Dr. Qi Hao, University of Alabama

TITLE: Intelligent Distributed Binary Sensors for Tracking and Recognition

ABSTRACT: In the biological world, insects possess relatively simple but effective sensory systems. They have some visual and auditory organs in the simplest forms, such as simple eyes and chordotonal organs, able to detect and track movements of targets. Some of their sensory organs employ complex geometric patterns based on uniform simplex elements, such as compound eyes and spider webs, able to recognize targets based on their movements. In fact, insects sport excellent sensory capabilities using intelligent compressive sensing principles: sparse representation, multi-channel sampling, and spatial awareness. The sparse representation of signals necessities an operation for data compression in the physical layer. Multi-channel sampling schemes can take geometric advantages of distributed sensors and exploit the coherence among distributedly acquired information through constructing pseudo-random measurement matrices. The spatial awareness refers to the ability to be aware of oneself in spatial relation to surrounding objects. Based on the above biological inspirations, we have developed a series of distributed binary sensor systems in various modalities: pyroelectric, photonic, fiber-optics, and laser. A low-cost binary sensor generates as little as one bit of information at each point in time. It can only be used to indicate the presence or absence of targets of interest. The use of a single bit of information allows for inexpensive sensing and minimal communications. The binary sensory data representation also enhances the system robustness against measurement noise and sensor model errors. This minimalist approach to extracting information from distributed sensors leads to binary sensor systems or networks. In this talk, I will introduce a series of distributed binary sensor systems, whose spatial awareness and sensing efficiency are enhanced by using sensor field of view (FOV) modulation techniques for target tracking and recognition purposes. Specifically, experimental results on multiple human tracking and recognition will be presented.

BIO: Dr. Qi Hao is an assistant professor of the ECE Department at The University of Alabama. He received his Bachelor and Master degrees in Electrical Engineering from Shanghai Jiao Tong University in 1994 and 1997, respectively. He earned his Ph.D. degree from Duke University in 2006 for the work in design and implementation of wireless distributed infrared sensors for human tracking and identification. His post-doctoral training in the Center for Visualization and Virtual Environment at The University of Kentucky was focused on 3-D computer vision for human tracking and identification. His current research interests include bio-inspired intelligent sensors for human tracking and recognition, and biomedical image processing. Recently, his work on intelligent compressive pyroelectric sensor networks for human tracking and recognition has been recommended for a NSF research award by the information and intelligent system (IIS) program.