Computer Vision Meets Forestry:
Multi-class Semantic Segmentation of Tree Species from UAV-Images

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Erasmus+ BLENDED INTENSIVE PROGRAMME

INTRODUCTION

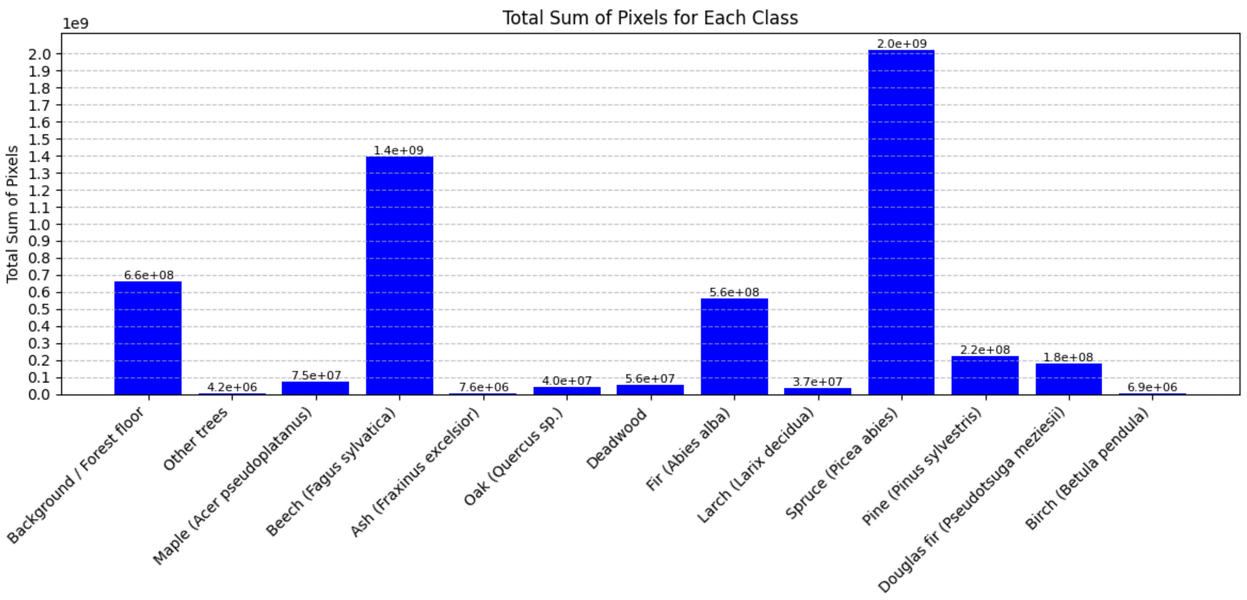
Accurate **tree species segmentation** is a complex challenge in forestry with profound implications for sustainable forest management, biodiversity conservation, and understanding forest ecosystems.

GOAL: explore the potential of deep learning to automate the multi-class semantic segmentation of tree species from UAV images.

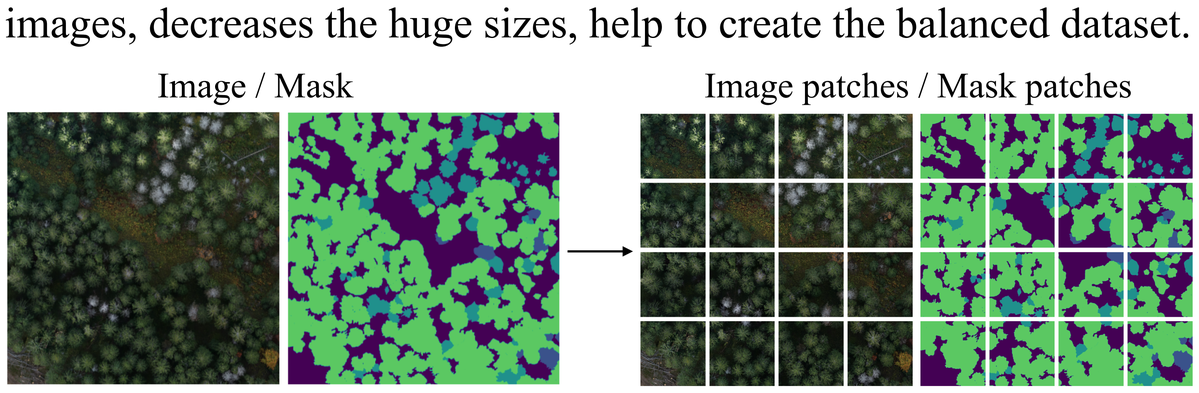
DATA PREPROCESSING

The size of images are very large and diverse:

- The minimum image/mask size: 5357x5357
- The maximum image/mask size: 15269x15269



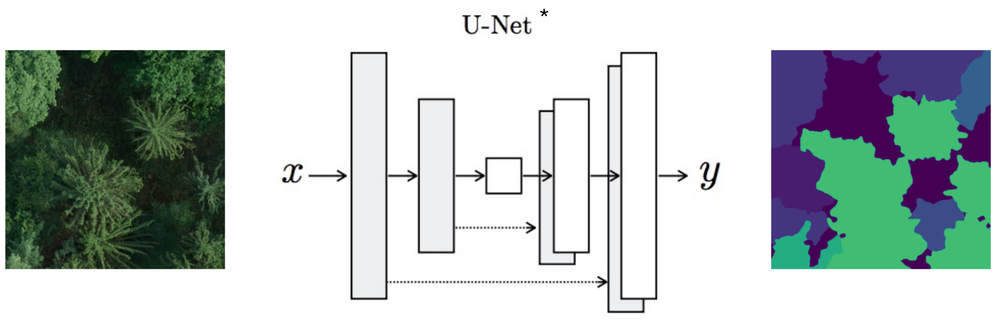
Taking into account of huge diversity and class imbalance, we divide images and masks into 16 patches, which increases the number of images, decreases the huge sizes, help to create the balanced dataset.



Preprocessed dataset: 100 patches of 512x512.

METHODS

The pre-trained state-of-the-art deep learning model, U-net with ResNet34 with “Imagenet” weights in backbone were utilised to automatically segment multi-class tree species from UAV-images.



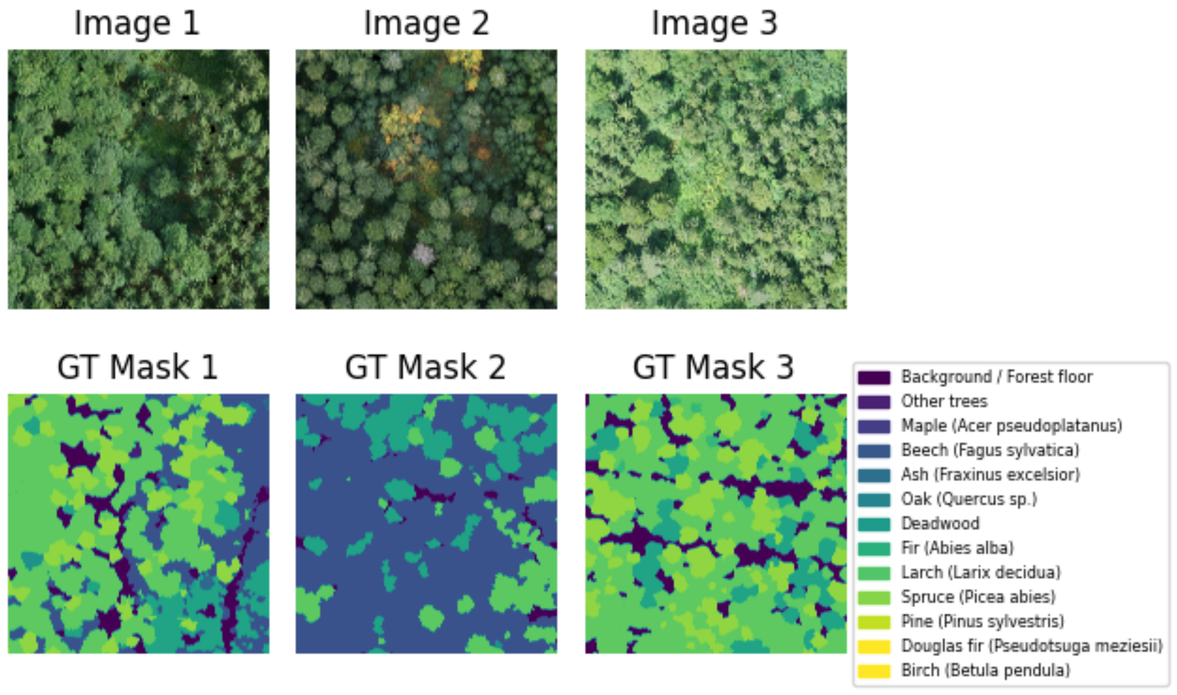
CONCLUSION & FUTURE WORK

- The model demonstrates ability to segments some tree specie very accurately, most of species species moderately, and for few species weakly, mainly due to imbalance of classes in the dataset. Strong model is advantageous from a forester’s perspective, as it simplifies the process of monitoring species within a forest. This necessitates further exploration of DL models for any type of segmentation of tree species from UAV-images.
- Credits and thanks to co-operation with Erasmus BIP project and to team members. Also, to DP4CV course team member, Remi Depreter, for help with data balancing.

* https://machinelearningmastery.com/how-to-implement-pix2pix-gan-models-from-scratch-with-keras/

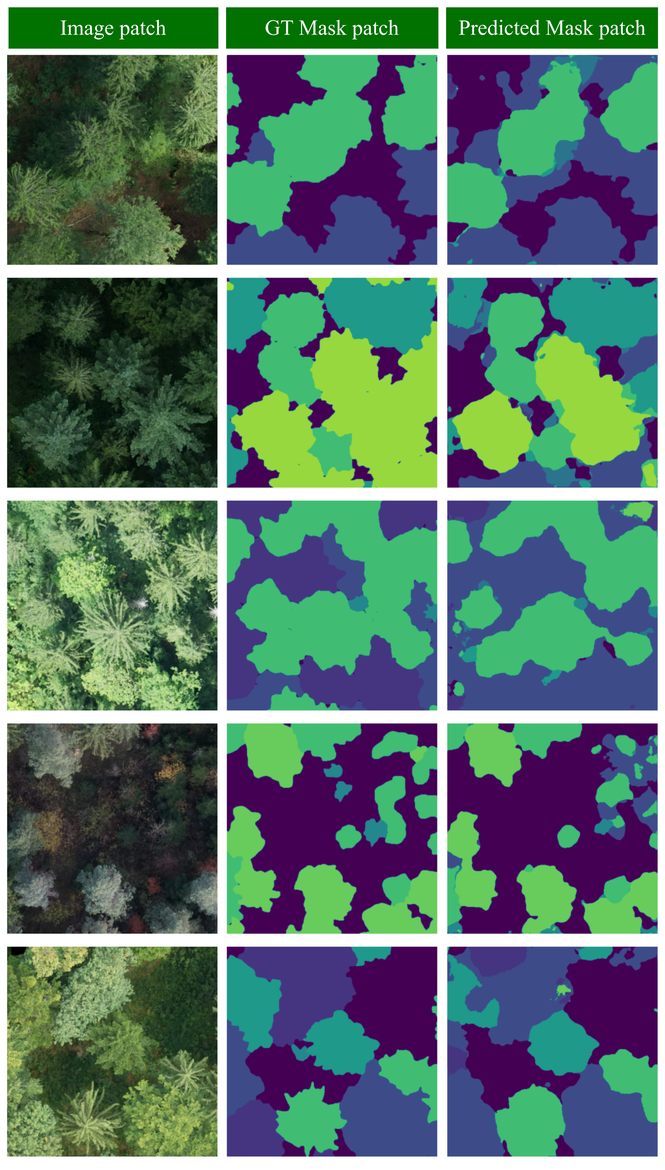
DATASET

The dataset consists of 47 UAV-based RGB-orthomosaics (drone pilot images) and corresponding tree species masks over temperate forests in the Southern Black Forest in Germany. The usage of aerial photography captured by UAVs (Unmanned Aerial Vehicles) in remote sensing applications has seen a significant boost due to their size and flexibility making them advantageous over satellite imagery.



EXPERIMENTAL RESULTS

The results of training U-net model with a ResNet34 backbone over 50 epochs. The Figure below displays visualisations of images, masks, and predicted masks, highlighting how the predictions match the ground truth.

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IoU for class Background: 0.515
IoU for class Other trees: 0.950
IoU for class Maple (Acer pseudoplatanus): 0.363
IoU for class Beech (Fagus sylvatica): 0.448
IoU for class Ash (Fraxinus excelsior): 0.718
IoU for class Oak (Quercus sp.): 0.150
IoU for class Deadwood: 0.620
IoU for class Fir (Abies alba): 0.505
IoU for class Larch (Larix decidua): 0.750
IoU for class Spruce (Picea abies): 0.753
IoU for class Pine (Pinus sylvestris): 0.400
IoU for class Douglas fir (Pseudotsuga meziesii): 0.913
IoU for class Birch (Betula pendula): 0.900
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