Colloquia

Archives: Fall 2015

Department of Electrical and Computer Engineering Colloquia: Tufts University

Halligan Hall, Fridays from 1:30pm to 2:45pm (refreshments at 1:20, talk begins at 1:30) unless otherwise noted.

All seminars are open to the public. Our seminars are a great opportunity to see the results of exciting new research by faculty, students, or other institutions, or just to get a sense of what the ECE Department is all about. For comments or questions, or if you would like to receive email notifications of upcoming colloquia, please send us an email.

Organizers: Shuchin Aeron and Tom Vandervelde

September 18, 2015
Halligan 102
Distinguished Speaker Series
A Signal-Processing Approach to Modeling Vision, and Applications
Speaker: Professor Sheila Hemami, Northeastern University

Abstract:
Current state-of-the-art algorithms that process visual information for end use by humans treat images and video as traditional signals and employ sophisticated signal processing strategies to achieve their excellent performance. These algorithms also incorporate characteristics of the human visual system (HVS), but typically in a relatively simplistic manner, and achievable performance is reaching an asymptote. However, large gains are still realizable with current techniques by aggressively incorporating HVS characteristics to a much greater extent than is presently done, combined with a good dose of clever signal processing. Achieving these gains requires HVS characterizations which better model natural image perception ranging from sub-threshold perception (where distortions are not visible) to suprathreshold perception (where distortions are clearly visible). In this talk, I will review results from our lab characterizing the responses of the HVS to natural images, and contrast these results with 'classical' psychophysical results. I will also present several examples of signal processing algorithms which have been designed to fully exploit these results.

Speaker Bio:
Professor Sheila Hemami, Northeastern University
University of Michigan, Ann Arbor, MI, USA, in 1990 and the M.S.E.E. and Ph.D. degrees from Stanford University, Stanford, CA, USA, in 1992 and 1994, respectively and all in electrical engineering. She was with Hewlett-Packard Laboratories, Palo Alto, CA, USA, in 1994 and was with the School of Electrical Engineering, Cornell University, Ithaca, NY, USA, from 1995-2013. In 2013, she joined Northeastern University's Department of Electrical Engineering in Boston, MA, USA, where she is Professor and Chair. She has held various visiting positions, most recently at the University of Nantes, France and at Ecole Polytechnique Federale de Lausanne, Switzerland. Her research interests broadly concern communication of visual information, both from a signal processing perspective and from a psychophysical perspective. Dr. Hemami was elected a Fellow of the IEEE in 2009 for contributions to robust and perceptual image and video communications. She has received numerous college and national teaching awards, including the HKN C. Holmes MacDonald Outstanding Teaching Award in 2000 and she was named a Cornell University Stephen H. Weiss Presidential Fellow, 2012, in recognition of inspiring teaching of undergraduate students. She has held various leadership positions in the IEEE Signal Processing Society (SPS), among them Editor-in-Chief

for the IEEE Transactions on Multimedia (2008-10). She was an SPS Distinguished Lecturer in 2010-11. She is currently serving as IEEE Vice President for Publications Services and Products.

September 25, 2015
Halligan 102
Search for Correlation Structures in Networked Data: Theory and Applications
Speaker: Dr. Ali Tajer, Rensselaer Polytechnic Institute

Abstract:
Driven by the advances in sensing and actuation, many physical systems are evolving towards networks of interconnected platforms in which large volume of data is constantly generated and processed. Correlation structures among the data streams generated by the agents in the network abstract their underlying interconnectivities and interactions. This has lead to recent studies on detecting correlation structures in networked-data. This talk will discuss data-adaptive correlation detection procedures, in which the network is observed only partially and sequentially, and evaluates their gains with respect to the commonly used approaches where observer affords observing the network with a full sample. As an application domain, we will discuss the application of this theory in agile detection and localization of power line outages in electricity.

Speaker Bio:
Ali Tajer is an Assistant Professor of Electrical, Computer, and Systems Engineering at Rensselaer Polytechnic Institute. During 2007-2010 he was with Columbia University where he received the M.A degree in Statistics and Ph.D. degree in Electrical Engineering, and during 2010-2012 he was with Princeton University as a Postdoctoral Research Associate. His research interests include mathematical statistics, statistical signal processing, and network information theory, with applications in wireless communications and power grids. Dr. Tajer Serves as an Editor for the IEEE Transactions on Communications, an Editor for the IEEE Transactions on Smart Grid, and as the Guest Editor-in-Chief for the IEEE Transactions on Smart Grid Special Issue on Theory of Complex Systems with Applications to Smart Grid Operations.

October 2, 2015
Halligan 102
Crucible: Enabling the future of successful health data exchange through testing
Speaker: Mr. Andre Quina, MITRE

Abstract:
Mr. Andre Quina, a Tufts 2016 computer science graduate alumnus and lead software systems engineer, will provide an overview of the new Fast Healthcare Interoperability Resources (FHIR) data exchange standard which aims to improve health data interoperability. Successful health data exchange is critical to improving patient outcomes and reducing costs through increased access to personal health information and more complete and accurate data. However, despite significant investment, successful exchange of computable health data is still relatively uncommon. This technical talk will introduce Crucible, a comprehensive, open source FHIR testing tool designed to help the Health IT community ensure accurate implementation of FHIR. As the healthcare industry capitalizes on FHIR, it is critical to make certain implementations are consistent and interoperable. Crucible provides an efficient and automated framework to succeed with FHIR.

October 9, 2015
Halligan 102
Sentinel: Predicting Power Outages
Speaker: Dr. Creighton Hager, MITRE

Abstract:
Dr. Creighton Hager, a principal Network and Distributed Systems engineer, will provide an overview of his

independent research and development project centered on the application of analytics to stability of power supply. MITRE has developed a methodology to find predictors of large scale disturbances in power utilizing data collected by Sentinel MITRE's high resolution, high fidelity, 24x7, power system collection network. Finding precursors of grid disturbances would enable more timely prevention, mitigation, and recovery of grid disruptions.

October 16, 2015
Halligan 102
Distinguished Speaker Series
Computational Imaging for Joint Processing and Labeling
Speaker: Dr. Clem Karl, Electrical and Computer Engineering Department Chair, Boston University

Abstract:
A revolution in imaging is currently underway involving the integration of sensing, models, and computation in what is being called "computational imaging". In this talk I will discuss two examples of such computational imaging that our group has been involved with. The first example concerns the integrated solution of inverse problems with data labeling. Many problems in science and engineering require the solution of inverse problems, wherein observed data must be inverted or reconstructed to produce usable imagery. Examples range from medical tomography, to scanning electron tomography, to baggage screening for security, to image deblurring. Often the ultimate goal is to produce a labeling or segmentation of the resulting latent image. Even when this is not the primary aim, if the observed data are limited or of poor quality it may make sense to constrain the resulting output to a limited set of values to obtain useful information. The traditional approach to obtaining such discrete outputs in inverse problems is to perform an ad hoc, decoupled set of processing steps consisting of conventional inversion (e.g. filtered back projection reconstruction) followed by some discretization of the resulting, often artifact-filled image. In contrast, I will present a new approach obtained by extending popular and efficient graph-cut based discrete-label methods to linear inverse problems which allows for the direct and integrated inversion and labeling of data. The second computational imaging example I will discuss focuses on X-ray CT security applications. In these problems the goal is to correctly identify materials of interest in baggage from multi-energy CT imagery. Unfortunately, these images suffer from severe metal artifacts which make object segmentation and labeling challenging. I will present a new learning-based framework for integrated metal artifact reduction and direct object labeling from CT derived data exploiting a graph optimization framework. The new integrated approach can produce accurate material labels in the presence of severe metal artifacts and clutter.

Speaker Bio:
W. Clem Karl received the Ph.D. degree in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology. He is currently Professor and Chair of Electrical and Computer Engineering and Professor of Biomedical Engineering at Boston University. Dr. Karl's research interests are in the areas of computational imaging, statistical image processing, estimation, detection, and medical signal and image processing. He has served as the Editor-in-Chief of the IEEE Transactions on Image Processing and is currently the inaugural Editor-in-Chief of the IEEE Transactions on Computational Imaging. Prof. Karl has served on the Signal Processing Society Board of Governors, Conference Board, Publications Board, Nominations and Appointments Committee, and Technical Committee Review Committee. He is also on the IEEE-wide Products and Services Publication Board Strategic Planning Committee responsible for examining the future of publication. He has been on the Steering Committees for the IEEE Transaction on Medical Imaging and the IEEE International Symposium on Biomedical Imaging, as well as serving as its General Chair. Prof. Karl is a Fellow of the IEEE.

October 23, 2015
Halligan 102
On the Convergence of Limited Communications Gradient Methods with Applications to Resource Allocation in Power Networks
Speaker: Dr. Carlo Fischione, KTH Royal Institute of Technology, Sweden

Abstract:
Distributed control and decision making increasingly play a central role in economical and sustainable operation of cyber-physical systems. Nevertheless, the full potential of the technology has not yet been fully exploited in practice due to communication limitations of real-world infrastructures. This work investigates the fundamental properties of gradient methods for distributed optimization, where gradient information is communicated at every iteration, when using limited number of communicated bits. In particular, a general class of quantized gradient methods are studied where the gradient direction is approximated by a finite quantization set. Conditions on the quantization set are provided that are necessary and sufficient to guarantee the ability of these methods to minimize any convex objective function with Lipschitz continuous gradient and a nonempty, bounded set of optimizers. Moreover, a lower bound on the cardinality of the quantization set is provided, along with specific examples of minimal quantizations. Furthermore, convergence rate results are established that connect the fineness of the quantization and number of iterations needed to reach a predefined solution accuracy. The results provide a bound on the number of bits needed to achieve the desired accuracy. Finally, an application of the theory to resource allocation in power networks is demonstrated, and the theoretical results are substantiated by way of numerical simulations. The seminar is based on a joint collaboration with Sindri Magnusson (KTH) and with Harvard University researchers Chinwendu Enyioha, Kathleen Masse, Na Li, and Vahid Tarok.

November 6, 2015
Halligan 102
Lightweight Beacon System for Unmanned Aircraft Systems and Other Aviation Applications
Speaker: Brian McHugh, MITRE

Abstract:
Mr. Brian McHugh, a principal communications engineer, will provide an overview of research MITRE is conducting for the Federal Aviation Administration (FAA). The introduction of small Unmanned Aircraft Systems (UAS) and a growing population of light sport aviation aircraft pose an increasing safety risk to other airspace users. These aircraft and many other small, low-altitude airspace users operate in visual meteorological conditions independently of Federal Aviation Administration (FAA) air traffic separation services. MITRE produced Universal Access Transceiver (UAT) Beacon Radio (UBR) suitable for a large population of airspace users from small UAS to gliders, balloons, and sky-divers.

November 13, 2015
Halligan 102
Distinguished Speaker Series
From biomedical imaging to online blogs: Graph signal processing
Speaker: Professor Jelena Kovačević, Carnegie Mellon University, Department Chair

Abstract:
I will present a path from classification in biomedical imaging to online blogs, where a common thread is graph signal processing, a theoretical framework that generalizes fundamental concepts of classical signal processing from regular domains, such as lines and rectangular lattices, to general graphs. It is particularly applicable to domains such as physical, engineering, and social, where signals are characterized by irregular structure. Signal processing on graphs has found multiple applications, including approximation, sampling, classification, inpainting and clustering, and I will describe some of these.

Speaker Bio:
Jelena Kovačević received a Ph.D. degree from Columbia University. She then joined Bell Labs, followed by Carnegie Mellon University in 2003, where she is currently the Edward David Schramm Professor and Head of the Department of ECE, and Professor of BME. She received the Dowd Fellowship at CMU, Belgrade October Prize, and the E.I. Jury Award at Columbia University. She is a coauthor on an SP Society award-winning paper and is a coauthor of the textbooks Wavelets and Subband Coding and Foundations of Signal Processing. Dr. Kovacevic is the Fellow of the IEEE and was the Editor-in-Chief of the IEEE Transactions on

Image Processing. She was a keynote speaker at a number of meetings and has been involved in organizing numerous conferences. Her research interests include multiresolution techniques, graphs, biomedical imaging, and smart infrastructure.