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| **Leveraging Deep Learning and NFI Data for Forest Attribute Mapping from Orthophotos** |
| In recent years, the Nordic countries have seen the development of detailed forest resource maps, primarily leveraging Airborne Laser Scanning (ALS) data due to its strong correlation with forest structure. However, the considerable cost associated with ALS data restricts the frequency of countrywide updates. In contrast, established national orthophoto collection programs offer extensive archives of highly detailed image data. The advent of machine learning now provides a unique opportunity to exploit these orthophotos for forest attribute prediction. This study explores the potential of using deep learning, informed by data from the Norwegian National Forest Inventory (NFI), to estimate forest attributes based on orthophotos, proposing a method that complements ALS for enhanced forest resource mapping at scale.  In our approach, we employ deep learning techniques to map forest attributes across Norway, utilizing conventional orthophotos obtained nationwide at five-year intervals. This is supported by field data from the Norwegian NFI, with a plot revisiting interval of five years, which inform the training of YOLOv8 image classification models. Specifically, we extracted over 100,000 orthophoto clips from the last decades, corresponding to all NFI plots across Norway, from publicly accessible online services. These clips were annotated with measurements from field data collected subsequent to the orthophoto acquisitions, forming a dataset to model various forest attributes. The models’ performance is evaluated against SR16, an ALS-based forest resource map, serving as a benchmark. Initial results indicate that our NFI-informed deep learning models achieve comparable accuracy in classifying specific forest attributes, such as old age, but perform not as good in forest development stages with closed, uniform canopy cover.  Our findings suggest that deep learning models, informed by NFI data and trained on conventional orthophotos, offer a viable supplementary tool for mapping forest resources in specific contexts. This method not only diversifies the available tools but also improves the accessibility and cost-effectiveness of large-scale mapping of forest attributes. Furthermore, the capacity to analyze historical orthophotos with this methodology holds promise for advancing our understanding of detailed forest dynamics on a large scale. |

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