Master internship subject

Garment MeshNet: Geometric Deep Learning on 3D Garment Mesh

Hosting institute

ICube Laboratory (The Engineering science, computer science and imaging laboratory) at the University of Strasbourg is a leading research center in Computer Science, with more than 300 permanent researchers, with the recently opened AI graduate school supported by the French government.

Work place and salary

The thesis work will take place in the MLMS (Machine Learning, Modeling & Simulation) research team of the ICube laboratory (The Engineering science, computer science and imaging laboratory) of the University of Strasbourg, a leading research center with more than 300 permanent researchers. The workplace is located on the hospital site of the laboratory, a 10-minute walk from the heart of downtown Strasbourg, listed as a UNESCO World Heritage Site.

650 euros net monthly

Supervisors

– director: Hyewon Seo (ICube, Univ. Strasbourg)

– co-supervisors: Cédric Bobenrieth (ICAM, Strasbourg)

Staring date

January 2025 – March 2025.

Work description

Geometric deep learning has emerged in the fields of computer graphics and computer vision, enabling deep learning models to operate on geometric data such as graphs, meshes, manifolds, and point clouds. Some notable models in this area include Graph Convolutional Networks (GCNs), PointNet, Geodesic Neural Networks (GNNs), and specialized architectures for 3D meshes, such as MeshNet and MeshCNN.

Motivated by these recent successes, we will explore and develop geometric deep learning models for a 3D mesh dataset. In particular, we are interested in 3D garment mesh data representing garment shapes. Our specific focus will be on the development of a geometric deep learning model capable of performing various downstream tasks, such as classification and segmentation.

We will proceed with the following tasks:

1. **Data generation:** We will augment our current garment dataset, composed primarily of T-shirts, by adding more garment types such as pants and skirts. Blender will be used to create and simulate 3D garment models, allowing for the generation of diverse and realistic training data that can improve the performance of our segmentation models.
2. **Shape representation:** The first step is to investigate how to represent various mesh data in a uniform manner, irrespective of its topological structure and geometric deformation. While the representation should be invariant to rigid transformations and vertex/triangle orders, it must be able to effectively

disentangle the canonical shape characteristics of the garment from the geometric shape changes caused by the physical self-interaction and the interaction with the environment. Specialized models for 3D meshes, such as MeshNet and MeshCNN, will be adopted to build the latent representation space.

3. **Mesh classification and segmentation**: Based on the above representation, we will perform several downstream tasks by developing deformation-invariant convolution and pooling methods, and by designing specialized loss functions tailored to each specific task.
4. **Experiments**: The developed model will be parameter-tuned, tested and compared with the state-of-the-art models. Additionally, a number of ablation studies will be conducted to assess the impact of various components on performance.

Candidate profile

− Master degree in Mechanical engineering, Computer Science, or Electronic & Electrical Engineering.

− Solid programming skills in Python/C++

− Working skills in Blender for 3D modeling and animation

− Experience in Deep Learning

− Background in Geometric Modeling

− Good communication skills

Application

Send your CV and academic records (Bachelor and Master) to seo@unistra.fr, for (a) possible interview(s).