BIOAg Project Report Template

Report Type: PROGRESS

Title: Deploying satellite-imagery based machine-learning models for large-scale mapping of tillage practices.

Principal Investigator(s) and Cooperator(s):

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Abstract:

State-wide mapping of soil-health indicators and related agricultural practices is key to tracking our progress towards improving the sustainability of agriculture. While this information and low-cost platforms to gather this information for large areas are currently lacking, there have been some recent successes such as satellite-imagery based tillage class mapping for the United States Corn Belt. Encouraged by these recent successes, we propose to leverage advances in open-source satellite imagery and develop and evaluate a prototype machine-learning platform to classify eastern Washington State's agricultural fields into three classes of tillage practices: "no till", "reduced till" and "conventional till". Given the need to undertake ground-truth data collection, our primary focus will be on wheat-growing areas of eastern Washington State to keep the project tractable. However, we will evaluate the generalizability of our wheat-based machine-learning method across diverse cropping systems and take steps to maximize generalizability. The proposed project will complement ongoing efforts of the Washington State Soil Health Initiative, and provide a prototype platform that can be collaboratively expanded in the future to facilitate low-cost state-wide automated measurement and monitoring of a broad array of soil health indicators and agricultural practices that influence them. Such a platform is critical to quantify the true costs and benefits of agricultural practices, monitor changes over time, evaluate policies and programs designed to incentivize specific practices, and ultimately move the agricultural sustainability needle in the right direction. This is a research proposal involving WSU faculty in collaboration with the Washington State Department of Agriculture and Conservation Districts.

Project Description:

Our specific objective for this project is to compile a ground-truth dataset, and develop and evaluate a prototype satellite-imagery based machine-learning platform to classify eastern Washington State fields into three classes of tillage practices: "no till", "reduced till" and "conventional till". The proposed platform can be used to capture a snapshot of acreage under different tillage practices, as well as monitor change over time. To keep the effort tractable, we will primarily focus on dryland and irrigated wheat-growing areas in eastern Washington State. However, we will also survey 3-5 additional crop types to test how generalizable our wheat-based machine-learning models are to multiple cropping systems and then alter the models to make them more generalizable.

Outputs

- Overview of Work Completed and in Progress:
    - We have surveyed approximately 400 fields in Fall 2021 and have finalized the protocol for Spring 2022 data collection.
    - Graduate student, Amin Nourozi has built the first version of a machine learning model that takes a photograph as an input and provides a residue percentage. The accuracy is around 82% and Amin is fine-tuning it. This is for photo-based ground-truthing of collected data.
    - Graduate student, Amin Nourozi is currently exploring the design of ML models for satellite-imagery based tillage classification.
- Methods, Results, and Discussion (discussion for final reports only):
- Publications, Handouts, Other Text & Web Products:
    - Nothing to report yet
- Outreach & Education Activities:
    - Nothing to report yet

Impacts

- Short-Term:
- Intermediate-Term:
- Long-Term:

Additional funding applied for/secured:

A follow-up proposal was submitted to the USDA NIFA DSFAS program in Summer 2021. Status: Declined, but we plan to resubmit/integrate into a larger submission to the USDA NIFA SAS program.

We are also exploring the opportunity to submit an EMSL proposal to the Department of Energy via new collaborations initiated with PNNL.

Graduate students funded:

Amin Nourozi.

Recommendations for future research: