AI and plant recognition – Experiences and future perspectives

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Before deep learning (before 2012)





Before deep learning (before 2012)

- **2010**
- Ard
 Nieuwenhuizen
- Jan Willem Hofstee
- Eldert van Henten







Before deep learning (before 2012)





 Breakthrough in computer vision in 2012





Handcrafted Algorithm

Machine Learning





Feature extraction + Classification

7









Sugar beet

7









Class



My experiences

- Started my PhD in October 2017 on the SMARAGD project
- Volunteer potato detection in sugar beets
- Deep-learning was commonly applied on agricultural datasets, but not in practice







Problem description

- After harvest of the potatoes, potatoes are left behind on the field.
- Next year, when growing another crop, the volunteer potatoes come up and compete with the crop and maintain soil borne diseases.
- Full field spraying cannot be applied as this will damage the crop. Therefore the potatoes are manually removed



Potato harvest





Volunteer potatoes in sugar beet field



Manual removal of potatoes

Solution: Automated volunteer potato removal









Results

- Tested in 8 fields
- Variation in performance between fields.
- On average 96% of the potatoes were terminated while damaging only 3% of the crops.





Lack of generalization

- Plants look different than the same plant in other growth stages, in another field, under different illumination
- Detection algorithms have difficulty to detect these plants in all circumstance



Research questions

How to improve the training data for a plant detection model?

- More training fields?
- More training images?
- Incremental training on the new field?
- 20 training fields and 5 test fields



Results



Training on 500 images sampled from 5 to 20 different fields

Training on 250 to 8540 images



Results

By finetuning on a small sample of only 50 images of the new field, the performance on that specific field can be greatly improved.



Detection performance after finetuning on a small sample of images from the target field



Now. Commercial robots enter the market





Agrointelli Robotti



Naio Dino



Steketee IC-Weeder AI



Odd Bot

The future

- Current challenges are solvable
- Robustness of hardware \rightarrow matter of time
- Robust software → Acquire more diverse data
 - Developments in fundamental science
 - Active learning
 - Domain adaptation
- Technically weeding robots are now available and reliable in a few years





The future perspective

Quality, reliability, cheap



Conventional



Organic



Questions/discussion



