E.CONNECT

ISSN 2010-1651 ■ OCTOBER 2014 ■ ISSUE 9 A BI-ANNUAL PUBLICATION OF THE DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING, NUS

NUS ECE IS RANKED 6TH IN THE QS WORLD UNIVERSITY RANKINGS BY SUBJECT 2014 FOR ELECTRICAL & ELECTRONIC ENGINEERING

TEAM "AEROLION" FROM NUS WON THE 2014 INTERNATIONAL MICRO AIR VEHICLE (IMAV) COMPETITION HELD IN DELFT, THE NETHERLANDS

NUS National University of Singapore

CONTENTS

Editorial Team Assoc Prof Dipti Srinivasan
Assoc Prof Xiang Cheng
Assoc Prof Ng Chun Sum
Dr Yu Changyuan
Ms Eunice Wong

Photography Ms Leng Mun Tze

Advisors Prof John Thong
Assoc Prof Arthur Tay

HoD SPEAKS...

"The Department is very proud of the achievements of our staff members and students."

Prof John **Thong**
Head, Department of Electrical & Computer Engineering, NUS

I took over as Head of ECE from Prof **Chua** Kee Chaing on 1 July 2014, upon his assumption of appointment as Dean of the Faculty of Engineering. Under Prof Chua's leadership in the past 5 years, we have witnessed a renewal of the Department's undergraduate and graduate programs to adapt to the changing educational and career landscapes. He steered the Department towards the pursuit of impactful research, and we have seen a significant growth in the level of research funding as well as in the quality of research. He also left a legacy in setting ECE's core values of excellence, commitment, and integrity.

We now have a new Departmental leadership team in place with new appointments of deputy heads, associate heads, and Area Directors. I would like to thank the previous management team members for their contributions in bringing the Department to where we are today. Several new colleagues have joined the Department in the past few months, and we warmly welcome them to the ECE family.

The Department is very proud of the achievements of our staff members and students. Prof **Low** Teck Seng was elected an International Fellow of the Royal Academy of Engineering, UK. Prof Bhatia Charanjit **Singh** was elected Fellow of the American Society of Mechanical Engineers (ASME), while Assoc Prof **Yan** Shuicheng was made an International Association for Pattern Recognition (IAPR) Fellow; he is also listed as a Highly Cited Researcher in the 2014 report published by Thomson Reuters. Prof **Chen** Zhining's team was awarded the Institute of Engineers (IES) Engineering Award, while several teams with student participation have done us proud by clinching a number of prestigious awards and prizes.

We witnessed the formation and inauguration of the Undergraduate Student Council (USC) comprising student leaders and representatives. The USC aims to enhance the university experience of ECE undergraduates through activities and services, and will work closely with the Department's management. We look forward to a more vibrant student community as the USC takes ownership to flesh out its plans in the coming year.

NEW MANAGEMENT TEAM

Prof John Thong (Head of Department) appointed the following faculty staff as the management team with effect from 1 July 2014:

Deputy Head (Administration) – Assoc Prof **Chor** Eng Fong

Deputy Head (Research & Graduate Programmes) – Prof **Lim** Teng Joon

Deputy Head (Undergraduate Programmes & Student Life) – Assoc Prof Vivian **Ng**

Deputy Head (External Relations & Outreach) – Assoc Prof Arthur **Tay**

Associate Head (Research) – Assoc Prof **Tan** Kay Chen

Associate Head (Graduate Programmes) – Assoc Prof Mansoor bin **Abdul Jalil**

Associate Head (Undergraduate Programmes) – Assoc Prof **Heng** Chun Huat

Associate Head (Student Life) – Assoc Prof Marc Andre **Armand**

The directors for the 7 major research areas are :

Area Director (Communications & Networks) – Assoc Prof Biplab **Sikdar**

Area Director (Signal Processing & New Media) – Assoc Prof **Cheong** Loong Fah

Area Director (Control, Intelligent Systems & Robotics) – Prof Ben **Chen**

Area Director (Power & Energy Systems) – Assoc Prof Sanjib Kumar **Panda**

Area Director (Microwave & RF) – Prof **Yeo** Tat Soon

Area Director (Microelectronic Technologies & Devices) – Prof **Teo** Kie Leong

Area Director (Integrated Circuits & Embedded Systems) – Assoc Prof Massimo Bruno **Alioto**

INTRODUCING PROFESSOR KAUSHIK ROY

Professor Kaushik **Roy** was appointed Visiting Professor in ECE Department on 10 June 2014, under GlobalFoundries' Chaired Professorship in Engineering.

During his one-year appointment, Prof Roy will be working with ECE faculty members to identify research problems centred on the theme of spin logic, spin memories and their hybrids, and to initiate collaborative projects.

Prof Roy is currently a Professor in Purdue University, USA, and holds the Edward G. Tiedemann Jr. Distinguished Professorship. Prof Roy is well-respected in the IC design and circuits community, in particular, for his expertise in the field of low-power electronics, and for his more recent work on spintronics and magnetic non-volatile memories at the circuit and architecture levels. His expertise in the field is seen in his leadership in Spintronic Circuits and Architectures at the Center for Spintronic Materials, Interfaces, and Novel Architectures (C-SPIN), a STARnet centre in the USA hosted by the University of Minnesota.

On top of having published more than 600 papers in refereed journals and conferences, Prof Roy holds 15 patents and is co-author of two books on Low Power CMOS VLSI Design. He received the National Science Foundation Career Development Award in 1995, IBM faculty partnership award, AT&T/Lucent Foundation award, 2005 SRC Technical Excellence Award, SRC Inventors Award, Purdue College of Engineering Research Excellence Award, Humboldt Research Award in 2010, 2010 IEEE Circuits and Systems Society Technical Achievement Award, Distinguished Alumnus Award from the Indian Institute of Technology (IIT), Kharagpur, and the Fulbright-Nehru Distinguished Chair.

Prof Roy has also won numerous best paper awards at international conferences as well as IEEE Transactions. Besides being an IEEE Fellow, Prof Roy has sat on several boards including the editorial board of IEEE Design and Test, IEEE Transactions on Circuits and Systems, IEEE Transactions on VLSI Systems and IEEE Transactions on Electron Devices.

AWARD OF ECE SCHOLARSHIPS

Every year, ECE Scholarships are awarded to three outstanding local freshmen who have performed well academically. The award is bond-free and each recipient will receive $10,000 per annum. The ECE scholarship is made possible with the generous donations by staff, alumni and corporate partners.

Lim Yi Hong, Prof John **Thong**, **Shi** Bohan and Joanne **Tan** Si Ying

Joanne **Tan** Si Ying (Electrical Engineering)

"Hello! I am Joanne Tan. I was from Hwa Chong Institution and am currently studying Electrical Engineering in NUS. I love electrical engineering because it is a highly dynamic and versatile field. Due to the large number of disciplines it encompasses, I am fascinated by its potential in creating solutions for societal issues.

During my High School and Junior College years, I was involved in various co-curricular activities. I was part of the Japanese Cultural Club as foreign cultures are of interest to me. The club allowed me to meet like-minded peers and pick up the Japanese language along the way. I also enjoy International Chess and Othello as I relish the adrenaline rush during each game. I have a passion for research, and have taken up a few research projects over the years. I was also part of the Student Research Council.

I feel that engaging the community is important and extremely rewarding, which is why I have volunteered at various community and grassroots activities. I was particularly inspired by the weekly Meet-the-People sessions in West Coast GRC that I was part of because it opened my eyes to many different aspects of society and taught me invaluable life lessons.

Shi Bohan (Electrical Engineering)

"Hi! I am Shi Bohan. I graduated from the Singapore Polytechnic (SP) before my admittance to NUS.

During my three years at SP, I realised that studying is just a small part of life and one can achieve more by stepping out of one's comfort zone, as well as doing meaningful things such as giving back to society.

Hence, I joined several programmes including the SP Mentoring Club (to help foreign students quickly settle down in the Singapore community) and the SP Tutoring Club (to teach students who need extra help with their school work).

I am now enrolled in Electrical Engineering. Every day, I look forward to what I will be taught. Engineering is where my interest lies. I feel that engineering is like the fundamental building blocks of everyday life. Look around and you will see engineering in every aspect of our daily lives. I aspire to become one of the engineers who find solutions to problems in everyday life, such as the solar panel, microwave ovens.

I would like to end off with one of my favourite quotes, "Birds born in a cage will think that flying is an illness" by Alejandro Jodorowsky. You will never know what you are capable of unless you try."

Lim Yi Hong (Computer Engineering)

"Hello! I am Lim Yi Hong. I am currently pursuing a degree in NUS Computer Engineering. Previously I was from Ngee Ann Polytechnic (NP), where I graduated with a Diploma in Network System and Security. I have a strong interest in computers and networking. In our modern society, computers are needed in every sector and networking is the connectivity between all the devices, thus both are needed to improve and enhance our performance. The need for Computers and Networking is of paramount importance, and I am fortunate to have the opportunity to pursue computer engineering in NUS.

I was from Holy Innocents' High School. In my secondary school days, I actively took on leadership roles, and during my senior year, I was elected as the President of the Student Leaders Board. During my tenure, I was exposed to the idea of Servant Leadership. The word "Servant" may be misleading, but in order for us to Lead others, we are actually in Service to others. Simply put, "Lead to Serve and Serve to Lead". This has always been my guiding principle.

The same guiding principle will follow me through NUS. Being in the NUS ECE Undergraduate Student Council, the idea of Servant Leadership holds true for me again. I will lead my peers by being of service to them."

ANNUAL TEACHING EXCELLENCE AWARD

Congratulations to Associate Professors Aaron **Danner** and **Heng** Chun Huat on being conferred the Annual Teaching Excellence Award!

We find out more from the two lecturers about what their classes are like.

Assoc Prof Aaron Danner

One of the classes Assoc Prof Danner teaches is Analog Electronics, where he holds a laboratory session in which each student has to build a working radio transmitter from basic parts like transistors, resistors, capacitors, and inductors in three hours.

"This is a difficult challenge for the students, and I make it even more challenging for them by assigning a different broadcast frequency to each student which means every circuit is different. It's a strictly outcome-based task - students do not receive lab marks until their circuits work. This encourages students to come to class prepared," said Assoc Prof Danner.

"Designing and building a radio transmitter is a complicated task requiring sophisticated know-how; it's one of those tasks that makes an electrical engineer feel like an electrical engineer. The act of bringing together multiple skills learned through building a working circuit is deeply satisfying for both student and lecturer."

Assoc Prof Danner added that he has even seen students go on to build better transmitters on their own after class, simply because they were interested and motivated.

Assoc Prof Heng Chun Huat

Assoc Prof Heng is another lecturer who was conferred the Annual Teaching Excellence Award (ATEA) for the extraordinary efforts that he puts into teaching his students. He believes that it is vital to cultivate students' interest in their modules.

For winning the award multiple times (2008 and 2011), Assoc Prof Heng has been placed on the privileged ATEA Honour Roll. Assoc Prof Heng was also the Faculty of Engineering Innovative Teaching Award winner in 2009.

ASME FELLOWSHIP

Professor Bhatia Charanjit **Singh** had the rare privilege of being elected as a Fellow of the American Society of Mechanical Engineers (ASME) in March 2014, for a lifetime of outstanding engineering achievements in magnetic recording.

Throughout his career at IBM/HGST and also at NUS, Prof Singh has been instrumental in leading and participating in teams that have achieved significant developments in the area of magnetic data storage systems. His achievements are partially responsible for the pervasiveness and low cost of high density storage that is available today.

The ASME Committee confers the Fellow grade of membership on worthy candidates to honour members who have distinguished themselves with outstanding engineering accomplishments and careers. Only 3,300 out of 140,000 professional members have been elevated to the grade of Fellow. Congratulations to Prof Singh!

ROYAL ACADEMY OF ENGINEERING (UK) FELLOWSHIP

PROFESSOR **Low** Teck Seng, former NUS Dean of Engineering, has been elected as an International Fellow of the Royal Academy of Engineering, UK. He is the 4th Singaporean to be elected to the Royal Academy.

Prof Low, faculty member with the NUS Electrical & Computer Engineering Department and CEO, National Research Foundation, was cited by the Royal Academy of Engineering as having made outstanding contributions to Singapore's R&D and education landscape. He founded two key institutions – the Data Storage Institute, a national research institute; and Republic Polytechnic (which now enrols 14,000 tertiary students).

Internationally, he served the IEEE in various capacities and chaired the Committee on Science and Technology for ASEAN.

Among other recognitions, Prof Low was awarded the National Science and Technology Medal in 2004, the highest honour bestowed on an individual who has made distinguished, sustained and exceptional contributions, and played a strategic role in the development of Singapore through the promotion and management of R&D.

In 2007 he was awarded the Public Administration Medal (Gold) by the President of Singapore for his outstanding contributions to the development of technical education and the management of science and technology for the nation.

He was also conferred the Honorary Doctor of Science by Southampton University in 2009, in recognition for his contributions to Singapore and his profession internationally, in the IEEE.

NEW APPOINTMENTS AND PROMOTIONS

PROMOTIONS FACULTY / ACADEMIC

- DR **THONG** THIAM LEONG, JOHN – promotion to Full Professor on 1 July 2014
- DR **HONG** MINGHUI – promotion to Full Professor on 1 July 2014
- DR **HO** GHIM WEI – promotion to Associate Professor on 1 July 2014
- DR PANIDA **JIRUTITIJAROEN** – promotion to Associate Professor on 1 July 2014

NEW APPOINTMENTS FACULTY / ACADEMIC

- DR **ANG** KAH WEE joined ECE Department as Assistant Professor on 14 July 2014. Prior to this, Dr Ang was an R&D Manager at the Institute of Microelectronics (IME), A*STAR. Dr Ang obtained a Master's degree in Advanced Materials for Micro- and Nano-Systems from the Singapore - MIT Alliance in 2004 and a Ph.D. in Electrical and Computer Engineering from NUS in 2009. His research interests are in the areas of Nano-Electronics and Nano-Photonics, (Nano CMOS Devices and Memories, New Materials and Process Technologies in Nano Electronics), New Bio-sensing Devices, Optoelectronics Materials, and Integrated Circuits (OEIC) in Nano- & Bio-Photonics.

- DR **GONG** XIAO joined ECE Department as Assistant Research Professor on 25 August 2014. Dr Gong obtained a Ph.D. in Electrical and Computer Engineering from NUS in 2013. Dr Gong's research interests and specialisations are in InGaAs and GeSn High Mobility Channel Transistors for Future High Speed and Low Power Applications. Prior to his appointment as Assistant Research Professor, he was a Research Fellow in the ECE Department working on design, simulation and fabrication in InGaAs channel high electron mobility transistors (HEMTs) with channel length down to 100 nm using fully CMOS-compatible process flow.

- DR **LIN** FENG joined ECE Department as Assistant Research Professor on 1 September 2014 in a joint appointment with Temasek Laboratories where he is currently a Senior Research Scientist. Dr Lin obtained a Ph.D. in Electrical and Computer Engineering from NUS in 2011. His research interests are in Flight Control (Control Application and Machine Vision System) and Vision-aided Inertial Navigation and Unmanned Systems.
- DR **HA** YAJUN joined ECE Department as Adjunct Assistant Professor on 3 March 2014. He is currently a Scientist at the Institute of Infocomm Research (I2R), A*STAR. Dr Ha holds a Ph.D. degree (2004) from Katholieke Universiteit Leuven, Belgium. His main area of research focuses on ultra-low power FPGA design and embedded systems.
- DR ROBBY TANTOWI **TAN** joined ECE Department as Adjunct Assistant Professor on 14 August 2014. He is currently the Head of Multimedia Technology and Design Programme and Senior Lecturer at SIM University. Dr Tan holds a Ph.D. degree (2004) in Computer Science from the University of Tokyo, Japan. His research interests are in the areas of computer vision (physics-based vision, human motion analysis), machine learning and computer graphics (computational photography, image/video editing).
- DR **SUN** YING joined ECE Department as Adjunct Assistant Professor on 1 September 2014. She is currently a Scientist at the Institute for Infocomm Research (I2R), A*STAR. Dr Sun holds a Ph.D. degree (2004) in Electrical and Computer Engineering from Carnegie Mellon University, USA. Her research interests are in the areas of signal processing and imaging.

TEACHING ASSISTANT

- MR SHAHZOR **AHMED** joined ECE Department as a Teaching Assistant on 2 June 2014.

EXECUTIVE AND NON-ACADEMIC

- MS **TAN** YONG SUAN joined ECE Department as a Management Assistant Officer (Human Resource Administration) on 17 July 2014.

ISI HIGHLY-CITED RESEARCHER AND IAPR FELLOW 2014: ASSOCIATE PROFESSOR SHUICHENG YAN

Some of the world's leading minds are on the Institute for Scientific Information's (ISI) "Highly Cited Researchers 2014" list.

Over 3,000 researchers have earned this distinction by writing numerous publications officially designated by Essential Science Indicators as Highly Cited Papers. These researchers rank among the top 1% most cited for their subject field and year of publication, a mark of exceptional impact.

Assoc Prof Shuicheng **Yan** is on the list this year for his series of highly-cited research papers on subspace learning and sparse coding. Of these papers, two have been cited more than 1,000 times each and more than 20 papers have been cited more than 100 times each. In total, 3,215 researchers are recognised globally, among which 187 are from the engineering field. All the awardees this year are also among the list of the "world's leading scientific minds" recognised by Thomson Reuters in 2014.

Assoc Prof Yan has also been made an International Association for Pattern Recognition (IAPR) Fellow 2014 for his contributions to computer vision and pattern recognition. The prestigious IAPR Fellow Award was introduced in 1994 and, since then, has been biennially conferred on those with outstanding contributions to the field of pattern recognition and IAPR activities. According to the Constitution and Bylaws of IAPR, the number of fellows elected every two years must not exceed 0.25% of the total IAPR membership. In total, 15 IAPR members were awarded IAPR Fellow this year.

Besides his research achievements in pattern recognition, Assoc Prof Yan serves as a board member of Pattern Recognition and Machine Intelligence Association (PREMIA), Singapore.

IES ENGINEERING ACHIEVEMENT AWARD

Prof **Chen** Zhining's team was awarded the prestigious Institute of Engineers (IES) Engineering Achievement Award on 18 July 2014.

The team, comprising NUS, Institute of Infocomm Research (I2R) and Defence Science Organsations National Laboratories' research staff, namely I2R's Drs **Liu** Wei and **Qing** Xianming, DSO's Mr **Yeo** Siew Yam, Mr **Yeo** An Da and Dr **Lu** Jian, was honoured for their breakthrough development on metamaterial ultra-low-profile broadband antennas.

Prof Chen led his team to work out a technology to address the most critical challenges of antenna design in practical applications requiring wide operating bandwidth and small size.

Based on the new physical concept of metamaterials, the team developed innovative technologies that enhance the performance of antennas by four times. This work has successfully translated the theoretical physical concept of metamaterials to practical engineering technologies for novel antenna designs. Their pioneering work has been successfully applied in industries ranging from mobile communication network to defence systems. In mobile communication, their metamaterial technologies are being used in WiFi in-coming small cells and millimeter-wave high-data-rate backhaul of the 5th generation network while in defence systems, vehicular radar systems are making use of their pioneering work.

NUS YOUNG INVESTIGATOR AWARD

Dr Vincent **Tan** was conferred the NUS Young Investigator award for his project, "An Information-Theoretic Understanding of Machine Learning Algorithms".

In this project, Dr Tan and his collaborators looked at the fundamental performance limits of various machine learning tasks (classification, prediction, estimation) by proving achievability and impossibility (converse) results. Dr Tan's team used tools from probability theory, such as large deviations, and weak convergence theorems.

Explained Dr Tan, "We wanted to try something that is different from typical machine learning approaches as we were not too concerned with formulating efficient algorithms, but more with studying their ultimate performance limits using information-theoretic techniques such as the method of types."

Dr Tan is pleased and proud to be conferred the award.

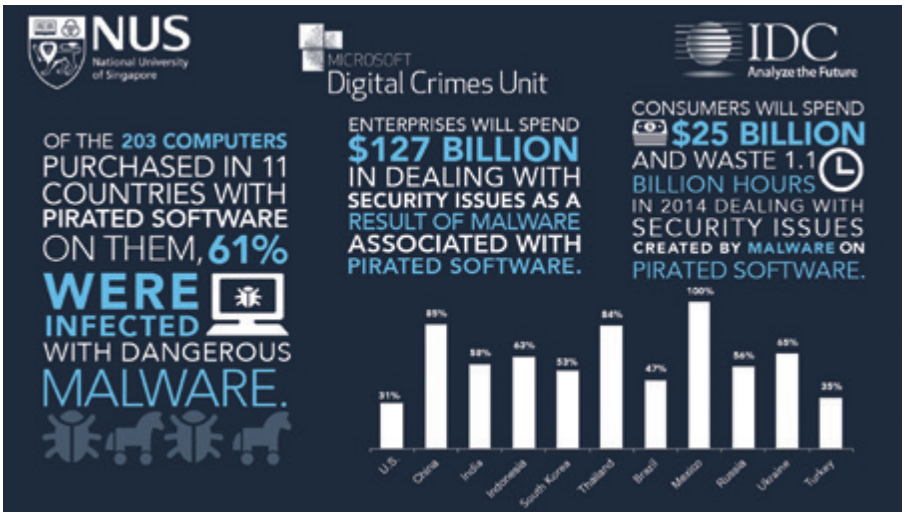
"This award is important for me to further my research agenda as it provides me with additional resources for inviting top researchers to NUS for collaboration here and for me to learn more at conferences and workshops abroad."

ECE CYBERSECURITY RESEARCH

In a project funded by Microsoft, ECE researchers have found the link between pirated software and malware that infects computers.

In a global study of computer samples procured from 11 countries, ECE researchers detected malware in 62% of the samples, with over 200 unique individual malware strains. The ECE study showed that PCs and laptops bought through prevalent supply chains came pre-infected with unsafe malware, including Trojans, worms, viruses, hack tools, rootkits and adware. The ECE study has received worldwide media attention with more than 800 media stories.

Software piracy is a global problem with possible profound impact on industries, governments, and individual users. According to recent studies, the global piracy rate for personal computer (PC) software was around 42% in 2011, and the commercial value of the market for pirated software was $63.4 billion. While the economic implications of software piracy in terms of lost revenue receive significant attention in the media and academia, another detrimental aspect of pirated software in terms of security issues is less known.



Pirated software often comes associated with diverse forms of malware such as worms, viruses, and Trojans, to name a few. The malware exploits various vulnerabilities in the host computer or uses unauthorised user information to inflict damage either locally or at remote locations.

The ECE team evaluated the security risks associated with the use of pirated software. The primary goal of the study was to find out the type of malware infections found in new PCs installed with pirated software when they leave the shops to enter private homes or offices. The study highlighted the fact that new PCs come pre-infected with malware before they are used by the consumer and before the PCs are connected with the Internet or external storage devices. Such behaviour shows how malware is maliciously embedded in the uncontrolled and unknown supply chain of pirated software, a process often controlled by cybercriminals and organised criminal syndicates.

The study is based on an in-depth analysis of 203 personal computers and 50 software CDs/DVDs that were bought from 11 countries (USA, Mexico, Brazil, Russia, Ukraine, Turkey, India, Thailand, China, Indonesia and South Korea). Each of the software and personal computer was thoroughly investigated for the presence of malware and signs of tampering with the software settings.

Based on this analysis, the major findings of the study are

(i) About 63.2% of the samples were infected with malware,

(ii) There are more than 200 unique strains of malware, and

(iii) More than 50% of the samples showed signs of tampering.

In collaboration with the International Data Corporation, the team also looked at the likely cost of reversing the damage caused by malware. The study showed that enterprises worldwide are expected to spend nearly $500 billion in 2014 to deal with issues caused by malware deliberately loaded onto pirated software, with $127 billion dealing with security issues and $364 billion dealing with data breaches. In addition, individual consumers are expected to spend $25 billion and waste 1.2 billion hours this year because of security threats and costly computer fixes stemming from malware on pirated software.

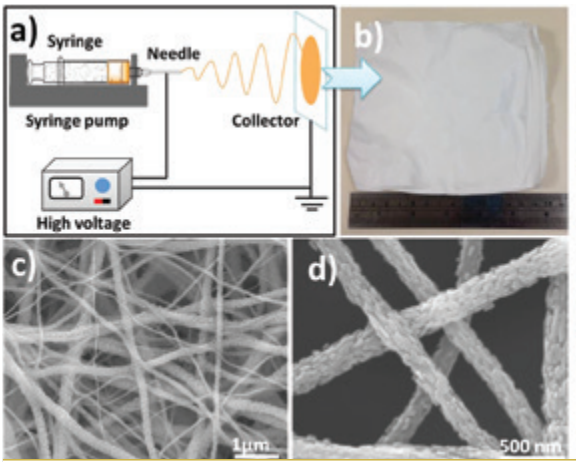
The ECE project, sponsored by Microsoft, is made up of a team of graduate students comprising Sravana **Kumar**, Logesh **Madhavan** and Mangalam **Nagappan** led by Associate Professor Biplab **Sikdar**. Kudos to the team for their impactful study!

FIBROUS PHOTOCATALYSTS RESEARCH

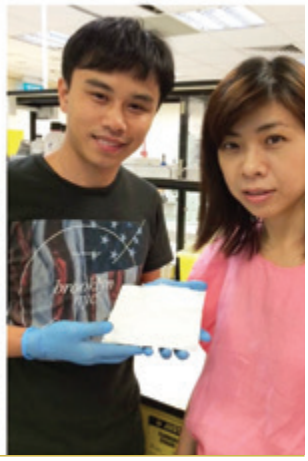
Finding new approaches to power by making its use cleaner and safer is one of the most important issues today. Hence, the global concern with the sourcing for renewable water and energy solutions.

The importance of a sustainable environment has led to new international legislations on carbon-emission, pollution, etc. This, in turn, has increased the demand for innovative materials that are effective in resolving energy and environmental issues.

One such material is Titanium Dioxide (TiO_2). TiO_2 remains stable in a chemical environment and has long-term photostability, thus making it an important semiconductor photocatalyst for the removal of pollutants from aqueous/gas phase systems. TiO_2 has been found to be effective in environmental clean-ups, in the treatment of drinking water as well as the splitting of water to generate clean and safe H_2.



(a) A schematic of an electrospinning setup.
(b) A fibrous photocatalyst mat.
(c-d) SEM images of composite nanofibres.



(From left) Dr **Zhu** Liangliang and Assoc Prof **Ho** with a fibrous photocatalyst mat.

A research team led by ECE's Associate Professor **Ho** Ghim Wei looked into the development of TiO_2 composite nanofibres for the co-generation of clean water and energy by photocatalysis. The result of the study was the development of a fibrous photocatalyst mat with a porous structure that can increase the specific surface area of charge carriers while decreasing migration distance.

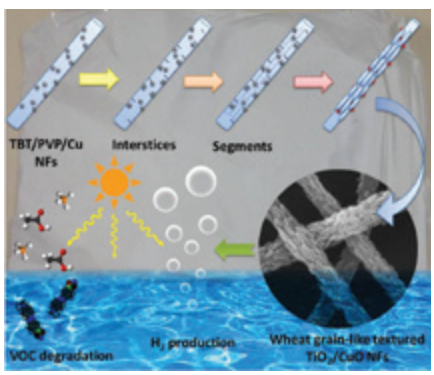
The innovative team also produced a hetero-interfacing charge carrier with a co-catalyst that enhances light absorption, charge separation and transfer efficiencies. By combining these strategies, the ECE team came up with a design of an advanced photocatalyst for the degradation of wastewater and generation of H_2 that uses abundant and inexhaustible solar energy.

The ECE team's study was recently published in the Nano Energy journal, authored by Dr **Zhu** Liangliang, Prof **Hong** Minghui and Assoc Prof Ho Ghim Wei, to demonstrate the multi-functional use of wheat grain-like textured TiO_2/CuO composite nanofibres.

"Purposefully designed TiO_2-based composite nanofibres that are highly textured have the best of both high-surface area and enhanced transport properties. The nanofibres have also been shown to provide a higher photocatalytic response," explained Assoc Prof Ho. "The electrospinning technique for the fabrication of composite nanofibres has high throughput as well as flexibility in the control of the dimensions of the nanofibres and the adjusting of their functionalities."

The direct amalgamation of active, non-noble and inexpensive nanoparticles during the electrospinning of TiO_2 nanofibers not only produces unique wheat grain-like textured morphology, it also achieves structural stability and enhanced catalytic activity of the nanofibres. In addition to producing H_2, the composite nanofibre has been proven to degrade wastewater with much higher efficiency than that of commercial TiO_2.

In conclusion, the employed synthetic approach offers an avenue for the preparation of fibrous photocatalyst with unique morphology and improved catalytic properties for simultaneous environmental and energy applications. An important pragmatic consideration of using these fibrous photocatalyst mats is the ease of separation and recovery after photoreactivity.



The process of phase separation and evaporation induced self-assembly of textured composite nanofibres is shown here. Nanofibres have high stability and can be recycled as a photocatalyst for H_2 generation and organic pollutant degradation.

NUS ENGINEERING CHARITY GOLF 2014 – A TEE OFF FOR A GOOD CAUSE

The inaugural NUS Engineering Charity Golf event was held on 20 May 2014 at the Orchid Country Club. Jointly organised by alumni from the Engineering Class of 1982, and the Electrical Engineering Class of 1986, the event aimed to raise $200,000 for the Engineering Class of 1982 Bursary Endowment Fund. Engineering students, as well as staff from ECE and the Faculty of Engineering's External Relations Office supported and coordinated the event.

Catching up with old friends

From left: Profs SL **Lee**, CC **Hang**, AC **Liew** and HF **Cheong**

After lunch, a full house of 144 golfers, comprising Engineering Alumni and friends teed off to near-perfect weather at 1.30pm. The tournament was followed by a sit-down dinner at the Jade Foyer, attended by more than 200 diners comprising golfers, donors, friends and staff. The dinner provided a good opportunity for old friends to catch up with one another and opportunities to make new friends.

Following the dinner, alumnus emcee Mr Melvin **Low** (Electrical Engineering '86), invited the Chairman of the Organising Committee, Mr **Seah** Cheng San (Engineering '82), to present a cheque of $388,000 to the Dean of Engineering, Prof **Chan** Eng Soon. This amount was nearly double that of the $200,000 target and is the highest sum ever raised by a golf event for NUS. Thereafter, Prof Chan presented tokens of appreciation to 11 Platinum ($25,000 and above) donors, including the Institute of Engineers, Singapore (IES), Tote Board and alumni.

Over the course of the evening, Prof Chan and Head of ECE, Prof **Chua** Kee Chaing, presented golf novelty awards, prizes and trophies to the golfers. The Most Inspiring Golfer award was presented to Prof **Lee** Seng Lip. At age 89, Prof Lee still plays golf regularly. He even outscored a number of the younger golfers that afternoon!

The Tigerlillies, whose members are also NUS alumni, kept diners entertained throughout the evening with renditions of popular favourites. The evening culminated with a Grand Lucky Draw which saw 12 happy winners walk home with attractive prizes. Our heartfelt thanks to all the generous donors and sponsors.

Another photo for the album

ECE ALUMNI HOMECOMING DAY 2014

The ECE Department held its seventh Alumni Homecoming Day on the late afternoon of Saturday, 30 August 2014. The event attracted more than 240 attendees from alumni members and their families, as well as present and past ECE staff members.

Highlights of the event included selected ECE research exhibits and poster presentations by our research scholars to keep the alumni abreast of some of the exciting new research frontiers charted by the ECE Department. Besides a buffet dinner, the programme included a balloon-sculpting workshop and an art and craft segment. For our alumni, it was an enjoyable day of renewing ties with ex-lecturers, advisors and classmates while meeting new people.

Many alumni joined the guided lab tour to see the wireless sensor network test-bed in CommNet Lab, and the vital signs monitor based on smart cushion with fibre sensor in the Optical Communication Lab. The alumni found the session engaging as they delved into technical discussions on cutting-edge research areas.

In his presentation, the new Head of Department, Professor John **Thong**, highlighted the global standing and international recognition of the ECE Department, and encouraged the ECE alumni to build stronger ties with the Department. Dr **Ahmed** Mahmood, the new Chairman of the NUS ECE Alumni Committee and Research Associate at the University's Tropical Marine Science Institute, then took to the stage to introduce the members of his committee and to explain its mission.

Following the speeches, a lucky draw was held which brought cheer to many. Everyone was then treated to a sumptuous buffet dinner. The whole event was a roaring success!

Creativity called for during the lantern artwork segment of the Homecoming!

Dr Rajesh Chandrasekhara **Panicker** (second from left), ECE lecturer and Ph.D. alumnus, reconnecting with other alumni. Assoc Prof Sanjib Kumar **Panda** is standing on the left

Alumni and Family on the lab tour

Lucky draw prize presentation by Prof John **Thong**, Head, ECE

Glitter away at the Homecoming – some tattooing glitter fun for the adults too!

STUDENT ACHIEVEMENTS

Members of Team "AeroLion" in Harskamp, Delft

2014 INTERNATIONAL MICRO AIR VEHICLE COMPETITION

Team "AeroLion" from NUS won the 2014 International Micro Air Vehicle (IMAV) Competition held in Delft, the Netherlands. The competition consisted of a single mission that combined both outdoor and indoor mission elements. The focus of the competition was on surveillance, recognition, endurance and multi-MAV operation.

Team "AeroLion" comprised

- **Cui** Jinqiang (NGS Ph.D. student)
- Kevin **Ang** Zong Yao (ECE Ph.D. student)
- **Phang** Swee King (NGS Ph.D. student)
- Dr **Wang** Fei (Research Scientist, Temasek Lab [TL])
- Dr **Lin** Feng (Senior Research Scientist, TL)
- Dr **Dong** Xiangxu (Research Scientist, TL)
- **Pang** Tao (ECE M.Eng student / Associate Scientist, TL)
- **Yang** Zhaolin (Associate Scientist, TL)
- **Lai** Shupeng (NGS Ph.D. student)
- **Li** Kun (ECE Ph.D. student)
- **Wang** Kangli (ECE Ph.D. student)
- **Ke** Yijie (ECE Ph.D. student)
- **Liu** Peidong (ECE M.Eng student)
- **Li** Xiang (Research Engineer, ECE)
- **Lin** Jing (Lab Technologist, ECE / TL)

The team, supervised by Prof Ben M. **Chen**, took home a trophy and certificate.

GUAN ZHAO-ZHI PAPER AWARD

Dr **Wang** Fei (left) receiving the award in Nanjing

An NUS team that worked on "Guidance, navigation and control of an unmanned helicopter for automatic cargo transportation" won the Guan Zhao-Zhi Paper Award at the 33rd Chinese Control Conference held in Nanjing, China, in July 2014. This is the highest award in control theory and applications in China for research work by first authors aged 40 years and below. The prize was a certificate and 5,000 Renminbi.

The team comprised

- Dr **Wang** Fei (Research Scientist, Temasek Lab [TL])
- **Liu** Peidong (ECE M.Eng student)
- **Zhao** Shiyu (NGS Ph.D. student)
- Prof Ben M. **Chen** (ECE Professor)
- **Phang** Swee King (NGS Ph.D. student)
- **Lai** Shupeng (NGS Ph.D. student)
- Prof **Lee** Tong Heng (ECE Professor)

SINGAPORE AMAZING FLYING MACHINE COMPETITION AWARDS

Proud winners: **Pang** Tao, **Li** Kun, **Wang** Kangli and **Ke** Yijie

Mook Wei Lian, Dr **Wang** Fei, **Phang** Swee King and **Liu** Wenqi with their prizes

At the Amazing Flying Machine Competition held at the Science Centre Singapore (SCS) in March 2014, three teams did NUS proud.

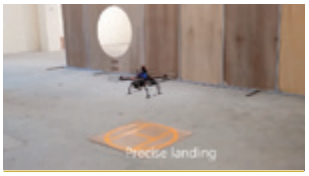
Team "U-Lion" won several awards and the overall championship at the competition co-organised by DSO National Laboratories and SCS. The team took part in Category E of the competition where the main task was to design an unconventional aircraft and then fly it at the competition.

Making up the team were **Wang** Kangli (ECE Ph.D. student), **Ke** Yijie (ECE Ph.D. student), **Li** Kun (ECE Ph.D. student) and **Pang** Tao (ECE M.Eng student / Associate Scientist, Temasek Lab).

Awards

- Overall Championship (Gold) – Cash Prize of $3,000 and five iPad Minis
- Best Performance Award (Gold) – Cash Prize of $1,000
- Most Creative Award (Bronze)

K-Lion, Cat D1, 2014



Q1-Lion, Cat D2, 2014

Also winners at the competition were Teams "Q1-Lion"and "Q2-Lion", both of which won awards in Category D2 of the competition where the main task was to design a fully autonomous aircraft to complete several indoor tasks. The tasks included navigation through windows and doors, payload dropping, information scrapping, and landing.

Team "Q1-Lion"comprised Dr **Wang** Fei (Research Scientist, Temasek Lab [TL]), **Phang** Swee King (NGS Ph.D. student), **Ai** Zizhang (EE4 Student), **Liu** Wenqi (EE4 Student) and **Mook** Wei Lian (EE4 Student).

Awards

- Overall Championship (Silver) – Cash Prize of $3,000
- Best Performance Award (Gold) – Cash Prize of $1,000
- Best Theory of Flight Award (Gold)

Team "Q2-Lion"comprised Kevin **Ang** Zong Yao (ECE Ph.D. student), **Liu** Peidong (ECE M.Eng student), **Cui** Jingqiang (NGS Ph.D. student), **Lai** Shupeng (NGS Ph.D. student) and **Wang** Dong (EE4 Student).

Award

- Best Theory of Flight Award (Silver)

GRADUATE STUDENT ACHIEVEMENT

Ph.D. student Abhra Roy **Chowdhury** did ECE proud again!

In addition to his IEEE Oceanic Engineering Society's Scholarship awarded in 2013, Abhra was awarded another scholarship this year.

Abhra was awarded the Society of Instrument and Control Engineers (SICE) International Scholarship for his research work entitled "Kinematic Parameter based Behaviour Modelling and Control of a Bio-inspired Robotic Fish Propulsion" presented during the SICE Annual Conference 2014, held in Hokkaido University, Sapporo, Japan, from 9 to 12 September 2014.

The SICE scholarship is given out to young foreign researchers with recognised potential ability to contribute to the field of Instrument and Control Engineering and who have records of achievements in their fields.

The prize includes a certificate and a sum of 100,000 Japanese Yen (US$1,000).

Abhra is supervised by Assoc Prof Sanjib Kumar **Panda** from the ECE Department.

ECE SWEEPS TOP PRIZES AT iNEMO DESIGN CONTEST

CYCLISTS will love this – a smart vest with LED lights for signalling. Hand gestures from cyclists are automatically translated to LED signals and messages such as "turning" or "slowing down" and "stopping". The vest will even sound an alarm when the cyclist falls and is unable to get up.

This innovative invention, the final year project of ECE students, Mr **Tan** Sze Wei and Mr **Low** Kang Jiang (supervised by Assoc Profs **Xu** Yong Ping and **Guo** Yong Xin), won the top prize of $10,000 at the iNEMO Design Contest. Organised by semiconductor giant ST Microelectronics, the contest aims to encourage young engineers to develop useful inventions using the company's microelectromechanical sensors (MEMS) and design innovative applications built around ST's iNEMO smart multi-sensor technology.

Another ECE team took the second prize of $5,000. This team, comprising Mr **Samdish** Suri and Mr **Bai** Xiao (supervised by Associate Professors Hari **Garg** and V **Prahlad**) impressed judges with their gesture recognition system. Using a neural network, the system is able to recognise increasingly complex gestures over time. The team hopes to refine the system so that it can eventually develop the ability to read hand gestures that can accurately control computers.

A third team comprising Mr Viyek Kamatchi **Sundaram** and Mr **Adeel** Safdar (supervised by Associate Professor Arthur **Tay** and Assistant Professor **Yen** Shih-Cheng) helped ECE make the clean sweep of the top three prizes by winning $3,000 for developing a tool for home physiotherapy sessions.

ECE UNDERGRADUATE STUDENT COUNCIL (USC) AND USC INITIATION CEREMONY

The ECE Undergraduate Student Council (USC) Initiation Ceremony took place on 19 September 2014 at the Engineering Auditorium. About 80 ECE staff members, students and parents witnessed the initiation ceremony. It was a proud moment for a very special group of students as they stepped forward to take up their roles in the USC as student leaders to serve the student body. The President of the USC, Alexander **Toh**, led his fellow council members to recite the USC Oath, marking their formal entrance into the NUS ECE community.

The ECE USC, together with the ECE management team and advisors leading the Council in the recitation of the USC Oath

The USC comprises Year 1 to Year 4 EE and CEG cohort representatives, ECE scholars, and the presidents of three student clubs, namely, the ECE Club, IEEE NUS Student Branch and IEEE HKN.

One of the objectives of the USC is to serve as the voice for the undergraduate student body to make a difference in the students' learning experience in the University. They will work closely with the Department's management to address student concerns, opinions and suggestions as well as be involved in some of the Department's decision-making processes. With the USC, students will have a stronger voice than before.

Another objective of the USC is to provide a rich and holistic experience for ECE students through a wide range of activities. The USC will bring the presidents of the three student clubs together to work collaboratively and synergistically, and provide checks and balances as needed. The USC will also engage ECE students in engineering-focused community projects. Through these activities, students get a chance to apply what they have learned in the classroom to develop ECE solutions to real-life problems, and are reminded not to forget others who may be less fortunate than they are. These activities will also help create greater awareness about ECE technologies and hopefully attract future generations of students to study ECE. In addition, Student Life activities previously organised by the Department such as the Freshmen Party, will be organised by the USC in future with the aim of making these activities more consistent with the interests and aspirations shared by the student body.

Given the challenging demands of the EE and CEG programmes and the possible distractions and difficulties that students may encounter during their university days, it is natural that some students may need help. Hence, another objective of the USC is to provide a safety net for ECE students with its team of student counsellors who will be trained to assist students with issues.

In short, the USC will play a critical role in helping the Department transform ECE students into mature graduates. Guiding the USC are four staff advisors, Assoc Prof Marc **Armand**, Assoc Prof Prahlad **Vadakkepat**, Dr **Qiu** Cheng Wei, and Ms Nicole **Phua**.

ECE FRESHMEN PARTY 2014

The ECE Freshmen Party for the incoming freshmen of 2014 was held on 21 August 2014 at the foyer of the Stephen Riady Centre. Despite the threat of rain, about 240 freshmen, senior volunteers, exchange students as well as faculty members turned up to party. This event was specially planned by ECE Student Life to welcome the freshmen and to promote interaction between faculty members and students. For the freshmen, the introduction to their academic advisors was a much anticipated occasion.

ECE Freshmen Party 2014 al fresco style

Rock performance by the NUS Sheares Band

The evening was an enjoyable one filled with games and performances. The event kicked off with an exciting ice-breaking game of People Bingo which helped both students and academic advisors to get to know one another quickly. At the end of the game, everyone felt more comfortable and relaxed in their groups.

This year's party took the form of a picnic-cum-outdoor-chill-out-concert. There were great performances by the 'NUS Sheares Band' rock group while ECE staff gave the 'ECE Freshmen Song' a different feel with the song sung to the tune of 'The Lion Sleeps Tonight'. Party-goers were treated to sumptuous and informal picnic fare such as satay, pasta, shepherd's pies, quiches and pastries to allow greater interaction among the students and the professors.

The ECE Freshmen Party 2014 was a perfect evening of music, fun and games for all!

ECE YEAR END PARTY

Assoc Prof Ashwin **Khambadkone** and Assoc Prof Ganesh **Samudra** (middle of picture) having fun with their students

The crowd for the party

The ECE Year End Party 2014 was held on 8 May 2014 at Kent Ridge Guild House.

This special afternoon gathered over 190 ECE undergraduate students and academic staff. This event was specially organised by ECE Student Life to celebrate the hard work that ECE undergraduates and academic staff had put in during the academic year. At the same time, for graduating students, this was a meaningful farewell occasion. It was a wonderful time for the students to mix and mingle with their fellow course mates and faculty members.

The afternoon was filled with a series of fun-filled entertainment programmes. The event started with a welcome address by then Head of Department, Prof **Chua** Kee Chaing, followed by a table game of "Collect & Tie". This game allowed people to interact with one another to achieve the goals of the game. Most of the guests seemed more relaxed after the game.

While enjoying the high tea buffet treats, guests were entertained by a variety of stage performances. Soon after the game, a splendid performance of "Good Riddance" was put up by Alex **Toh**, an EE year 3 student. It was very enjoyable although it was his first public performance.

Next came a spellbinding performance by Backbenchers, a band consisting of three EE year 2 students. This acoustic rock band set a cool ambience for the party.

A crowd favourite was a photo booth that printed snapshots of students and faculty members who wanted a memento of the event. Kicking off the second part of the programme was a game of "Guess Who What Where?" that was met with enthusiastic participation from the audience. The game involved identifying places, items and academic staff from sections of their photographs. The highlight of the game was for participants to identify academic staff from photographs dating as far back as 1995. It was not easy to identify the staff members as some had changed significantly through the years.

The event ended with a creative rendition of Gaudeamus Igitur, a popular song sung mainly at university graduation ceremonies, by the Department's professors. The lyrics were rewritten into a light-hearted composition with a message to the graduates, "Now that you are armed with ECE knowledge, go forth, succeed and remember that you are ECE and NUS alumni."

All in all, it was a perfect day for all to let down their hair and mingle with one another. May the year of 2013/2014 end with a bang for NUS ECE!

Rendition by the professors

SINGAPORE SEMICONDUCTOR INDUSTRY ASSOCIATION (SSIA) INDUSTRY SITE VISIT

Sharing by CEG1 student JEREMIAS **WONG**

Sometime in the early 1990s, more than 45% of all hard disk drives in the world were produced in Singapore. During that time, the electronics industry evolved to move up the value chain to produce more advanced electronics by engaging in electronics assembly (such as for the logic boards of the Apple II) and semiconductor fabrication. Electronics constituted 6.1% of Singapore's GDP in 2011, of which 3.6% (59% of the electronics industry) came from the semiconductor industry. In the same year, 17% of all exports from Singapore came from the semiconductor industry. It was not surprising that this industry held a certain allure for budding electrical engineers then.

Group picture at Broadcom

Students working on RaspberryPi, guided by the engineering team in Broadcom

Given the encouraging performance of the electronics industry, it seems contradictory that many people find it difficult to imagine life in a design studio or a silicon fabrication plant. The need to protect the intellectual property of engineers and research scientists alike shrouds the entire industry in a blanket of secrecy equal to, if not greater than, that of the defence sector.

Hence, it is difficult for the general public to appreciate the innovations, significance and "magic" behind one of the most lucrative industries in Singapore. As a student interested in the startup industry, I must confess that I felt a sense of anxiety and apprehension towards the semiconductor industry prior to my visit to the semiconductor industry.

My trip first commenced in a design house where integrated circuits were conceptualised. This design house was part of a larger network of design houses around the world, cumulatively known as Broadcom. To my astonishment, we had a large community of engineers absorbed in the next big semiconductor implementation. Their approach, as explained by the staff, starts with the design of a new chip, followed by the proof-of-concept, ending with benchmarking and production with the use of Electronic Design Automation (EDA) tools such as Cadence and Altium. All these processes had been continually streamlined to ensure that their products stayed competitive and met the future demands of potential customers.

For me, this design house completely changed my earlier belief that Singaporean businesses were conservative. The in-house facilities of the design house, which included a gym, spacious cafeteria with free drinks, and countless wall-mounted thought-provoking art, clearly reflected the emphasis placed on the well-being and creativity of the employees.

One of my favourite things about the site visit was a RaspberryPi workshop in which we made a simple python programme to perform various tasks such as motion-triggered image capture and traffic light simulator. It was amazing that the Samsung-System-On-Chip implementation actually used a layout designed by BroadCom as the main microprocessor. I typed the python script from the comforts of my laptop before exploring the rest of the available interfaces on the RaspberryPi, all of which was conducted over WiFi.

Singapore Semiconductor Industry Association (SSIA) Industry Site Visit *(continued from page 17)*

Group picture at Globalfoundries

Next, we travelled to Globalfoundries, a fabrication plant formerly known as Chartered Semiconductors Manufacturing Limited. Even though Singapore's fabrication had down to 40nm process capabilities (which in today's day and age is no longer earth-shattering), Singapore is a decent entry point for fabless chip makers to push certain products at a smaller price bracket and increase operational efficiencies coupled with faster production ramps.

The fabrication and test facilities, especially the clean rooms, were an eye-opener for me. Everyone was dressed in clean room apparel, white coveralls and hair cover to avoid contamination which can then lead to a reduction in yield. The manager of the test facilities brought us around the laboratories that were responsible for identifying production errors from failed wafers. We saw the use of a wide variety of tools ranging from simple microscopy, computer-aided wafer slicing, tunnelling electron microscope and even an automatic probe machine. Employees would spend half their time in labs or fabrication facilities and the rest of their time typing, compiling and testing algorithms to make their processes more efficient.

Overall, I believe that the visits to Broadcom and Globalfoundries gave great insights into the electronics fabrication industry in Singapore. The fabricators, design houses and product manufacturers took great pride in their contributions to the global landscape. This could be seen from the proliferation of quality products that utilise electronics components assembled, designed and innovated in Singapore. In other words, made in Singapore!

NUS ECE IDREAM INNOVATION & ENTERPRISE WORKSHOP

On 20 and 21 March 2014, 41 students from several IP schools and JCs were treated to an innovation workshop which encouraged them to think out of the box, pursue their ideas and convert them to reality. The NUS, ECE iDream Innovation and Enterprise Workshop was conceived, organised and facilitated by Associate Professor Hari Krishna **Garg** (Ph.D., MBA) who has founded several successful start-up companies in Singapore. Ms Peggie **Chan** from the Centre for English Language Communication (CELC) discussed the role of communication in innovation.

The Workshop began with a discussion about the various dreams that the youth of today have, such as becoming a scientist, engineer, inventor, innovator, entrepreneur or a policeman. A clear distinction and a better understanding of what these dreams mean in the real world and their personalisation was discussed in an interactive way. The audience was engaged with a clear message that they must participate actively as the workshop is about them.

The sessions were interactive and fun. The workshop called for teamwork and hands-on experimentation in innovation and technology-focused product design. Students also had an immediate opportunity to put the skills they just learnt into practice. They invented, conceptualised and presented ideas that ranged from a pet travel case to a window-cleaning machine. Prizes were given to several winning teams.

The workshop was aimed at arming the students with innovation and enterprise skills to face the challenges of tomorrow. We hope they took home valuable lessons and fun memories.

Participants of the NUS ECE iDream Innovation & Enterprise Workshop with the instructor, Assoc Prof Hari Krishna **Garg** (centre, in suit).

A student group presenting their innovative ideas to the judges and fellow workshop participants.

Much engaged: Students having a lively discussion with co-instructor Ms Peggie **Chan** while others take notes.

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