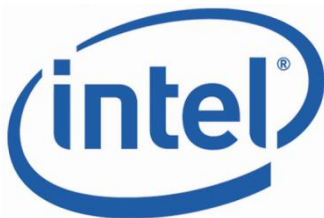University of Toronto ECE Graduate Symposium

Connections 2014

May 5th, Bahen Centre for Information Technology

Event Programme

Welcome to the tenth annual University of Toronto Electrical and Computer Engineering (ECE) Graduate Symposium, *Connections 2014*.

This latest instalment of ECE *Connections* continues its tradition of bringing together both industry and academia in an exhibition of ongoing research activities of mutual interest. While maintaining the symposium's original objectives of promoting multidisciplinary enrichment and cross-collaboration, we have also expanded upon the theme of *Academia and Industry Crossroads* to address growing trends in research commercialization and innovation management. Along with our industrial participants, which include *Intel, Infinera, Compuware, Siemens, Bionym* and *Geotab*, we are pleased to welcome several local organizations such as *IEEE Toronto Section, Mitacs, The Entrepreneurship Hatchery,* and the *Creative Destruction Lab* that have been instrumental in strengthening corporate partnerships and helping to establish a healthy environment for innovation at the University of Toronto.

This year's event will consist of:
- 27 poster and oral presentations by ECE graduate students
- 9 technical/informational presentations by external participants
- A keynote speech by renowned U of T professor Brendan Frey
- An industry booth session
- A panel discussion on *Academia and Industry Crossroads* featuring U of T professors and industry representatives.

We would like to express our gratitude to all sponsors, industry speakers, student presenters, panellists, volunteers, and participants of this symposium for taking part in and contributing to *Connections 2014*. We hope that you enjoy your experience!

Sincerely,
The *Connections 2014* Organizing Committee
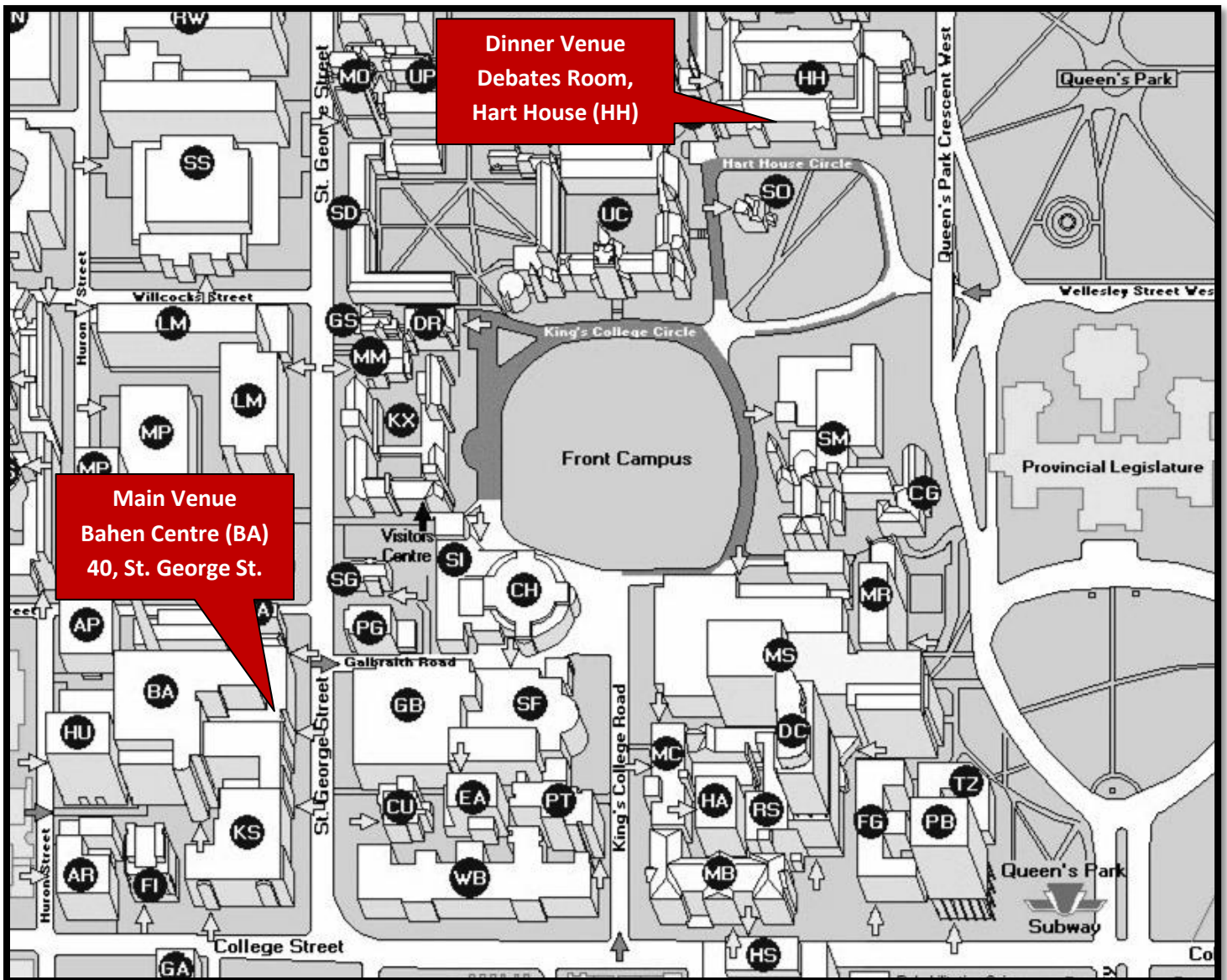
Main Venue

Bahen Centre for Information Technology (BA)
University of Toronto
40 St. George Street
Toronto, ON

Dinner Venue

Debates Room, 2nd Floor
Hart House (HH)
University of Toronto
7 Hart House Circle
Toronto, ON

** Parking **

There is convenient underground parking below the Bahen Building, which has elevator access to the Bahen ground floor. The entrance is at 213 Huron Street, west of Bahen in the map above.

Event Itinerary

All events will be held in Room 1130 of the Bahen Centre, unless otherwise indicated.

| Time	Session	Speaker/Info
9:30 AM	Registration & Breakfast (Bahen Atrium)	**Food and refreshments will be provided.**
9:50 AM	Welcome Address	
10:00 AM	Keynote Speech Topic: *Connections: Machine Learning, Genome Biology and Medicine*	Professor Brendan Frey (University of Toronto)
10:30 AM	Tech Talk – **Intel** Topic: *Intel and Intel Custom Foundry SerDes Overview*	Dr. Aleksey Tyshchenko (Senior Systems Engineer, Intel)
11:00 AM	Info Talk – **Hatchery** Topic: *Entrepreneurship and the Hatchery*	Joseph Orozco (Executive Director, Hatchery)
11:15 AM	Tech Talk – **Compuware** Topic: *The Next Generation of Application Performance Management*	Daniel Pohanka (Compuware)
11:30 AM	**Student Poster Presentations & Industry Booth Session** (Bahen Atrium)	
12:15 AM	**Networking Lunch & Industry Booth Session** (Bahen Atrium)	**Food and refreshments will be provided.**

1:00 PM	<u>Tech Talk</u> – **Infinera** Topic: *Infinera and its Advanced Technologies for 100G and Beyond*	Dr. Yuejian Wu (Director of ASIC development, Infinera) Dr. David Krause (Photonics Engineer, Infinera)
1:30 PM	<u>Info Talk</u> – **Mitacs** Topic: *Facilitating Academic-Industrial Research Collaborations; Developing the Next Generation of Innovators*	Dr. Fiona Cunningham (Director, Business Development, Mitacs)
1:45 PM	<u>Tech Talk</u> – **Siemens** Topic: *Digitizing the Modern Energy Grid: The Pressing Need for a Paradigm Shift*	Kamyar Moghadam (Senior Engineer & SmartGrid Business Development Manager, Siemens)
2:00 PM	<u>Tech Talk</u> – **Geotab** Topic: *Telematics Technology and Geotab Company Overview*	Maria Sotra (Marketing Manager, Geotab)
2:15 PM	**Student Oral Presentations I**	[See next page]
3:15 PM	**Coffee Break**	
3:30 PM	**Student Oral Presentations II**	[See next page]
4:15 AM	<u>Tech Talk</u> – **Bionym** Topic: *The Nymi and Your Identity*	Dr. Karl Martin (CEO of Bionym)
4:30 PM	<u>Info Talk</u> – **IEEE Toronto Section** Topic: *IEEE - Connecting the World, Connecting You*	Dr. Emanuel Istrate (Chair, IEEE Toronto Section)
5:00 PM	**Panel Discussion** Topic: *Academia & Industry Crossroads*	Michael Galle (CEO of Inometrix Inc.), Dr. Karl Martin (CEO of Bionym), Dr. Inmar Givoni (Senior Scientist, Kobo), Professor Jason Anderson (U of T), Professor Tony Chan Carusone (U of T), Professor Natalie Enright Jerger (U of T) <u>Moderator:</u> Professor Stark Draper (U of T)
6:15 PM	Closing Address	
6:30 PM	Awards Presentation & **Intel Networking Dinner Banquet** (Debates Room, Hart House)	**Please bring your dinner ticket.** Reception opens at 6:30 pm. Awards presentation is at 6:45 pm. Dinner begins at 7:00 pm.

Student Oral Presentation Schedule

Timeslot	Room	Presenter	Topic
2:15 PM	BA 1130	**Victor Wen** (Energy Systems)	*A Cell-Level Power Management IC for Partial Power Processing in PV Energy Harvesting Applications*
	BA 1170	**Wei Wang** (Computer Engineering)	*Multi-Resource Fair Allocation in Heterogeneous Cloud Computing Systems*
2:30 PM	BA 1130	**Jason Grenier** (Photonics)	*Ultrafast Laser Inscription of Optical Fiber Sensors and Circuits*
	BA 1170	**Nazanin Calagar** (Computer Engineering)	*Source-Level Debugging for FPGA High-Level Synthesis*
2:45 PM	BA 1130	**Juan Gonzalez** (Biomedical)	*A Feedback System to Improve Gait in Lower-Body Amputees*
	BA 1170	**Narges Norouzi** (Computer Engineering)	*Assessment of Alcohol Withdrawal Tremor in the Emergency Department*
3:00 PM	BA 1130	**Heng Xu** (Computer Engineering)	*Efficient Strong Consistent Communication in Distributed Control Plane of Software Defined Networks*
	BA 1170	**He Xu** (Photonics)	*Characterization of Superconducting Single Photon Detector (SSPD)*
3:15 PM		**Coffee Break (Bahen Atrium)**	
3:30 PM	BA 1130	**Feihu Xu** (Photonics)	*How to Foil a Quantum Hacker*
	BA 1170	**Hamed Sadeghi** (Communications)	*An Epipolar Geometry-Based Approach for Vision-Based Indoor Localization Using Smartphone Cameras*
3:45 PM	BA 1130	**Mario Badr** (Computer Engineering)	*SynFull: Synthetic Traffic Models Capturing Cache Coherent Behaviour*
	BA 1170	**Amer Samarah** (Electronics)	*Spurious Free Digital PLL*
4:00 PM	BA 1130	**Michael Selvanayagam** (Electromagnetics)	*Passive and Active Methods for Controlling [and 'Cloaking'] Electromagnetic Fields*
	BA 1170	**Saber Amini** (Electronics)	*Beyond Technical: Life Lessons Learned in Grad School*

Keynote Speaker: Professor Brendan Frey
"Connections: Machine Learning, Genome Biology and Medicine"
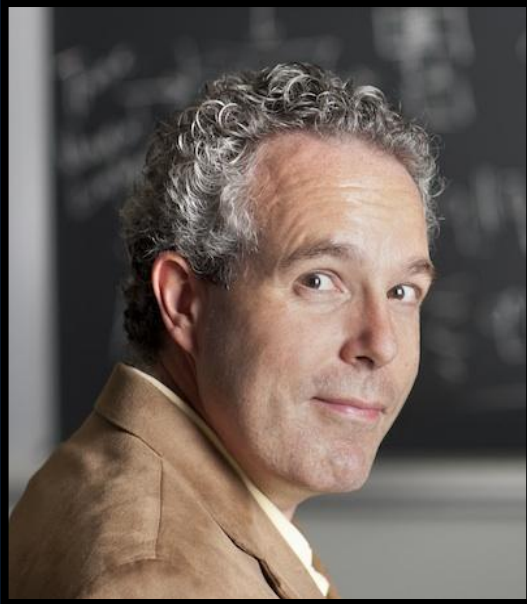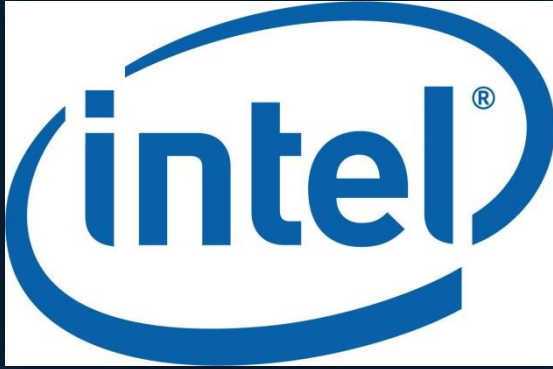
⟡ Biography ⟡

Dr. Brendan Frey is a Professor at the University of Toronto, with appointments in Engineering, Medicine and Arts and Science. He conducts research in genome biology, machine learning and vision. He is a Fellow of the Canadian Institute for Advanced Research, the Institute of Electrical and Electronic Engineers and the American Institute for the Advancement of Science. Dr. Frey has received several awards, including the John C Polanyi Award in 2012, the EWR Steacie Fellowship in 2009, and Canada's Top 40 Leaders Under 40 award in 2008. In addition to studying in Canada, Dr. Frey has spent several years studying abroad, including at the University of Cambridge, England, and the University of Illinois at Urbana-Champaign, USA. He consults for industrial research and development laboratories in the United States, Europe and Canada and is currently on the Technical Advisory Board of Microsoft Research India. His former students and postdoctoral fellows are professors (Harvard, Montreal, Toronto, UNC, UPenn, UWM), industrial researchers (Google, IBM, Microsoft, Siemens, Yahoo!) and have joined startup companies in the Toronto area and abroad (Chango, Shape Collage).

Tech Talk: Dr. Aleksey Tyshchenko (Intel)
"Intel and Intel Custom Foundry SerDes Overview"

⚛ Biography ⚛

Dr. Aleksey Tyshchenko received his B.A.Sc. degree in 2004 from the Division of Engineering Science, University of Toronto, and M.A.Sc. and Ph.D. degrees in 2006 and 2011 respectively from the Department of Electrical and Computer Engineering, University of Toronto. His Ph.D. research focused on the design of clock and data recovery (CDR) systems for high-speed ADC-based receivers. In 2006, he spent 6 months with Fujitsu Labs of America working on circuit design for high-speed signaling applications. In 2011 he joined V Semiconductor as an analog designer, and since 2012 he has been with Intel working as a senior systems engineer on various aspects of high-speed SerDes IP development.

Info Talk: Joseph Orozco (The Entrepreneurship Hatchery)
"Entrepreneurship and the Hatchery"

Joseph will talk about entrepreneurship and its journey in the Hatchery.

❧ Biography ❧

Joseph Orozco (Adjunct Professor, Centre for Management of Technology and Entrepreneurship) at the University of Toronto brings an international perspective through his professional experience in Canada, the United States and South America.

A spirited entrepreneur, Joseph has founded and led several companies, including C.R., a logistics company on contract with Dow; Telequote, which was ultimately sold to Reuters; Latamtrade, an agnostic trading platform for the Latin American community and 'POP' system for brokerage firms; and Simeon International, a Canadian company providing soundfield amplification systems for the classroom. He was an angel investor in Medipattern Corporation until 2010.

Orozco earned his Bachelor of Industrial Engineering (Laureate Thesis Award) from Javeriana University , and his Masters in Marketing from Andes University. Orozco has also studied at The Wharton School, University of Pennsylvania in its Mergers and Acquisitions Executive Program; at the Rotman School of Management, University of Toronto, where he completed its Small and Medium-Sized Enterprise (SME) Board Effectiveness Program in 2011 and Lean Launch Pad Educators Teaching training (Steve Blank & Jerry Engels).

Tech Talk: Daniel Pohanka (Compuware)
"The Next Generation of Application Performance Management"

Abstract

Applications have increasingly become the life-blood of business. What used to be focused on back-office only, have now become our primary means of engagement. Compuware has spent over two decades developing a best of breed Application Performance Management system incorporating three foundational elements that give the Compuware APM solution unique value. First, smart analytics have been applied across the platform to make implementation, operation and management extremely easy yet powerful. Second, purpose build performance lifecycle collaboration capabilities, sometimes call DevOps capabilities, have been embedded to dramatically reduce problem resolution time and speed new application functionality to market. And third, Compuware's patented PurePath Technology has been extended across all dimension of the system to provide the industry's deepest and most accurate visibility into application performance and behavior. APM is quickly shifting from just another IT tool set used for reactive application troubleshooting, to a strategic IT fabric used to monitor, manage, tune and assure superior application availability and performance on a proactive basis.

Tech Talk: Dr. Yuejian Wu, Dr. David Krause (Infinera)
"Infinera and its Advanced Technologies for 100G and Beyond"

Yuejian Wu received his Ph.D in electrical engineering from UBC in 1993. He worked at various positions at BNR/Nortel from 1993 and 2009. He joined Infinera in 2009 and is now the director of ASIC development. Dr. Wu is a senior member of IEEE. He taught courses at the University of Ottawa and is an adjunct professor at UBC.

David Krause joined Infinera in 2010. Since then he has been involved in system design, high speed RF testing and characterization, all in support of Infinera's ASIC development for coherent optical communication systems. Before Infinera, he worked at Nortel Networks, and holds a PhD in Electrical and Computer Engineering from Queen's University.

Abstract

Infinera is a market and technology leader who builds optical transmission equipment that provides scalable digital capacity for the internet. This talk will introduce you to Infinera, its business and its advanced technologies, such as the unique photonic integrated circuit and coherent technologies for 100G and beyond.

Info Talk: Dr. Fiona Cunningham (Mitacs)

"Facilitating Academic-Industrial Research Collaborations; Developing the Next Generation of Innovators"

Mitacs

Abstract

Mitacs is a national not-for-profit research organization offering innovative training & research programs that will develop the next generation of researchers and innovators for Canada's new, knowledge-based economy. Through a unique suite of programs, Mitacs partners Universities and industry to solve shared research questions.

Dr. Fiona Cunningham completed her PhD at the University of Toronto, in the department of Biochemistry. Prior to joining the Mitacs Ontario Business Development team, Fiona held a Field Application Specialist position with a life science research company called New England Biolabs, where she advised scientists on DNA and Enzyme based research tools to facilitate their research. Now in her current role as a Director of Business Development with Mitacs, Fiona connects University Professors, graduate students and postdoctoral fellows with industry to tackle mutually interesting research challenges.

Tech Talk: Kamyar Moghadam (Siemens)

"Digitizing the Modern Energy Grid; The Pressing Need for a Paradigm Shift"

SIEMENS

Kamyar Javan Moghadam is the head of proposals and application engineering team in Siemens Energy Automation Business Unit. He is also SmartGrid Business Development Manager. He earned his electronic engineering degree from the University of Science and Technology in Tehran-Iran in 1999. After graduation Kamyar worked with different EPCs in power transmission and distribution automation field as design/commissioning engineer, site manager and project manager. He joined Siemens in 2005. Upon joining Siemens he successfully finished several projects in different countries such as Canada, UAE, Qatar, Bahrain, Iran and Oman. With over 13 years of experience in the Energy Automation field, Kamyar's main focus is Siemens' SmartGrid and Energy Automation projects in Canada.

Abstract

Digitizing modern grids means optimally combining the communication technologies in the power delivery to the best possible extent to make an electrical grid perform to its maximum. Digitization of electric grids can help resolve some major challenges to improve Energy efficiency, cost effectiveness and to create a resilient self healing grid

This presentation will focus on the advantages of digitizing the secondary side of the electric grid and identify some aspects of modern grids and trends that the power distribution industry is moving towards.

Tech Talk: Maria Sotra (Geotab)
"Telematics Technology and Geotab Company Overview"

GEOTAB
management by measurement

Maria Sotra has worked with over 50 businesses across North America to offer creative marketing solutions. Today, Maria leads the marketing and communications direction for Geotab, one of North America's fastest growing technology companies. With an Executive Masters in Communications Management (MCM) from McMaster University, Maria has built a strong foundation in both theory and business practice.

Abstract

This presentation will provide an industry overview on telematics machine-to-machine (M2M) technology, in addition to understanding what Geotab does and where the company is today

Tech Talk: Dr. Karl Martin (Bionym)
"The Nymi and Your Identity"

Dr. Karl Martin is the CEO and co-founder of Bionym. He holds BASc (Engineering Science, 0T1), MASc (ECE, 0T3), and PhD (ECE 1T0) degrees, all from the University of Toronto. He expertise is in biometrics, security, and privacy. He has served as an expert witness in these areas and was also an instructor for a senior level ECE course at UofT. He has been quoted by several major media outlets, including the CBC, CNN, BBC, The Economist, The New York Times, Time Magazine, and Wired. He is also an active volunteer within the IEEE Toronto Section.

Abstract

This talk introduces the world's first wearable technology device that seeks to create persistent identity. The Nymi uses a wearer's unique electrocardiogram (ECG) to authenticate. Once authenticated, it is then able to send off a secure, digitally signed credential to nearby devices through Bluetooth Low Energy, using proximity detection and gesture recognition to create a seamless, dynamic experience. The Nymi will not only be able to replace older identity prompts such as passwords, PINs and keys, but will also allow for personalized experiences in retail, hospitality and more. Think about how your technology would behave differently if it really knew who you were.

Info Talk: Dr. Emanuel Istrate (IEEE Toronto Section)
"IEEE – Connecting the World, Connecting You"

Dr. Emanuel Istrate received his Ph.D. in Electrical Engineering from the University of Toronto in 2005, studying photonic crystals. After a brief post-doctoral fellowship working on the nonlinear optical properties of quantum dots he joined the Institute for Optical Sciences as the Academic Programs Coordinator where he set up a number of courses and training programs for students studying optics at all levels of the University, including a popular holography course. More recently, he has contributed to the IOS' and Impact Centre's entrepreneurship and industry collaboration programs, as well as the VicOne program at Victoria College. He has delivered a number of projects for industrial collaborators, using his expertise in optical and electronic systems.

Abstract

This presentation will start by giving an overview of the IEEE, including its technical achievements, its structure and affiliated organizations in Canada. Then it will discuss what international professional organizations have to offer and how today's interconnected world changes and shapes the way professionals connect with each other and to the resources they need.
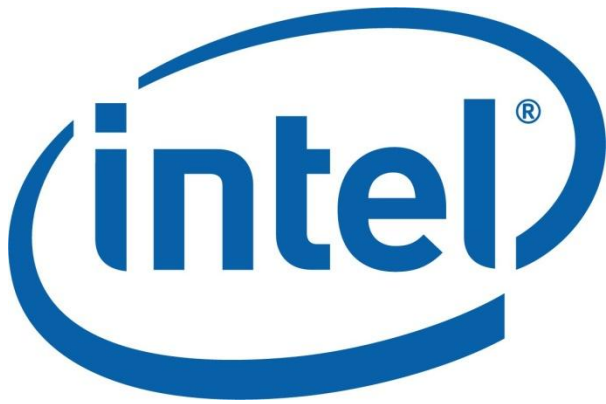
Hui-Lin Hsu (Photonics)	*"Reduction in the Photoluminescence Quenching for Erbium-Doped Amorphous Carbon Photonic Materials by Deuteration and Fluorination"*

The integration of photonic materials into CMOS processing involves the use of new materials. A simple one-step metal-organic radio frequency plasma enhanced chemical vapor deposition system (RF-PEMOCVD) was deployed to grow erbium-doped amorphous carbon thin films (a-C:(Er)) on Si substrates at low temperatures (<200 ºC). A partially fluorinated metal-organic compound, tris(6,6,7,7,8,8,8-heptafluoro-2,2-dimethyl-3,5-octanedionate) Erbium(+III) or abbreviated Er(fod)3, was incorporated in situ into a-C based host. Six-fold enhancement of Er room-temperature photoluminescence at 1.54 µm was demonstrated by deuteration of the a-C host. Furthermore, the effect of RF power and substrate temperature on the photoluminescence of a-C:D(Er) films was investigated and analyzed in terms of the film structure. Photoluminescence signal increases with increasing RF power, which is the result of an increase in [O]/[Er] ratio and the respective erbium-oxygen coordination number. Moreover, photoluminescence intensity decreases with increasing substrate temperature, which is attributed to an increased desorption rate or a lower sticking coefficient of the fluorinated fragments during film growth and hence [Er] decreases. In addition, it is observed that Er concentration quenching begins at ~2.2 at% and continues to increase until 5.5 at% in the studied a-C:D(Er) matrix. This technique provides the capability of doping Er in a vertically uniform profile.

Francisco Morales Gonzalez (Biomedical)	*"A feedback system to improve gait in lower-body amputees"*

The current research of sensory-feedback systems in amputees tries to improve sensory-motor coordination. Several technologies have been developed to help the users acquire information from the environment in order to improve the use of prosthesis. In this project, a non-invasive technique using cutaneous mechanical stimulation is been investigated as a channel to provide feedback to the user. One aspect of mobility and prosthetic function that is a common part of real-world mobility where sensory feedback has not been investigated is in obstacle crossing and avoidance. There is evidence that individuals with lower-limb amputations have increased failure rates in obstacle avoidance. Studies have also shown that one of the main indicators of successful obstacle avoidance is foot clearance. The proposed development aims to study the ability to control foot clearance via vibrotactile sensory feedback. The experiment will require a subject to walk wearing a sensory device. Vibrotactile feedback based on foot clearance will be provided to the subject, who will interpret it and try to maintain the foot clearance within a certain limit. Measurements will be taken to determine the feasibility of foot clearance control based on vibrotactile feedback.

Amit Deshwar **(Communications)**	*"Inferring cancerous sub-populations from tumor DNA sequencing data"*

Tumors are highly complex environments in which multiple cancerous populations compete and evolve to grow, avoid immune response and fight drug therapy. Untangling this complexity is critical to improving our understanding of cancer and how to treat it. Sequencing the DNA found in a tumor can identify what mutations are present but leaves unanswered the questions of how many different genetic populations are present, what their evolutionary relationship is, and what mutations define a population. We have developed a machine learning method to answer these questions. Our method fits a non-parametric Bayesian model to the output of Next Generation sequencing experiments and has been validated by comparing our results to the results of single-cell sequencing. The ability to identify tumor sub-populations has great potential to enable more effective, personalized treatment of cancer.

Ruediger Willenberg **(Electronics)**	*"SimXMD: Simulation-based HW/SW Co-Debugging for Reconfigurable Embedded Systems"*

We are presenting SimXMD (Simulation-based eXperimental Microprocessor Debugger), a tool that allows developers to debug microprocessor software code and custom-designed hardware simultaneously. SimXMD connects a GNU debugger instance to a full-system simulation of an embedded FPGA system. This enables free-roaming investigation of hardware-software interactions inside the system, including reverting back to an earlier point in simulation time. A custom memory logging mechanism enables access to variables in on-chip, off-chip and cached memory. SimXMD is open source, and its modular architecture facilitates extension to other embedded processors as well as different simulators and debuggers.

Rojina Ghasemi **(Photonics)**	*"Observation of Polarization-dependent Spectral Hole Burning of Brillouin Scattering in Spun Fiber"*

Stimulated Brillouin Scattering (SBS) in optical fibers has been the subject of research for many years. Different uses such as sensing and distributed measurements of temperature, strain, and vibration have been investigated using this phenomenon. The Brillouin gain (BG) is usually homogeneously broadened. However, for some specific fiber length, and pump-to-probe power ratios, Spectral Hole Burning (SHB) has been observed in Single Mode Fibers (SMF). Here, we observed, for the first time, highly polarization-dependent SHB of BG. The observation is made in a spun fiber, produced by spinning an elliptical core fiber preform during drawing. Its birefringent beat length is ~15 mm and the twist period is 10-12 mm. This effect was only observed in spun fiber and not in SMF or Polarization-Maintaining Fiber (PMF). The observed SHB dip is as narrow as 8MHz. The narrowband feature of the dip can potentially be used to make high resolution temperature and stain measurements.

To observe the dip, probe frequency is downshifted from the pump by a single sideband modulator. When pump and probe polarizations are aligned to produce the maximum BG, we do not observe SHB, but when they are orthogonal, the SHB dip is clearly visible in the spun fiber.

Yujin Kim **(Photonics)**	*"Effect of gold nanoparticle morphology on the photocatalytic activity of thin film TiO2: Study in particle distribution and clustering"*

Titanium dioxide (TiO2) thin film photocatalyst and the effect of surface modification with gold nanoparticles (NPs) has been investigated. This study explores three gold nanoparticle deposition techniques and relates the resulting morphologies to the photocatalytic activity of TiO2 thin film catalyst under UV illumination. The three techniques employed in this study are spin coating, convective self-assembly, and spray coating. Scanning electron microscopy (SEM) was used to characterize the surface morphologies and nanoparticle distribution. The catalytic activity has been monitored and quantified by observing the degradation of stearic acid under FT-IR spectroscopy. Stripe patterned gold nanoparticles achieved by convective self-assembly improved the efficiency of catalyst by 24% with respect to reference TiO2 catalyst without gold nanoparticles.

Prashanth Menon **(Computer Engineering)**	*"CaSSanDra: An SSD Boosted Key-Value store"*

With the ever growing size and complexity of enterprise systems there is a pressing need for more detailed application performance management. Due to the high data rates, traditional database technology cannot sustain the required performance. Alternatives are the more lightweight and, thus, more performant key-value stores. However, these systems tend to sacrifice read performance in order to obtain the desired write throughput by avoiding random disk access in favor of fast sequential accesses.

With the advent of SSDs, built upon the philosophy of no moving parts, the boundary between sequential vs. random access is now becoming blurred. This provides a unique opportunity to extend the storage memory hierarchy using SSDs in key-value stores. In this work, we extensively evaluate the benefits of using SSDs in commercialized key-value stores. In particular, we investigate the performance of hybrid SSD-HDD systems and demonstrate the benefits of our SSD caching and our novel dynamic schema model.

Ali Ramezani-Kebrya **(Communications)**	*"Likelihood-Based Modulation Classification for Multiple-Antenna Receiver"*

Likelihood-based algorithms for the classification of linear digital modulations are systematically investigated for a multiple receive antennas configuration. Existing modulation classification (MC) algorithms are first extended to the case of multiple receive antennas and then a critical problem is identified
that the overall performance of the multiple antenna systems is dominated by the worst channel estimate of a particular antenna. To address the performance degradation issue, we propose a new MC algorithm by optimally combining the log likelihood functions (LLFs). Furthermore, to analyze the upper-bound performance of the existing and the proposed MC algorithms, the exact Cramer-Rao Lower Bound (CRLB) expressions of nondata- aided joint estimates of amplitude, phase, and noise variance are derived for general rectangular quadrature amplitude modulation (QAM). Numerical results demonstrate the accuracy of the CRLB expressions and verify that the results reported in the literature for quadrature phase-shift keying (QPSK) and 16-QAM are special cases of our derived expressions. Also, it is demonstrated that the probability of correct classification of the new algorithm approaches the theoretical bounds and a substantial performance improvement is achieved compared to the existing MC algorithm.

Dongpeng Kang (Photonics)	*"How to generate polarization entangled photons on a monolithic chip"*

Photon pairs are indispensible sources in various applications in the area of quantum information science, such as quantum key distribution, quantum teleportation, quantum computing, etc. The standard method to generate photon pairs is via the nonlinear optical process of spontaneous parametric down-conversion, which requires a laser pumping a nonlinear crystal with careful alignment. The system is generally bulky, vulnerable, and sensitive to external environment and therefore it's only useful in specially equipped labs. On the other hand, a commercializable quantum information processing system, such as an optical quantum computer, requires chip-scale, portable, robust sources of photon pairs operating in room temperature. Although significant progress has been made using different techniques, electrically pumped, room-temperature photon pairs are still unavailable. To this end, Bragg reflection waveguides (BRWs) made of III-V semiconductor Aluminum Gallium Arsenide (AlGaAs) have been shown as the most promising platform.
In this work, we first briefly review BRWs as a platform for photon pair generation. We will show how waveguide dispersion engineering can modify the properties of the photon pairs, for example, to generate polarization entangled photons on-chip without any off-chip compensation or interferometer. Our results show that BRWs could lead to fully integrated nonclassical photon sources.

Weiwei Li (Communications)	*"Assessing Video Quality of Experience: Accessibility, Retainability and Integrity"*

QoE(Qualigy of Experience) is a quality measure based on user's perception. It provides an important guide to the next generation of network architecture. Video traffic constitutes the majority of network traffic over wireless network. We aim to explore how to assess QoE for video streaming service over wireless network. Be different from previous quality assessment. We view QoE from a service provider perspective. Three key quality indicators are defined: accessibility, retainability, and integrity. Integrity are widely discussed previously. However, the addition of accessibility and retainability for QoE evaluation impacts the distribution of quality assessment scores. The presentation will present some results of a subject experiment involving the three indicators, and discuss future work.

Eric Zhu (Photonics)	*"An FPGA-based Time-Interval Analyzer for Experimental Quantum Optics"*

Quantum optics is the study of light when it behaves not just as a wave, but also as a particle, the photon. In such cases, the light intensity is necessarily low, usually at the level of a single photon per pulse or less. Single-photon detection requires the use of high-gain detector modules that will only provide binary information (1 = AT LEAST one photon was detected/ 0 = no photons were detected), information that is outputted from the modules in the form of digital (TTL, NIM) pulses.

In most quantum optics experiments and applications, such as quantum cryptography, it is necessary to time-resolve the detection events from two or more detectors. Essentially, this involves measuring the arrival time between two TTL pulses. In this presentation, we report a simple implementation of such a time-interval analyzer, based entirely in FPGA fabric, with a resolution of 500 ps.

Narges Norouzi	"Assessment of Alcohol Withdrawal Tremor in the Emergency Department"
(Computer Engineering)	

Alcohol withdrawal (AW) syndrome is commonly encountered in the Emergency Department (ED) and can be life-threatening in most severe form. Despite its prominence, it is poorly managed in ED. Emergency physicians are often reluctant to treat patients in AW because Benzodiazepines can cause excessive sedation and they have high abuse potential (patients present to the ED complaining of AW but are actually drug-seeking).

We propose a signal processing method of assessing the severity tremors caused by AW syndrome. We have developed an iOS application to calculate the Clinical Institute Withdrawal Assessment (CIWA) score which captures iPod movements using the built-in accelerometer in order to reliably estimate the tremor severity component of the score. We report on the characteristics of AW tremor, the accuracy of electronic assessment of tremor compared to expert clinician assessment, and the potential for using signal processing assessment to differentiate factitious from real tremor in patients seen in ED.

Our preliminary result based on 38 subjects shows linear relationship between energy measured by the accelerometer (in the 6.5-10.5 Hz range) and the expert rating of tremor severity. Additionally, we find out that the tremor above 7 Hz could be a potential discriminator of real versus fictitious tremors.

Heng Xu	"Efficient Strong Consistent Communication in Distributed
(Computer Engineering)	Control Plane of Software Defined Networks"

Traditional networks employ a distributed mechanism for controlling the network, thus making it resilient to network fragmentation, among many of its original goals. However, many of these original design goals are no long valid in today's operating environments. Software Defined Networking (SDN) is a new computer networking paradigm, where thousands of switches are managed by a centralized controller. The switches are basically just forwarding elements controlled by central controller. In this way, the forwarding plane (the switch) and the control plane can evolve independently of each other, which could lead to a diverse range of new innovations.

Applying SDN to Wide Area Networks (WANs) is a recent discovery. The main challenges of applying the SDN paradigm to WANs is that the characteristics of links of WANs differ significantly from that of the Local Area Networks. The major innovations in the work is the investigation of use multiple controllers to partition the WAN topology, thus creating a logically centralized physically distributed control plane. SDN paradigm leads itself easily to interdisciplinary collaboration, for instance, we can have different optical wired or wireless links connecting the switches, and the controller would not have to be changed regardless of the change in the underlying link properties.

2:15 PM	Slot A [Room 1130]	**Victor Wen (Energy Systems)**	*"A Cell-Level Power Management IC for Partial Power Processing in PV Energy Harvesting Applications"*

Photovoltaic (PV) energy harvesting market has grown at a remarkable rate over the past decade. Much research has been conducted to find methods that can extract the maximum power from PV modules under various weather conditions. These methods are known as Maximum Power Point Tracking (MPPT), and they are usually implemented at string or module level. Recently, there is a growing interest to have Distributed MPPT (DMPPT) at the sub-string or cell level to further maximize the available PV power. In this work, we developed a partial power processing technique, known as the ∆ - Conversion scheme, that can achieve the same power benefit as the DMPPT scheme but with less power conversion losses, and therefore is more cost-effective and compact for cell-level integration. A Power Management Integrated Circuit (PMIC) is designed to realize the ∆ - Conversion scheme for Concentrating-PV (CPV) systems. On average, 10% more PV output power is obtained in a CPV system with this IC design.

Wei Wang (Computer Engineering) — *"Multi-Resource Fair Allocation in Heterogeneous Cloud Computing Systems"*

Slot B [Room 1170]

We study the multi-resource allocation problem in cloud computing systems where the resource pool is constructed from a large number of heterogeneous servers, representing different points in the configuration space of resources such as processing, memory, and storage. We design a multi-resource allocation mechanism, called DRFH, that generalizes the notion of Dominant Resource Fairness (DRF) from a single server to multiple heterogeneous servers. DRFH provides a number of highly desirable properties. With DRFH, no user prefers the allocation of another user; no one can improve its allocation without decreasing that of the others; and more importantly, no user has an incentive to form a coalition with others to lie about its resource demand. DRFH also ensures some level of service isolation among the users. As a direct application, we design a simple heuristic that implements DRFH in real-world systems. Large-scale simulations driven by Google cluster traces show that DRFH significantly outperforms the traditional slot-based scheduler, leading to much higher resource utilization with substantially shorter job completion times.

2:30 PM	**Slot A [Room 1130]**	**Jason Grenier (Photonics)**	*"Ultrafast Laser Inscription of Optical Fiber Sensors and Circuits"*

Jason Grenier (Photonics) — *"Ultrafast Laser Inscription of Optical Fiber Sensors and Circuits"*

Optical fibers form the backbone of the Internet and are also routinely used for biomedical and sensing applications. The fiber core, which guides the light through the optical fiber, represents less than 1 percent of the total volume, leaving room to add much more functionality to this compact and highly utilized platform. Ultrafast laser microstructuring offers new 3D fabrication opportunities for the dense integration of laser-formed optical devices directly inside optical fibers thereby overcoming the many challenges and costs of otherwise connecting and packing optical fibers with discrete bulk optics. This talk will overview the current progress and future opportunities towards fabricating in-fiber temperature-independent bend and torsion sensors, as well as polarization splitters, taps and polarization selective elements of interest for quantum photonics systems. Furthermore, laser-formed microfluidic channels (micron-sized pipes) that allow light guiding structures to probe their contents to make sensitive measurements that underpins the possibility for creating complex laboratory diagnostics on a compact optical fiber are discussed.

Nazanin Calagar (Computer Engineering) — *"Source-Level Debugging for FPGA High-Level Synthesis"*

Slot B [Room 1170]

High-level synthesis (HLS) raises the level of abstraction for hardware design by allowing software methodologies to be used. Implementing computations in hardware typically provides speed and energy benefits vs. a software implementation, and the value proposition of HLS is to bring such benefits to two types of users: 1) hardware engineers who use HLS to increase engineering productivity, and 2) software engineers with a limited (or no) knowledge of hardware design. Given a bug in the HLS-generated hardware or its integration with a surrounding system, the user is forced into HW-debugging methodologies, logic simulation and manual inspection of waveforms. Thus, debugging HLS hardware is virtually impossible for users without hardware skills.

We describe a source-level debugging framework for FPGA high-level synthesis that offers gdb-like step, break, and data inspection functionality for an HLS-generated hardware circuit. With the proposed framework, the user can inspect the values of logic signals in the hardware from the C source code perspective. In addition to the software-like ecosystem for HLS debugging, the framework permits concurrent hardware and software debugging to discover the first point at which at which any logic signal in the hardware mismatches with its corresponding variable in software.

2:45 PM	**Slot A [Room 1130]**	**Juan Gonzalez (Biomedical)**	*"A Feedback System to Improve Gait in Lower-Body Amputees"*

The current research of sensory-feedback systems in amputees tries to improve sensory-motor coordination. Several technologies have been developed to help the users acquire information from the environment in order to improve the use of prosthesis. In this project, a non-invasive technique using cutaneous mechanical stimulation is been investigated as a channel to provide feedback to the user. One aspect of mobility and prosthetic function that is a common part of real-world mobility where sensory feedback has not been investigated is in obstacle crossing and avoidance. There is evidence that individuals with lower-limb amputations have increased failure rates in obstacle avoidance. Studies have also shown that one of the main indicators of successful obstacle avoidance is foot clearance. The proposed development aims to study the ability to control foot clearance via vibrotactile sensory feedback. The experiment will require a subject to walk wearing a sensory device. Vibrotactile feedback based on foot clearance will be provided to the subject, who will interpret it and try to maintain the foot clearance within a certain limit. Measurements will be taken to determine the feasibility of foot clearance control based on vibrotactile feedback.

	Slot B [Room 1170]	**Narges Norouzi (Computer Engineering)**	*"Assessment of Alcohol Withdrawal Tremor in the Emergency Department"*

Alcohol withdrawal (AW) syndrome is commonly encountered in the Emergency Department (ED) and can be life-threatening in most severe form. Despite its prominence, it is poorly managed in ED. Emergency physicians are often reluctant to treat patients in AW because Benzodiazepines can cause excessive sedation and they have high abuse potential (patients present to the ED complaining of AW but are actually drug-seeking).

We propose a signal processing method of assessing the severity tremors caused by AW syndrome. We have developed an iOS application to calculate the Clinical Institute Withdrawal Assessment (CIWA) score which captures iPod movements using the built-in accelerometer in order to reliably estimate the tremor severity component of the score. We report on the characteristics of AW tremor, the accuracy of electronic assessment of tremor compared to expert clinician assessment, and the potential for using signal processing assessment to differentiate factitious from real tremor in patients seen in ED.

Our preliminary result based on 38 subjects shows linear relationship between energy measured by the accelerometer (in the 6.5-10.5 Hz range) and the expert rating of tremor severity. Additionally, we find out that the tremor above 7 Hz could be a potential discriminator of real versus fictitious tremors.

3:00 PM	**Slot A [Room 1130]**	**Heng Xu (Computer Engineering)**	*"Efficient Strong Consistent Communication in Distributed Control Plane of Software Defined Networks"*

Slot A [Room 1130]

Traditional networks employ a distributed mechanism for controlling the network, thus making it resilient to network fragmentation, among many of its original goals. However, many of these original design goals are no long valid in today's operating environments. Software Defined Networking (SDN) is a new computer networking paradigm, where thousands of switches are managed by a centralized controller. The switches are basically just forwarding elements controlled by central controller. In this way, the forwarding plane (the switch) and the control plane can evolve independently of each other, which could lead to a diverse range of new innovations.

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Slot B [Room 1170]

He Xu (Photonics) — *"Characterization of Superconducting Single Photon Detectors (SSPD)"*

Among many other Single Photon Detectors (SPD), Superconducting nanowire or Superconducting SPD- SSPD present distinct advantages of high detection efficiency and low dark counts. With such superior SPD, the main effort of the research community is geared towards completely characterizing the SSPD to understand its performance. Our work filled the niche by presenting an experimental procedure to predict the response of the SSPD. While many phenomena of the SSPD are of interest, the SSPD 'afterpulse' phenomenon is of particular importance. Not only does the afterpulse behaviour reveal internal details about the SSPD, but it also provides clues on how to better tune the SSPD to reduce afterpulse. A recent publication of ours postulated the after pulse is a result of the combination of finite bandwidth and spurious reflection. This hypothesis is confirmed by experimentally varying the bandwidth of the SSPD. The results of characterization will enable research to probe quantum effects more efficiently.

3:30 PM	Slot A [Room 1130]	**Feihu Xu** **(Photonics)**	*"How to Foil a Quantum Hacker"*
		Quantum cryptography or quantum key distribution (QKD) can provide unconditional (i.e. information-theoretic) security based on the laws of quantum physics. During the past decade, commercial QKD products have appeared in the market; various field-test QKD networks have already been built in the USA, Europe, China, and Japan. However, owing to the imperfections in real-life implementations of QKD, a large gap between its theory and practice remains unfilled. In particular, an eavesdropper may exploit these imperfections and launch quantum hacking not covered by the original security proofs of QKD. Here, I will discuss the quantum hacking activities in the QKD community by using some well-known quantum attacks for illustration. Then, I will present a novel countermeasure scheme, namely measure-device-independent QKD (MDI-QKD), which removes all attacks in the detection system, the most serious loophole of QKD implementations. Finally, I will present our group's recent works on MDI-QKD.		
	Slot B [Room 1170]	**Hamed Sadeghi** **(Communications)**	*"An Epipolar Geometry-Based Approach for Vision-Based Indoor Localization Using Smartphone Cameras"*
		Due to lack of GPS signal coverage in indoor scenarios, indoor localization of users using their mobile phone sensors has been a very hot and challenging field in the last decade. Various signals such as WiFi, infrared, images, etc have been studied for the purpose of user localization. Among all the studied signals, image has demonstrated greater accuracy and stability compared to other signals. In our work, we have proposed an Epipolar-geometry algorithm that provides sub-meter accuracy for user localization (fine localization) while reducing the size of needed database. The proposed method is even able to localize the user at locations not stored in the database, i.e. extrapolates the locations.		

3:45 PM	**Slot A** **[Room 1130]**	**Mario Badr** **(Computer Engineering)**	*"SynFull: Synthetic Traffic Models Capturing Cache Coherent Behaviour"*

Slot A [Room 1130]

Full-system simulation is a long and tedious process; as a result, it limits the range of designs that can be explored in a tractable amount of time. We propose a novel methodology to accelerate NoC simulation. SynFull enables the creation of synthetic traffic models that mimic the full range of cache coherence behaviour and the resulting traffic that is injected into the network. We accurately capture spatial variation in traffic patterns within and across applications. Furthermore, 'burstiness' is captured in our model. These two attributes lead to a model that produces accurate network traffic. We attain an overall accuracy of 10.5% across 3 configurations for all benchmarks relative to full-system simulation. Furthermore, our technique uses the steady-state behaviour of Markov chains to speedup simulation by up to 150 times. SynFull is a powerful and robust tool that will enable faster exploration of a rich design space in NoCs.

Slot B [Room 1170]

Amer Samarah (Electronics) — *"Spurious Free Digital PLL"*

I present a novel digital solution to avoid the problem of dead-zone behaviour in digital phase locked loop (DPLL) caused by the quantization effect of time-to-digital converter (TDC). The dead-zone behaviour results in chaotic limit cycle behaviour causing higher than expected in-band phase noise and strong spurious tones. This behaviour is dependent on the initial phase difference between the output and reference clock which makes the DPLL performance inconsistent and unpredictable. To alleviate this problem, a noise shaped offset is added to the phase error, in the digital domain to keep the TDC active and away from the dead-zone. The proposed solution is verified by extensive simulation and using a DPLL prototype in a 0.13 um CMOS process.

4:00 PM	**Slot A** **[Room 1130]**	**Michael Selvanayagam** **(Electromagnetics)**	*"Passive and Active Methods for Controlling Electromagnetic Fields"*

Michael Selvanayagam (Electromagnetics) — *"Passive and Active Methods for Controlling Electromagnetic Fields"*

Being able to control electromagnetic fields forms the basis for many communication and imaging systems. In this talk we look at how we can control and shape electromagnetic fields using a single surface of electric and magnetic dipole antennas. This will give rise to thin and conformal hardware. We will examine two configurations of these surfaces. An active configuration and a passive configuration.

An active configuration involves arrays of electric and magnetic dipoles which are fed to radiate as an antenna array. We will show how such an array can be designed to cloak an object from an incident electromagnetic field. This is achieved by using the antenna array to cancel the field scattered by the object.

A passive configuration involves a surface of electric and magnetic dipoles which act instead as scatterers. Here by properly designing the dipoles which make up the surface we can form lens-like devices using a single surface. Here we will demonstrate how a single surface is capable of refracting a wave into an arbitrary direction.

Slot B [Room 1170]

Saber Amini (Electronics) — *"Beyond Technical: Life Lessons Learned in Grad School"*

As you go through grad school, you learn more than technical skills. With a dash of humour, this presentation summarizes some valuable advice from current and former grad students that might be useful to you in your future career.

PANEL DISCUSSION:
"ACADEMIA & INDUSTRY CROSSROADS"
5:00 PM – 6:15 PM

Panellists:

Michael Galle	(CEO of Inometrix Inc.)
Dr. Karl Martin	(CEO and Co-Founder of Bionym)
Dr. Inmar Givoni	(Senior Research Scientist, Kobo)
Dr. Jason Anderson	(Professor, U of T)
Dr. Tony Chan Carusone	(Professor, U of T)
Dr. Natalie Enright Jerger	(Professor, U of T)

Moderated by Professor Stark Draper (U of T)

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