NRI: INT: COLLAB: Cooperative Robotic Systems for Precision Agriculture and Plant Health Management

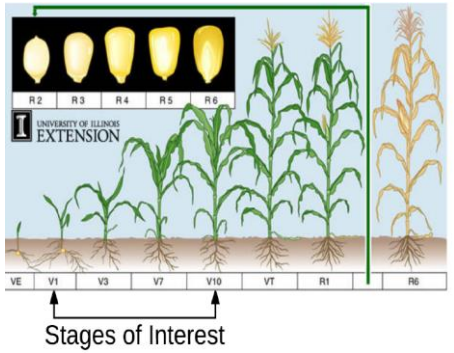
USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

Introduction & Motivation

- Collaborative aerial and ground robots-based and plant-centric crop management.
- Multi-modal and multi-resolution, 2D/3D approach on Nitrogen and potassium deficiency detection and biomass assessment.
- Automated and optimized fertilizer recommendation reflecting spatio-temporal crop needs and enabling reduced environmental impact.
- Extensive field testing in multiple corn test sites especially in Minnesota but also in Western Nevada.
- Major impact in improved yield, superior product quality and environmental protection. Generalizability across crops.

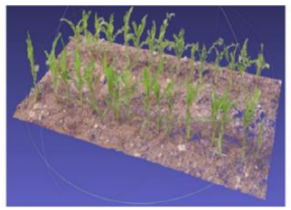
Plant Characterization and Nutrient Deficiency Detection

- N/K deficiency assessment on RGB through automated classification with custom features.
- Hyperspectral imaging for N deficiency identification utilizing Markov random fields.
- Multi-modal sensor fusion for enhanced and unified N/K deficiency detection.
- Multi-resolution approach working across spatio-temporal scales.

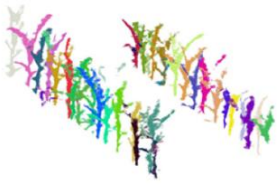


Multi-modal 3D Reconstruction and Biomass Assessment

- Multi-modal sensor fusion for real-time and single map representation on for N/K deficiency detection.
- 3D model-based assessment of crop phenological characteristics.



3D Reconstruction



Crop Separation

Stem Separation

Leaf Separation

http://distrob.cs.umn.edu | https://www.autonomousrobotslab.com/

Robotized Precision Agriculture & Fertilizer Recommendation

- Informative path planning for spatio-temporal deficiency-aware crop monitoring.
- Computer modeling for optimal fertilizer recommendation based on the EPIC model.
- Field evaluation on specific scenarios relating to the corn growth and production.
- Reproducible results & annotated datasets.
- Technology transition and open-sourcing.
- K-12 Outreach in both States. Emphasis on developing the future workforce in agriculture. Synergies with RET & REU Sites.

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