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NATURAL RESOURCES

AGRICULTURE

HUMAN SYSTEMS

AUTOMATED SENSING

As the world population climbs toward an estimated 9.7 billion by 2050[1], food demand will surge, increasing the need for efficiency in agricultural production systems. Utilizing robots and other autonomous agricultural techniques to streamline tasks such as planting, fertilizing, and harvesting is one way researchers with the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) are addressing this challenge.

The advancement of electronic technologies has expanded the arsenal of tools to use, such as Global Positioning System (GPS), Geographic Information System (GIS), drone scouting, variable rate application technology, and remote-sensing technologies.

Automated-sensing research has typically focused on traditional crops such as citrus and tomatoes, but as Florida's crops, population, and land uses have changed, UF/IFAS faculty have sought to develop innovative, technology-based solutions to challenges facing specialty crop production, urban landscapes and environmental areas. Researchers at UF/IFAS are dedicated to developing alternative technologies to more efficiently produce valuable products while leaving a smaller environmental footprint.

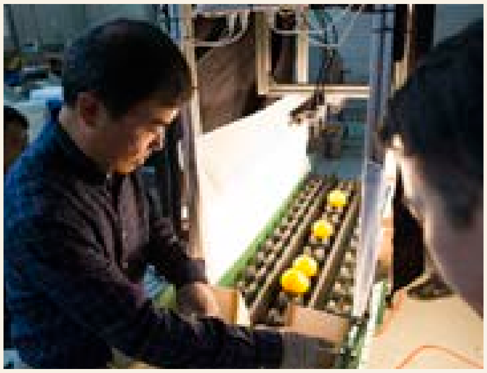
Ongoing Research

INTELLIGENT FERTILIZATION

Wild blueberry fields can have up to 50 percent bare and weedy spots, but existing applicators dispense fertilizer uniformly across the entire field. Arnold Schumann, a professor at the UF/IFAS Citrus Research and Education Center, and his colleagues at Dalhousie University developed a modified fertilizer spreader that combines a GPS map of the field with a real-time, camera-sensing system to deliver targeted fertilizer applications. His team evaluated the performance of this modified spreader under two different lighting conditions and three ground speeds. They quantified its effectiveness compared to traditional applicators by applying collection devices to a field's bare soil and weeds and compared fertilizer levels after using each system. This sensing-based system is being modified for use as an agrochemical sprayer for crops like strawberries and peppers.

ROBOTIC DISEASE DETECTION

Traditional disease-detection techniques in citrus groves and strawberry fields rely on human scouts, which are time-consuming, expensive, and prone to error. Reza Ehsani, a professor at the UF/IFAS Citrus Research and Education Center, is developing an alternative – electronic sensors and algorithms that work in conjunction with robots designed by collaborators at the University of Central Florida. First, aerial drones determine zones that are susceptible to disease, and then ground-based robots canvass those areas, scanning the crops to determine plant health. If a disease is identified, the robot records the location. If the robot cannot determine the specific disease, it collects a leaf and soil sample for lab analysis. Further development will ultimately provide large-scale growers with a more efficient and cost-effective method for early disease detection and management.



POSTHARVEST INSPECTION SYSTEM

Citrus greening disease, also called huanglongbing (HLB), and other citrus defects cause fruit to vary in quality. Daniel Lee, a professor in the UF/IFAS Department of Agricultural and Biological Engineering, led a team that developed an inspection system with real-time video processing and a state-of-the-art algorithm that automatically identifies HLB-infected citrus and other defects such as citrus canker, melanose, rust mites, and wind scar. The prototype system can be mounted on a portable conveyer system to identify blemished fruit in the field or integrated into optical-grading systems in packinghouses to maintain marketable quality by removing blemished fruit from the supply chain. The system correctly identifies HLB-infected citrus with 94.9 percent accuracy. Lee's team is modifying the system to make it a cost-effective solution for producers aiming to increase orange juice quality and competitiveness.

[1]https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf

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Research with Impact

SATELLITE DATA

New satellite data at microwave wavelengths provide unprecedented soil-moisture information critical for establishing best management practices for optimal crop production. However, the information is only available at coarse spatial resolutions, while farmers need validated, field-scale information to make decisions. To provide accurate observations of soil moisture at the field level, Jasmeet Judge, an associate professor with the UF/IFAS Department of Agricultural and Biological Engineering, and her colleagues developed an algorithm for downscaling satellites' soil moisture data from resolution of 100 km^2 to 1 km^2. Then they integrated the data into a crop-growth model that provides daily observations of root-zone soil moisture at field scales. This model allows for improved field management strategies for row crops on large farms, and is freely available, so producers in Florida can begin using this methodology.

NUTRIENT MAPPING

Florida's decision-makers need scientific support when determining soil- and water-resource conservation strategies over large geographical areas. To help guide their decisions, Sabine Grunwald, a professor with the UF/IFAS Soil and Water Sciences Department, led a team that created three-dimensional predictive maps of nutrient levels in the Santa Fe River watershed. Her team sampled soil from more than 100 sites spanning eight land-use types and then identified the spatial patterns of phosphorus in the soil using a variety of geostatistical methods that were correlated with environmental attributes, land-uses, vegetation cover, and geological composition data. The resulting maps provide regulators insight into phosphorus distribution in local ecosystems and improved agricultural management recommendations for nutrient-runoff limits and watershed-wide protection of natural areas.

SENSOR SENSITIVITY

Soil moisture sensor systems control water application in urban landscapes by allowing irrigation systems to activate only when soil moisture drops below a certain threshold. In many areas including Florida, irrigation water is commonly reclaimed water, or highly treated wastewater, which can have elevated salinity levels. Irrigation expert Michael Dukes helped demonstrate that sensors from various manufactures have distinctly different accuracy when exposed to Florida's reclaimed water. Dukes, a professor in the UF/IFAS Department of Agricultural and Biological Engineering, tested three commercially available sensors under controlled, replicable conditions. The findings provide recommendations to home and small-business owners on which brands are likely to function best under their particular irrigation conditions, reducing irrigation and saving millions of gallons of water annually.

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