FieldDock: An Integrated Smart Farm Platform for Real-Time Agronomic Optimization and Accelerated Crop Breeding

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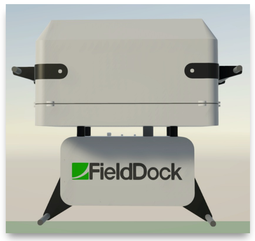
https://fielddock.org

What is FieldDock?

FieldDock is a cyber-physical system that combines autonomous UAVs, wireless sensor networks, edge computing, cloud connectivity, cloud computing, and advanced data analytics. It offers a comprehensive solution for enhancing crop breeding, performance measurement, and farm management, embodying the forefront of field phenotyping research to meet future agricultural challenges.

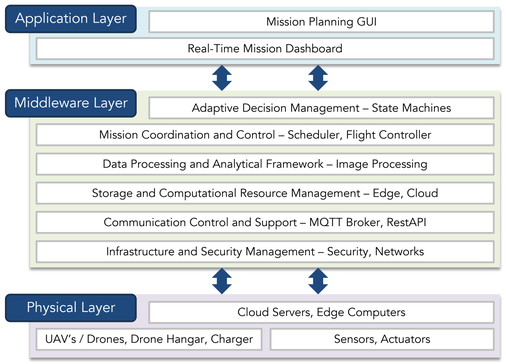


Challenges & Goals

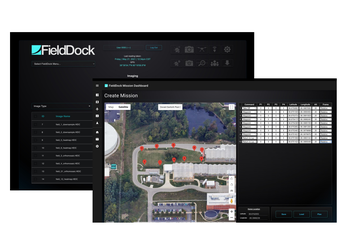
- Fully autonomous platform that integrates UAVs, sensors, and edge computing for comprehensive remote field data collection
- Complex, resource-intensive image processing performed at the edge
- Captures high quality crop performance insights daily to better inform breeding
- System is completely solar powered

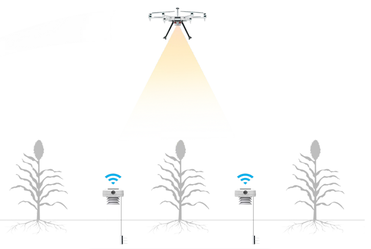
FieldDock Platform

- Integrated Hardware Solutions for Drone Docking and Edge Computing
- Network Infrastructure for Sensors, UAVs, and Ground Stations
- Autonomous UAV flight and Precision Landing
- Edge processing and Cloud-Based GWAS Support for Real-time Crop Modeling
- Robust GUI for Mission Planning and Data Visualization

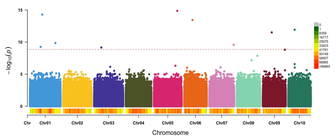


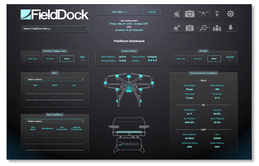
Autonomous System Workflow Overview



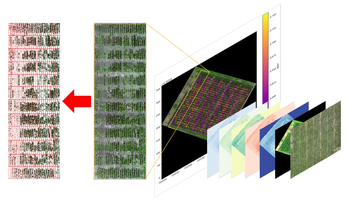


User plans mission → FieldDock remotely orchestrates mission → Drone is deployed & data is collected → Drone returns to dock & uploads its data → Image processing happens at the edge → Processed data sent to cloud → Data accessed via FieldDock GUI → Field data informs cloud-based GWAS → User plans mission





Orthomosaics, Downsampled images, Plot Indices, etc.



Scientific Impact

- Wireless sensor network provides hyperlocal environmental data for all field plots
- Daily GWAS analysis provides quick trait insights
- Immediate warnings for critical stress areas
- Middleware adapts to changing mission needs
- Edge computing supports real-time decision-making and minimizes data transfer

Broader Impact

Environment & Sustainability
- Optimized planting and harvesting windows
- Targeted resource use minimizes impact
- Completely solar powered

Research
- Continuous, autonomous data collection
- GWAS/Crop Model integration
- Facilitates collaboration through cloud-accessible data

Economic
- Resource savings through optimized input application (e.g. water, fertilizer)
- Reduced manual labor

Education
- AgSTEM education opportunities
- Integrated cross-disciplinary concepts

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