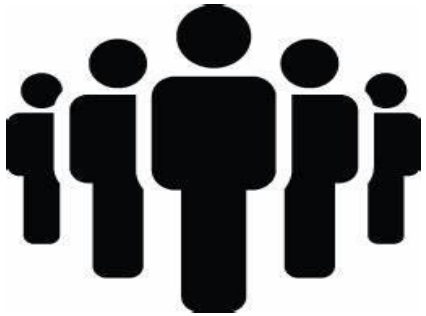
Precision Agriculture
School of Life Sciences
Technische Universität München

# Deep Learning for Object Detection in The Context of Smart Agriculture

**Diego Ponce de León**
*Specialist in ML methods*



**Chenghao Lu**
*Specialist in smart agriculture*

**Emmanuel Nnadozie**
*Specialist and support in DL/ML methods*

**Julia Yukovich**
*Data scientist*

**Myriam Afrounn**
*Team leader*

# Outline

1. Mission
2. State of the art in maize plant tassels detection
3. Introducing innovation into maize plant tassels detection
4. Pipeline
5. References

# Mission: develop ML or DL models to detect maize plant tassels under a diverse range of light conditions and application scenarios

**Goal**: Enhance the production efficiency and facilitate the development of “Human-Centered Technologies” for future agriculture

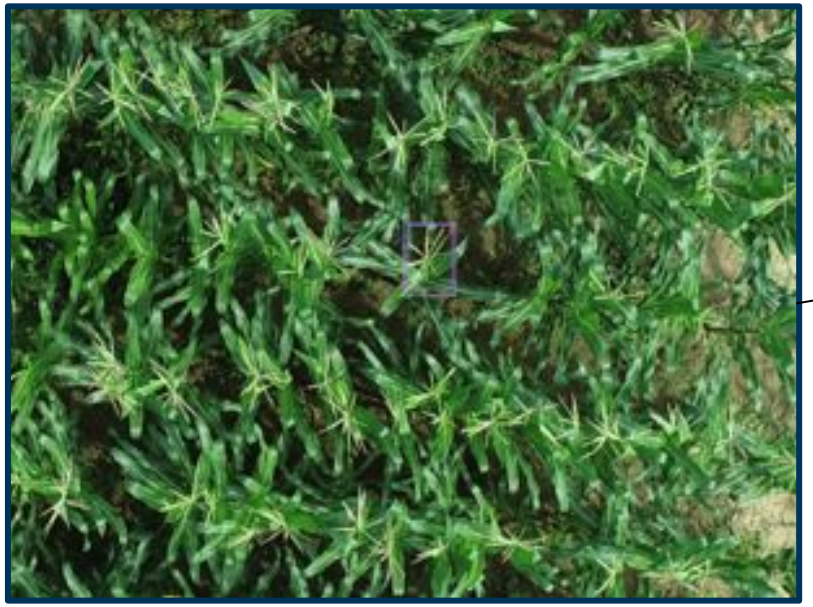


Figure 1: Sample image from our data set [1]

Figure 2: Maize tassel [2]

**Challenges**

**Parameters relating to the maize tassel:**

- growth e.g. maize tassel at different points in time
- genotype e.g. different colors (light, dark, black)

**Parameters relating to the environment:**

- light conditions e.g. sunny or dark
- real-life environment e.g.
  *field boundaries,*
  *presence of other type of plants*
  *overlap between maize tassels*

# State of the art in maize plant tassels detection

**Existing DL models**:

- Faster R-CNN, YOLOv3, TasselNet...
- Acceptable accuracy

**Limitations**:

- ❏ Limited to images under good conditions  e.g., strong light contract, no shadows, noiseless...
- ❏ Problems with crowded scenes e.g. underestimation of number of tassels.
- ❏ Not suitable for images taken with drones.

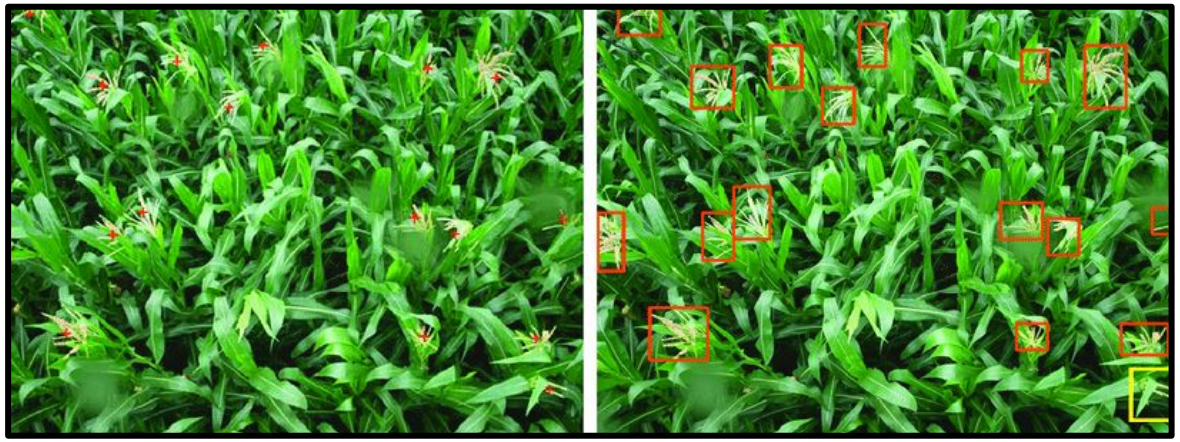


Figure 3: Samples for maize tassels detection using TasselNet (left) and faster R-CNN (right) [3]

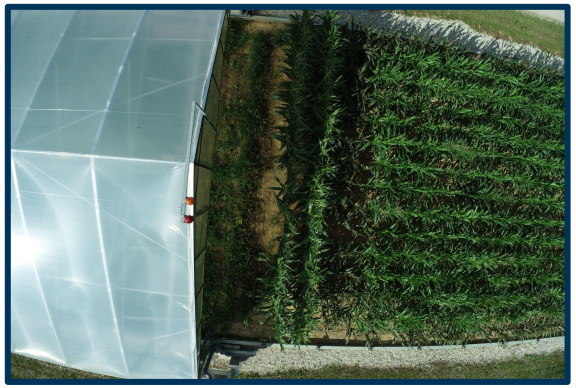


Figure 4: Samples images from our data set [1]

# Introducing innovation into maize plant tassels detection

**Innovative method:** use the YOLOv5 to detect the maize plant tassels.

**What is YOLOv5**?

It's a family of compound-scaled object detection models and includes simple functionality for Test Time Augmentation (TTA), model ensembling, hyperparameter evolution.

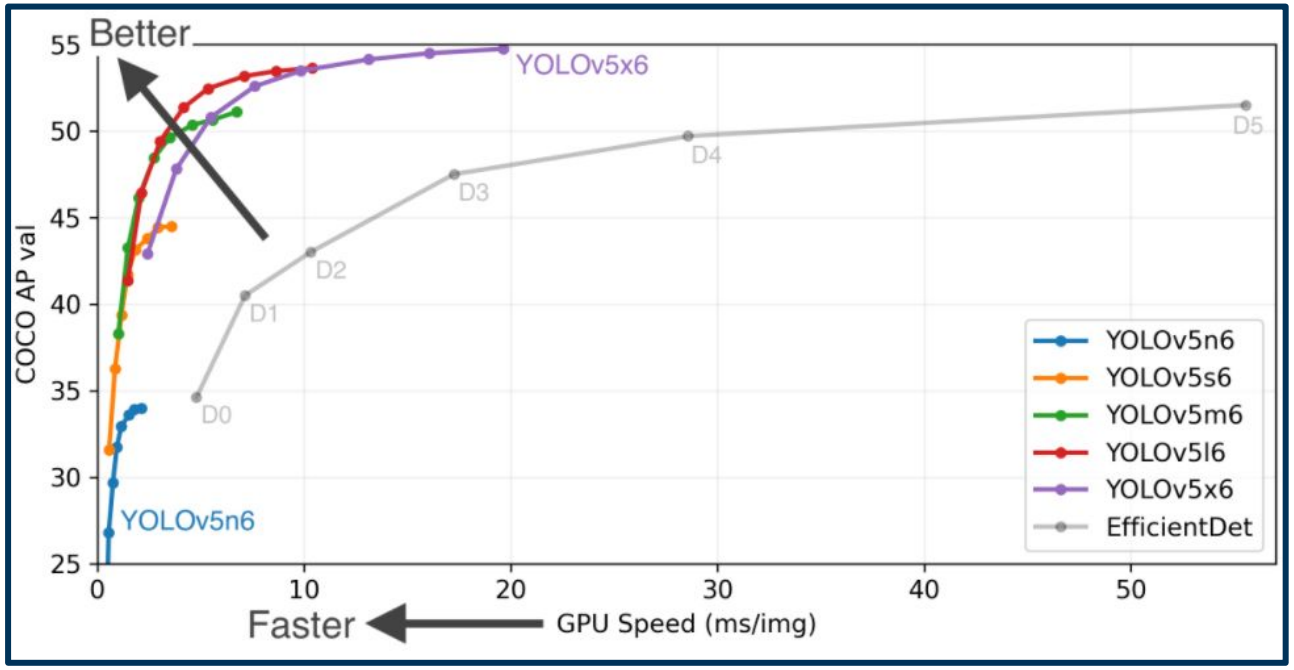



Figure 5: GPU Speed measures end-to-end time per image averaged over 5000 COCO val2017 images using a V100 GPU with batch size 32, and includes image preprocessing, PyTorch FP16 inference, postprocessing and NMS.[4]

# Pipeline

**Develop a pipeline using a deep learning module to detect the maize plant tassels under differents conditions.**

- **Data set of 50 images**
- **Preprocessing:**
  -reduction of image's size ~ under 1000px (960*960 for ex)
  -image treatment like flickering or illumination
  -image annotation according to the environment parameters
- **Data augmentation to increase data set's size**
- **Training of the model YOLOv5**
- **Tuning of hyperparameters:**
  -related to the model: number of epochs, learning rate...
  -related to the training set: image augmentation, image saturation, image rotation, image translation...

Innovation

# References

[1] Data set from Precise Agriculture Chair of Technical University of Munich
[2] from China Agricultural University lecture
[3 ]Liu, Yunling & Chaojun, Cen & Che, Yingpu & Ke, Rui & Ma, Yan & Ma, Yuntao. (2020). Detection of Maize Tassels from UAV RGB Imagery with Faster R-CNN. Remote Sensing. 12. 338. 10.3390/rs12020338.
[4] https://pytorch.org/hub/ultralytics_yolov5/

# Thanks!