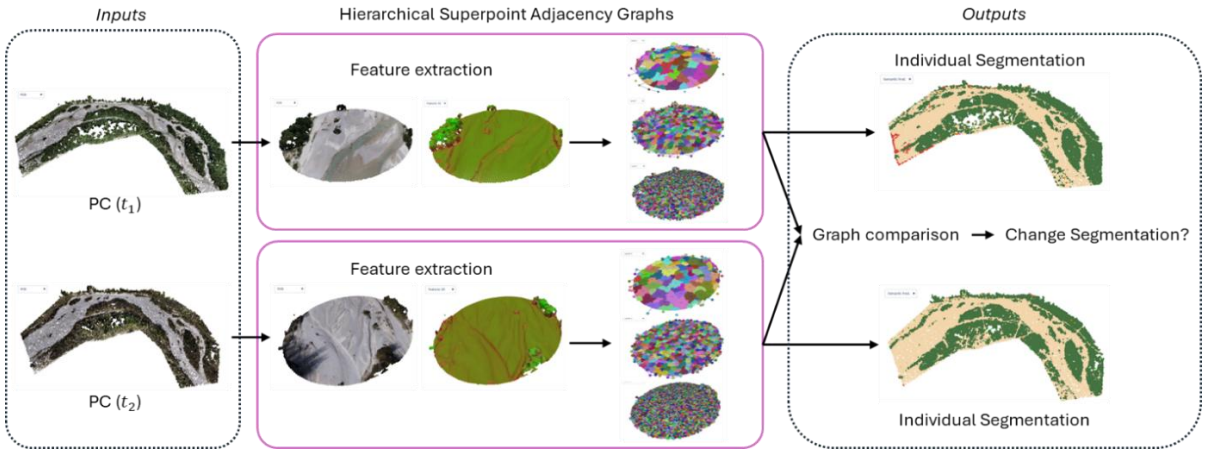
Professorship of Remote Sensing Applications
TUM School of Engineering and Design
Technische Universität München

Master Thesis

Topographic Change Segmentation from Multi-Temporal Point Clouds Using Superpoint Graphs



High-resolution topographic point clouds from UAV LiDAR and photogrammetry enable precise geomorphic change observation. Recent progress in geometric deep learning and graph-based representations offers a new opportunity for representing contextual and structural relationships and analyzing change in multitemporal 3D scenes. The *superpoint*, which divides a point cloud into smaller homogeneous, semantically consistent regions through preprocessing operations (e.g., voxelization, neighbor search, elevation estimation, pointwise local geometric features), provides an effective abstraction that enables efficient and scalable computation. By constructing superpoint graphs, we can encode both geometric features and spatial relationships, allowing the potential modeling of complex topographic patterns and their evolution over time.

This thesis aims to establish a comprehensive workflow for superpoint graph construction from large-scale topographic point clouds and to explore graph-based change representation as a comparison to traditional point-wise methods. Expected outcomes of this thesis:

- Develop an end-to-end superpoint graphs construction workflow for UAV point clouds.
- Optimize superpoint partitioning for topographic point clouds.
- Investigate graph-based comparison for surface change representation.

The student requires experience with point cloud data and analysis methods, equipped with good programming skills (preferably Python) and knowledge of deep learning algorithms.

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References:

Robert, D., Raguet, H., & Landrieu, L. (2023). Efficient 3d semantic segmentation with superpoint transformer. In *Proceedings of the IEEE/CVF International Conference on Computer Vision* (pp. 17195-17204).

Jia, S., de Vugt, L., Mayr, A., Liu, C., & Rutzinger, M. (2025). Location and orientation united graph comparison for topographic point cloud change estimation. *ISPRS Journal of Photogrammetry and Remote Sensing*, *219*, 52-70.