UNIVERSITY OF CALIFORNIA MERCED | SCHOOL OF ENGINEERING

Mechanical Engineering
Ph.D. Dissertation Defense

Remote Sensing of Water Stress in Almond Trees Using Unmanned Aerial Vehicles

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Date:

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Time:

1:00 pm-
2:00 pm

Location:

SSM-230

Abstract:

The technologies of unmanned aerial vehicles (UAVs) and minimized cameras have been improved significantly in the last decade. Unlike satellites providing low resolution images, or field scanners with limited field of view, UAV-based remote sensing platforms can collect very high resolution images with flexible temporal resolution and spectral band configuration. However, there is still lack of a workflow to fully explore the benefits of high resolution images from UAV-based remote sensing. In this dissertation, three key parts of the workflow are discussed, extraction region of interest from high resolution images, extraction of related features for further classification or regression problems and optimization of UAV-based remote sensing practices, using almond tree water status detection as a case study. To extract the region of interest more accurately, two types of methods are evaluated. One uses manual features such as color, texture and morphological features, and the other is based on the latest deep learning based instance-segmentation models. To extract application related information from these high resolution images, a methodology is proposed to convert the feature extraction problem to a dimensionality reduction problem. According to this methodology, moments, histograms and traditional dimensionality reduction methods are discussed based on the performances of irrigation treatment classification, almond tree variety classification, and stem water potential (SWP) regression. Finally, best remote sensing practices are discussed using irrigation treatment classification and almond tree variety classification as reference applications. Effects of spatial resolution, spectral configuration, band-to-band registration and image formats are evaluated in terms of classification accuracies.

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Biography:

Tiebiao Zhao received his B.S. in Automation from Yantai University, China and M.S. in Control Theory and Control Engineering from University of Science and Technology of China, China. He joined MESA Lab to pursue his Ph.D. in the field of plant health monitoring using unmanned aerial vehicles (UAVs). He is the recipient of Yara North America Almond Fellowship 2016-2017, 2017-2018 and Blum Center Seed Grant Award 2016-2017 from UC Merced. He also won twice in Big Ideas Contest 2015 and 2016 from UC Berkeley.