EGU21-8297
https://doi.org/10.5194/egusphere-egu21-8297
EGU General Assembly 2021

Automatic Tree Crown Feature Extraction from UAS Multispectral Imagery for the Detection of Bark Beetle Disturbance in an Urban Forest

Robert Minařík, Jakub Langhammer, and Theodora Lendzioch
Charles University, Faculty of Science, Dept. of Physical Geography and Geoecology, Prague, Czechia
(minarikro@natur.cuni.cz, langhamr@natur.cuni.cz, lendziot@natur.cuni.cz)

Multispectral imaging using unmanned aerial systems (UAS) enables rapid and accurate detection of pest insect infestations, which are an increasing threat to midlatitude natural forests. Pest detection at the level of an individual tree is of particular importance in mixed forests, where it enables a sensible forest management approach. Moreover, urban forests may be affected more seriously because an urban environment produces additional stressors. The stressors include changes in forest soil properties, tree species diversity, higher temperatures, and carbon dioxide content. The stressed trees are then optimal material for a bark beetle feeding. Therefore, it is necessary to use an appropriate method for the detection of individual infested trees.

In this contribution, we present a novel method for individual tree crown delineation (ITCD) followed by feature extraction to detect a bark beetle disturbance in a mixed urban forest using a photogrammetric point cloud (PPC) and a multispectral orthomosaic. An excess green index (ExG) threshold mask was applied before the ITCD to separate targeted coniferous trees from deciduous trees and backgrounds. The individual crowns of conifer trees were automatically delineated as (i) a full tree crown using marker-controlled watershed segmentation (MCWS), Dalponte2016, and Li 2012 region growing algorithms or (ii) a buffer around a treetop from the masked PPC.

We statistically compared selected spectral and elevation features extracted from automatically delineated crowns of each method to reference tree crowns to distinguish between the forest disturbance classes and two tree species. Moreover, the effect of PPC density on the ITCD accuracy and feature extraction was investigated. The ExG threshold mask application resulted in the excellent separability of targeted conifer trees and the increasing shape similarity of automatically delineated crowns compared to reference tree crowns. The results revealed a strong effect of PPC density on treetop detection and ITCD. If the PPC density is sufficient (> 10 points/m^2), the automatically delineated crowns produced by Dalponte2016, MCWS, and Li 2012 methods are comparable, and the extracted feature statistics insignificantly differ from reference tree crowns. The buffer method is less suitable for detecting a bark beetle disturbance in the mixed forest because of the simplicity of crown delineation. It caused significant differences in extracted feature statistics compared to reference tree crowns. Therefore, the point density was found to be more significant than the algorithm used.

We conclude that the automatic methods may constitute a reliable substitute for the time-consuming manual tree crown delineation in tree-based bark beetle disturbance detection and sanitation of individual infested trees using the suggested methodology and high-density (>20 points/m^2, 10 points/m^2 minimum) PPC.