EGU24-12259, updated on 22 Apr 2024
https://doi.org/10.5194/egusphere-egu24-12259
EGU General Assembly 2024

Enhancing the temporal resolution of forest canopy height levels by combining Airborne Laser Scanning and Image Matching point clouds with the help of Machine Learning

Lorenz Schimpl, Anna Iglseder, Sebastian Mikolka-Flöry, and Markus Hollaus
Technical University of Vienna, Department of Geodesy and Geoinformation, Research Division Photogrammetry, Vienna, Austria

Airborne laser scanning (ALS) point clouds are employed for the generation of country-wide digital terrain and surface models (DTMs and DSMs) and to derive further information about forested areas. This acquisition method has been established as a state-of-the-art of topographic data acquisition, especially in forested areas. However, as ALS data acquisitions are done on relatively low temporal resolution (e.g. for Austria every 6-10 years), forest parameter extraction with high temporal resolution based on ALS data is limited. In particular, the derivation of dynamic forest information such as biomass or canopy cover changes requires relatively high temporal resolution.

Aerial images, along with their image-matching-based point clouds (IM), provide a further option for the creation of DSMs. Especially in areas with high vegetation such as forests, the ALS and IM data yield different elevation values.

The aim of this study is to systematically quantify these differences and to investigate strategies to approximate IM-based DSMs to the ALS-based DSMs. For this research, a study site within the Vienna Woods Biosphere Reserve in the Eastern part of Austria was selected for the development and evaluation of an approach to minimise the height differences. For this area ALS and IM datasets from the same month are available.

Initially, topographic models, such as the normalised DSM (nDSM), were derived from the available point clouds. Statistical parameters for different kernel sizes of the image matching nDSM were further calculated within a derived canopy mask. These parameters as predictors, along with the known differences of the nDSMS based on ALS and IM as target values, were used to train a random forest regression to further fit the IM to the ALS data.

The validation, conducted on three different areas, showed an approximation of the elevation values to the ALS nDSM utilised as a reference within the canopy mask. This improvement demonstrates a promising approximation of the two models of about 77% in relation to the median of the deviations between the adjusted and the given model compared to the initial situation. The IM data shows its limitations in elongated gaps in the canopy, as the closing effects of small canopy gaps in forested areas pose challenges for the IM-based nDSM. In such instances,

the regression function cannot make any improvements.