Distinguished Lecture

Friday, April 20 **1 p.m.** **3043 ECpE Building Addition**

Ralph Etienne-Cummings:
Professor and Chair of Electrical and Computer Engineering at Johns Hopkins University

Hardware Compressive Sampling: Communicating Videos over Narrow Data Pipes

ABSTRACT: Mobile wireless sensor nodes (MWSN) mounted with low power CMOS video cameras (CVC) have been utilized for surveillance, emergency management and monitoring of hazardous areas [1]. These nodes are integral parts of Internet-of-Everything as they are the "eyes" of the network to interact with the world. Due to physical constraints, CVC mounted on MWSN must be small and low power. It also needs to provide videos with high spatial (high pixel counts, good SNR) and temporal resolution (high framerate, low motion blur) when the scene is changing under different lighting conditions. These specifications are often difficult to satisfy simultaneously with conventional sensors: Capturing a scene with high framerate increases readout (RO) power consumption. Additionally, high frame rate also limits pixel exposure time which degrades scene contrast and SNR. We present a CVC chip to achieve these specifications simultaneously. To reduce RO speed while guarantee high frame rate, the imager is designed with Compressed Sensing (CS) based Pixel-wise coded exposure (PCE) techniques. We demonstrate the advantage of PCE over conventional imager is that pixel exposure interval is no longer defined by the framerate. The pixel exposure interval can span multiple frames to enhance SNR without inducing motion blur to the recovered video. Our CVC is the first CMOS implementation of PCE. Further, we report a complete single chip that includes an APS array with spatiotemporal compressive sampling circuits and wireless transmission using an Ultra-Wide Band (UWB) transmitter (TX). Lastly, we generalize this approach for other data collection and low power transmission applications, such as in wireless neural recording.

BIO: Ralph Etienne-Cummings received his B. Sc. in physics, 1988, from Lincoln University, Pennsylvania. He completed his M.S.E.E ('91). and Ph.D. ('94) in electrical engineering at the University of Pennsylvania. Currently, Dr. Etienne-Cummings is a Professor and Chairman of Department of Electrical and Computer Engineering at Johns Hopkins University (JHU). He was the founding Director of the Institute of Neuromorphic Engineering. He has served as Chairman of various IEEE Circuits and Systems (CAS) Technical Committees and was elected as a member of CAS Board of Governors. He also serves on numerous editorial boards and was recently appointed Deputy Editor in Chief for the IEEE Transactions on Biomedical Circuits and Systems. He is the recipient of the NSF's Career and Office of Naval Research Young Investigator Program Awards. He was a Visiting African Fellow at U. Cape Town, Fulbright Fellowship Grantee, Eminent Visiting Scholar at U. Western Sydney and has also won numerous publication awards, most recently the 2012 Most Outstanding Paper of the IEEE Transaction on Neural Systems and Rehabilitation Engineering. He was also recently recognized as a "ScienceMaker", an African American history archive. He has published over 220 peer reviewed article, 11 books/chapters and holds 10 patents/applications on his work.

IOWA STATE UNIVERSITY
Department of Electrical and Computer Engineering
ECpE Contact: Ratnesh Kumar, rkumar@iastate.edu