Fraunhofer
IVI

CERES field robot

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Intelligent weed removal

» The current events demonstrate just how important efficient regional agriculture is for our daily lives.«

Prof. Dr. Matthias Klingner,
Director

Highly efficient and sustainable agriculture

Cognitive Agriculture – COGNAC

Within the Fraunhofer »Cognitive Agriculture« Lighthouse Project (short: »COGNAC«), eight Fraunhofer institutes carried out joint research to make agriculture both sustainable and productive in the future.

Cognitive Electrical Robot Environment System – CERES

Through automation achieved with the help of field robotics, it is possible to continuously collect locally resolved sensor data needed to optimize agricultural processes.

For this purpose, the CERES field robot (»Cognitive Electrical Robot Environment System«) was developed at Fraunhofer IVI as part of the COGNAC project. CERES has a full-electric drive system and is used to demonstrate the use case »weed removal without chemicals«.

In order for agriculture to become more efficient and more ecologically and economically sustainable, the use of chemical plant protection agents must be reduced. The accompanying increase in plant care tasks is a prime operating area for field robots acting as a swarm, such as CERES. In addition, CERES serves as a sensor platform that transfers data to the »Agricultural Data Space« and is used to develop and test cognitive services such as app development for hyperspectral and multispectral sensors, automated machine learning for efficient image processing and sensor data fusion.

Automation of field work

Small and flexibly operable field robots can work together, combine their features and are useful for automated data acquisition. All this is made possible by data-based services.

Economic and agronomic advantages:

- continuous acquisition of measuring data for the purpose of generating digital services,
- cost-efficient operation of sensors through mobile application,
- increased environmental friendliness through reduction of chemical plant protection agents,
- sustainable through targeted use of resources,
- introduction of fututre-oriented drive technology to the field of agriculture, and
- reduced soil compaction due to smaller, lighter units.

Contact system of the automated charging device.
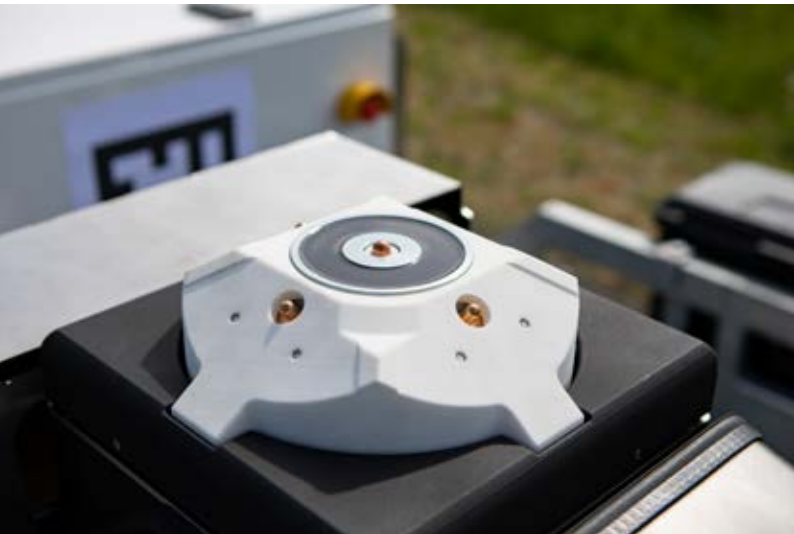
Testing of components from the COGNAC project in the field.

Electrification and charging of field robots

To guarantee full-electric, 24/7 field operation, an automated charging solution was developed: a trailer-mounted charging station including a flexible contact system. Autonomous field robots working as part of a swarm can drive on this trailer and use its automated charging function. The station is suited for use in 400 V three-phase grids. In the future, the fast charging system kann be scaled up to a charging capacity of > 1 MW. The complete system can be used without restrictions in outdoor areas and agricultural surroundings.

helyOS® – online control tower for agriculture

helyOS® is a control tower framework for the fast and efficient creation of control stations in diverse application areas including agriculture. helyOS® connects monitors and controls single robots and robot swarms. In the process, the tasks to be carried out are transformed into missions for mobile work machines. Different modular services, such as path and cooperation planning as well as map services, are integrated as external services and customized to fit the respective application case.

Within the COGNAC project, a specific path planning service was developed for driving in-between plant rows on fields, and the automation system was tested using the field robot as a platform.

Navigation box

To realize the field robot's autonomous navigation, Fraunhofer IOSB developed a navigation box and implemented it in CERES. This box allows the flexible integration of navigation and perception sensors (GNSS/GPS, IMU, 3D-LiDAR, Kamera, etc.). Their data is processed on the spot and their functionalities are made available for autonomous navigation. This includes high-precision positioning and obstacle detection systems, as well as special capabilities such as plant row tracking.

Outlook

The project makes a major contribution to

- transferring the findings about underbody contact systems
  - to additional vehicle types, such as commercial vehicles and passenger cars, as well as
  - to applications in other field robots, such as »Elwobot« created at TU Dresden,
- testing the helyOS® swarm functionality using CERES and the autonomous Feldschwarm® units,
- transferring the cognitive services developed to additional crops, and
- improving the safety of autonomous field work units and their operation in agriculture.

Path planning for robots using helyOS®.

Contact

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