Marios Loizou

Computer Science · Research Associate

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Research Interests

My research lies in the intersection of **deep learning**, **computer vision** and **geometry processing**, focusing on data-driven 3D segmentation and 3D shape analysis. I am particularly interested in deep learning architectures that process 3D shape representations and can infer semantics of real world environments. The latter facilitates scene understanding, with key applications in robotics, autonomous navigation, engineering and entertainment.

Education

University of Cyprus — *Nicosia, Cyprus*

PhD candidate — *Jan 2018 — present*

University of Cyprus — *Nicosia, Cyprus*

MSc. in Computer Science — *Sep 2016 — Dec 2017*

Thesis: "3D Object Tracking via Gauss-Newton Optimization"

University of Patras — *Patras, Greece*

MEng. in Computer Engineering & Informatics — *Sep 2009 — Jul 2016*

Thesis: "System Implementation for Virtual Tour Services Using a Panoramic Camera"

Work Experience

CYENS Centre of Excellence — *Nicosia Cyprus*

Research Associate — *Jul 2018 — Present*

- Work under the supervision of Dr. Melinos Averkiou and Prof. Evangelos Kalogerakis, mainly on deep learning approaches for 3D semantic understanding. My work focuses on 3D deep learning architectures like PoinNet, PointNet++, DGCNN, RS-CNN and Sparse Tensor Networks (MinkowskiEngine) that can directly process 3D shape representations, e.g. point clouds.
- Designed and developed a 3D boundary detector [4], that localizes boundary points between semantic parts or geometric patches.
- Actively participated in the collection, annotation and creation of benchmarks for the BuildingNet dataset [3].
- Implemented a prototype deep learning-based retail shelf monitoring application, with the use of Intel RealSense D430 Depth Camera.
- Designed a deep learning architecture that propagates point-wise feature representations across shapes based on a novel cross-shape attention mechanism [1].
- Member of the organizing committee for the 2nd StruCo3D CVPR workshop.
- Hosting the BuildingNet Challenge on EvalAI.
- Currently working on 3D reconstruction via neural fields.

Teaching Experience

Department of Computer Science, University of Cyprus — *Nicosia Cyprus*

Teaching Assistant — *Jan 2018 — Present*

- Postgraduate courses
  - DSC515: Deep Learning — Fall 2022
  - CS607: Visual Computing — Fall 2018, 2019, 2020, 2021
  - CS653: Computer Games Engineering — Spring 2018, 2019, 2020
- Undergraduate courses
  - CS447: Computer Vision — Spring 2021, 2022

Publications

[1] **Marios Loizou**, Siddhant Garg, Dmitry Petrov, Melinos Averkiou, Evangelos Kalogerakis. "Cross-Shape Attention for Part Segmentation of 3D Point Clouds", *Computer Graphics Forum (Proc. SGP)*, 2023

[2] Gopal Sharma, Bidya Dash, Aruni RoyChowdhury, Matheus Gadelha, **Marios Loizou**, LiangLiang Cao, Rui Wang, Learned-Miller Erik, Subhransu Maji, Evangelos Kalogerakis. "PRI FIT: Learning to Fit Primitives Improves Few Shot Point Cloud Segmentation", *Computer Graphics Forum (Proc. SGP)*, 41(5), 2022

[3] Pratheba Selvaraju, Mohamed Nabail, **Marios Loizou**, Maria Maslioukova, Melinos Averkiou, Andreas Andreou, Siddhartha Chaudhuri, Evangelos Kalogerakis, "BuildingNet: Learning to Label 3D Buildings", *In Proc. ICCV*, 2021

[4] **Marios Loizou**, Melinos Averkiou, Evangelos Kalogerakis. "Learning Part Boundaries from 3D Point Clouds", *Computer Graphics Forum (Proc. SGP)*, 39(5), 2020

[5] **Marios Loizou**, Paris Kaimakis. "Model-Based 3D Visual Tracking of Rigid Bodies using Distance Transform", *In Proc. VISUAL*, 2019

Projects

Cross-ShapeNet [1] (GitHub Repo, Project Website, SOTA - 3D Semantic Segmentation on PartNet)

- Introducing a deep learning method that enables long range interactions across 3D shapes.
- This method employs a novel cross-attention mechanism to effectively combine point representations from multiple shapes.
- Moreover, key shapes are retrieved from an input shape collection based on the similarity of self-shape representations, enabling efficient cross-shape operations,
- Experimental results demonstrate improvements in fine-grained shape segmentation, achieving state-of-the-art performance on PartNet.

BuildingNet [3] (GitHub Repo, Project Website)

- BuildingNet is a large-scale dataset of 3D semantically-annotated building models.
- The dataset covers several building categories, such as houses, churches, skyscrapers, town halls, libraries, and castles.
- In addition, a graph neural network is proposed that labels building meshes by analyzing spatial and structural relations of their geometric primitives.
- Finally, a benchmark is included for evaluating mesh and point cloud labeling.

PB-DGCNN [4] (GitHub Repo, Project Website)

- A deep learning approach that detects boundaries of parts in 3D shapes represented as point clouds.
- Based on a graph convolutional network architecture, it can output a boundary probability for a point to lie in an area that separates two or more parts in a 3D shape.
- The output per point probability can be used in pairwise terms to improve graph-based semantic segmentation methods by localizing boundaries between semantic part and in the geometric decomposition of point clouds into regions enclosed by sharp boundaries detected by PB-DGCNN.

Visual Tracking [5] (GitHub Repo)

- An edge-based method for achieving 3D object tracking, via Gauss-Newton optimization.
- It relies on natural features observations, like edges, for the detection of interest points.
- Using the 3D pose of the detected object in the previous frame, it can correctly estimate its new 3D position and orientation, in real-time.

Workshops

StruCo3D @ CVPR 2023 Vancouver (Workshop Website, Challenge Website)

- The 2nd workshop on Structural and Compositional Learning on 3D Data.
- BuildingNet Challenge that includes two benchmarks for mesh and point cloud semantic labeling.

Skills

- **Languages:** Greek (Mother Tongue), English (C2)
- **Programming:** Python, C/C++, Bash-Shell, MATLAB
- **Deep Learning Frameworks:** PyTorch, TensorFlow
- **Libraries/APIs:** MinkowskiEngine, OpenCV, OpenGL, Intel RealSense SDK 2.0
- **Version Control:** Git (Bitbucket/GitHub/GitLab)
- **Job Scheduling/Virtualization:** Slurm, Docker
- **Game Engines:** Unity
- **Platforms:** Unix/Linux, Windows