Design Project – SIE 2022

Automatic detection of tree crowns in remote sensing

Students: Sophia Ly, Tamara Baumgartner

Company: Küpfer Géomètres SA, Vaïk Küpfer

EPFL supervisor: Prof. Bertrand Merminod

Introduction

Trees in urban areas improve the quality of life. Therefore Geneva aims to protect the remaining trees with strict regulations. Pruning or felling a protected tree requires a permission, including a landscape plan. This is prepared by a surveyor using terrestrial methods. The location, tree trunk diameter as well as the tree crown are primarily important. The aim of this work is to develop a program using remote sensing data in order to verify these measurements.

Methodology

Verification data is needed for the evaluation of the program's result. To improve the understanding of the measurement procedure and to have reference data, a field survey was carried out. Further verification data were provided by Küpfer Géomètres SA.

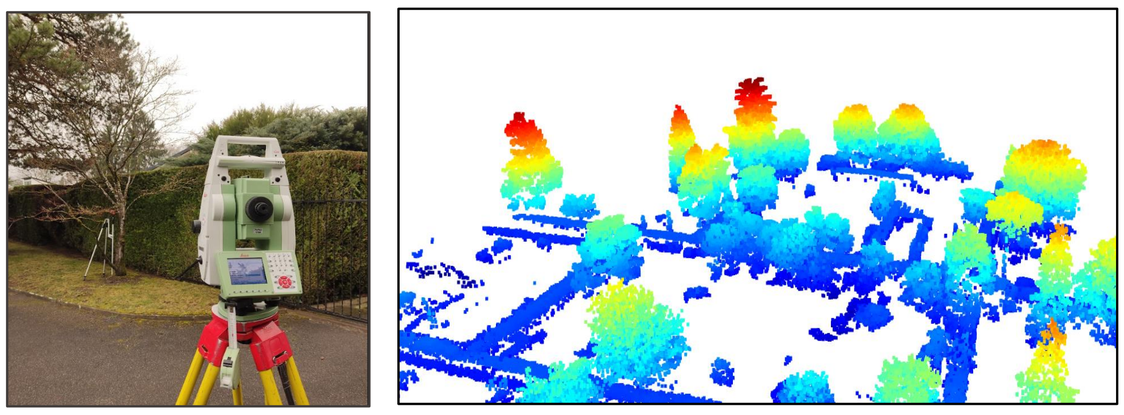

Fig. 1: *Picture from the field survey (left) and from the used lidar data cloud (right).*

A broad investigation of existing papers was done to find the state of art for tree detection and delineation. The most used method was the watershed algorithm based on lidar data.

With the knowledge gained through the literature research, various implementations were tested.

Program structure

Methods such as edge detection and density-based watershed were tried and discarded.

The final model is adaptable to site characteristics and produces a las and a dwg file.

Results & Discussion

Around 150 trees distributed over 5 sites were evaluated with 8 different script-settings each. Every site was chosen according to its characteristics.

The sites were compared by the statistical true positive rate (TPR). The result showed that site 3 with a lot of distinct trees had the best results (figure 2).

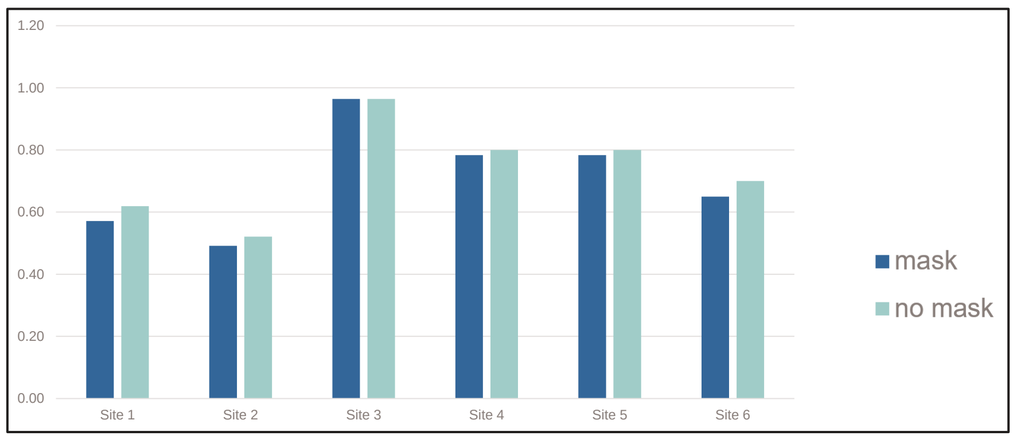

Fig. 2: *Results of the TPR implemented with and without mask for different sites.*

Gardens are a big challenge due to their exotic trees and bushes. No differentiation between a single bush and tree is possible by the program.

A hedge mask was implemented to avoid false tree detection and to improve delineation. The implementation can be seen in (figure 3). There is a trade off between tree omission and avoiding false tree detection.

Other possible improvements include lidar data with higher resolution or also using other data sources such as infrared or orthographic images.

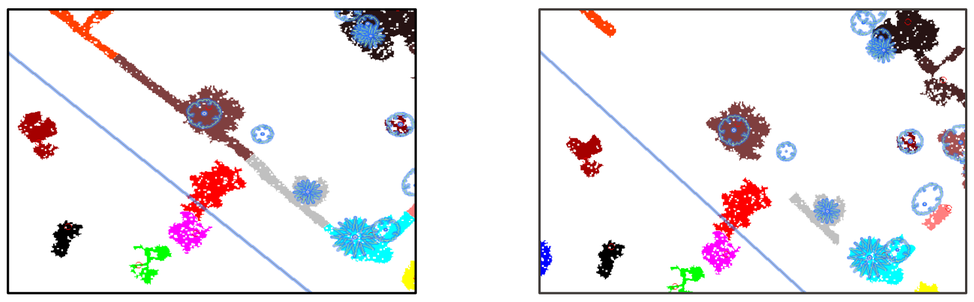

Fig. 3: *Results of the script overlayed with the terrestrial measurements without mask (left) and with mask (right).*

Conclusion

To validate the terrestrial measurements a program was developed that identifies individual trees and detect their crown size. Caution should be taken if vegetation is close in space, as it could lead to under detection and wrong delineation. In addition, the provided lidar data does not always reflect the current state of the vegetation. Therefore, field work is and remains valuable to ensure reliable results.