Website address:
https://www.biooekonomie-bw.de/en/articles/pm/autonomous-outdoor-navigation-machines-used-farming-livestock-and-forestry

Autonomous outdoor navigation for machines used in farming, livestock and forestry

Autonomous and robust navigation is an essential capability for agricultural robots or machines that are to reach a new level of autonomy to manoeuver safely and reliably in their environment. Fraunhofer IPA will showcase what is currently technologically and economically feasible with live demos at agritechnica, the agricultural trade fair taking place in Hanover from November 12 to 18, 2023.

Current demands on agriculture seem almost contradictory: On the one hand, profits should continue to rise while costs are kept as low as possible, but on the other, sustainability and biodiversity are becoming increasingly important. Added to this are regulatory concerns such as a widely discussed potential ban on the herbicide glyphosate.

While meeting these requirements is a challenge, this is where autonomous systems or robots can assist. For example, drones are already being used to gather information on crop stress linked to periods of drought or nutrient deficiencies, to precisely measure agricultural areas and to carry out analyses. Ground-based systems also are already operating across fields in very small numbers and support weed control efforts, which are often still carried out in a more conventional manner. Harvesting robots are being tested in research contexts.

All autonomous systems have in common that they must be able to move independently in their environment, regardless of the specific task they are ultimately asked to perform. In order to facilitate autonomous mobility of this kind and therefore enable robots to actually complete their tasks, Fraunhofer IPA is developing outdoor navigation technology. This has the ability to interpret surroundings, for example rows of crops or different types of ground, fully autonomously and accordingly adjust the planned route for the robot to navigate. Visitors to the agritechnica trade fair in Hanover (November 12–18, 2023) can experience this navigation technology for themselves via live demos with two autonomous agricultural robots in Hall 11, Stand C62.

Indoor navigation leaves the halls behind

Indoors, mobile robots can already successfully detect their surroundings based on 2D sensor data and dynamically adapt their path planning to take account of this information. It is now possible to gradually transfer this technology to the highly complex and dynamic environment of the outside world. This includes agricultural settings, as well as other applications that lie in between from a technological perspective. One example here is intralogistics in outdoor areas, where the environment is structured very similarly to indoor areas. Stables, on the other hand, are more complex than usual indoor areas and are equally as demanding for autonomous navigation as outdoor areas. The same applies to processes downstream of the harvest.

Further development in the direction of outdoor navigation is not quite as simple: In contrast to indoor areas, most outdoor areas tend not to have any stationary structures such as walls or shelves that mobile robots can consistently use for orientation purposes even over a matter of weeks. On the contrary: Outdoor areas feature a variety of potential obstacles, all of which must be interpreted. For example, tall grass is flexible and can be driven through or over. However, the presence of a baby deer should by no means be overlooked, no matter how deeply it might be nestled in the grass. The subsoils themselves can also be very different and have varying levels of traversilibity. And depending on the weather, visibility might be limited. This can reduce the quantity and quality of sensor data collected.

IPA robots demonstrate autonomous route planning capability

The autonomous outdoor navigation technology developed at Fraunhofer IPA under the watchful eye of Kevin Bregler can cope with all of these challenges and allows agricultural robots to be used, for example, for mechanical weed control. In addition to software development, the research group is creating agricultural robot prototypes known as “CURT”. Two of these robots will be on show at the trade fair stand, giving visitors an insight of how it all works.

The first, CURTdiff, has the ability to autonomously recognize rows of crops between artificially raised ridges, as is common practice in potato and aspa ragus cultivation, and manoeuver along them fully autonomously. The second, CURTmini, which is the smallest robot representative, will move across an area featuring floor modules that offer different levels of maneuverability, e.g., grass, wood and gravel. Depending on the calculated level of traversibility, the robot accordingly adapts to the situation to independently plan a path that avoids obstacles. Thanks to interchangeable floor modules, the course is interactive. Trade fair visitors will also have an opportunity to change the floor modules to see the robot's adaptive path planning capability for themselves. In addition, visitors can place obstacles in the way of the robots to see how the robot dynamically recalculates its path. Furthermore, screens will be installed at the trade fair stand playing videos to highlight potential application areas such as winemaking and apple cultivation.

The exhibits organized by the Fraunhofer IPA development team are particularly geared towards manufacturers and users of agricultural machinery. However, the navigation software is of interest for a range of other autonomous machinery used both indoors and outdoors. The CURTmini is also available for purchase as a research platform.

Press release

25-Sept-2023
Source: Fraunhofer Institute for Manufacturing Engineering and Automation IPA

Further information

Dr. phil. Karin Röhricht
Press communication
Fraunhofer Institute for Manufacturing Engineering and Automation IPA
Nobelstr. 12
70569 Stuttgart
Tel.: +49 (0)711 970 3874
Email: karin.roehricht(at)ipa.fraunhofer.de

M.Sc. Kevin Bregler
Expert contact
Fraunhofer Institute for Manufacturing Engineering and Automation IPA
Nobelstr. 12
70569 Stuttgart
Phone: +49 (0)711 970 1371
Email: kevin.bregler(at)ipa.fraunhofer.de

- Fraunhofer Institute for Manufacturing Engineering and Automation IPA