Concordia University
ENCS
Engineering & Computer Science

Professor Daniel Therriault
September 26,2013
EV2.260, 11:00a.m.

ABSTRACT

Overview of Lm^2 research program: from advanced materials to 3D printing

Many of today's high-tech products are approaching their technological limits. For example, the microelectronics community is faced with overheating devices with a demand for compact three-dimensional (3D) architectures and lower power consumption, whereas the aerospace industry is seeking lighter, stiffer and more electrically conductive materials for the creation of more energy efficient aircraft. A promising solution is to capitalize on the amazing electrical, thermal and mechanical properties of some nanoscopic materials (one billionth of a meter). However, several challenges in material processing and manufacturing must be resolved, namely exploiting these properties at the industrial scale and overcoming the current planar configuration with a truly 3D method.

This seminar is an overview of the Laboratory of Multiscale Mechanics (Lm2) research program at Polytechnique. The nature of work presented is mainly on the development of high-performance materials for the manufacturing of microscopic or larger systems featuring multiple functionalities. On the material side, Prof. Therriault will explain the work of his team on polymer-based nanocomposite materials using two different kinds of plastics. On the manufacturing side, he will describe his 3D printing method used to build complex 3D shapes at the microscopic scale. This research program provides an original and promising approach to resolve the aforementioned issues, thus making nanotechnologies more accessible to industry, especially in aerospace, microelectronics and biomedicine.

BIOGRAPHY

Professor Daniel Therriault is a full-time faculty member in the Mechanical Engineering Department at École Polytechnique de Montréal (ÉPM) and is a Canadian Research Chair on the fabrication of advanced microsystems and materials. His research interests involve the fabrication of mechanical micro/nano systems such as three-dimensional (3D) microstructures or microfluidic networks, fuel cells, laboratory-on-chips and nanocomposite materials. His UV-assisted direct-write assembly method was selected in the top 10 scientific discoveries in Quebec by the magazine Québec Science in 2009. He received the "Outstanding recent alumna" prize in 2012 from the University of Illinois at Urbana-Champaign for his excellence in aerospace research, the "Excellence in teaching" award from École Polytechnique in 2012, and the NSERC Discovery Accelerator Supplement in 2013. Dr. Therriault is currently supervising or co-supervising 8 PhD students, 4 MSc students, and 4 postdoctoral fellows.

Professor Alfred Ng, Canadian Space Agency
October 22, 2013
EV2.260, 11:00A.M.

ABSTRACT

Interplanetary Exploration- The Future

The first step in the interplanetary exploration is finding ways to arrive at the destination. The traditional mission design is based on Keplerian orbital mechanics which is essentially a 2-body problem. In the 90's, researchers at the Jet Propulsion Lab revisited the 3-body problem again and have discovered "tunnels" in the universe that could be utilized to transport spacecraft efficiently. This discovery will create possibilities of future interplanetary exploration which were previously thought to be energy prohibitive. In this presentation, the fundamentals of Keplerian orbital mechanics will be reviewed. The essence and the impact of the new methodology will be explained.

BIOGRAPHY

Professor Alfred Ng obtained his Ph.D. from the University of B.C. in 1992. Immediately after graduation, he joined the Canadian Space Agency as the Research Scientist in Orbital and Attitude Dynamics. In 1997, he was promoted to be the Manager for the technical group in Control & Analysis. He has extensive experience in satellite attitude control systems, formation flying, nanosatellite and mission analysis. Over the years, he is active in supporting academia. He volunteered for CAMAQ Aerospace Case Studies 3 times: Concordia in 2002, McGill in 2009 and ETS in 2012. He was invited as the Ph.D. external examiner 4 times. He is currently the Adjunct Professor at York University Dept of Earth Science & Space Engineering. Currently, he is serving as the Chairman of the Astrodynamics Committee within the International Astronautical Federation. In 2012, he was also elected as the Corresponding Member of the International Academy of Astronautics.

Professor Peter E. Caines
November 19, 2013
EV002.260,11:00 A.M.

ABSTRACT

Mean Field Games, Systems and Control

Large population dynamical multi-agent competitive and cooperative phenomena occur in a wide range of designed and natural settings such as communication, environmental, epidemiological, transportation and energy systems, and they underly much economic and financial behaviour. When the agents in such systems are modelled by controlled stochastic dynamical systems, Mean Field Game (MFG) theory, or, more generally, Mean Field Systems and Control theory (MF theory), studies the existence of Nash equilibria together with the individual strategies which generate them. One of the main results of MF theory is that in large population stochastic dynamic games individual feedback strategies exist for which any given agent will be in a Nash equilibrium with respect to the pre-computable behaviour of the mass of the other agents, namely the system's mean field; this holds exactly in the asymptotic limit of an infinite population and with increasing accuracy for a finite population of agents using the infinite population feedback laws as the finite population size tends to infinity, a situation which is termed an e-Nash equilibrium.

In this talk we shall introduce the basic ideas and some of the currently developing research topics: (i) Motivation for MF Theory, (ii) Basic Results for Linear- Quadratic (LQG) Systems, (iii) Adaptive LQG MF Systems, (iii) Adaptive MF Leader-Follower Flocking Behaviour, (iv) Applications to Electric Power Markets, (iv) Non-linear Major-Minor (MM) Agent MF Systems, (iv) LQG MM-MF Systems, (iv) Estimation and Filtering Problems for MM-MF Systems. Citations and references for the results above will be given during the talk.

BIOGRAPHY

Peter Caines received the BA in mathematics from Oxford University in 1967 and the PhD in systems and control theory in 1970 from Imperial College, University of London, under the supervision of David Q. Mayne, FRS. After periods as a postdoctoral researcher and faculty member at UMIST, Stanford, UC Berkeley, Toronto and Harvard, he joined McGill University, Montreal, in 1980 where he is James McGill Professor and Macdonald Chair in the Department of Electrical and Computer Engineering. In 2000 the adaptive control paper he coauthored with G. C. Goodwin and P. J. Ramadge ({\it IEEE Transactions on Automatic Control}, 1980) was recognized by the IEEE Control Systems Society as one of the 25 seminal control theory papers of the 20th century. He is a Life Fellow of the IEEE, a Fellow of SIAM, the Institute of Mathematics and its Applications (UK) and the Canadian Institute for Advanced Research and was elected to the Royal Society of Canada in 2003. In 2009 he received the IEEE Control Systems Society Bode Lecture Prize. Peter Caines is the author of {\it Linear Stochastic Systems}, John Wiley, 1988, and his research interests include stochastic, multi-agent and hybrid systems theory together with their links to renewable energy generation and transmission, communications, physics, economics and biology.

Concordia University
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Professor Andy Banerjee
December 6, 2013
EV001.605,13:00 P.M.

ABSTRACT

Industrial Engineers at the Crossroads of Micro- and Macro-level Challenges in Health Care Delivery

Health care delivery systems have been studied from different perspectives by industrial and systems engineers. Most of the research studies focus on modeling, solving and analyzing problems at the component level of the health care delivery systems. This talk is divided into two parts. As an example of a component level problem of health care delivery system, three different quantitative approaches to the outpatient appointment scheduling problem are discussed.

There are much bigger challenges at the health care delivery system level. The joint 2005 U.S. National Academy of Engineering and Institute of Medicine (NAE/IOM) Report titled "Building a Better Delivery System – A New Engineering/Health Care Partnership" highlights some of the major challenges in the U.S. health care system. It provides a framework and action plan for a systems approach to health care delivery based on a partnership between engineers and health care professionals. Since then, there has been a renewed interest at the federal and state levels in the U.S. in the form of several large initiatives to improve health care delivery. The second half of this talk will focus on a few of these initiatives and the underlying problems where industrial engineering, systems approach and information technology are being used. The audience will see a rapidly emerging application area of industrial engineering, and some of the impact industrial engineers can make in health care delivery today and in the future. There will be some discussion on the rural health care landscape in Texas and their unique challenges.

BIOGRAPHY

Dr. Andy Banerjee is an Associate Professor in the Department of Industrial and Systems Engineering at Texas A&M University. His research expertise is in modeling, simulation and visualization, and their applications in health care, manufacturing, and information systems. He is currently working on several health care delivery system problems serving as a Co-PI in the U.S. Department of Health and Human Services funded CentrEast Regional Extension Center, a joint endeavor between the Rural and Community Health Institute at the Texas A&M Health Science Center, and the Department of Industrial and Systems Engineering and Mays Business School at Texas A&M University. The CentrEast Regional Extension Center is one of 62 funded centers in the U.S. that is providing expertise to primary care providers and critical access hospitals to adopt electronic health records and achieve meaningful use. He was appointed to the Texas Health Services Authority, where he provided assistance in the statewide collaborative planning process to create the infrastructure for health information exchanges in the state.

Concordia University
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Professor Rolf Wuthrich, Concordia University
Mr. Luc Pouliot, Tecnar Company
January 21, 2014
EV2.260, 14:30P.M.-12:00P.M.

ABSTRACT I

To be hired at an academic position is extremely competitive. To plan a career as a faculty member or researcher one has to undertake the right steps from the first day one enters in graduate school.
In this short seminar we will cover some important aspects on how you should take advantage of your time during your graduate studies in order to prepare an academic resume that becomes competitive. No simple recipes exist, but some important facts have to be known. What are the key persons to help you, how important is your research work? Are publications enough? What else should be done? How can you start to prepare your teaching skills? How do you build up your network? These questions and several others will be addressed.

BIOGRAPHY I

Prof. Wuthrich's current research interests focus on developing micro- and nano- systems using electrochemical discharges with particular interest on nano-particle fabrication with applications to electro-catalysis and similar fields. He also works on novel micro-machining technologies for a variety of materials, with focus on glass. He published over 200 journal and conference papers, several books and book chapters. His teaching interests are in engineering fundamentals, in particular mechanics, numerical methods and modeling of systems where he developed a unified formalism for engineers which includes thermodynamics. He has supervised and graduated over 30 students from the master to post-doctoral level. Several of them work now in academia, in research centers and as faculty members at various universities.

ABSTRACT II

TECNAR activities are focused around four core technologies, namely automated pipe welding robots, thermal spray sensors, laser-ultrasonics NDE systems & LIBS probes. All four technologies were invented and re-engineered in Canada. In the first part of my talk, I will summarize the fundamentals of each technology, and will provide some market information as well as examples of industrial applications. In the second part of my talk, I will discuss what Canadian employers are expecting of young engineers, and I will also try to shed some light on the question "How can you distinguish yourself from the crowd?"

BIOGRAPHY II

In 1994, after completing his graduate studies in Engineering Physics at Montreal's Ecole Polytechnique, Luc Pouliot pursued his career as a researcher in the field of micro-sensors and actuators, more specifically gas sensors (CO2, SOx, NOx) for domotic applications as well as high-speed transistors based on III-V semiconductors. He then moved on from the academic to the private sector and joined TECNAR in 2005, where he pioneered the commercialization of the DPV-2000, the first particle sensor for thermal spraying and still the reference in the thermal spray research community. Over the years, he grew the business and diversified its product portfolio to consolidate TECNAR's worldwide leadership in the field. As Chief Operating Officer, Luc Pouliot's main focus is to maintain an efficient JIT supply chain, to ensure that the company's four divisions deliver high-quality products that meet international & local standards, and to further grow & maintain an already very efficient service organization. Mr. Pouliot also remains in charge of TECNAR'S Thermal Spray division, and as acting President of the ASM's Thermal Spray Society (http://tss.asminternational.org/portal/site/tss), he is deeply involved in that community.

Concordia University
ENCS
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Dr. Teodor Veres
February 13, 2014
EV2.260, 15:30P.M.

ABSTRACT

Fabrication and integration of nanomaterials with Lab-On-Chip systems for bio-analytical applications

The development of disposable microfluidic devices for rapid point-of-care applications has become central to progress in medical diagnostics and a variety of other fields. The recent developments in micro-systems-based technologies and in particular the use of microfluidic Lab-On-Chip (LOC) make possible automation for most of protocols involved in traditional detection methods but with minute amounts of samples and reagents while providing multiplexing, speed and miniaturization necessary for portability. To this end LOC systems have mostly been shown to function in conceptual ways, yet their commercialization and widespread in clinical use has been hindered by a number of challenges, which include materials and low-cost fabrication technologies as primary concerns. After presenting an overview of the activities and NRC Functional Nanomaterials Group expertise and infrastructure in the field of nanomaterial's fabrication, this talk will present specific examples on the design, fabrication and use of polymer-based microfluidic systems developed at NRC for rapid diagnostics applications in clinical, environmental and food safety applications that integrate functional nanomaterial's but can be manufactured at low-cost with industrial scale processes.

BIOGRAPHY

Dr. Veres is a Senior Research Officer and Group Leader in the Life Sciences Division of the National Research council of Canada. He graduated from the Université de Montréal with a Ph.D. in Physics. His work was dedicated to the study of spin-dependent electronic transport in Co/Cu and Co/Ag nanostructured systems (layers and granular materials) with emphasis on interface effects on transport properties and the correlation between the structure, magnetic and magnetotransport properties. Dr. Veres holds adjunct professor positions in McGill Biomedical Engineering and Bioengineering departments, Laval University Medical School and INRS-EMT. Dr. Veres has extensive expertise in the design and fabrication of nanomaterial's and their integration in microfluidic systems for applications in clinical and environmental rapid diagnostics as well as for cell and tissue engineering. He coauthored more than 125 papers and 15 patent applications in the field of design, fabrication and testing of polymer-based micro-systems and magnetic nano-carriers and their applications for rapid diagnostics.

Concordia University
ENCS
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Professor Thomas Gervais
March 11, 2014
EV2.260, 11:00A.M.-12:00P.M.

ABSTRACT

Microtumors on chip & Microfluidic Multipoles

Ovarian cancer is the fifth leading cause of cancer death among women in the Western world. Only a small fraction of patients undergoing conventional therapies will maintain complete response to drugs due to high tumor variability among them, highlighting the need for a more personalized approach to prescribe optimal treatments while minimizing costs and toxicities associated with no clinical benefit.
Seeking to address this issue, we have developed a platform capable of holding miniature ovarian cancer samples – including spheroids, xenografts and patient biopsies – and exposing them to chemotherapeutic agents over the course of days. The proposed platform combines microfluidics to manipulate and trap tumor samples and confocal microscopy to assay drug sensitivity via live-dead fluorescence cell imaging. Early results suggest that the IC50 of 3D ovarian cancer spheroids under the effect of conventional drugs is an order of magnitude higher than those of 2D primary cultures under similar conditions and is likely to be more representative of the in vivo chemoresponse.

BIOGRAPHY

Thomas Gervais is assistant professor of engineering physics and biomedical engineering at Polytechnique Montréal, where he develops miniature systems for the interrogation of live cancer tissue. He holds a bachelor degree in engineering physics from Polytechnique Montreal and a Ph.D. in bioengineering from the Massachusetts Institute of Technology (MIT). Prior to his professorship appointment in early 2013, he worked as an instructor in physics and biomedical engineering at Polytechnique Montreal since 2009. Beyond research and teaching, he is also a seasoned populariser of science, having presented scientific research on screen for the weekly science show “Le Code Chastenay” (Télé-Québec, 2008-2013).

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Career Development Workshop
December 5, 2013
EV001.605, 15:00P.M.-18:00P.M.

Speakers:

- Dr. Mosen Jalali: Bombardier (Core Systems Engineering)

- Dr. Mohammad Arabnia: Bombardier (Power Plant Integration and Engine Performance)

- Dr. Amir Khataie: Canada Post Corporation (Logistics and Network Design)