DEPARTMENT OF BIOLOGICAL SCIENCES
SEMINAR SERIES

Dr. Nicolias Cermakian
McGill University, Montreal

“Clocks, Immunity and Cancer in Mice and Night Shift Workers”

Monday, November 12, 2018
12:00 Noon
CBIS, Bruggeman Room

Refreshments Served 11:45
FALL 2018

RENSSELAER POLYTECHNIC INSTITUTE

DEPARTMENT OF MATHEMATICAL SCIENCES COLLOQUIUM

“A Block Coordinate Ascent Algorithm for Mean-Variance Optimization”

Abstract:

Risk management in dynamic decision problems is a primary concern in many fields, including financial investment, autonomous driving, and healthcare. The mean-variance function is one of the most widely used objective functions in risk management due to its simplicity and interpretability. Existing algorithms for mean-variance optimization are based on multi-time-scale stochastic approximation, whose learning rate schedules are often hard to tune and have only asymptotic convergence proof. In this talk, we develop a model-free policy search framework for mean-variance optimization with finite-sample error bound analysis (to local optima). Our starting point is a reformulation of the original mean-variance function with its Legendre-Fenchel dual, from which we propose a stochastic block coordinate ascent policy search algorithm. Both the asymptotic convergence guarantee of the last iteration’s solution and the convergence rate of the randomly picked solution are provided.

Bo Liu (Auburn University)

Monday, November 12, 2018

4-5pm

Amos Eaton 214

Host: Yangyang Xu
CBE Seminar Series – Fall, 2018

Krishna Mahadevan, Ph.D.
Professor of Chemical Engineering & Applied Chemistry
University of Toronto

Seminar: Wednesday, November 14
9:30 a.m. (Ricketts 211)

“Design Principles for Engineering Metabolism”

Abstract

Bioprocess development for biofuels and biochemicals typically requires several rounds of metabolic engineering to meet process targets including product yield, titer and productivity, all of which impact the process economics. Advances in computational modeling techniques have allowed the development of genome-scale models of metabolism in several organisms. Such models have been the basis of several algorithms that often produce hundreds if not thousands of strain designs. Such a plethora of strain designs leads to the open question of prioritizing these designs for experimental implementation. In this talk, we present two different principles that could govern the implementation of such strain designs. First, we will introduce a complementary approach based on orthogonality of the production pathways to growth and examine how such an approach can facilitate the dynamic metabolic engineering of strains for metabolite production. In second part, we will describe methods for the identification of metabolite valves for the dynamic control of metabolism.

Biography

Prof. Mahadevan is a pioneer in the fields of systems biology, synthetic biology, and constraint-based models of metabolic networks. His research interests include systems analysis, engineering and control of biological processes, and genome-scale models of cellular processes. Applications of this work include optimization of bioremediation strategies, engineering for microbial fuel cells, and the designing cells to economically produce high-value chemical products. Using computational and experimental methods, Prof. Mahadevan was the first to model the unique metabolism of Geobacter sulfurreducens, an anaerobic metal-reducing bacterium with applications in bioremediation of toxic metals and bioelectricity generation. His computational expertise is critical to the development of organism-independent metabolic models based on the metagenome sequence data generated by researchers in BioZone. He received his Bachelor of Technology from the Indian Institutie of Technology and his Ph.D. from the University of Delaware.

Refreshments: 9:00 a.m., Coonley Lounge
Quantitative models for decision-support in healthcare applications

Pinar Keskinocak
Chair & Professor
Georgia Tech

Wednesday, November 14, 2018
10:00am – 11:00am
CII 5003

(The public is invited to attend. Refreshment will be served)

Abstract:
With the goal of improving patient outcomes, efficiency, and effectiveness, quantitative models are increasingly used for decision-support in healthcare. In this presentation we will discuss a few applications from organ transplant, vaccination, screening, and workforce allocation decisions.

Bio:
Pinar Keskinocak is the William W. George Chair and Professor in the School of Industrial and Systems Engineering, and co-founder and Director of the Center for Health and Humanitarian Systems at Georgia Tech. She also serves as the College of Engineering ADVANCE Professor. Her research focuses on the applications of quantitative methods to have a positive impact in society, particularly in healthcare and humanitarian systems. She has worked on projects with a variety of governmental and non-governmental organizations, and healthcare providers, including American Red Cross, CARE, Carter Center, CDC, Children’s Healthcare of Atlanta, Emory Healthcare, Grady Hospital, and Task Force for Global Health.
“What’s trust got to do with it? - Closing the loop between human and machine”

Dr. Neera Jain
Purdue University

Wednesday, November 14, 2018
10:30 AM – 11:30 AM
DCC 330

Today, autonomous systems interact and collaborate with humans in ways that demand a greater level of trust between human and machine. From the control engineer’s perspective, this is a feedback control problem. However, closing the loop between human and machine is not trivial – we require sensors to “measure” human trust (and other relevant feedback variables) as well as mathematical models of the plant (human behavior) and actuator (user interface) through which the machine affects the human. In this talk, I will describe our interdisciplinary efforts at tackling this problem, focusing specifically on recent work in which we synthesized a near-optimal control policy using a trust-workload POMDP (partially-observable Markov decision process) model framework that captures changes in human trust and workload for a context involving interactions between a human and an intelligent decision-aid system. Using transparency as the feedback variable, we designed control policies for two cases: 1) increasing human trust and reducing workload, and 2) improving overall performance as defined in the mission context. We implemented these solutions in a reconnaissance mission study in which a virtual robotic assistant aided human subjects in surveying buildings for physical and chemical threats. I will discuss how trust alone may be insufficient to achieve synergistic human-machine interactions and highlight how our approach is able to mitigate the negative consequences of “over trust” that can occur in such interactions.

Biography
Dr. Neera Jain joined the School of Mechanical Engineering and Ray W. Herrick Laboratories at Purdue University as an assistant professor in January 2015. She has authored several articles on the topics of dynamic modeling and control of thermal energy systems as well as human-machine interaction. From May 2013 through May 2014, Dr. Jain was a visiting member of the research staff in the Mechatronics Group at Mitsubishi Electric Research Laboratories in Cambridge, MA where she designed advanced control algorithms for HVAC systems. Before earning her doctorate in Mechanical Engineering at the University of Illinois at Urbana-Champaign in 2013, she earned her S.B. from the Massachusetts Institute of Technology in 2006 and her M.S. from the University of Illinois at Urbana-Champaign in 2009, both in Mechanical Engineering. Dr. Jain is a recipient of the Department of Energy Office of Science Graduate Fellowship (2010-2013) and the ASME Graduate Teaching Fellowship (2011-2012).
User-Programmable Hydrogel Biomaterials to Probe and Direct 4D Stem Cell Fate

Cole A. DeForest\textsuperscript{1,4}

\textsuperscript{1}Department of Chemical Engineering
\textsuperscript{2}Department of Bioengineering
\textsuperscript{3}Institute for Stem Cell and Regenerative Medicine
\textsuperscript{4}Molecular Engineering & Sciences Institute
University of Washington, Seattle, WA

Abstract:
The extracellular matrix directs stem cell function through a complex choreography of biomacromolecular interactions in a tissue-dependent manner. Far from static, this hierarchical milieu of biochemical and biophysical cues presented within the native cellular niche is both spatially complex and ever changing. As these pericellular reconfigurations are vital for tissue morphogenesis, disease regulation, and healing, \textit{in vitro} culture platforms that recapitulate such dynamic environmental phenomena would be invaluable for fundamental studies in stem cell biology, as well as in the eventual engineering of functional human tissue. In this talk, I will discuss some of our group’s recent success in reversibly modifying both the chemical and physical aspects of synthetic cell culture platforms with user-defined spatiotemporal control. Results will highlight our ability to modulate intricate cellular behavior including stem cell differentiation, protein secretion, and cell-cell interactions in 4D.

Bio
Dr. Cole A. DeForest is currently an Assistant Professor in the Department of Chemical Engineering at the University of Washington, where he began in 2014. He received his B.S.E. degree from Princeton University in 2006, majoring in Chemical Engineering and minoring in Material Science Engineering and Bioengineering. He obtained his Ph.D. degree under the guidance of Dr. Kristi Anseth from the University of Colorado in Chemical and Biological Engineering with an additional certificate in Molecular Biophysics. His postdoctoral research was performed with Dr. David Tirrell in the Divisions of Chemistry and Chemical Engineering at the California Institute of Technology. He has authored and co-authored >30 articles in peer-reviewed journals including Nature Materials, Nature Chemistry, Advanced Materials, and Angewandte Chemie. Dr. DeForest has received numerous research awards and honors including the Safeway Early Career Award (2018), NSF CAREER Award (2017), AIChE 35-Under-35 Award (2017), ACS PMSE Young Investigator Award (2017), University of Washington Presidential Distinguished Teaching Award (2016), Jaconette L. Tietze Young Scientist Award (2015), Biomedical Engineering Society Student Fellow Award (2013), DSM Polymer Technology Award (2011), ACS Excellence in Graduate Polymer Research Award (2010), MRS Graduate Student Research Gold Award (2009), Society for Biomaterials Outstanding Achievement Award (2009), Princeton University Material Science Student of the Year (2006), Princeton University Most Approachable Resident Adviser (2005), and Boulder High School Valedictorian (2002). His research has been supported through fellowships and grants from the National Science Foundation, the National Institutes of Health, and the US Department of Education.
Neutrinos, the most ghostly of Standard Model particles, were first detected by Clyde Cowan and Frederick Reines in 1956. Although these particles are included in the Standard Model, their properties such as mass and mixing parameters are not predicted and must be measured. Ever since their discovery, physicists have been trying to piece together a comprehensive understanding of the neutrino and over the past 6 decades a nearly complete picture has emerged. However, there are still some undetermined parameters as well as phenomena that have resisted explanation. One of these unexplained phenomena that has arisen rather recently termed the "reactor antineutrino anomaly" is the deficit in the measured flux of antineutrinos from nuclear reactors relative to the expected flux from calculation. Furthermore, the energy spectrum of reactor antineutrinos from recent experiments deviates from the calculated shape in the region of 5-7 MeV antineutrino energy.

PROSPECT, the Precision Reactor Oscillation and Spectrum experiment, currently taking data at Oak Ridge National Lab, aims to shed some light on these anomalies by measuring the flux a few meters from the core of a highly enriched uranium (HEU) research reactor. In so doing, many obstacles had to be overcome, not the least of which was designing a detector that could isolate antineutrino events from huge backgrounds inherent in the environment at the surface of the Earth and next to a reactor. In this talk, I will give a brief history of neutrinos and how their properties were determined highlighting some key experiments. Special emphasis will be given to the PROSPECT experiment with recent data and analysis shown.