# ELECTRICAL & COMPUTER ENGINEERING SEMINAR

# "A Diversity/Multiplexing Tradeoff for Distributed Sensing"

by

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**Abstract:** Sensor networks are emerging as a new technology with the potential to enable cost-effective and reliable surveillance. Typically, information gathered by sensors-ranging from sufficient statistics to binary local decisions- is transmitted to a fusion center, which makes a decision about the presence or absence of a target by combining the local information. Over the past three decades, optimal decision rules for different detection principles and network topologies have been studied extensively. However, less attention has been paid to fundamental limits and trade-offs in distributed sensing.

In this talk, we develop a counterpart for distributed active sensing of the fundamental trade-off in wireless communication between rate and reliability. Multiple sensors can cooperate to monitor a single surveillance cell (e.g. a range cell) with high fidelity, or they can act independently to monitor multiple cells simultaneously, but with less fidelity. The former is the counterpart of reliability and the latter is the counterpart of rate. We introduce a notion of diversity order for distributed sensing by establishing how network-wide detection error probability behaves as a function of SNR. Detection error probability depends on two error sources- false alarm and miss-detection. As a case study, we look at joint and distributed detection, under a constant false alarm rate (CFAR) regime. We show that, in an N-element network, joint detection achieves diversity order N/r, where r is the number of surveillance cells monitored simultaneously (multiplexing order), while distributed detection achieves diversity order N/r-k, where k is the minimum number of degrees of freedom required to achieve the desired CFAR.

This is joint work with Robert Calderbank and Stephen Howard.

**Bio:** A. Pezeshki received the BSc and MSc degrees in electrical engineering from the University of Tehran, Tehran, Iran, in 1999 and 2001. He earned his PhD degree in electrical engineering at Colorado State University in 2004. In 2005, he was a postdoctoral researcher with the Signal Processing and Communications Laboratory at Colorado State University. Since January 2006, he has been a postdoctoral research associate with The Program in Applied and Computational Mathematics at Princeton University. His research interests are in applications of statistical signal processing and coding theory to sensing and communication networks.

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