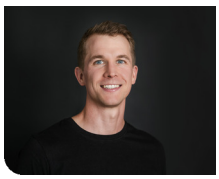
Realisation of an Automatic Hot-water Weed Treatment System

Graduate



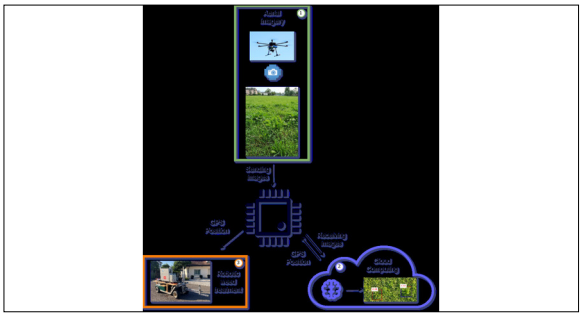
Severin Weiss

Introduction: This master thesis delves into two distinct yet interconnected aspects of agricultural robotics and environmental monitoring. Firstly, the study explores the precision requirements in robot control while simulating hot water penetration into ground soil. Examining temperature dynamics reveals intricate heat transfer phenomena around the penetration area, highlighting the necessity for precise control mechanisms.

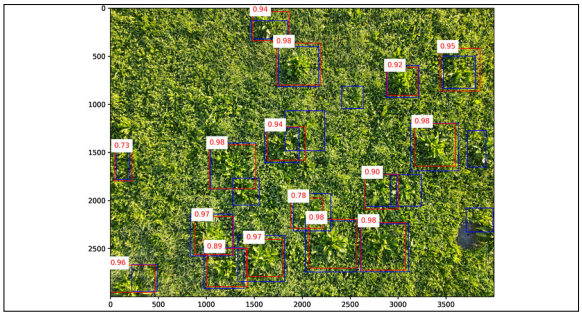
Approach: The research addresses the detection of Rumex obtusifolius, a prevalent weed, utilizing aerial imagery and a close-up detection model. Aerial imagery analysis yielded an average Intersection over Union (IoU) of 0.3556 on the test dataset, emphasizing the algorithm's proficiency in identifying the weed. However, challenges arise when ground truth annotations are absent, potentially leading to underestimating the algorithm's overall performance.

Approach / Technology: In the case of the close-up detection model, the study reports a commendable mean average precision (mAP) of 0.894 and a Recall of 0.864 in Rumex obtusifolius detection. Nevertheless, applying this model to estimate relative distances exposes a measurement bias. Triangulation and leveraging LiDAR data are applied to enhance position estimation accuracy and mitigate measurement bias.
This research contributes to the evolving field of agricultural robotics and environmental monitoring, shedding light on the intricacies of robot control precision, the challenges in weed detection algorithms, and strategies to address biases in position estimation. The insights gained have implications for improving the robustness and reliability of such technologies in practical agricultural settings.

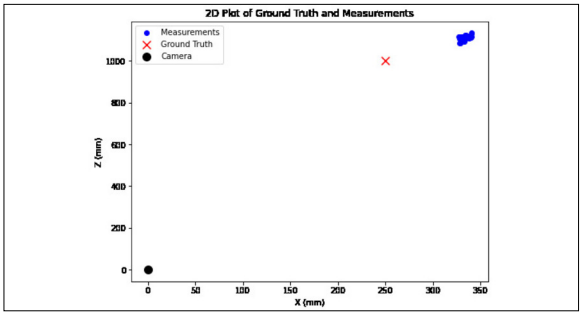
Overview weed treatment system
Own presentment



Agriculture meadow with high density of rumex-obtusifolius (predictions in red and ground truths in blue)
Own presentment



Example of position estimation measurements using depth camera.
Own presentment



Advisor
Prof. Dr. Dejan Šeatović

Co-Examiner
Prof. Dr. Dejan Šeatović, Winterthur, ZH

Subject Area
Data Science, Mechatronics and Automation

Project Partner
Agroscope, Tänikon, Thurgau