

Aerial Image Depth Estimation for 3D Surface Reconstruction

The ability to accurately reconstruct 3D environments from visual data is a cornerstone of modern robotics and geospatial analysis. While recent deep learning-based approaches such as UniDepth have made significant progress in monocular depth estimation, their training has been largely limited to generic or automotive-centric datasets, leaving a substantial gap in their performance on aerial imagery.

This thesis will explore the state of the art in monocular depth estimation, with a specific focus on adapting and advancing these techniques for aerial images. The primary goal is to develop a model capable of generating accurate 3D point cloud maps from single aerial images, leveraging both existing architectures and newly collected domain-specific data.

To address the domain gap between conventional training datasets and aerial perspectives, the project will begin by curating a dedicated dataset of aerial images paired with surface models. This will involve selecting representative scenes and ensuring sufficient diversity in terrain and environmental conditions. The collected dataset will then be used to fine-tune or retrain state-of-the-art monocular depth estimation models.

The research will further investigate the use of depth-to-point-cloud reconstruction pipelines, with the aim of producing geospatially accurate 3D models from the inferred depth maps. Particular emphasis will be placed on evaluating the generalization of the trained models to unseen aerial data, as well as on assessing their accuracy against ground truth surface models.

The developed methods will contribute to improving the automated interpretation of aerial imagery and enabling cost-effective 3D mapping pipelines in autonomous navigation.

What you have to bring:

- Experience with Linux-based systems and shell
- Experience with Python, PyTorch and Docker
- Experience with dataset curation, model training and evaluation
- Fluent in English or German

Contact:

If you are interested in this project or have your own ideas on this topic, send your CV and transcript of records with a few sentences about your motivation or idea to:

Dominik Kulmer, M.Sc. | dominik.kulmer@tum.de