Professorship Big Geospatial Management
TUM School of Engineering and Design
Technichal University of München

Bachelor or Master Thesis

Hybrid 3D Reconstruction: Bridging Learning-Based and Photogrammetric Approaches

Are you looking for a Bachelor or Master thesis in 3D computer vision and photogrammetry? Are you interested in enhancing 3D reconstruction by combining the domain knowledge from classical photogrammetry with the flexibility of deep learning? Do you want to explore the intersection of 3D reconstruction, photogrammetry, and Deep Learning?

We look forward to you joining us as a Bachelor or Master Thesis student (d/f/m) within the Big Geospatial Data Management Group at the Department for Aerospace and Geodesy, TUM School of Engineering and Design. A Supervision in the School of Computation, Information and Technology is also possible.

Location: Ottobrunn/Munich/Remote

Duration: 3 to 6 months depending on your study program

Your topic:
The field of 3D reconstruction has traditionally relied on photogrammetric techniques, which offer high geometric accuracy by leveraging multi-view geometry and image-based feature matching. In recent years, deep learning-based methods such as Neural Radiance Fields (NeRF) and 3D Gaussian Splatting (3DGS) have shown impressive capabilities in reconstructing a wide range of scenes from small objects to entire cities from sparse or imperfect data. While powerful, each approach presents trade-offs in terms of completeness, precision, and generalization. In this thesis, we want to investigate how learning-based methods can be meaningfully integrated into the photogrammetric pipeline to address its limitations while preserving geometric fidelity.The central research question is: How can we integrate photogrammetric and learning-based methods within a unified pipeline to improve precision and completeness of 3D scene reconstruction?

This includes:

- Literature Review of traditional photogrammetric and modern AI-based 3D reconstruction methods.
- Comparative analysis of accuracy, completeness, and usability in different scene types.
- Design and Implement a hybrid reconstruction pipeline.
- Benchmark the results on different publically available datasets.

Related Work:
[1] AliceVision Meshroom: An open-source 3D reconstruction pipeline (Griwodz et al 2021)
[2] NeRF: Representing Scenes as Neural Radiance Fields for View Synthesis (Mildenhall et al 2020)
[3] 3D Gaussian Splatting for Real-Time Radiance Field Rendering (Kerbl et al 2023)

Qualifications:

- Interest in 3D reconstruction and photogrammetry
- Familiarity with 3D data representation (point clouds, meshes or voxel grids)
- Advanced programming skills in Python
- Experience with machine learning frameworks and libraries such as PyTorch or TensorFlow
- Understanding of camera models and projection geometry is beneficial
- Interest and experience in literature-based work with a good scientific practice
- Enrolled full time student within Computer Science, Remote Sensing or similar field of study
- Fluent English is mandatory; German would be an asset

Applications via Mail with CV and transcript to:

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