Press release

Agricultural robotics in collaboration: Feldschwarm gains momentum

Zeulenroda, September 22, 2025

The Feldschwarm Ecosystem research project is developing a manufacturer-independent technology platform that enables multiple agricultural machines and robots to work simultaneously in a swarm, either partially or fully autonomously – with the operator retaining control and able to intervene at any time. The aim is to increase productivity and resource efficiency, reduce the workload on workers, and ensure integration into existing agricultural IT systems. The project is being carried out by a consortium of industry and science as part of the BMFTR (Federal Ministry of Research, Technology, and Space) RUBIN program.

The alliance has been in the implementation and testing phase since 2023. Highlights in 2025 included public demonstrations and specialist workshops, including at the Öko-Feldtage (eco field days) at Wassergut Canitz, where swarm work planning, mission control, and remote monitoring were demonstrated and discussed in practical use. These events also served as a forum for feedback from research and practice for the next development steps.

At the heart of the project is an open, scalable control and data architecture based on scientific principles: from the cloud- or on-premise-capable web platform with mission and swarm planning, through standardized interfaces (ISOBUS/TIM), to safety and diagnostic systems for autonomous units. Cross-manufacturer applicability – in classic tractors as well as in field robots – is a central requirement. This is imperative, as it should ultimately contribute to the agricultural and economic success of each individual farmer.

Technological progress is driven by coordinated components from the partners. LACOS is developing key parts of the web platform as a central hub for planning, controlling, and monitoring the swarm. Lane and mission planning has been expanded to include heterogeneous swarm planning. The control module distributes tasks to machines, starts operations, monitors process parameters, and allows for real-time adjustments. Import/export functions and connections – for example, via agrirouter – link common farm management information systems (FMIS) and manufacturers. At the same time, an “AutonomyKit” is being developed that runs as an ECU in the robot or on the tractor display, retrieves missions from the cloud, and operates both the towing vehicle and attachments via ISOBUS/TIM or proprietary protocols. These functions were presented publicly for the first time in the project consortium and will be further refined until completion.

IndiKar is developing drone platforms for environmental perception and mission documentation. Programmed scenarios include meandering flights and documentation of processing areas, following a processing unit to evaluate results, and reconnaissance flights to coordinates in case of unclear obstacles or errors. The next step is to integrate the charging infrastructure.

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Hydrive provides a universal remote control station for field robots from different manufacturers and is developing a virtual test environment that allows autonomous control systems and their respective environment recognition to be developed and verified more quickly and closer to reality. This speeds up iterations and reduces testing efforts in the field.

ESTINO contributes a robust gateway for recording machine and process data as well as a powerful, cyber-secure transmission system. Based on real-world operating data, critical load conditions are identified and converted into standardized load scenarios – a basis for predictive service life and operational stability analyses of failure-critical components.

Fraunhofer IWU is developing sensor-based soil cultivation tools that record loads and wear on coulters and disc harrows. A demonstrator with a “measuring sleeve” shows tensile and transverse forces live. Combining these results with other sensors allows conclusions to be drawn about process quality and tool condition – a building block for robust autonomy in variable fields.

To ensure process reliability in attachments, the Eidam Group is working with IWU and BITs electronics to develop sensor-based tool diagnostics. A force measuring clamp mounted on the tool handle records loads. Algorithms use these values to determine fault probabilities in real time. Speed analyses on rotating tools, pattern and vibration detection, and modular signal processing enable the classification of typical faults – from blockages and wear to blade loss. If necessary, the control system automatically intervenes in driving and hydraulic functions via ISOBUS-TIM. The first device with integrated diagnostics, which will be officially unveiled at Agritechnica in Hanover in Hall 25, Stand B17, is currently being tested and is also intended as a retrofit solution.

LEMKEN combines three sensor systems to create the iQblue smart implement for cultivators:

iQblue tool monitoring uses a camera and AI to assess the condition of the headland, iQblue flow control monitors the material flow in the tine field and reports accumulations at an early stage, and iQblue slippage control measures roller slip and dynamically adjusts the driving speed, also via Tractor Implement Management (TIM). The modules provide visual feedback on the ISOBUS terminal or human-machine interface (HMI) and increase efficiency, process stability, and safety – while also enabling automated and autonomous soil cultivation.

From the consortium's point of view, the greatest challenges lie in secure, standards-based interoperability between heterogeneous machines, in safety concepts for mixed operation (human/machine/robot), and in consistent integration into agricultural data rooms and FMIS landscapes. Here, Feldschwarm Ecosystem addresses open interfaces, scalable cloud services, and user-centered HMI concepts – with the aim of making autonomous swarms economical, safe, and practical. The consortium will continue to operate and develop the ecosystem after the research project has been completed. To this end, manufacturers of robots, attachments, or process modules are being sought to expand the Feldschwarm ecosystem.

Further information on the Feldschwarm ecosystem project and the project partners can be found on the homepage www.feldschwarm.de/.

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Image 1: Field trials are conducted regularly as part of the Feldschwarm ecosystem project – here with the innoMADE TK100 implement carrier during soil cultivation.

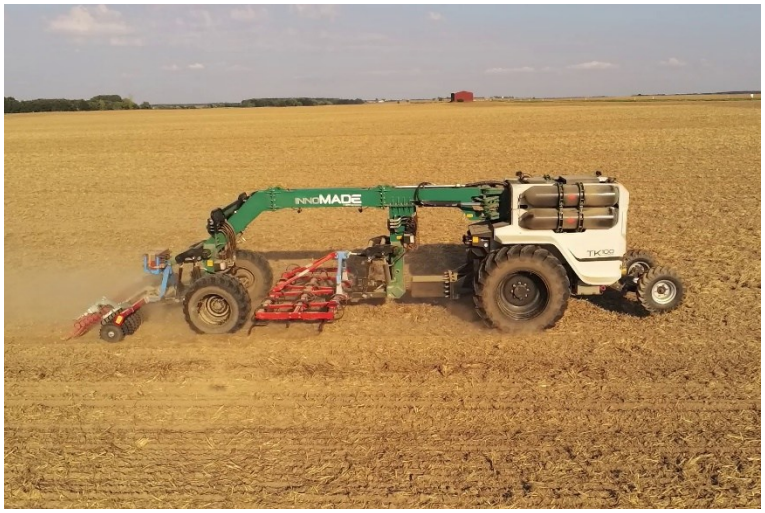
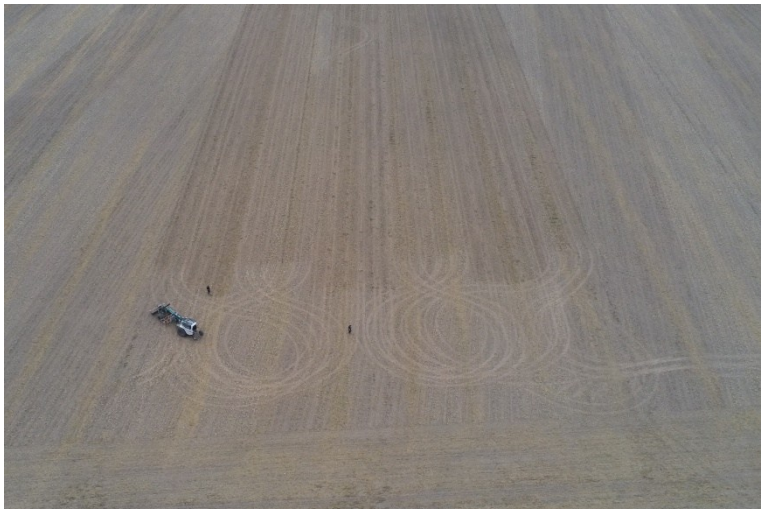


Image 2: Detailed field test of the innoMADE TK100 with the AutonomyKit and mission planning from LACOS.



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