

Executive Farm Management 2026

Precision Crop and Livestock Management using AI and Robotics

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Outline

1. Self Introduction
2. The influence of AI and robotics on farming
3. Ongoing Projects from the Lab
 - Drones for autonomous scouting and crop breeding
 - Autonomous robots for broiler houses
 - Autonomous topping and suckering robot for tobacco growers
 - Animal-centered ventilation and heating control
 - 3D phenotyping robot for crop breeding and plant science
4. Summary

My Journey: Connecting the dots



Beijing, China

B.E. and M.E. Degrees

China Agricultural University

Hydraulic and Hydropower Engineering

Agricultural Water and Soil Engineering



Niigata, Niigata, Japan

Doctoral Degree

Niigata University

Environmental Science

and Technology



Lincoln, Nebraska, USA

Postdoc and Faculty

University of Nebraska-Lincoln

High-Throughput Plant

Phenotyping



Raleigh, North Carolina, USA

Assistant Professor

North Carolina State University

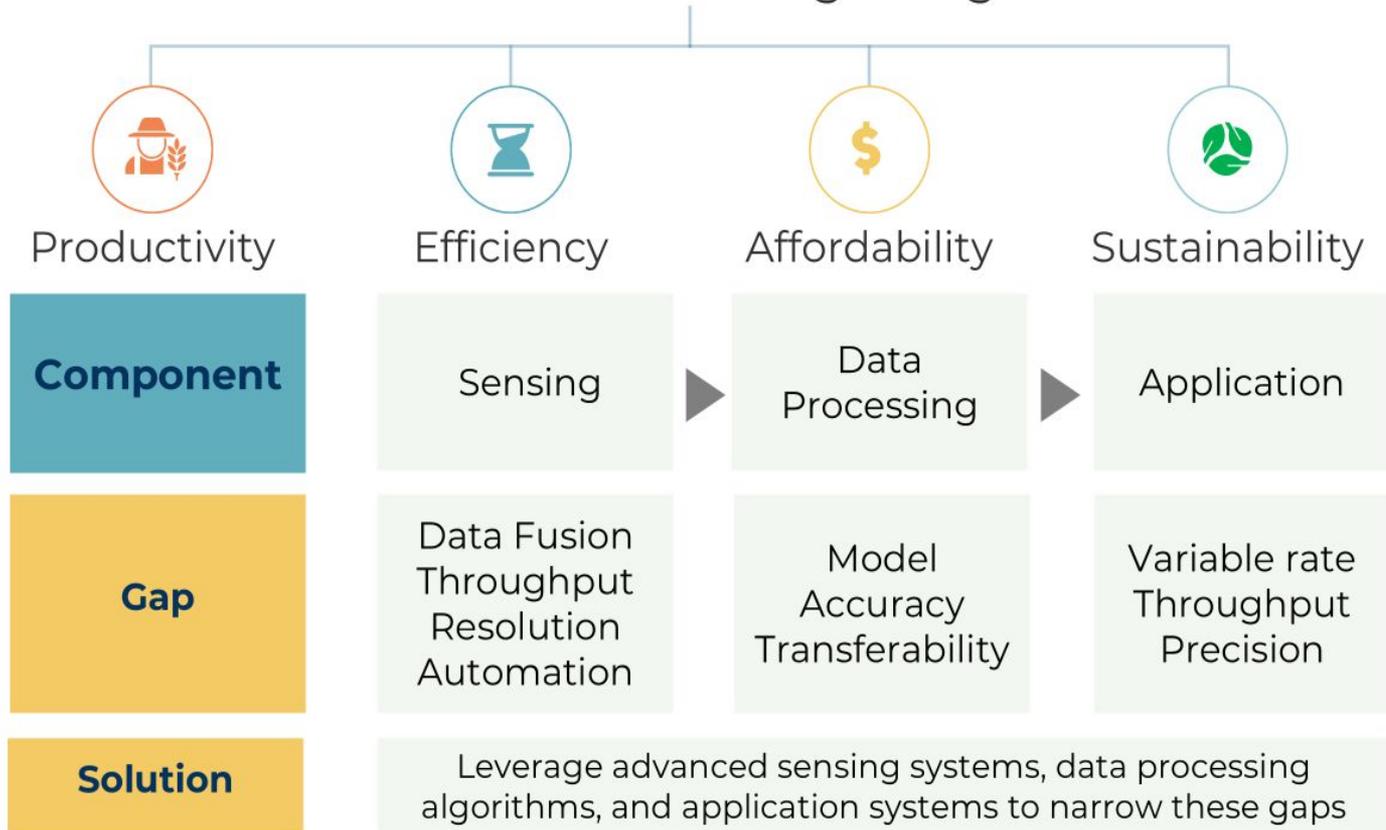
Precision and Digital Agriculture

Department of Biological and Agricultural Engineering



Introduction

Goals of Precision and Digital Agriculture



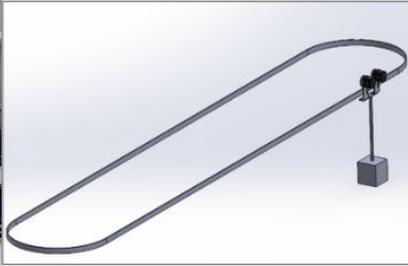
Will AI and robotics improve farming efficiency?



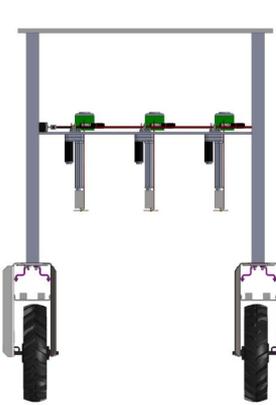
Discussion Points

- What is the AI component in that weeding machine?
- Why we need agricultural robots in NC?
- What does ag robots look like?
- What are the important evaluation metrics for ag robots?
- What is the current and future market size of ag robots?
- What are available business models of adopting ag robots?

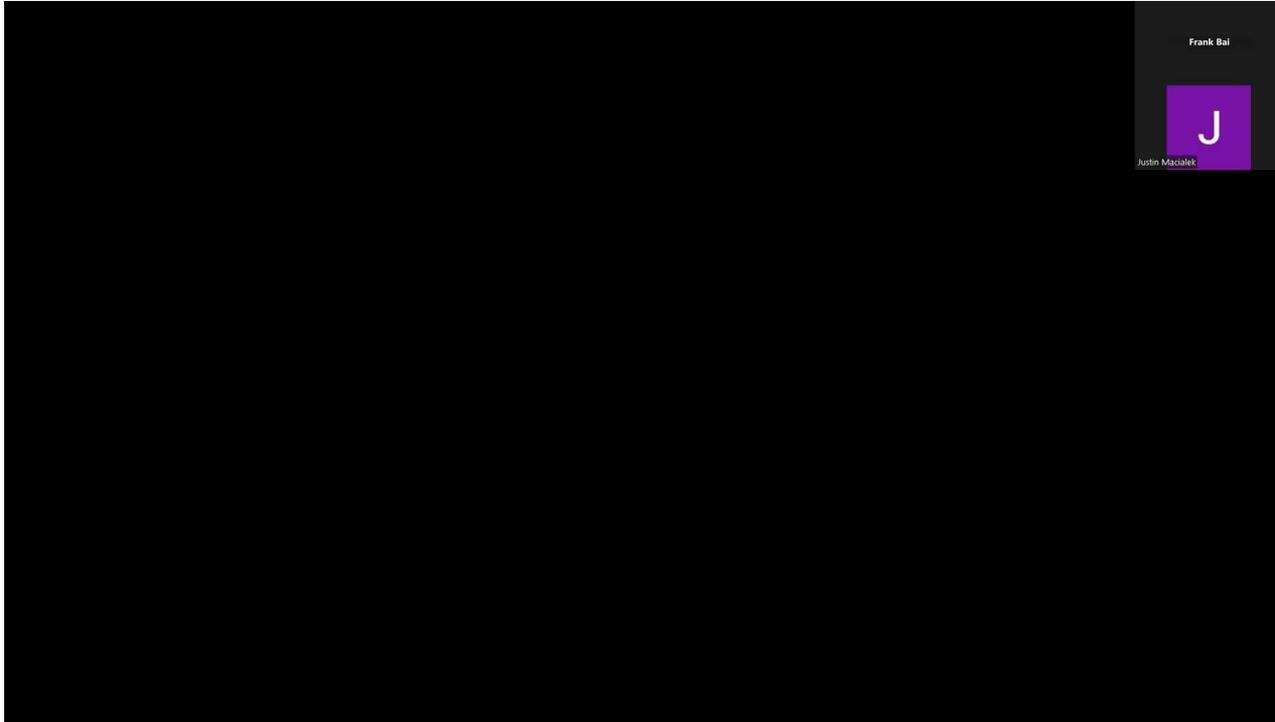
Ongoing Projects from BAI Lab (unpublished research)



1. Drones for autonomous scouting and crop breeding
2. Autonomous scouting for broiler houses
3. Autonomous topping and suckering robot for tobacco growers
4. Animal-centered ventilation and heating control for swine facilities
5. 3D phenotyping robot for crop breeding and plant science



Drones for autonomous scouting and crop breeding



System capacity

- Over 150 flights in 2025
- The technology is mature
- Can be used for autonomous missions
- Fraction of cost

Drought stress quantification



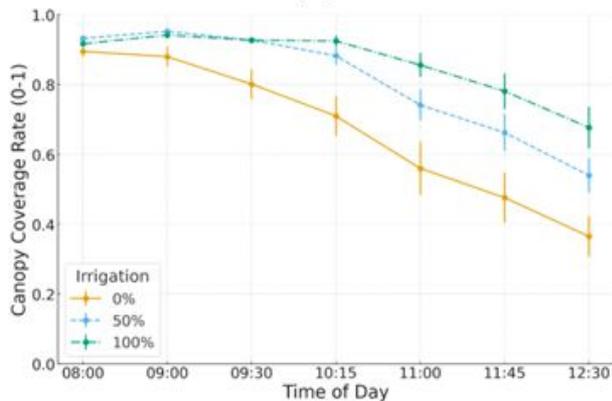
(A)



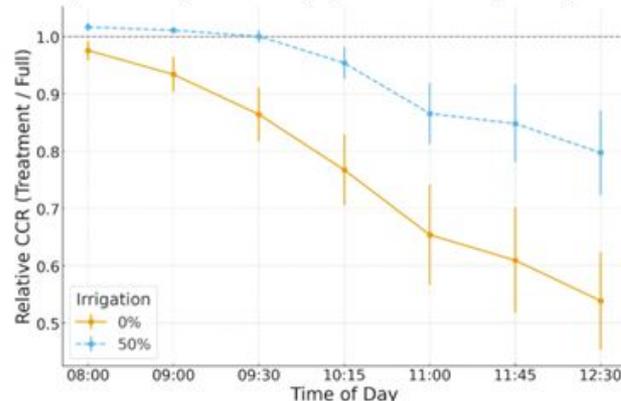
Rainfed (12:30 PM)



(B) Full Irrigation (12:30 PM)

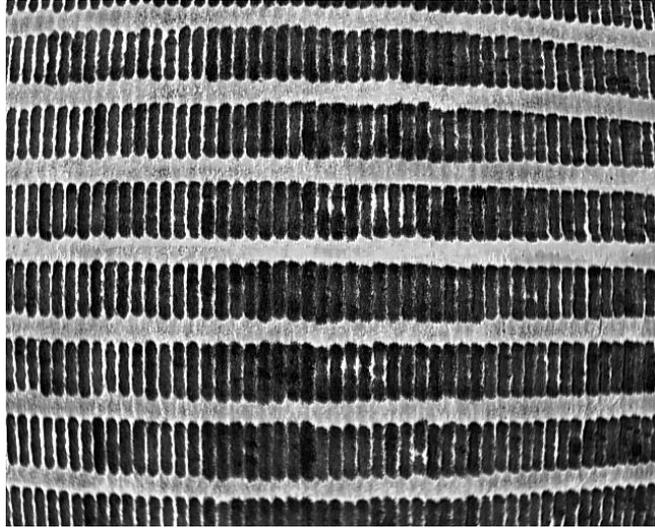


(C)



(D)

Soybean phenotyping for drought tolerance



Expected output: Water use efficiency of breeding plots

2026 research goals using drone platforms

- Data collection on cotton and maize fields
- Create AI models to
 - Count the emergence rate for replanting decision
 - Create weed map
 - Create crop health map
 - Send manager daily field report with prescription maps

Autonomous robots for broiler houses

- Growers need to walk the houses daily
- It is a repeated labor cost under harsh environment

A reliable, affordable, and autonomous robot that can

- Continuously monitor the birds and the environment
- Map critical parameters every hour
- Detect negative situation as early as possible for intervention

Autonomous robots for broiler houses



Autonomous robots for broiler houses



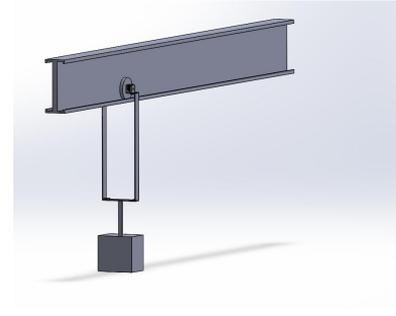
- Hourly scouting
- Bird distribution
- Behavior time budget
- Stress map
- Dead bird detection
- Temperature map
- etc.

January 2025
Project initiated



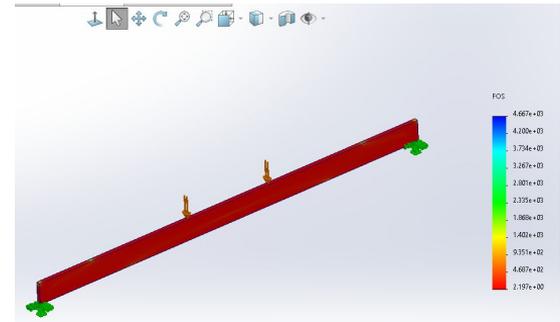
June 2025
First cable-driven system tested at a commercial farm

October 2025
Second gen system under development
-precise localization
-sensing



March 2025
Imaging module completed

Sep 2025
Second experiment completed
Vision model built



Second generation is expected to be ready in mid 2026 with basic feature of high-accuracy mapping of bird local distribution and air temperature & RH.

Autonomous topping and suckering robot for tobacco growers

- Visited a few tobacco farms in 2025
- Learned the process from seedling to packaging.
- Use robots to reduce labor cost/shortage will benefit growers

- Develop a robot prototype that can
 - Continuously working in the field for 4 hours
 - Can perform the tasks accurately
 - The whole robot should not cost more than \$30K

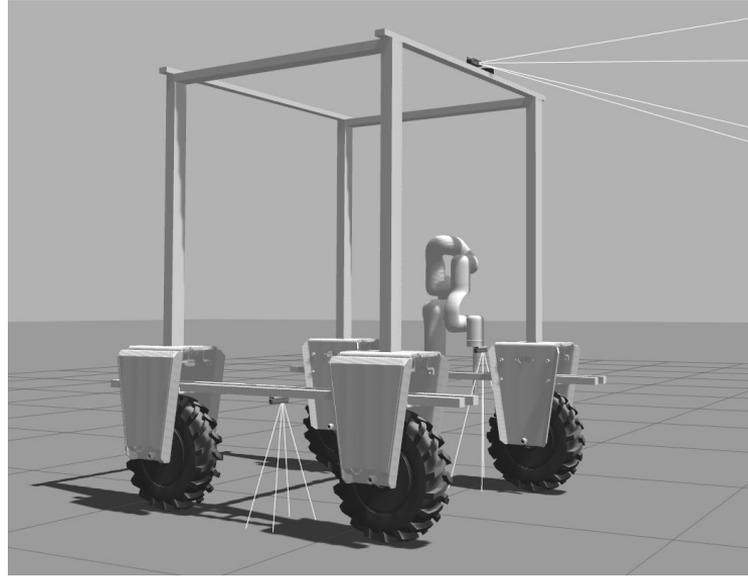
Autonomous topping and suckering robot for tobacco growers



AI models for navigation and
flower localization



Autonomous topping and suckering robot for tobacco growers



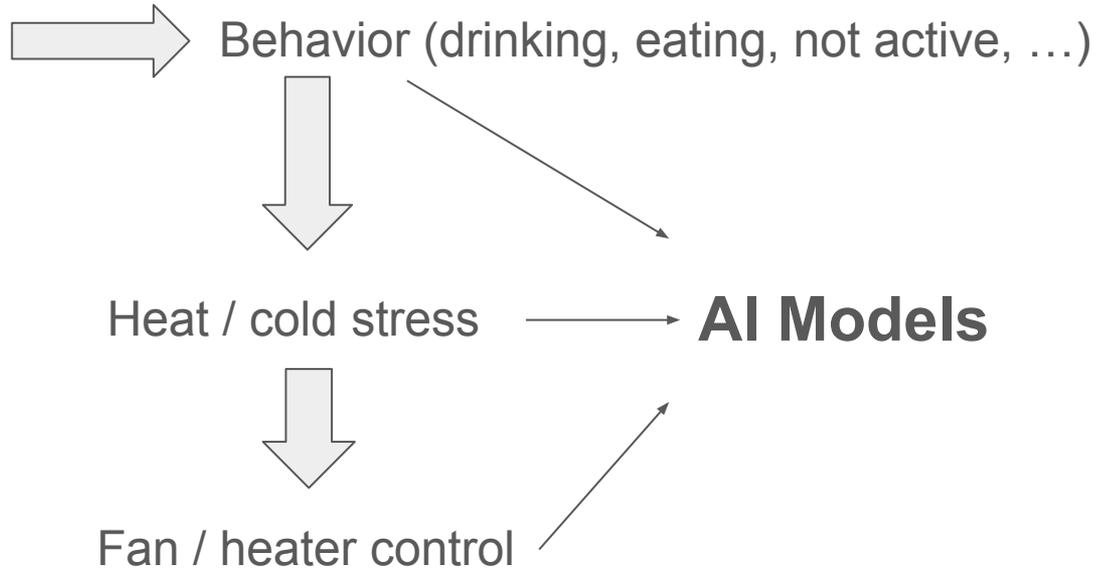
Simulation

Mechanical design

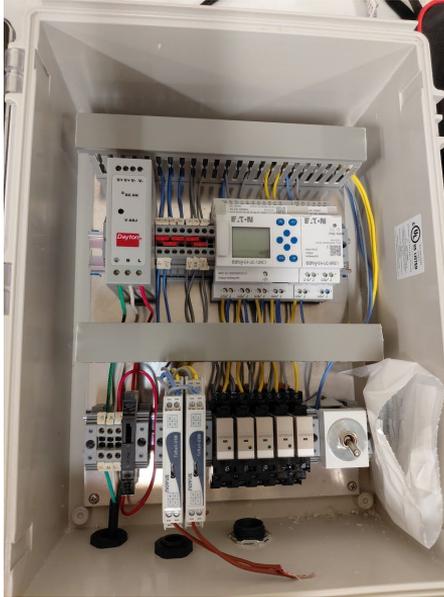
Animal-centered ventilation and heating control (Co-PI)

Expectation: Better animal welfare, less energy cost

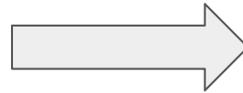
24/7 data stream: Videos,
Environmental sensors, Audio



Animal-centered ventilation and heating control



Integrated sensing and control



AI model development

3D phenotyping robot for crop breeding and plant science



- Fully automated
- Expensive
- Difficult to upgrade

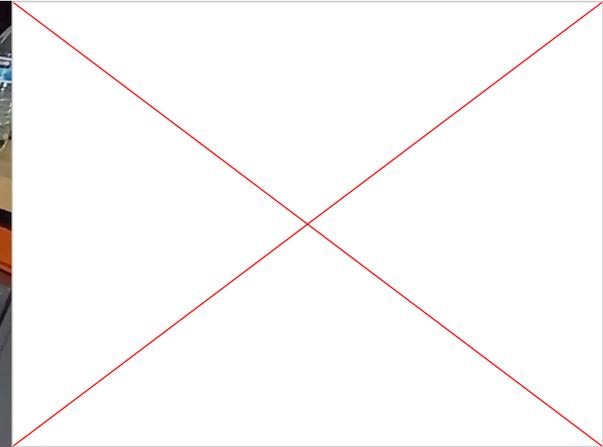
3D phenotyping robot for crop breeding and plant science



- A single, portable device
- Semi-automatic
- Deliver comparable data
- Deliver 3D data using AI models

<https://ard.unl.edu/plant-phenotyping/services-we-provide/nebraska-innovation-campus-greenhouse/>

3D phenotyping robot for crop breeding and plant science



- Leaf area
- Leaf angle
- Chlorophyll content
- etc

The role of AI and robotics in modern agriculture

- AI is fundamentally changing how digital work is conducted
- AI-driven robots are expected to transform many major industries
- Modern agricultural equipment increasingly embeds AI models
- Effective use of these tools requires adequate digital skills
- Sound investment and purchasing decisions require technical understanding

Acknowledgement

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