ECONNECT

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A BI-ANNUAL PUBLICATION OF THE DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

ECE DEPARTMENT PAGE INTRODUCES SEVERAL NEW MODULES FOR SECOND-YEAR B ENG STUDENTS IN 2011/12.



AVIATION OPEN HOUSE SHOWCASES MULTIFACETED AVIATION INDUSTRY AND PRESENTS VARIOUS OPPORTUNITIES AVAILABLE.



ECE TEAM LED BY **PAGE** DR QIU CHENG **1** WEI PROPOSES A TECHNOLOGY THAT WILL USE A SINGLE OPTICAL BEAM TO DRIVE MOLECULES BACKWARDS TOWARDS A LIGHT SOURCE.







PAGE SOC OS PRC

SOCIAL ROBOTICS DEVELOPMENT TODAY HAS ADVANCED TO A STAGE WHERE IT IS TECHNICALLY FEASIBLE TO PROVIDE ROBOTICS-BASED HEALTHCARE ASSISTANCE AND HOSPITALITY SERVICES.

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Assoc Prof Xiang Cheng
Assoc Prof Marc Andre Armand
Ms Eunice WongPhotographyMr Abdul Jalil Bin DinAdvisorsProf Chua Kee Chaing
Prof Lee Tong Heng

HoD SPEAKS...

We received close to \$26 million in new research grants last year. This is a fairly healthy level of research funding needed to sustain research productivity and excellence in the Department.



In December last year, we took experiential learning a step further by immersing a small group of students in rural India to experience for themselves the daily challenges faced by medical workers in a community hospital there. The idea was for the students to explore opportunities and come up with frugal engineering solutions to some of the problems faced by the medical workers there. This is the first time we have embarked on such a field trip and the students are now back on campus, working on developing their ideas and solutions in the lab. We hope that this does not only allow them to see the applicability of what they have learnt, but also exposes them to the joy of social entrepreneurship in which engineers have much to offer.

We received close to \$26 million in new research grants last year. This is a fairly healthy level of research funding necessary to sustain the level of research productivity and excellence in the Department. A number of our faculty colleagues and students have done well in their research and have been recognised with prestigious awards and fellowships. These and selected examples of ongoing research in the Department are highlighted in this issue of E.ConnEct.

Last year, a group of very dedicated alumni formed our own ECE Alumni Committee. Led by Mr Melvin **Low** (BEng'86), the committee sponsored and organised the first Alumni reception on 24 February 2012 at the Shaw Foundation Alumni House. It was a very successful event which brought many ECE alumni back to campus for an evening of interaction with their former professors. The Department will hold its annual Alumni Family Day in August this year. I look forward to seeing many of our alumni and their families back on campus on that day. In addition, we will be organizing this year's Graduation Night in July. I hope many of our students graduating this year will come and join in the fun with their parents and professors.

AN ARM SYSTEM-ON-CHIP APPROACH TO TEACHING MICROPROCESSORS IN A SECOND-YEAR CORE MODULE

The ECE Department introduced several new core modules for second-year BEng (Electrical Engineering) students in 2011/12. Amongst them is EE2024 Programming for Computer Interfaces, which aims to give a contemporary twist to the teaching of microprocessor systems at the Department.

For many years, students have studied microprocessor systems based on Intel x86, which adopts the Complex Instruction Set Computer model. Presently, the electronics industry is increasingly moving towards powerful, low-cost and energy-efficient system-on-chip (SoC) designs that integrate the microprocessor core together with useful peripherals such as analogue-to-digital converters and communications and networking controllers in a single chip. Many SoC platforms incorporate the Advanced Reduced Instruction Set Computer (RISC) Machines (ARM) core, which adopts the RISC model. ARM-based SoCs are the "brains" behind many high-volume communications and computer products today such as smartphones and tablets like the Apple iPhone and iPad. Even Microsoft Windows, which traditionally executes only on Intel x86-based microprocessors in personal computers, will be able to run on ARM processors in Windows 8, to be released this year.

The new EE2024 module is more than just about replacing the Intel x86 microprocessor with an ARM-based SoC. Students develop both assembly language and C programs and are able to see the trade-offs between them. After that, they connect the SoC with devices like sensors and actuators using industry-standard interfacing protocols. In addition, a system design methodology based on the Unified Modeling Language (UML) is introduced.

In lectures and tutorials, students study topics like the ARM instruction set, interrupt system, low-level C library functions and the Inter-Integrated Circuit, Serial Peripheral Interface and Universal Asynchronous Receiver/Transmitter interfacing protocols. EE2024 has two projects. The first uses ARM assembly language to create an efficient computational component embedded within a C program. The second uses the UML design methodology to design a real-world application such as a smart home climate-control system, before students convert their designs into reality by developing fully functioning embedded system applications.

Preparations for EE2024 began about eight months before the start of semester 1 of academic year 2011/12. The NXP LPC1769 SoC with an ARM Cortex-M3 core was selected as the development platform. Teaching Assistants **Do** Thi Thu Trang and Lucas **Tschuor** were recruited to work with the module lecturer, Assoc Prof **Tham** Chen Khong, to develop both the course materials and the detailed specifications of the projects. Ten ECE graduate students saw the exciting possibilities of ARM-based SoC systems and came forward to master the brand new platform and serve as graduate assistants to supervise the pioneering batch of 168 EE2024 students in their projects.



(L-R) Graduate Assistant Sreejaya Viswanathan, EE2 students Andrew Ian Jian Hong and Lee Jun Hui holding the NXP LPCXpresso board used in the EE2024 projects, module lecturer Assoc Prof Tham Chen Khong, and Teaching Assistants Lucas Tschuor and Do Thi Thu Trang. Andrew and Jun Hui added special features to their smart home climate-control system to display the state of the home in animated graphics.

The response to the inaugural offering of EE2024 has been very positive. **Lee** Jun Hui, an EE2 student who took the module, says: "EE2024 is definitely one of the most interesting modules! At the end of the course, I had gained a sense of respect for the ARM system and the intricate functions it is able to perform. While the projects may be tough initially, eventually, one gets the hang of it and cannot stop writing new features! It is really a great hands-on module that teaches practical concepts".

Another EE2 student, **Nguyen** Anh Tuan, echoes this sentiment: "The ECE Department has taken the bold step of replacing conventional Intel chips with ARM, and got us working mostly with the C language, which was just amazing. I have to say it is really a state-of-the-art module!"

EE2024 is offered to second-year BEng (Electrical Engineering) students twice a year in each semester. It gives students an excellent head-start to developing their ECE skills, which will be further developed with more complex problem-solving tasks in their senior years of study.

ECE STRENGTHENS THE ENGINEERING SPIRIT AS STUDENTS TAKE UP REAL-LIFE CHALLENGES

The Department has launched a new module entitled "Exploring Frugal Engineering". This optional module aims to provide students the experience of daily challenges in a rural community setting and the chance to explore opportunities to develop engineering solutions. Its focus is on the creation of quality solutions for consumers at the bottom of the pyramid.

In December 2011, 11 students worked with Walawalkar Hospital in Dervan (some 250 kilometres from Mumbai), India, for three weeks. Working with doctors, community healthcare providers and villagers there, students learnt about the problems faced by the community, and participated in a health awareness and nutrition screening programme for children in the local school. As part of the experience, they accompanied the hospital's community health teams to villages to conduct health screening. A concern for the doctors in the area is the high incidence of oral cancer, and there is great urgency to design simple, yet effective, screening devices to detect the disease as early as possible. The students observed that the doctors and healthcare teams often performed their duties in poor lighting conditions with basic equipment, yet they strive to provide the best service for the needy. These heartwarming and inspiring experiences gave our students a renewed determination to continue their participation in the hospital's projects.

Assoc Prof **Loh** Ai Poh conveyed that this programme was motivated by the need to reinforce the Department's spirit of critical thinking and problem solving in the context of real-life situations. An effective way to inspire and strengthen these skills is to immerse our students in actual situations where affordable engineering solutions that they have developed can improve the lives of community dwellers. The goals are to identify needs and to propose solutions that can be prototyped in our labs. These innovations will be customised and eventually brought to Dervan communities.

It was not all work and no play in India for these students. They spent a weekend enjoying the sights in Goa, a beautiful, historical, coastal city south of Dervan, and, in Mumbai, they visited the Gateway of India.

Kudos go to the 11 students who, since returning to NUS, have successfully raised funds for the hospital in Dervan.



At Changi Airport on the day of their departure.



Briefing by the hospital staff.



In serious discussion with Prof Prahlad.



Having fun in Goa

ECE FACULTY RECEIVE MAJOR RESEARCH AWARDS / RECOGNITIONS





Assoc Prof Hong Minghui





Prof Dim-Lee Kwong

DR YAN SHUICHENG Conferred the National Young Scientist Award 2011

Dr **Yan** Shuicheng has been conferred the national Young Scientist Award 2011 by the Singapore National Academy of Science for his research on computer vision, multimedia and machine learning.

The award was presented at the President's Science and Technology Awards Ceremony held on 8 November 2011. Awardees were young researchers, aged 35 and below, who have been actively engaged in R&D in Singapore and have shown potential to become worldclass researchers in their fields of expertise. The award comprised a trophy, certificate and S\$10,000 cash.

ASSOC PROF HONG MINGHUI Elected Fellow of OSA and SPIE

Assoc Prof **Hong** Minghui was elected Fellow of the Optical Society of America (OSA) in October 2011 for his outstanding contributions to laser interactions with materials. In December 2011, Assoc Prof Hong was also elected Fellow of the International Society for Optics and Photonics (SPIE) for his outstanding contributions to laser microprocessing and nanoengineering.

Assoc Prof Hong specialises in laser microprocessing, nanofabrication and optical engineering and its applications. He has co-authored 10 book chapters, and over 250 scientific papers in Nature, Chemical Reviews, Nature Communications, etc. He has 24 patents and has delivered over 30 plenary/keynote/invited talks in international conferences. He has served as chair/member of organising committees for numerous international conferences, on top of being a reviewer, editor and associate editor in various publications. Assoc Prof Hong has held appointments as the Simon Industrial and Professional Fellow of the University of Manchester in the UK, Guest Professor of the University of Science & Technology of China, Guest Professor of Xiamen University of China and Visiting Professor of the Institute of Optoelectronics, Chinese Academy of Sciences.

PROF XU JIANXIN Elected Fellow of IEEE

Prof **Xu** Jianxin was elected Fellow of the Institute of Electrical and Electronics Engineers, Inc (IEEE), on 29 November 2011 for his contributions to motion control systems.

Prof Xu has produced about 400 peer-reviewed journal and conference papers, two monographs and three edited books. He has supervised/co-supervised 21 PhD and 20 Master students as well as 11 research staff including postdoctoral fellows and research fellows. Prof Xu's current research projects are in the areas of hard disc modelling and control, UAV formation and coordination, and biometric locomotion and control.

PROF DIM-LEE KWONG Awarded the 2011 IEEE Frederik Philips Award

This prestigious award recognises Prof Dim-Lee **Kwong** for his leadership in silicon technology and excellence in the management of microelectronics R&D. The award was presented at the 2011 IEEE International Electron Devices Meeting in Washington, DC, USA, on 6 December 2011.

Prof Kwong is currently Full Professor in the Department, IEEE Fellow, and Executive Director of Singapore's Institute of Microelectronics (IME).

Prof Kwong has co-authored more than 1,000 research papers, supervised 55 PhD students and holds over 25 US patents. Prior to joining NUS and IME, Prof Kwong was the Earl N. and Margaret Bransfield Endowed Professor at the University of Texas, Austin.

ECE FACULTY RECEIVE TEACHING AWARDS

Several ECE faculty received excellence awards for their extraordinary commitment to teaching. These awards recognise teaching excellence in their profession, and serve as testimony to the great importance the institution accords to teaching.



Prof Lian Yong received the Annual Teaching Excellence Award (ATEA) for his novel teaching methods, such as the four-in-one teaching strategy, which effectively enhances learning in a large class through the use of conceptual learning, adaptive teaching, adaptive tutoring and experiential learning. He previously won the Faculty

of Engineering's Innovative Teaching Award for his ingenious teaching methods.



Assoc Prof Mehul Motani was the recipient of the Innovative Teaching Award. His teaching and learning philosophy is grounded in the idea that students learn best in an interactive environment, where they can get instantaneous feedback from teachers. To that end, he has designed and built an innovative, real-time,

teacher-student and student-student interaction system (supporting dynamic polling, asking questions and disseminating answers) that takes a modern approach to creating interaction in the classroom, allowing students to use tools they are familiar with (e.g., their mobile phones).



Prof Lee Tong Heng was listed on the honour roll for ATEA as well as nominated for the Engineering Educator Award to honour his consistently exceptional teaching performance. Prof Lee's teaching initiatives have helped his students acquire not only disciplineor profession-specific knowledge and abilities but

also ideas, mental capacity, mindsets and habits beyond the boundaries of their specific disciplines.



Assoc Prof Dipti **Srinivasan** employs a variety of instructional techniques to create new learning environments and to explore the innovative application of new methods that will help to make the learning process more effective and better adapted to students' needs. She received the Engineering Educator Award in 2010 for

her outstanding efforts in teaching and has been on ATEA teaching honours lists and commendation lists for many years.

EDUCATOR & INNOVATIVE TEACHING AWARDS

ENGINEERING EDUCATOR HONOUR ROLL, AY 2010/2011, FOE, DECEMBER 2011.

Prof Lee Tong Heng

ENGINEERING EDUCATOR AWARD, AY 2010/2011, FOE, DECEMBER 2011.

Assoc Prof Dipti Srinivasan

HONOURS LIST, AY 2010/2011, FOE, DECEMBER 2011.

Dr Heng Chun Huat

- Dr Aaron Danner
- Dr Mandar Chitre

COMMENDATION LIST,

Prof Wu Yihong

- Prof Wang Qing Guo
- Assoc Prof Tan Kay Chen Assoc Prof Mansoor
- Assoc Prof Adekunle
- Adeveve
- Assoc Prof Xiang Cheng Dr Lee Sungjoo

A) HONOURS LIST, AY 2010/2011, FOE, DECEMBER 2011. B) INNOVATIVE TEACHING AWARD, AY 2010/2011, FOE, DECEMBER 2011.

Assoc Prof Mehul Motani

DEPARTMENT 04

- AY 2010/2011, FOE, DECEMBER 2011. Prof Lian Yong
 - Prof Liew Ah Choy
- Assoc Prof Chim Wai Kin Assoc Prof Hong Minghui
 - **Bin Abdul Jalil**
 - Dr Moorthi S/O Palaniapan

DEPARTMENT

NEW APPOINTMENTS AND PROMOTIONS

FACULTY APPOINTMENTS

We welcome the following new members into our ECE family.

- DR TSANG MANKEI joined the ECE Department on 31 August 2011 as Assistant Professor and National Research Foundation Fellow, with a joint appointment at the Department of Physics. Dr Tsang received BS degrees in Electrical Engineering and Physics from the University of California, Los Angeles in 2002 and his MS and PhD degrees from the California Institute of Technology in 2004 and 2006, respectively. He held postdoctoral fellowships at the Massachusetts Institute of Technology and the University of New Mexico before he moved to Singapore. His research interests include quantum measurement and control theory, quantum optics, nonlinear optics and nano-optics.
- Dr GOH CHER HIANG joined the ECE Department on 1 August 2011 as Adjunct Professor. He is a Distinguished Member of Technical Staff at the National DSO Laboratories. Dr Goh obtained his PhD in 1993 from Ruhr-Universitat Bochum, Germany. His areas of research interests are in satellite systems development, project leadership and management, unmanned systems development, guidance and control, guided systems technologies evaluation, aided inertial navigation, flight control design and analysis, robust digital control design and implementation, flexible structure robust control and servo-controlled systems.
- Dr LUO SHA joined the ECE Department on 13 September 2011 as Lecturer. She obtained her PhD in 2011 from Nanyang Technological University (NTU), Singapore, and was Project Officer in NTU, where she was involved in the design of CMOS-based millimetre-wave passive components and the design of VCOs using high Q inductors. From 2006 to 2007, she was an R&D Engineer at NTU's Satellite Engineering Centre, where she was involved in the design of the matching networks to integrate devices in the RF receiver, the investigation of the required power and specifications, and the measurement of the performance of the RF receiver.
- DR SUN SUMEI joined the ECE Department on 18 July 2011 as Adjunct Associate Professor. She is Head of the Modulation and Coding Department at the Institute for Infocomm Research (I²R), A*STAR. Dr Sun obtained her PhD in 2007 from NUS. Her research interests are in the areas of channel coding and network coding, and their application in digital communication systems, joint source-channel-network coding, optical transceiver techniques for wireless communication systems, cooperative transmission and interference management, and energy-efficient resource optimisation in wireless communication systems.
- DR JULIUS MING-LIN TSAI joined the ECE Department on 18 July 2011 as Adjunct Assistant Professor. He is currently Principal Investigator of the Sensors and Actuators Microsystems Programme at the Institute of Microelectronics, Singapore, which focuses on research in RFMEMS, exploiting AIN for resonators, filters, tunable capacitors, NEMS switches, miniaturised ultrasound transducers, miniaturised medical devices and rugged sensors for oil and gas exploration. Dr Tsai obtained his PhD in 2004 from the National Tsing Hua University, Taiwan. His research interests are RFMEMS devices design, fabrication, characterisation, design, modelling, fabrication, testing of Optical/CMOS MEMS devices, integrated analogue circuits, capacitive sensing circuits, RF device characterisation, measurement, circuit design and microsystem modelling.

TEACHING ASSISTANTS

- MR CHRISTOPHER MOY SHIN LEE LAN CHONG assumed duty as Teaching Assistant on 8 September 2011.
- MR SANGIT SASIDHAR assumed duty as Teaching Assistant on 11 January 2012.
- MR LOKE YUAN REN assumed duty as Teaching Assistant on 20 February 2012.

SPECIALIST ASSOCIATES (EMERGENCY RESPONSE TEAM)

- MR HOE YEOW LIANG on 25 July 2011
- MR KYAW KYAW OO on 2 September 2011
- MR HTIKE AUNG on 24 October 2011
- MR LEE WENG FOOK. DAVID on 1 March 2012
- ADMINISTRATIVE APPOINTMENTS
- MS TAN MUI CHING, OLIVIA was appointed Executive on 1 March 2012. She handles the research administration portfolio in the ECE Department.
- MS TANG LEE FA, LISA joined the ECE Department as Management Assistant Officer on 2 November 2011.

ADMINISTRATIVE PROMOTIONS (from 1 January 2012)

- MS ONG POH GEK, JADE Manager
- MS NG GUAT PING, DIANA Management Assistant MS SIM MONG CHOON Management Assistant Officer (Grade 2)
- MS CHUA WEI NEE, WINNIE Assistant Manager
 - Officer (Grade 4)
- MR TAN BENG HWEE Lab Technologist (Grade 3)
- MR TEO SEOW MIANG Lab Technologist (Grade 3)

NEW APPOINTMENTS: INTERVIEWS WITH...

PROF LIM TENG JOON



🕽 Tell us about yourself.

A I grew up in Singapore, was educated at Raffles Institution, Raffles Junior College and obtained my BEng (Electrical Engineering) from NUS in 1992. After three months as a journalist with the Straits Times, I accepted a Cambridge Commonwealth Trust scholarship to study for a PhD at the University of Cambridge.

In September 1995, I returned to Singapore to work as a member of the technical staff at the Centre for Wireless Communications (now I2R). In December 2000, I took up a faculty position at the ECE Department of the University of Toronto, where I remained for 10½ years. In late May 2011, I returned to Singapore and NUS.

Q How would you compare the Department during the time you were a student and now?

A I was with the Department from 1989 to 1992, in a class of about 160. During my time, there were limited elective courses, so students took common courses until the final year. As a result, there was much comradeship, with lasting friendships made. Lecturers used transparencies and overhead projectors, as laptops were not widely available. My personal preference is still the tried and tested writing and speaking style of teaching, as compared to PowerPoint slides. The faculty has physically expanded significantly, with new buildings such as Engineering Annex and T-Labs. The core buildings E1 through E5 have remained unchanged and never fail to bring back fond memories of my student days.

Q What is your view on the research scene in Singapore today?

In my research community of communication and information theory, Singapore has an impressive depth and breadth of expertise, both within our borders and around the world. There is no doubt in my mind that this strength must be supported financially and encouraged institutionally for reasons both lofty (Cardinal Newman in the Idea of a University, 1852, said, "A university training aims at raising the intellectual tone of society") and grounded. While immediate economic benefits may be elusive in such projects, the advanced training that students and other research personnel will receive adds knowledge and hence value to Singaporean society. Further, it will improve the chances of finding the "disruptive" breakthrough that funding agencies are ever eager to claim. I consider the opportunities for collaboration with the many excellent researchers in Singapore a key selling point for me and others who are thinking of relocating to Singapore. Concerted efforts should also be made to attract the best young minds to NUS for graduate studies to support the researchers based permanently here.

Q What would you wish to see in the coming year and beyond?

A My wish is for our Department, faculty and university to fly ever higher, not by chasing after rankings and other statistics but by doing that which we all collectively know is right and which we all individually can achieve – instil into our students excitement for the pursuit of knowledge, innovate in our own fields of expertise at a global level, and nurture and respect each and every student and colleague. Only then will success be achieved.

DR ZHAO QI



Tell us about yourself.

A I was born and raised in Hangzhou, China, and obtained my BEng (Computer Science) from Zhejiang University in 2004. I received my MSc and PhD degrees (Computer Engineering) from the University of California, Santa Cruz, in 2007 and 2009, respectively. At Santa Cruz, I started my career as a

researcher on computer vision and machine learning. I also worked as an intern at Microsoft Research, Redmond and Google Research, New York, developing artificial visual systems for real-world applications.

Upon graduation, I worked as Postdoctoral Fellow in Computation & Neural Systems at the California Institute of Technology. I developed an interest in the biological principles underlying vision during my PhD study. The thirst for knowledge enabled me to work efficiently with key industry personalities such as Caltech's Dr Christof Koch, a leading scientist in biological vision and consciousness, as well as other high-calibre researchers in interdisciplinary fields encompassing brain science, computing and engineering, in the exploration of vision.

Q Why did you choose Singapore and NUS/ECE?

A I returned to Asia in the summer of 2011 and joined the Department as Assistant Professor. The University is an internationally acclaimed institute, with strengths in a wide range of disciplines, including engineering, computing, life science and medicine. The interdisciplinary resources are essential and important elements for my research. Having enjoyed the mixture of Western and Eastern cultures and cuisine, I feel at home here in Singapore and at NUS/ECE.

Q What are your research interests?

A My interests centre on integrating theories and tools from various fields, including visual cognition, computer vision, machine learning and computational neuroscience, to develop neuroscience-inspired artificial visual systems. I use these approaches to inspire interesting experimental designs for psychophysical and neurophysiological study of the biological visual systems and to gain insights into visual and cognitive disorders.

Q How is your one-year university experience different from your overseas experience?

A Compared with the USA, where Universities/research institutes are relatively sparsely distributed, the proximity of different institutes here, along with the vibrant and collaborative research environment supported by national/university policies and international interactions, makes NUS a great hub for interdisciplinary and collaborative research.

What are your plans in Singapore?

A With the support from the University and the Department, as well as the available resources and willingness of faculty members to collaborate, I envision that our joint efforts will lead to greater impact and international visibility.

DEPARTMENT

ECE PARTICIPATION AT THE AVIATION OPEN HOUSE 2011

The Aviation Open House (AOH) 2011, held on 3–5 November 2011, showcased the multifaceted aviation industry and presented career, education and training opportunities available in this sector.



"Held in a special year when Singapore is celebrating 100 years of aviation, AOH 2011 aims to ignite young Singaporeans' passion for aviation. It will give them a comprehensive panorama of the many exciting and rewarding opportunities provided by the aviation industry, and allow them to experience the buzz of aviation. With its manpower demands set to increase further, encouraging young Singaporeans to join the industry is essential to develop and sustain the talent and human resource pool for the industry's further growth", said Mr **Yap** Ong Heng, Director-General of the Civil Aviation Authority of Singapore (CAAS).

In line with ECE's vision of reaching out to the general public and students to interest them in Engineering, the Department participated in the Aviation Open House 2011. The ECE booth showcased two unmanned aerial vehicles (UAVs) and an exhibit on human vision research and development.

The award-winning ECE-UAV team has been working on various research projects related to defence technologies since 2003. The group focuses mainly on developing unmanned rotorcraft systems and other vertical-take-off-and-landing vehicles, and exploring the potential of the next-generation intelligent UAVs in various applications. The exhibits were well received by visitors and featured the current technology and state-of-the-art algorithms for real-time flight control in both indoor and outdoor terrains, which are largely relevant to the defence industry.

Another attraction at the ECE booth was the eyetracking system developed by Dr **Yen** Shih-Cheng. This system makes use of eye movements to control an on-screen cursor so that users can interact with a computer simply with their eye movements. This is applicable to the aviation industry, as it will allow fighter pilots to control their weapons' targeting systems with their eyes. This way, they can aim and shoot their targets just by looking at them. The system garnered great interest from the crowd, and many of the young visitors were fascinated by the exhibits.

According to CAAS, over 11,000 visitors attended the event. There was positive feedback from many, who found the event useful to them and felt that it showcased the vibrancy of the sector. The visitors also anticipated that, in the long run, this will translate into students making Aviation their educational and career path.

As the ECE Outreach Team continues its efforts to reach out and cultivate students' interest in Engineering from a young age, the Department looks forward to participating in more of these exciting roadshows and events.



Eye-tracking system developed by Dr Yen Shih-Cheng

ECE TEAM PARTICIPATING IN THE UAVFORGE COMPETITION



An NUS ECE team consisting of postgraduate students and research scientists, supervised by Prof Ben M **Chen** and Prof **Lee** Tong Heng, is participating in the ongoing 2012 UAVForge Challenge organised by the Defense Advanced Research Projects Agency of the United States. The NUS Team consists of two supervising professors, six research scientists and seven postgraduate students, all from the ECE Department.

The ongoing competition, which started in October 2011, involves a self-designed aircraft that has to complete a series of tasks. These include take-off and landing, manoeuvring around obstacles, landing on a building's rooftop, long-duration surveillance and target tracking. In order to compete in the challenge amongst competitors from around the world, the team has specially designed and constructed a rotary aircraft code-named GremLion to perform the given tasks.

GremLion is a unique unmanned coaxial rotorcraft constructed based on a sophisticated mechanical design. It features a robust and efficient flight behaviour and an optimised structure. It can also retract its blades when not in flight, reducing its dimensions to the size of a backpack.

During the current phase of the competition (Milestone 2), the ECE team has achieved a rating of 3.148 out of 5, positioning them first amongst all participating teams. The closest competitor, rated at 2.944, is a team from Anna University, India. The upcoming third milestone of the competition, which requires a live video demonstration, commenced in late February 2012. Upon completing

Milestone 3, the top 10 teams will be selected and awarded a trip to Fort Stewart, United States, in May for a live demonstration and to complete a series of tasks.

For more information, please visit *www.uavforge.net* or *http://uav.ece.nus.edu.sg.*



GremLion in flight.



The NUS unmanned aerial vehicle research team

MEET NANCY AND ADAM - SOCIAL ROBOTS FOR CARE AND SERVICE

Social robotics development today has advanced to a stage where it is technically feasible to provide robotics-based health-care assistance and hospitality services for the emerging demands of homes, hotels and many other industries.



Figure 1: Social robots: Nancy (left) and Adam (right).

Nancy (Figure 1, left), capable of engaging in friendly, social interaction, is designed to traverse the home environment fashionably and safely while delivering assistance to people who need special care, such as the elderly. Derived from Nancy, Adam (Figure 1, right) has the potential to transform the way hospitality service providers operate today. It has the ability to amaze guests and energise hotel receptions, ceremonies and other special events as well as to provide information intuitively through multiple interactive channels. From another perspective, it is also a powerful marketing tool that will bring hotel services to the next level.

Nancy and Adam were developed in the Social Robotics Laboratory (SRL), Interactive Digital Media Institute (IDMI) at NUS, which is a research laboratory focused on developing socially competent, personal, health-care and edutainment robotics for scientific, social and economical purposes through the synergies between arts, engineering, medicine and sciences (Lab website: http://robotics.nus.edu.sg/, Email: samge@nus.edu. sg). A research team composed of three professors (Prof Ge Shuzhi Sam, Prof Hang Chang Chieh and Prof George **Bishop**), two associate professors, three assistant professors, fourteen research fellows, eleven research engineers and ten PhD students from ECE, ME, IDMI, Department of Psychology and other institutes and universities, dedicated their skills and expertise to conceiving and realising the concept of social robots.

Both Nancy and Adam display good overall reconciliation of functionality, intelligence, flexibility and safety. The embedded advanced artificial intelligence (AI) and adaptive control systems allow them to make informed decisions, to act in a natural way and, more importantly, to adapt to a changing environment. Nancy is currently able to perform fundamental, functional and specific social tasks such as tapping, handshaking, hugging and storytelling, while Adam is capable of welcoming, entertaining and instructing guests (Figure 2). During a recent demonstration, many lab visitors experienced pleasant and enjoyable interactions with Nancy and Adam.



Figure 2: Mr Yanan Li, an NGS PhD student, interacting with Nancy (top) and Miss Quek Fon Ping Nuraisha, an ECE FYP student, communicating with Adam (bottom).

EXPLOITING SMART ANTENNAS IN COGNITIVE RADIO NETWORKS: SPECTRUM SENSING AND COGNITIVE TRANSMISSION

In recent years, cognitive radio networks (CRNs), through which the so-called secondary users (SUs) or cognitive radios communicate over certain bandwidth originally allocated to a primary network, have drawn great research interest in the wireless communication industry.

The key challenge in designing such networks is maximising the throughput of SUs' opportunistic transmissions, while concurrently minimising the interference to coexisting primary users (PUs). Dr **Zhang** Rui, one of the pioneers in identifying this problem, proposed the use of smart antennas as a solution. Recently, he was awarded the 6th IEEE Communications Society Asia Pacific Best Young Researcher Award for his work.

With the emergence of diverse wireless services and applications, the currently deployed spectrum has experienced increasing congestion. Hence, accommodating new wireless systems within the limited spectrum poses a huge challenge. According to a report published by the Federal Communication Commission of the United States, most of the allocated spectrum today is, however, underutilised. This indicates that perhaps it is the inefficient and inflexible allocation, rather than the physical shortage of the spectrum, that causes this scarcity.

Cognitive radio, the new promising technology that addresses this problem, has drawn great research interest over the years. In a CRN, SUs are allowed to access the spectrum that is originally allocated to PUs when the spectrum is not used by any PU. This secondary spectrum usage method is called dynamic spectrum access, or DSA (see Figure 1). In this way, the spectrum utilisation efficiency can be greatly improved. However, to precisely detect a vacant spectrum, or the so-called "spectrum hole", is not an easy task, and sophisticated designs are needed. Alternatively, a CRN can be designed to allow simultaneous transmissions of the PU and the SU to achieve better spectrum efficiency than that of DSA, provided that interference from the SU does not degrade the quality of service of any active PU to an unacceptable level. This transmission strategy is known as spectrum sharing (see Figure 2). However, the main challenge here is how to effectively avoid the interference to active PUs.

Dr Zhang Rui, together with his research collaborators Dr Liang Ying Chang (I²R, Singapore), Dr **Zeng** Yong Hong (I²R, Singapore) and Prof Lim Teng Joon (ECE, NUS), has developed innovative solutions to the key design problems in CRNs by exploiting the celebrated smart antenna technology. For DSA-based CRNs, the team has invented a new, multi-antenna, blind spectrum sensing method, whereby the SU is able to detect a vacant spectrum accurately over a very short period of time but without the need for any information on the PU's signal



Figure 1: DSA for cognitive radio.



Figure 2: Spectrum sharing based CRN.

format or its propagation channel. Another innovative cognitive beamforming method has been developed for spectrum sharing based CRNs by embedding the traditional antenna beamforming's new capabilities of environmental learning and cognitive adaptation. With this method, a multi-antenna SU transmitter is able to efficiently learn the signal space that the PU resides in and thereby beams its own transmission into a space orthogonal to that of the PU, thus achieving optimal cognitive transmission with minimum interference to active PUs. Substantial research and development activities have been driven by these new technologies towards implementing next-generation cognitive radiooriented wireless communication systems.

THE OPTICAL TRACTOR BEAM

Dr **Qiu** Cheng Wei and his team have proposed a technology that will use a single optical beam to drive molecules backwards, towards a light source. This technology has never been imagined or realised since the invention of the traditional "optical tweezers" or "optical motor". This beam will move suitable molecules and nanoparticles towards the light source. This means that sci-fi *Star Trek* has had it right all this while, and the "beam me up" concept may be plausible.





Figure 1: (a, b) The conventional optical tweezers. (c, d) The typical application of the tweezers in testing the sustainability of red blood cells under stretching. (e) A tractor beam: A scientific fantasy or an unknown challenge?

The tractor beam, inspired by Star Trek, can pull "suitable" objects towards the light source and tow such objects along the light trajectory. The aim of this project is to develop the science and technology of constructing such beams and to discover the relationship between beam types and corresponding objects that can be towed/pulled, although the original idea comes from pseudoscientific media.

The findings demonstrate that the pulling effect by a tractor light is feasible by manipulating the most fundamental mechanisms of light-matter interaction and laser beam physics. The importance of the development of this new science is self-evident, and this discovery can lead to revolutionary, next-generation optic platforms, especially in the commercialisation of novel devices for optical engineering and cell manipulation applications.

In particular, existing technologies find it very difficult, if not impossible, to automatically "sort out" or "stretch" different types of molecules to examine and sort out infected molecules (e.g. in malaria infection), as shown in Figure 1(c, d). In contrast, this optical traction technology can pull only suitable particles towards the light source, while pushing others away, as shown in Figure 2.



Figure 2: (a) The light beam pulls a particle towards the beam source (it will keep dragging if the light keeps shining). (b) Light conventionally pushes the particle away from the beam source. On the right, the non-diffraction Bessel beam wave vectors lying on the cone are sketched, as per the non-paraxial Bessel beam (*k* and the propagation axis are not along the same direction, i.e. a large angle α in between). (a) and (b) show the cross sections of the intensity of such a beam propagating along the beam axis (z-axis).

This finding has been published in the premier physics journal *Physical Review Letters*.

SMART ACTIVE NANOPORES MEMBRANES: INTEGRATED CATALYTIC DISINFECTANT AND SENSOR FOR AIR POLLUTION



A Green Mark building is not only about water and energy efficiency but also about indoor air quality. Dr **Ho** Ghim Wei is amongst four recipients of the National Research Foundation's proof-of-concept research grant (6th call). Her team aims to develop a smart, multifunction membrane for a low-cost system to improve indoor air quality.

The impact of indoor air pollution has been identified to be greater than that of outdoor air pollution for a typical industrialised country such as Singapore. This can be explained by the fact that, nowadays, people spend 70–90% of their time indoors, whether at work, home or even in a vehicle. Furthermore, good insulation of modern buildings reduces natural ventilation. All these factors lead to an incremental sick building syndrome and building-related illness symptoms.

The causes of indoor air pollution have been widely identified. According to the US Environmental Protection Agency, amongst the most dangerous sources of indoor air pollution are volatile organic compounds, whose presence is usually quantified at a trace concentration at the ppm level. In spite of their low concentrations, volatile organic compounds are known to cause detrimental health effects to an individual's respiratory, cardiovascular and reproductive systems.

This project aims to develop a hybrid organic–inorganic membrane, equipped with complementary filtering and disinfectant capabilities that will monitor and assess indoor air quality. This membrane system offers building occupants the needed assurance of on-site and dynamic response to airborne pollution and hazards. This project aims to achieve air monitoring and quality assurance for buildings in the short term. Its long-term goal includes extending its benefits to other key membrane technology sectors (such as the military) and upcoming markets for energy technologies, since the global market for membrane industry evolves with changing living standards, infrastructure and commodity prices.



Figure 1: (a) The schematic diagram of the membrane. (b) Top and cross-section views of the hybrid organic–inorganic membrane with enhanced disinfectant and detection capabilities.

AN INTERVIEW WITH TAO YI JUN

Wushu and engineering do mix, as ECE alumna **Tao** Yi Jun will tell you. A member of the Singapore National Wushu Team, this former student of CHIJ St Nicholas Girls' School has represented Singapore in numerous competitions, including the 24th SEA Games in Thailand and the 26th SEA Games in Indonesia. E.ConnEct catches up with this martial arts exponent.

Q Why did you want to take up Electrical Engineering?

A I have always been good at numbers and, after my first year at NUS, I realised that I liked Electrical Engineering the most.

Q What thoughts could you draw from Electrical Engineering that could be applied to wushu?

A Electrical Engineering has taught me problem-solving skills and to look at a problem objectively and come up with the best solution to solve it. It has helped me to assess my strengths and weaknesses such that I can improve my skills faster.

O How did you become interested in wushu?

A I developed an interest in wushu at a young age, when I started watching Jet Li action movies and reading Dragon Ball comics. I admired the beauty and agility of their moves. When I first took up wushu in secondary school, it was not a recognised CCA in my school so I had to juggle studies, wushu and my other CCA (gymnastics).

Q What's the most enriching thing about pursuing wushu?

A Being able to represent Singapore at international competitions and getting to know friends from different countries.

Is your family also interested in the art?

A My mother practises Taijiquan for health and fitness. My father and elder brother are not really interested in Chinese martial arts. My father is a businessman, and my mother works in the IT industry. My brother recently obtained his PhD in Engineering from NUS.

What was your reaction when you got your first Gold in Taijiquan?

A I got my first Gold at the 6th Beijing International Invitational Wushu Tournament in 2005. I also got a Bronze for Taijijian (sword). It was an assurance for me, but it was unexpected, as anything can happen on the competition ground.



Tao Yi Jun (on the right) with team members at the 26th SEA Games

What was your reaction when you got your second SEA Games Gold in the Women's Duilian event?

A I was thrilled and relieved at the same time. I was thrilled as our team managed to beat the other teams against all odds and our hard work had paid off. I was also very relieved, as we managed to clinch the last 26th SEA Games Gold Medal for Singapore and wushu.

Q How did you balance wushu and studies, and how do you balance wushu and your career now?

A I guess I am very fortunate because my professors in NUS were very understanding and supportive of me being a national wushu athlete. They allowed me to take control of my time and were very understanding when I had to go overseas for training or competitions.

Currently, I am teaching Physics at Maris Stella High School (Secondary). My colleagues are very understanding and helpful, as they help to cover my work when I am competing overseas. My colleagues and students also send me good luck messages when they know that I have competitions.

What do you hope to do next?

A I hope to spend more time on my career while maintaining my passion for wushu by teaching Taiji in the future.

GRADUATE STUDENTS' ACHIEVEMENTS

TANTALUM OXIDE-BASED RESISTIVE RANDOM ACCESS MEMORY

Wu Wenjuan, an MEng student, received the Best Student Award for her poster presentation at the 11th IEEE Non-Volatile Memory Technology Symposium 2011 (NVMTS 2011) in Shanghai, China, in November 2011.

Her winning entry, entitled "Novel Bipolar TaO_x-based Resistive Random Access Memory", reported a new Resistive Random Access Memory (RRAM) structure that comprises a chromium (Cr) electrode and an aluminum (Al) electrode sandwiching a tantalum oxide (TaO_x) layer. The memory device works in a bipolar switching mode. In previous studies of TaO_x-based RRAM, platinum (Pt) was often used as one or both of the electrodes. Replacing Pt with Cr and Al enables easier process integration due to the availability of dry etching processes for Cr and Al, as well as better adhesion on common dielectrics. The RRAM devices reported show excellent memory performance including small magnitude and tight distribution of switching voltages, low switching current, large off/on resistance ratio and good retention characteristics at high temperatures.

Wenjuan is jointly supervised by Dr **Yeo** Yee-Chia from the ECE Department, and Dr **Zhao** Rong and Dr **Shi** Luping from the Data Storage Institute.



Wu Wenjuan (third from right)

UNDERWATER AMBIENT NOISE IMAGING

Subash **Kuselan**, an MEng student, emerged as the Overall Winner of the Best Student Award at the ECE Department's Graduate Student Symposium in May 2011. This symposium was launched with the aim of enhancing the quality of graduate seminars as well as providing a platform for graduate students and faculty to share their latest research findings and ideas. Over 200 students participated in this symposium, which spanned over seven research areas. As the Overall Winner, Subash receives sponsorship of up to \$4,000 from the Department to attend a conference.

Subash's research is in the area of underwater ambient noise imaging (ANI). ANI relies on the acoustic



Subash Kuselan (on the right)

illumination produced by natural noise sources to image an underwater object of interest. Snapping shrimps are a dominant natural source of illumination in tropical waters, and their snaps occur randomly. Hence, incoherent energy detection methods, which require no knowledge of the source locations, are usually employed to form images of the objects. This approach, although simple, only produces images when the anisotropy in ambient noise is conducive. Subash's research describes a different approach. Snap detection and localisation algorithms are used to estimate the locations of the noise sources on the sea bottom and then the sound from these sources is used to passively range and form images of the objects. He also developed 3D visualisation techniques to view underwater objects using snapping shrimp noise as the sole source of insonification.

Subash is supervised by Dr Mandar Chitre.

WEIGHTED SUM-RATE MAXIMISATION FOR MULTI-USER GAUSSIAN INTERFERENCE CHANNELS

Liu Liang, a second-year PhD student, received the Best Paper Award at the 2011 International Conference on Wireless Communications and Signal Processing in Nanjing, China, in November 2011. His winning paper, entitled "A New Approach to Weighted Sum-Rate Maximization for the K-User Gaussian Interference Channel", presented a new approach to resolving a long-standing open problem in the area of wireless communications and networking.

The K-user Gaussian interference channel (GIC), with the interference treated as Gaussian noise, is a fundamental model in wireless communications, for which characterisation of the user's maximum weighted sum-rate (WSR) is a problem of high scientific interest and practical value. However, due to the user's mutual interference, this problem is, in general, non-convex and thus difficult to solve using conventional optimisation techniques. Different from prior works, Liu's paper presents a new approach to maximising the WSR for the GIC based on a novel observation that the achievable rate region is a "normal" set and the users' WSR is a "strictly increasing" function over the rate region. Consequently, the WSR maximisation problem is identified for the first time as belonging to the class of monotonic optimisation over a normal set and thus can be solved globally optimally by an outer polyblock approximation algorithm (see figure at top right). However, an essential step in this algorithm hinges on how to efficiently characterise the intersection point on the Pareto boundary of the non-convex rate region with any prescribed "rate profile" vector. The paper shows that such a problem can be transformed into a sequence of signal-tointerference-plus-noise ratio feasibility problems, which are convex and thus can be solved efficiently. The methodology proposed in this paper also has broad applications in solving other non-convex utility optimisation problems in multi-user communication systems.

Liu Liang is supervised by Dr **Zhang** Rui and Prof **Chua** Kee Chaing.



Outer Polyblock Approximation Algorithm



Liu Liang

INTELLIGENT MULTI-AGENT SYSTEM FOR A SMART GRID

Thillainathan **Logenthiran**, a PhD student, walked away with 1st Prize at the highly prestigious Siemens Smart Grid Innovation Contest in Berlin, Germany, in September 2011 for his entry "Multi-agent System for Operation of a Smart Grid". Furthermore, three of his four submissions made it to the top 20 in the contest out of 463 submissions from various industries, research institutes and universities from all over the world. The prize comprised a plaque, certificate, EUR5,000 in cash and a paid trip to Berlin to receive the prize.

In his winning entry, Thillainathan proposed an intelligent multi-agent system (MAS) approach for the operation of a smart grid. A smart grid is a vision of future power systems. It is made possible by applying sensing, measurement and control techniques with two-way communication between the electricity production, transmission, distribution and consumption components of the power grid. Two-way communication is necessary for system users, operators and automated devices to have knowledge of grid conditions in order to respond to changes in the grid dynamically. The current approach of using a central supervisory control and data acquisition (SCADA) system and several smaller distributed SCADA systems is no longer sufficient for large, complex, smart grid operations. An approach that provides adaptable local control and intelligent decision making is required. This intelligent MAS is a promising technology for



Thillainathan Logenthiran (on the right)

implementing such a system because it provides a common communication interface for all elements and has the potential to provide autonomous intelligent control actions in a distributed manner. Intelligent MAS provides the platform for modelling autonomous decision-making entities in a decentralised fashion and can be applied to microgrids and other power distribution systems.

Thillainathan is supervised by Assoc Prof Dipti **Srinivasan**.

CONTACT RESISTANCE REDUCTION AND OPTIMISATION

Koh Shao-Ming, a PhD student, received the Best Student Paper Award at the 2011 International Symposium on VLSI Technology, Systems and Applications in Hsinchu, Taiwan, in April 2011. His award-winning work, "New Tellurium Implant and Segregation for Contact Resistance Reduction and Single Metallic Silicide Technology for Independent Contact Resistance Optimization in n- and p-FinFETs", presented new technology to reduce contact resistance and improve the switching speed of advanced transistors.

Transistors are the basic building blocks of integrated circuits, which are pervasively used in almost all electronic products, for example, computers, cameras and smartphones. Miniaturisation of the transistor improves the speed of integrated circuits, but recent efforts to scale transistor size presented challenges related to high off-state leakage current and high standby power consumption. To suppress the leakage current, transistors can be built on narrow fin-like semiconductor structures, enabling the gate electrode to exert better electrostatic control of the potential in the conducting channel. Such transistors are termed multiple-gate transistors, or FinFETs, and will be adopted by the semiconductor industry at the 22 nm technology node and beyond.

As the dimensions of FinFETs are aggressively reduced, challenges associated with high parasitic resistance would be encountered. This is an obstacle to achieving



Koh Shao-Ming

high drive current or speed in the future. To tackle this issue, Shao-Ming presented an integration solution that employs tellurium segregated platinum metal contacts to lower the parasitic resistance in FinFETs. The potential "barrier" for charge carriers to surmount at the metal contact-semiconductor interface is reduced, leading to significantly reduced parasitic resistances and increased drive current in both n- and p-channel FinFETs. This technology shows promise for possible adoption in future technology nodes.

Shao-Ming is supervised by Dr **Yeo** Yee-Chia and Assoc Prof Ganesh **Samudra**.

ECE GRADUATION NIGHT 2011

Held on 11 July 2011, this annual event (on its second run) gathered nearly 200 graduating students, their families as well as ECE staff members. The students reminisced their memorable days in the university and realised they had to bid farewell to this phase of their lives. A group of ECE3, ECE4 and PhD students organised a programme that took us down memory lane that night – a nostalgic trip to the good old days on campus.

The night began with a welcome address by Head of Department Prof **Chua** Kee Chaing, congratulating all graduates and their parents, and encouraging the graduates to stay connected with their alma mater. The evening's entertainment started with the exciting "Do you remember ECE?" game, which involved identifying places on campus from sections of photographs. The game garnered much enthusiastic participation from the audience.

Next, the audience was held spellbound by the dance performance of PhD student Mr Ganesh Neelakanta **lyer**, who re-enacted a scene in the great epic Mahabharata. Mr **Zhang** Jiaxi was greeted with thunderous applause as he made his entrance and walked the length of the lecture theatre playing a medley of songs on the accordion. The audience was also mesmerised by two artistic performances by our talented staff: Prof WK **Choi**'s solo guzheng recitals of two Chinese folk songs and Prof Marc **Armand**'s electric guitar performance.

The highlight of the night was the ECE professors' creative rendition of Gaudeamus Igitur, a popular song sung at university graduation ceremonies. Prof **Liew** Ah Choy rewrote the lyrics into a light-hearted composition with a strong message to the graduates: now armed with ECE knowledge, go forth, succeed and remember that you are ECE and NUS Alumni. The finale had everyone on their feet singing Auld Lang Syne, while a montage of past events on campus was played, providing a heartwarming conclusion to an unforgettable night.



Top left: Emcees Mr Auo Wai Kit Clement and Ms Tan Mei Hui; *Bottom left:* After the party; *Right:* A scene from the great epic Mahabharata by PhD student Mr Ganesh Neelakanta lyer



A creative rendition of Gaudeamus Igitur, where the professors exhorted the graduates to go forth and succeed

ECE ALUMNI FAMILY DAY 2011

Held on Saturday, 6 August 2011, the 4th Alumni Family Day attracted more than 100 alumni members and their families, including prominent alumni such as Mr Melvin **Low** (CEO of EQUVO Pte Ltd) and Ms Angie **Ng** (CEO of the Institution of Engineers, Singapore), to name a few. Both Mr Low and Ms Ng are also Chairman and Vice-Chairman of the recently formed ECE Alumni Committee, whose mission is, in part, to build an alumni network to connect peers and link juniors and seniors across the years, hence developing business and social links.

The event began with a magic-cum-puppet show for the children, who were further entertained by face painting, henna art and balloon twisting. A caricature artist was also present to draw portraits.

Running in parallel was a guided tour of the Department's Mechatronics & Automation Lab and Control & Simulation Lab, with a preview of the latest advances in robotics and flight control for unmanned aerial vehicles. A new feature in this year's event was the array of poster presentations by PhD students, as well as a demonstration of an e-soccer game, developed and implemented in FPGA by undergraduate students.

In his welcome address, Head of Department Prof KC Chua, encouraged ECE alumni to be more involved with their alma mater and described various ways in which they could contribute to the Department. Mr Melvin Low then took to the stage to share his heartfelt reasons for wanting to give something back to the Department through his role as Chairman of the ECE Alumni Committee.

Following the two speeches, everyone was treated to a sumptuous buffet lunch. A lucky draw, which gave many alumni much to cheer about, drew the event to a memorable close.



Left: Mr Melvin Low giving his heartfelt speech Right: A very happy lucky draw winner

NUS ECE ALUMNI COCKTAIL RECEPTION 2012

The NUS ECE Alumni Committee held its first ECE Alumni Cocktail Reception on 24 February 2012 at Benefactors' Foyer @ NUS Shaw Foundation Alumni House (Level 2). The theme of the event was "Celebrating NUS ECE's Achievement of the 10th Best School of EE under QS University World Rankings". This was the first event organised and sponsored by ECE alumni, and it attracted nearly 100 attendees, including ECE alumni and ECE staff members.

Mr Melvin **Low**, Chairman of the NUS ECE Alumni Committee, kicked off the celebration. In his welcome speech, he shared his excitement for the Department's achievement in making it to the top 10 EE schools under the QS University World Rankings and, in particular, for being the first EE school outside of US/UK to be included in the top 10.

In his speech, Head of Department Prof KC **Chua** thanked the ECE Alumni Committee for organising and sponsoring this event. He shared that the achievement of the Department includes the contributions made by our alumni as well as the recognition of graduate employers. Prof Chua also encouraged the alumni to promote engineering and EE programmes to youths and to be engaged in the Department's accreditation process.

Dr Jimmy **Chen** Wie Ying, the founding professor and Head of the EE Department from 1970 to 1979, also attended the event. He received a token of appreciation from Prof Chua in recognition of his outstanding service and significant contributions to the Department.

After the speeches, everyone was treated to a buffet, topped with free flow of wine and beer. It was a wonderful night for all to remember, for it gave our alumni a chance to catch up with their former classmates and professors, and more importantly, it made everyone present proud to be an alumnus and/or staff of NUS ECE.



Top left: Mr Melvin Low giving his welcome speech; Bottom left: Prof KC Chua giving his speech; Right: Dr Jimmy Chen receiving his memento



Top left: The NUS ECE Alumni Committee; *Bottom left:* Buffet spread; *Right:* NUS ECE alumni at the Benefactors' Foyer

DO LOOK OUT FOR THESE TWO UPCOMING EVENTS:

- 3rd ECE Graduation Night 2012
- 5th ECE Alumni Family Day 2012

We look forward to welcoming you there.



If you have any comments on this issue or would like to contribute an article for subsequent ones, please email to e.connect@nus.edu.sg.