

Unveiling the Canopy: Potential and Limitations of Drone-Based Structure from Motion (SfM) in Forests



Background & Relevance:

This Master of Science (MSc) research project delves into the realm of drone-based Structure from Motion (SfM) techniques applied to forest ecosystems. Focused on the utilization of DJI Mavic 3M data, the study centers on a comprehensive analysis of 32 forest plots situated in the diverse landscape of Lägern. The chosen plots exhibit a spectrum of forest structures, ranging from simplistic to intricately complex, offering a unique opportunity to explore the adaptability and efficacy of SfM approaches in capturing the nuances of varied ecosystems. The primary objective of this research is to assess the potential of drone-based SfM methodologies in accurately characterizing different forest structures. By leveraging the capabilities of the DJI Mavic 3M, the study aims to provide a improved understanding of the strengths and limitations of this technology in capturing fine-scale details, thus contributing to advancements in remote sensing applications within forestry. Furthermore, the research presents an opportunity to formulate diverse research questions that extend beyond mere structural analysis. The acquired data can be used to investigate potential links between forest structure and biodiversity, as well as ecosystem functioning. This interdisciplinary approach opens avenues for exploring the intricate relationships between forest composition, biodiversity patterns, and overall ecosystem health. This is especially so, as the project is nested within the SNF project “BEF Lägern” (PI: Kurt Bollmann, Co-PI: Felix Morsdorf), which established in-situ sampling and surveying of species richness and abundance across trophic levels (e.g. from bug to bird). While the study leverages on existing data from 32 plots, the flexibility to acquire new data provides a dynamic dimension to the research. In summary, this MSc research project offers a comprehensive examination of the potential and limitations of drone-based SfM approaches in forest ecosystems, utilizing DJI Mavic 3M data.

Study area:

- Space: Lägern Mountain Ridge
- Time: Spring – Summer 2024



Data Input:

- Drone based data of 32 sample plots sampled in Summer and Fall 2023.
- Terrestrial laser scanning data available for cross-comparison and validation.
- Possibility of acquiring new datasets during the surveying and sampling season in 2024.

Analysis tasks:

- Computation of point clouds and derivation of metrics suitable for cross-comparison.
- Evaluation of survey patterns and conditions.
- Cross-comparison and validation with TLS data (already acquired) and drone-based laser scanning data (to be acquired by Co-Supervisor).

Objectives:

- Potential and limitations for 3D data acquisition in forests using drone based SfM.
- Guidelines for obtaining best results.

Links & References:

- <https://www.geo.uzh.ch/en/units/sg/research/4D-remote-sensing-of-forests.html>
- <https://www.wsl.ch/de/projekte/auswirkungen-struktureller-und-physiologischer-waldmerkmale-auf-die-biodiversitaet-multitrophische-interaktionen-und-oekosystemfunktionen-in-den-vertikalen-waldschichten/>

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