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DeepTrees: Deep-Learning based spatiotemporal tree inventorying from public orthoimages

Field-based methods for tree inventorying are time-consuming, labour-intensive, and often expensive. With the advent of remote sensing technologies and deep learning, it is now possible to leverage digital public orthoimages and artificial intelligence to automate and enhance the tree inventorying process [1].

The DeepTrees project aims to develop and implement deep learning models for tree crown segmentation, tree trait detection and tree species classification for the publicly available imagery from the Digital Orthoimages Program (DOP) at 20 cm scale in Germany. The resulting tree inventories and monitoring data can be used for various applications, including forest management, biodiversity monitoring, and ecological research.

Segmented tree crowns can give a wealth of information about the individual trees. The significance of a tree's fitness is closely tied to both the structure and size of its crown [2]. These factors influence the tree's access to resources, its utilisation and occupation of space, the magnitude of its growth, as well as seed production and dispersal. In densely populated environments, the growth of crown size results in competition for space, leading to social differentiation, reduced growth of suppressed trees, mortality, and self-thinning [3]. Furthermore, the practical and economic relevance of crown structure and size should not be overlooked. Wider crowns contribute to heightened mechanical stability due to lower slenderness (h/d ratios), but this comes at the expense of wood quality, influenced by the number and thickness of branches [4]. This finer level of detail holds importance in the analysis, modelling, or management of diverse environments, spanning natural forests, planted forests, urban forests, and orchards.

DeepTrees has three components:

1. A Python Package that allows users:

i. to aggregate training and prediction of deep learning models for standardised tree inventorying.

ii. to analyse the delineated trees (tree allometry + tree classes).

2. A public spatiotemporal database of trees in Sachsen and Sachsen-Anhalt, ready for scientific applications.

3. Training datasets for further downstream learning tasks.

The DeepTrees project website can be found here: https://deeptrees.de

References:

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