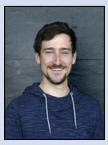

Benjamin Eggimann

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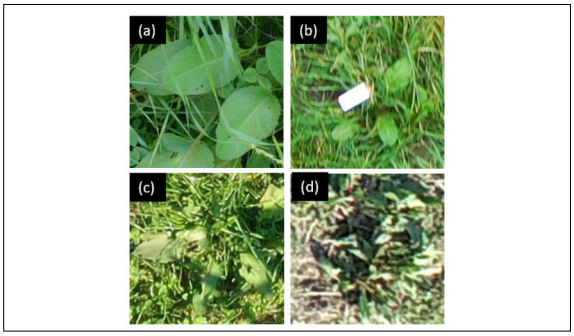
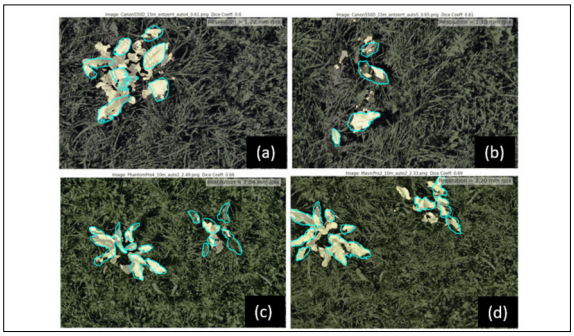
Subject Area	Innovation in Products, Processes and Materials - Industrial Technologies

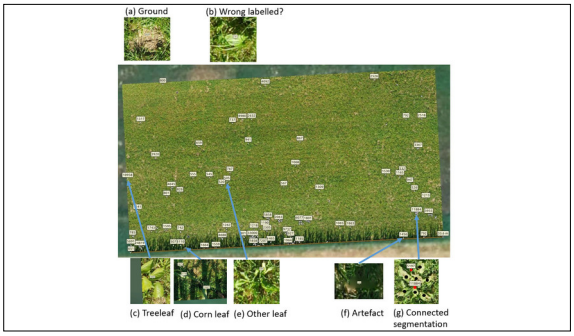
Towards reliable Rumex detection from areal images



Zoomed single images R. obtusifolius: (a)1,5m from the ground (b) MavicPro2 10m ,(c) MavicPro2 10m, (d) Phantom4Pro 15m
Own presentment



Leaf prediction yellow with purple mask overlaid. (a)&(b) Canon550D 15m, (c)Phantom4Pro 10m, (d)MavicPro2 10m.
Own presentment



Created Metashape Orthomosaic view of the labelled GPS points. Detail views (a-g) of manually selected positions
Own presentment

Introduction: In automated agriculture, accurate detection of specific plants is required. One of these plants is called Rumex obtusifolius. This invasive plant is not appreciated in grasslands, as livestock does not like it. As a result, valuable grazing areas are reduced and the mown grass becomes unpalatable to livestock.

Past developments in unmanned aerial vehicles (UAVs) and performance improvements in the field of machine learning are expected to help control this invasive plant.

Problem: The current problem is that detection algorithms are mostly designed for images taken at low altitude (1-3m). Recording by UAV at a height of 10-25 meters significantly affects the image quality. Aggravating factors are known environmental influences such as motion blur, wind, solar radiation, flight time constraints. To reduce these, an image quality check has to be done automatically. Since the pixel resolution has an important influence on the flight altitude to be selected and on the available image acquisition device, it must also be evaluated with which pixel resolution a detection algorithm can still detect the plant. In addition, weed control is interested in the most correct GPS position determination possible.

The goal is to find an optimal interaction of the initial image quality, the creation process of an orthomosaic as well as a correct position detection of the invasive plant.

Result: To demonstrate this interaction, a workflow is proposed. Initially acquired UAV image data sets are evaluated by different "Focus Measure Operators", which provide first thresholds for the future exclusion of bad images. Furthermore, the program Metashape Agisoft shows high potential in the creation of the orthomosaic as well as in the creation of labelled images.

The previously developed machine-learning algorithm, which was used for the detection of Rumex obtusifolius, proves to be applicable despite the changed data basis. Images from three different UAVs and the existing ML algorithm were used to determine an optimal pixel resolution. A resolution below 3mm can be determined with this combination. If the factor of a correct manual labelling is added, a lower resolution of below 2mm is recommended. The entire workflow achieved a recognition rate of GPS positions of R. obtusifolius leaves of 82.2% in a radius of 30 cm. The increased false detection rate of 47.5% of the used algorithm can be attributed to the new scenes seen by the algorithm.

This work provides fundamental insights for the detection of R. obtusifolius, its current limitations, and how it can be improved in the future.