ETAROB: an Autonomous Agricultural Robot for Weed Control

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Mobile Robotics is one of the most promising future technologies

Autonomous mobile robots enable a large number of applications.

Mowers

Drones

Humanoid robots

The use of open-source software and hardware generates faster development cycles.

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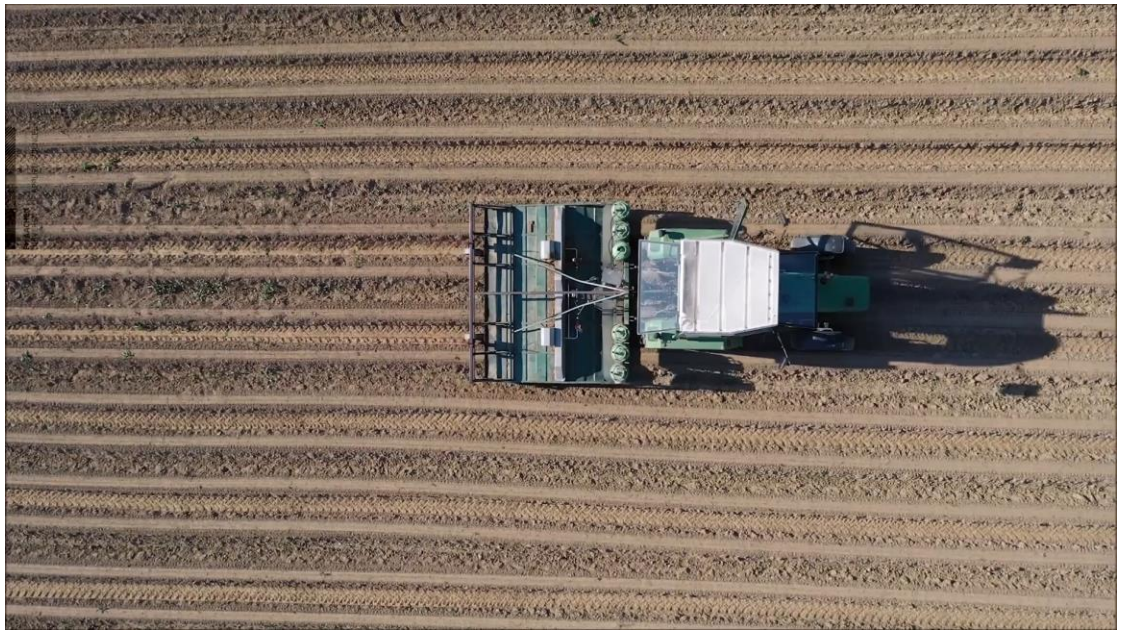
Mobile Robotics is one of the most promising future technologies

Today’s farmers face major challenges in a global market:

- Shortage of skilled farm workers
- Prohibition of chemicals
- Electrification of agriculture machinery
- Automation
- Digitization



From the idea to the autonomous field robot ETAROB

The project started in 2017 with a group of robotic enthusiast.

Josef Franko

Heiko Engemann

Enno Dülberg

1st Generation (2017)

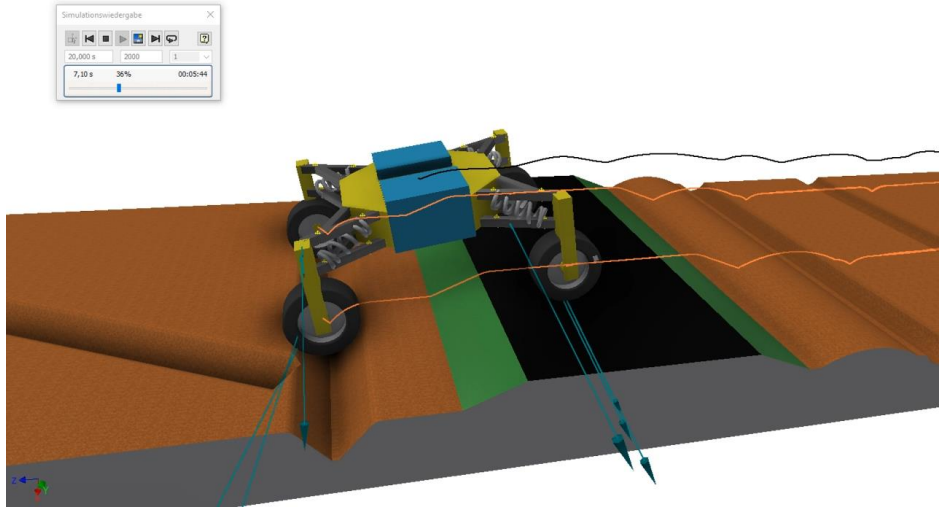
2nd Generation (2018)

3rd Generation (2019)

Basic challenges for an autonomous agriculture robot

An agriculture robot is different to industrial mobile robotics.

- Precise localization
- Path following and planning
- Safety
- Robustness
- High operational readiness



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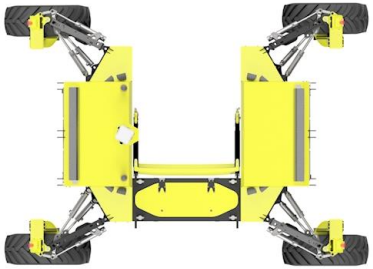
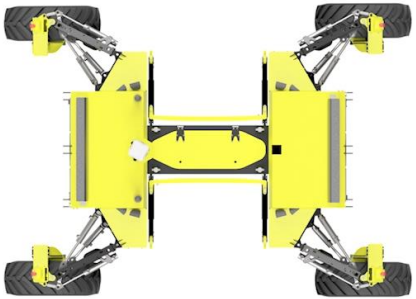
Mechanical design of the ETAROB

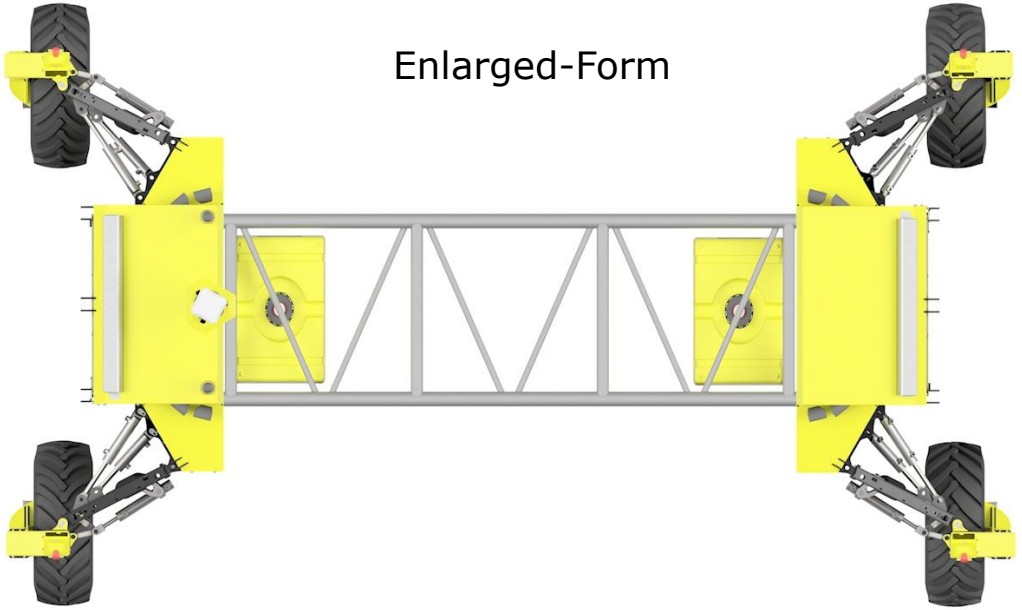
C-Form



H-Form



Enlarged-Form



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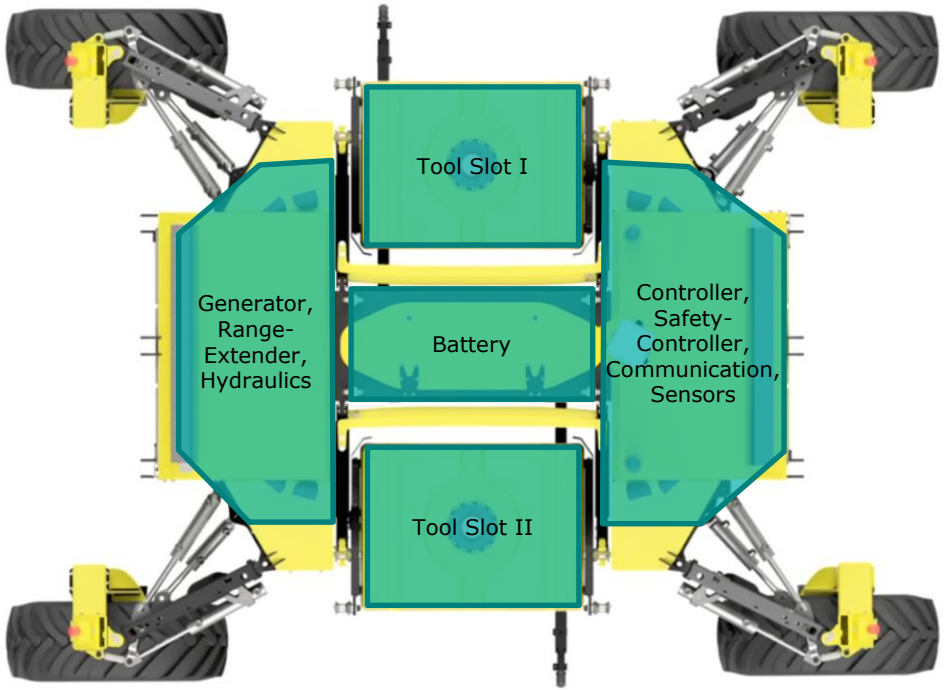
Mechanical design of the ETAROB

The modular concept of ETAROB.



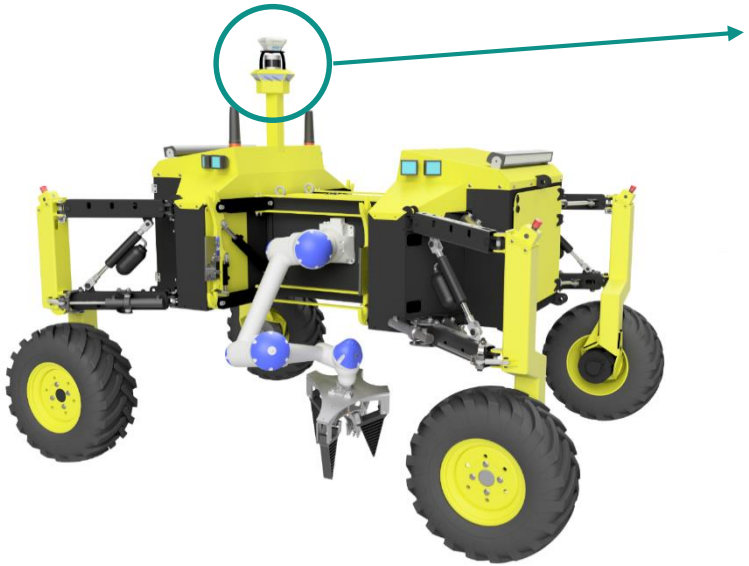
Mechanical design of the ETAROB

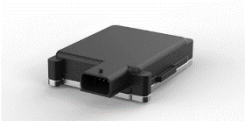
General technical specifications of the ETAROB:

- Hybrid Electric
  - 4 x 800NM
  - 24 Hours operation time
- 4 Wheel Steering
  - Side-Drive
  - On Spot Turning
- 1000 kg Payload
  - 950 kg Robot Weight

Workspace monitoring as a combination of hard-safety and soft-safety components

Safety concept must be precise and reliable.





Soft-Safety:

The multi-layer sensor concept detects obstacles, especially animals and humans, under different environmental parameters.

Hard-Safety:

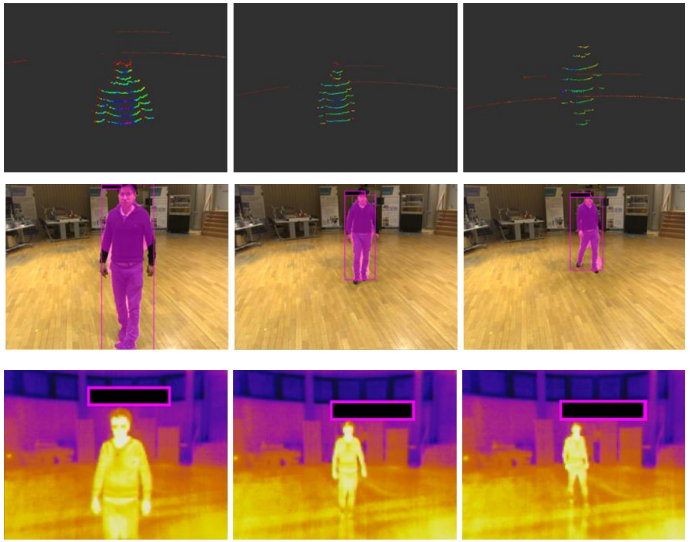
The functional safety of the Etarob is guaranteed by the use of proven safety sensor technology.

Workspace monitoring as a combination of hard-safety and soft-safety components

360° 3D Lidar

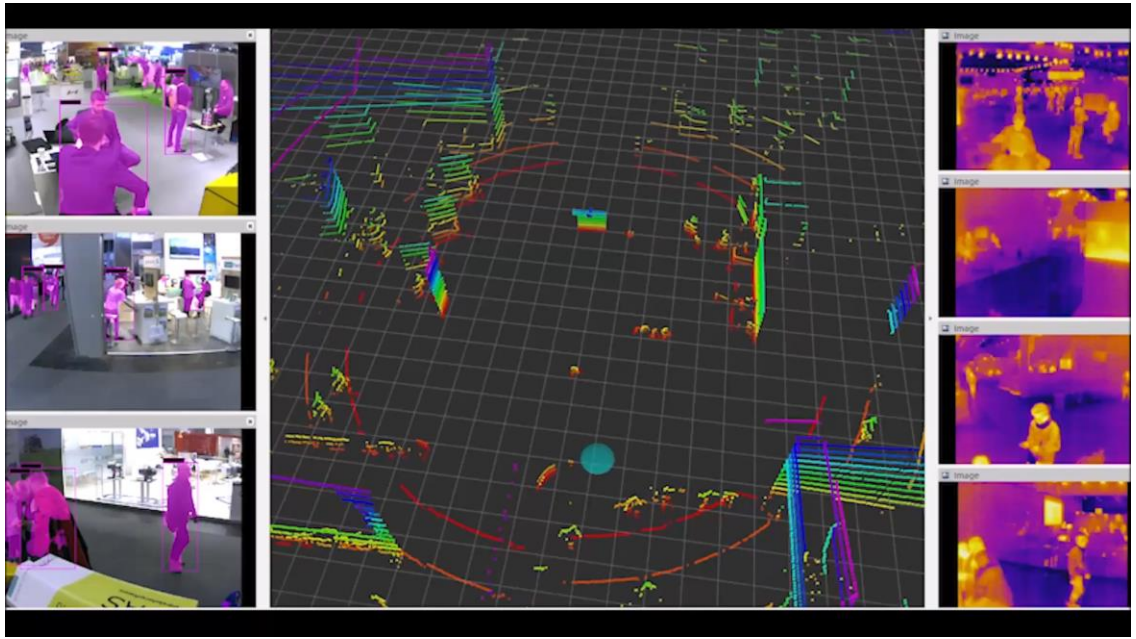
RGB Cameras

Thermal Cameras



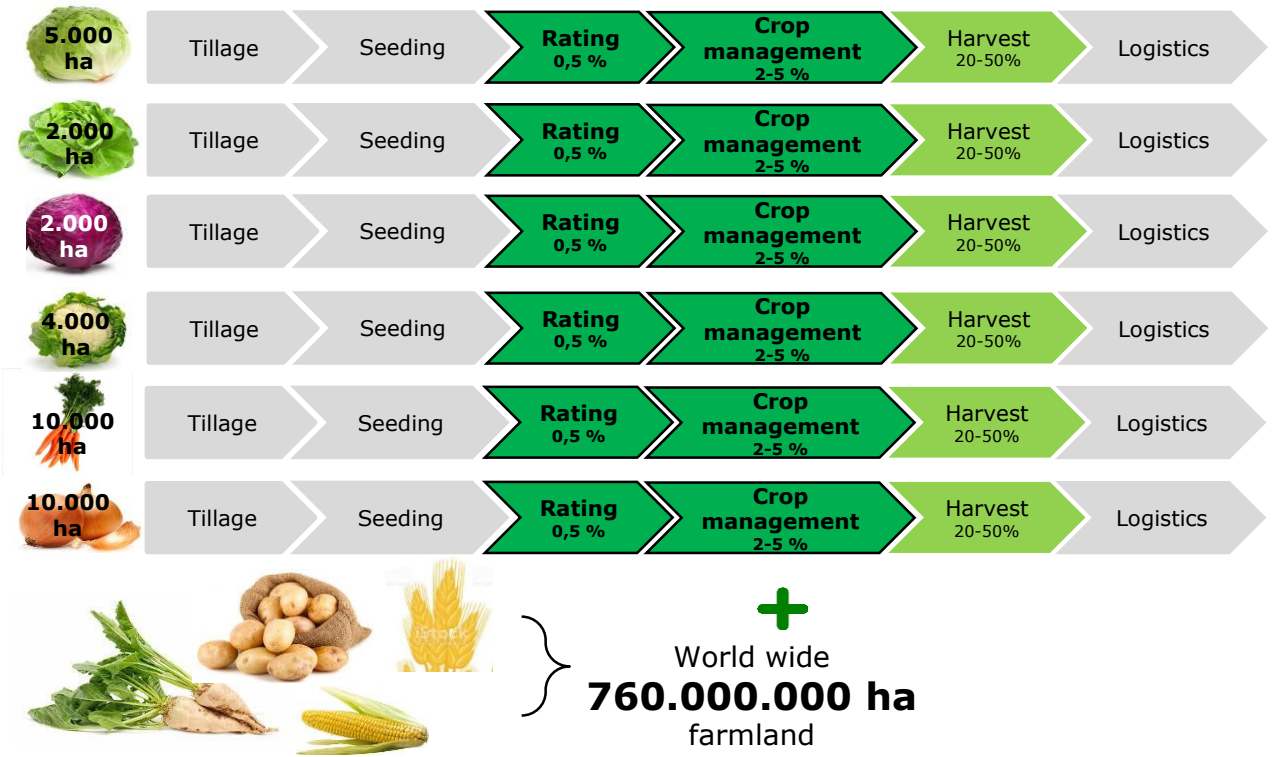
The concept combines the strengths of the different sensor types and thus compensates for the weaknesses.

Workspace monitoring as a combination of hard-safety and soft-safety components



Intelligent workspace monitoring enables the robot system to perceive and interpret its complex environment and act accordingly.

The value chain in agriculture



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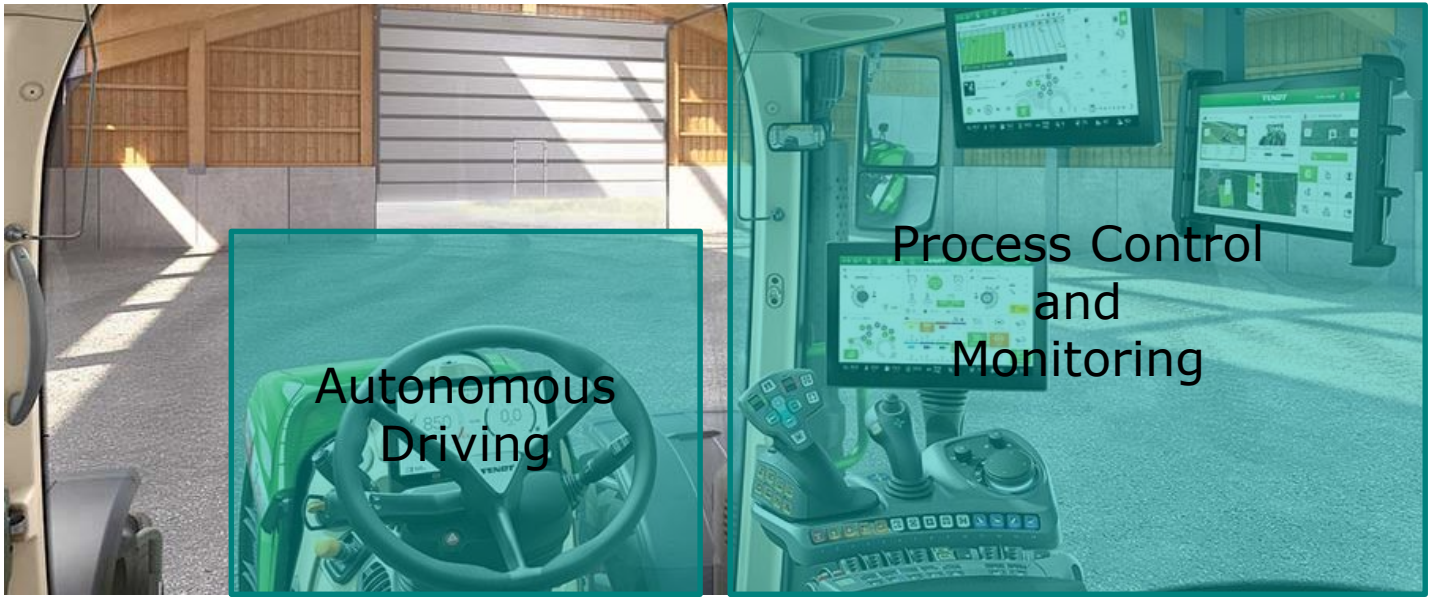
The true challenge is the process control

Autonomous agriculture robots combine two sub domains.



Autonomous navigation in agriculture, not as simple as expected

GPS-based lane assistant can be as simple as a line follower, but …

- Robust localization:
  - Global GNSS based localization is improved by adding local features
  - Multidata sensor fusion approach
- Reliable safety concept:
  - Detection of obstacles under different environmental parameters
- Path planning
  - Active collision avoidance through bypassing
  - Autonomous approach of service points

The true challenge is the process control

Artificial intelligence is a promising technique to monitor the processes under different environmental parameters.

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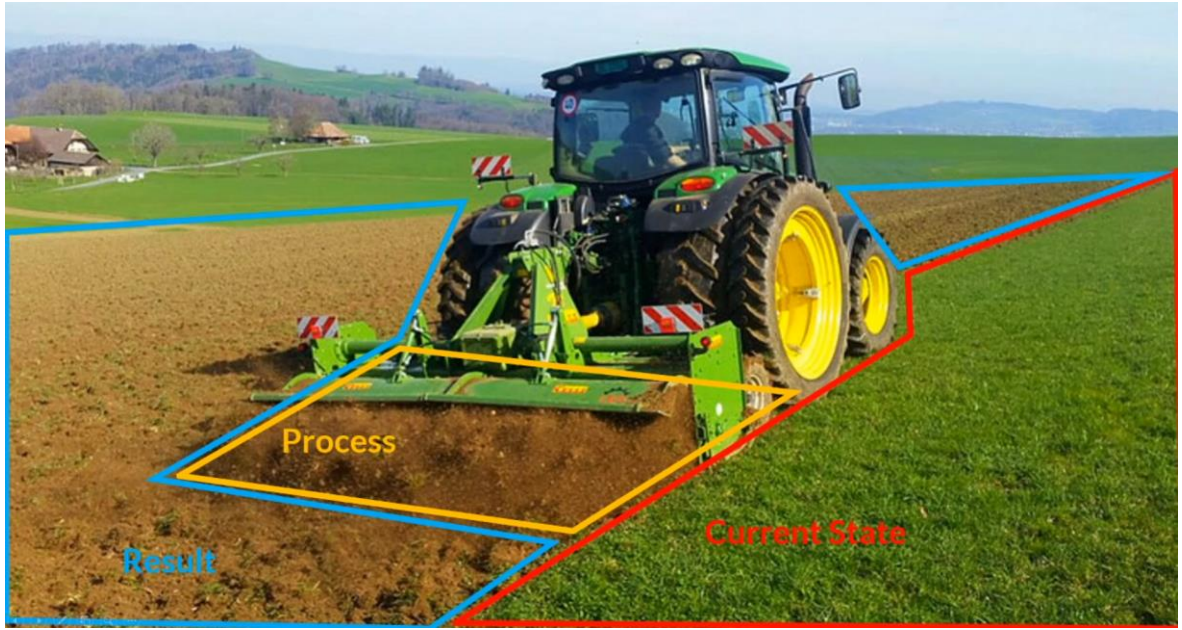

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Plant detection and segmentation based on deep learning

Highly detailed 3D models of crop and weed plants.

Plant detection and segmentation based on deep learning

Virtual worlds generated by CGI rendering software, enables the automated change of environmental parameters.

- Plant modification:
  - Position and orientation
  - Scaling
  - Vegetation stage
- Soil structure:
  - Various objects
  - Reflection
- Environment:
  - Daytime
  - Weather
  - Ray tracing

Research project SEWIA
Selective electro-physical weeding in agriculture

rentenbank

Bundesanstalt für Landwirtschaft und Ernährung

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A non-chemical weeding application.

CROP.ZONE integrated weed management

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