TO: The Engineering Faculty

FROM: The Faculty of the School of Agricultural and Biological Engineering

RE: New graduate course – ABE 53000 Plant Phenotyping Technologies (3 Credit Hours)

The Faculty of the School of Agricultural and Biological Engineering has approved the following new graduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM:

ABE 59100 Plant Phenotyping Technologies Sem. 1, Class 2, Lab 1, Cr. 3. Classification: 4 or higher

> Temporary course number. Course was taught Fall 2017 (7), Fall 2018 (10), and Fall 2019 (5).

TO:

ABE 53000 Plant Phenotyping Technologies Sem. 1, Class 2, Lab 1, Cr. 3. Restrictions/Prerequisites: Instructor Permission or Graduate Standing

> Introducing concepts, models, algorithms, and tools in plant phenotyping development and application projects. Class topics include high-throughput phenotyping in greenhouse, field phenotyping platforms, Ag remote sensing, plant sensors (hyperspectral, 3D thermal, florescent, X-ray, etc.), plant image processing technologies, statistical modeling, big data, database requirement, artificial intelligence algorithms, and hybridizations of the above techniques applied in plant phenotyping. Typically offered Fall. Credits: 3.000

REASON: This course has been taught successfully as a temporary course and it is now being submitted for a permanent course number

Nathan S Mosier

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Head of ABE

ABE 53000 Plant Phenotyping Technologies

3 Credits Grad Class Each Fall

Instructor: Jian Jin (jinjian@purdue.edu)
Office: ABE 315
Telephone: 49-41182 (office)
Office Hours: Before/after each lecture and by appointment

Class Schedule

9:30 am - 10:20 am MW
1:30 pm – 3:20 pm M (Lab)

Catalog Description

Introducing concepts, models, algorithms, and tools in plant phenotyping development and application projects. Class topics include high-throughput phenotyping in greenhouse, field phenotyping platforms, Ag remote sensing, plant sensors (hyperspectral, 3D thermal, florescent, X-ray, etc.), plant image processing technologies, statistical modeling, big data, database requirement, artificial intelligence algorithms, and hybridizations of the above techniques applied in plant phenotyping.

Restrictions/Prerequisites

Graduate Standing or Instructor Permission

Student Learning Outcomes

On the completion of this course, the student will have:

- The concept of digital agriculture and plant sensors' applications
- An understanding of plant phenotyping technologies, in both software and hardware
- The skills of designing a professional phenotyping imaging system and collecting data
- The understanding of the current phenotyping activities in academia and industry
- The knowledge of major plant sensors and their applications
- The capability of choosing or designing the most feasible sensor system for specific phenotyping projects
- The understanding of the role of the plant sensors in a precision agriculture system
- Basic image processing skills
- The capability of applying computational intelligence and machine learning techniques to classification, prediction, pattern recognition, and optimization problems.

Grading

There are no exams. Grading will be based on 50% assignments/labs and 50% Final Project.

Final Project

The student can choose one of the assigned projects to practice the phenotyping technologies. The Final Project should be submitted as a technical report and presented in class. The project will be graded as follows: 60% implementation quality, 20% report quality, and 20% presentation quality. The report document should contain: problem description, benchmarking, and discussion. The presentation should be made with 10-15 slides, in about 15 minutes, including questions and answers.

Prerequisite Knowledge and Skills

The ability to program in MATLAB is required to complete the course.

Textbook

Digital Image Processing Using MATLAB
by Rafael C. Gonzalez (Author), Richard E. Woods (Author), Steven L. Eddins (Author)
ISBN-13: 978-0130085191
ISBN-10: 0130085197

Course Schedule

Date	Topics
Week 1	Introduction, Syllabus
Week 2	Overview of Plant Phenotyping in Industry and Academia
Week 3	Introduction to Phenotyping Sensors 1
Week 4	Introduction to Phenotyping Sensors 2
Week 5	Image Processing for Plant Features 1
Week 6	Image Processing for Plant Features 2
Week 7	Designing a phenotyping imaging system 1 – lighting, cameras, imaging box and automations
Week 8	Designing a phenotyping imaging system 2 – Environmental conditions, data storage and processing protocols, noise removal
Week 9	Statistics Basics in Plant Phenotyping 1– Training, Testing, Validation, Data Pre-Processing, Regression, Classification
Week 10	Statistics Basics in Plant Phenotyping 2– PCA, PLS Modeling, SVM, SOM and Neural Network
Week 11	Ag Remote Sensing Applications 1
Week 12	Ag Remote Sensing Applications 2
Week 13	Hyperspectral Imaging
Week 14	Root Phenotyping
Week 15	Artificial Intelligence for Plant Phenotyping; Genetic Algorithms
Week 16	Future technologies for phenotyping
Week 17	Final Project Presentations

Actual course schedule will be adjusted along the semester based on the students' interests and performance.