ENGINEERING RESEARCH CENTER FOR THE INTERNET OF THINGS FOR PRECISION AGRICULTURE (IOT4AG)

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Abstract: By 2050, the US population is estimated to grow to 400 million and the world population to 9.7 billion. Current agricultural practices account for 70% of global water use, energy use is one of the largest costs on a farm, and inefficient use of agrochemicals is altering Earth's ecosystems. With finite arable land, water, and energy resources, ensuring food, energy, and water security will require new technologies to improve the efficiency of food production, create sustainable approaches to supply energy, and prevent water scarcity.

The National Science Foundation granted the University of Pennsylvania, Purdue University, the University of California at Merced, and the University of Florida an award to establish the Engineering Research Center for the Internet of Things for Precision Agriculture (IoT4Ag) in September 2020. IoT4Ag's mission is to create and translate to practice Internet of Things (IoT) technologies for precision agriculture and to train and educate a diverse workforce that will address the societal grand challenge of food, energy, and water security for decades to come.

IoT4Ag is creating next-generation IoT sense-communication-response technologies and establishing engineered integrated systems for precision farming of tree crops and row crops, mainstays of the food supply chain. The Center's research is driven by the agricultural-specific use case of IoT to achieve breakthrough technologies in sensors, robotics, and energy and communication devices to inform data-driven models constrained by plant physiology, soil, weather, management practices, and socioeconomics that enable the optimization of farming practices for every plant. Integrated systems engineered from these technologies are being designed to capture the microclimate and spatially, temporally, and compositionally map heterogeneous stresses for early detection and intervention to ensure better outcomes in agricultural crop production. Here, I will focus on nano-enabled, multi-mode sensors being co-designed and co-created with energy and communications technologies for agricultural use that calls for sensor systems that require zero- or near-zero power, are low cost, can be deployed at large scale, are biocompatible/biodegradable, and can operate below the soil surface and in/below the canopy.

Bio: Kagan is the Stephen J. Angello Professor of Electrical and Systems Engineering, Professor of Materials Science and Engineering, and Professor of Chemistry at the University of Pennsylvania. She is Penn Engineering's Associate Dean for Research, the 2021 President of the Materials Research Society, and an Associate Editor of ACS Nano. Kagan is also the Director of the newly awarded NSF Engineering Research Center for the Internet of Things for Precision Agriculture. The Kagan group's research is focused on the synthesis, assembly, and properties of nanostructured materials and in their integration in devices with applications in electronics, photonics, and sensing.