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THE DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, ECE DIVISION

Presents the Spring 2012 EECS Seminar Series

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"Sparse Signal Processing and Controlled Sensing: Applications, Theory, and Algorithms"

Tuesday, February 28, 2012 10:30 a.m. HEC 450

Abstract

This talk focuses on two classes of sensing problems that naturally arise in a wide range of signal processing applications, namely, sparsity-based sensing and controlled sensing. The former deals with sampling and reconstruction of compressible signals and phenomena, which are known to be sparse in some basis. The latter refers to dynamically managing and controlling different sensing assets and modalities to achieve an inference task with a desired quality level.

As an instance of sparsity-based sensing, we first consider the group testing problem where the goal is to recover a small distinguished subset of items from a large population while efficiently reducing the total number of tests. We formulate the group testing problem as a channel coding/decoding problem and derive a unifying result that characterizes the sample complexity through computation of a mutual information expression. The result is shown to be fairly general and applicable to many interesting scenarios in sparse signal processing, including Bayesian compressive sensing and relevant features' identification.

As an example of controlled sensing, we examine the problem of tracking objects in an energy efficient manner using a sensor network. In order to conserve energy, the sensors are allowed to enter a sleep state at the expense of observability. Our objective is to find sleep control policies that yield the best tradeoff between tracking error and energy efficiency. While optimal solutions are generally intractable, we show that we can find efficient control policies that approach computable lower bounds on optimal performance. More importantly, these control policies significantly outperform traditional approaches based on duty cycling the sensors between on and off states. This work offers one common platform for studying a broad range of controlled sensing for inference problems on account of the commonality of their structural and informational architectures.

Biography

George Atia joined the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign in Fall 2009, where he is currently a postdoctoral research associate with the Coordinated Science Laboratory. He received his Ph.D. degree in Electrical and Computer Engineering from Boston University, Massachusetts, in 2009. He received the B.Sc. and M.Sc. degrees, both in Electrical Engineering, from Alexandria University, Egypt, in 2000 and 2003, respectively. He is the recipient of many awards including the outstanding graduate teaching fellow of the year award in 2003-2004, the 2006 College of Engineering Deans Award at the Science and Engineering Research Symposium, and the best paper award at the International Conference on Distributed Computing in Sensor Systems (DCOSS) in 2008. His main research interests are in wireless communications, statistical signal processing and information theory. His current research focus is on controlled sensing for inference and sparse signal processing.

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