.

Main activities

The PhD student will be tasked with:

- Examining the state of the art of implicit shape reconstruction and self-supervised learning.

- Contributing new self-supervised deep implicit models for 3D reconstruction from images and point clouds.
- Achieving generalization to images, videos and point clouds of clothed people.

Skills

Candidates should preferably have a MSc or equivalent degree in computer science, applied mathematics, computer vision, computer graphics or machine learning. Proficiency in coding in Python and C++ is a plus.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- Partial payment of insurance costs

Remuneration

Monthly gross salary amounting to 2051 euros for the first and second years and 2158 euros for the third year

General Information

- **Theme/Domain** : Vision, perception and multimedia interpretation
Scientific computing (BAP E)
- **Town/city** : Rennes
- **Inria Center** : [Centre Inria de l'Université de Rennes](#)
- **Starting date** : 2022-12-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-01-31

Contacts

- **Inria Team** : [MIMETIC](#)
- **PhD Supervisor** :
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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

We are looking for excellent candidates, preferably with a good background in mathematics or computer science, passionate for research and innovation, who can work independently and who are also keen to collaborate with other students and researchers.

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.

Instruction to apply

Please submit online : your resume, cover letter and letters of recommendation eventually

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.

