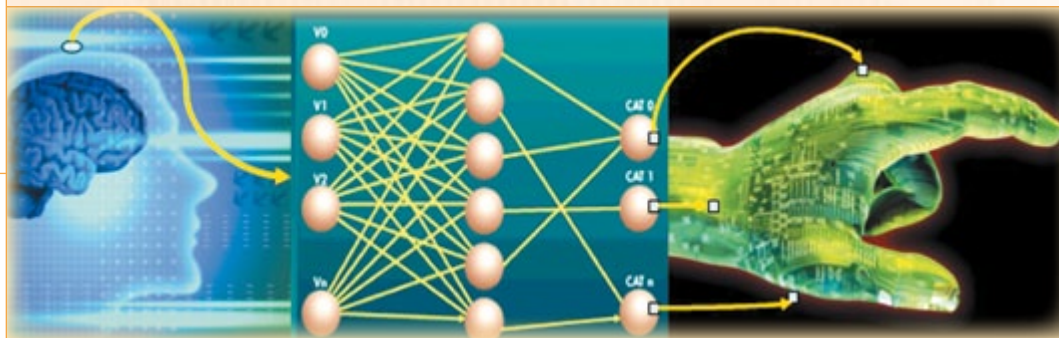




RECRUITMENT OF PROFESSOR NITISH THAKOR TO LEAD SINAPSE



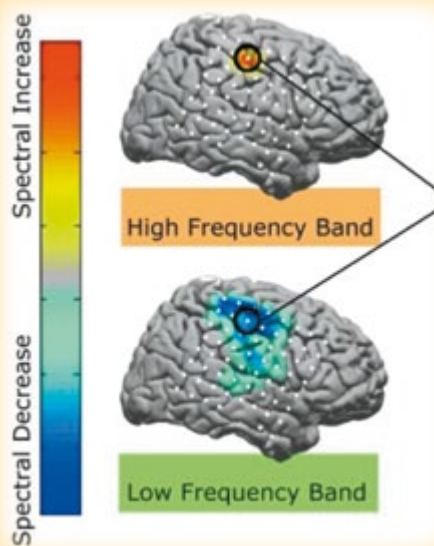
ACCORDING TO THE AMERICAN HEART ASSOCIATION, THE TOTAL DIRECT MEDICAL COSTS OF CARDIOVASCULAR DISEASES ARE PROJECTED TO TRIPLE FROM US\$272 – 818 BILLION BETWEEN 2010 AND 2030.

PAGE 07



COMPUTER GRAPHICS SEEKS TO GENERATE REALISTIC PICTURES AND ANIMATION TO BROADEN OUR IMAGINATION.

PAGE 08



The ambition of SINAPSE is to use advanced research partnerships between engineers and scientists to develop neurotechnologies that offer the breakthrough potential for scientific discovery, medical or defence needs and for commercialisation and economic benefit.

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“ Ensuring that students have good experience while studying in NUS ECE is as important as imparting our knowledge and experience to them. ”

Prof **Chua** Kee Chaing
Head, Department of Electrical & Computer Engineering, NUS

1 July marked the start of my second term as Head of Department with a partially renewed and slightly enlarged management team. On behalf of the Department, I would first like to thank Professors **Lee** Tong Heng, **Choi** Wee Kiong, **Kam** Pooi Yuen and **Wu** Yihong for their dedicated services as Deputy Heads or Area Directors during my first term of office. Associate Professor **Tay** Teng Tiow has now assumed the position of Deputy Head (Administration) while Associate Professor **Tham** Chen Khong is the new Deputy Head (External Relations and Outreach). Professors **Lim** Teng Joon and Adekunle **Adeyeye** are the new Area Directors for Communications & Networks (CommNet) and Microelectronics Technologies & Devices (MTD), respectively. I have also expanded the team by appointing four younger colleagues as Associate Heads to expose them to leadership and management experiences within the Department. Associate Professors Vivian **Ng**, **Tan** Woei Wan, Mansoor bin Abdul **Jalil** and **Tan** Kay Chen are now Associate Head for Student Life, Undergraduate Programmes, Graduate Programmes and Research, respectively.

In a large department like ECE, it is quite easy for our students and faculty to not get to know one another better and to have little interaction outside of the lecture halls and classrooms. Proper counselling and career guidance are also necessary today to help our students cope with their studies and prepare for work upon completion of their studies. These and other activities form the core of our new Student Life portfolio under the office of the Deputy Head (Undergraduate Programmes and Student Life). As can be seen in this issue, the first Student Life event organized was the Staff Freshmen BBQ Party held at the UTown Town Green in August to let ECE faculty meet with their student mentees. I am glad that many colleagues turned up to interact with the AY2012 ECE freshmen that evening.

ECE's continued success as a department depends critically on the quality of our staff, research and education programmes. While we continually look into ways to enhance our curriculum, we are also planning new pathways in response to what industry demands of our graduates today and in the near future. Earlier this year, in response to increasing needs for design capabilities and knowledge of systems engineering, we started our new nano-satellite programme under the Faculty of Engineering's Design Centric Curriculum initiative. The programme uses the satellite as an example of a complex engineering system to let students learn ECE fundamentals through designing and developing different components of a nano-satellite. Two of our faculty colleagues, Drs. Aaron **Danner** and **Heng** Chun Huat, were honoured with the University's Annual Teaching Excellence Awards this year, while another colleague, Dr **Yan** Shuicheng, was conferred an NUS Young Researcher Award. Professor **Lian** Yong led a multi-disciplinary team to secure a major CRP grant from the National Research Foundation to work on a self-powered wireless body sensor network for future healthcare. These developments and achievements are described in this issue of our newsletter, which I hope you will enjoy reading.

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AWARD OF THE FIRST THREE ECE SCHOLARSHIPS

The Department has set up ECE Scholarships for incoming first-year undergraduate students in Electrical and Computer Engineering. Each \$10,000 per annum ECE Scholarship is bond-free, merit-based, and awarded to a deserving Singaporean or PR who has performed well academically. The scholarships were launched in August 2012, and were made possible with generous donations by staff and corporate partners.



Hello! I am **Chen** Wai Cheung. I came from Hong Kong and migrated with my family to Singapore at the age of six. I can converse in Cantonese, Mandarin and English.

I had six years of education in Raffles Institution before coming to NUS. During my secondary school days, I was in the Military Band and I joined fencing in junior college. I played the euphonium in the band and besides that, I can also play the violin and the piano. It has been a while since I played any of them though.

I am now enrolled in the Double Degree Programme (DDP) with Electrical Engineering as my home faculty and Business as my second degree. I like Engineering because I believe that the core drive is to

make the world around us better. Electrical Engineering, specifically, has many different applications and can lead to endless possibilities. This not only excites me intellectually but opens up many different career opportunities for me in the future.

In my free time, I like to read and sleep. Reading allows for the broadening of the mind and one can always find tidbits of knowledge in the most unexpected places, even in novels. Sleeping gives me the energy to enjoy the things I do in the day.



Hey! I am Jason **Ang**. I was from Singapore Polytechnic, where I pursued a Diploma in Electrical & Electronics Engineering. People think that getting into NUS from a polytechnic is tough. I would like to say that while it is indeed tough, it is nevertheless possible with hard work and effort. I managed to do it and I think many others can as well.

I am proud of being accepted into NUS' Electrical Engineering programme. In this modern day, almost everything in our daily lives requires power and energy, whether natural or electrical energy. And as we progress, we divert from natural energy and focus on renewable energy, specifically on electrical energy. Thus, I am interested in learning about the different fields of electrical energy and, as much as I can, contribute to its innovation in the many years to come.

I have a strong passion in community service. Having volunteered in various community and grassroots events, I have used my free time and talent to help the less fortunate. One example of such events is the Charity Drive, which aims to collect used textbooks for needy students. I was deeply heartened by the excitement and joy on the children's faces when they received the textbooks. Their parents, too, heaved a sigh of relief knowing that their children would have the necessary textbooks for school.

Beyond academics, I enjoy swimming. I was a member of the SP Lifesavers, during which I attained the Lifeguard Certification. Carrying on this keen interest, I have recently joined the NUS Lifeguard Corps to further develop my lifeguard skills and fulfil my passion in swimming. In addition, I like reading and watching movies. Reading helps me broaden my knowledge while watching movies helps me relax my mind. These activities allow me to re-energise my mind in preparation for the challenges ahead.



Hi! I am Stephanie **Leong** Hui Jen and I was from Singapore Chinese Girls' School primary and secondary levels. Ten years in SCGS has indeed moulded me into who I am now. I was very active in school and made sure every single moment spent there was worth it. Spending time with my friends and planning events alongside teachers and fellow schoolmates were the most valuable times and experiences I had there.

I was with the Dance Group during my secondary school days. Dance allowed me to challenge myself continuously due to the tough competition and high standards set by teachers and seniors. I was exposed to many different genres of dance and this was where my interest in dance started to build. I went to Hwa Chong Institution (College) thereafter and joined Modern Dance. I was only active in my CCA, but even so, I had many enjoyable moments in school to

remember. Though it spanned just two years, I managed to make good friends who will last a lifetime. Studying in Hwa Chong was an eye-opener for me too because I met different kinds of people. The people that amazed me the most were those who could not study as hard but still did superbly well.

I really enjoy dancing and have been dancing since I was young. I am especially interested in ballet, jazz and tap. I love kids too and enjoy teaching them. Thus, teaching dance to children is definitely the best combination. They really do make my day! I treasure time spent with my family and friends and, to me, weekends are for family, friends and God, while weekdays will be the time to work hard. Occasionally I have to work on Saturdays if I am unable to complete my work. However, Sunday is the Sabbath Day, which is a day to rest, relax and do what I love. Studying is important, but there is so much more to life than that. For me, life is about God, family, friends and dance! I hope to enjoy my university days!

TEACHING AWARDS

Two faculty members from the Department recently received the Annual Teaching Excellence Award (ATEA) for their exceptional efforts in teaching. ATEA is a university level award that aims to highlight excellence and encourage best practices in teaching and learning.

DR AARON DANNER



Dr Aaron Danner received the Annual Teaching Excellence Award (ATEA) for the teaching methods he employs that mix old-school and modern methods to create a rich learning environment for students. One of the teachers that Dr Danner had when he was an undergraduate student (now inspiring him in his own teaching) was a chemistry professor who used to wheel a miniature chemistry lab bench into the lecture theatre every week. On this bench, he would boil up different concoctions and mixtures, creating mini-explosions and various colourful liquids and dangerous-smelling vapours, much to the delight of his students. Dr Danner's classes are now replete with demonstrations of electrical engineering "concoctions" such as spark-gap transmitters like the one used on the Titanic,

oscillators so loud that they jolt weary students awake midway through his classes and a circuit operating from no fewer than twenty 9-V batteries, added one-by-one to the circuit. The lectures are divided into time slots for demonstrations, work-together problems on the board or overhead projector and traditional lectures. The one learning outcome of which he is most proud is that it is a rare student coming out of his lectures that ends up unable to bias a transistor.

DR HENG CHUN HUAT



Dr Heng Chun Huat received the Annual Teaching Excellence Award (ATEA) for the extraordinary efforts that he puts into teaching his students. Dr Heng employs calculus analogy that most engineering students are familiar with to teach circuit analysis. First, an important circuit configuration table, which is very similar to a differentiation table in calculus, is derived. Subsequent analysis on complex circuits can then be done by breaking it down into various simple and recognisable forms tabulated in the table. This is very similar to the concept of applying a differentiation table to solve derivatives of complex functions. This approach avoids traditional tedious ways of solving simultaneous algebraic equations to find important circuit quantities, and brings a more intuitive understanding of circuits.

He has also developed the portable Electronic Testbench, which allows students to carry out circuit experiments without the constraints of time and space. He is also a past winner of the Faculty Innovative Teaching Award.

TESTING OF MICRO ELECTRIC CARS FOR SHORT-DISTANCE TRAVEL ON NUS CAMPUS

Researchers from the Department will be collaborating with Toyota Tsusho Asia Pacific Ltd (TTAP) to study the feasibility of micro electric vehicles for short-distance travel. Using the NUS Kent Ridge campus and NUS University Town as a test bed, NUS and TTAP will deploy a fleet of 10 Toyota Auto Body COMS, which are single-seater micro EVs, for the study. The findings will help to develop a system to enable efficient management of EVs and a self-service EV rental scheme for staff and students to commute on campus.

The study will use Toyota Auto Body COMS (Japanese acronym for 'Chotto Odekake Machimade Suisui', translated as 'smooth, short rides into town'), which are micro electric vehicles designed to provide a driving range of between 35 km to 45 km via the use of sealed lead-acid batteries. Weighing about 300 kg, each vehicle is able to travel at an electronically limited top speed of 50 km/h. Other features include a low running cost (S\$0.03/km), zero carbon dioxide emissions, 93 per cent parts recyclability and regenerative braking.

The vehicles and users will be wirelessly linked to a telematics hub that will log data for analysis and management purposes. The data will then be processed for information that is relevant to specific user groups.

The study aims to come up with a sustainable vehicle-sharing system that can potentially overcome the 'last mile' and environmental issues for future urban mobility. TTAP and NUS researchers will study the robustness, performance, cost-effectiveness and environmental impact of such personal mobility vehicles in tropical climatic conditions, as well as the acceptance by users for short-distance travel. The study will also look at user charging behaviour to determine the most efficient location for the placement of battery-charging stations.

Professor **Chua** Kee Chaing, Head of Department said: "With the growing popularity of EVs in the global market, this is a timely collaboration in which to involve our staff and students in the testing and deployment of EV technology on campus."

Mr Yasuhiro **Kakihara**, Executive Vice President, Singapore Business Unit COO, TTAP added that the behavioural needs of the next generation of consumers have to be satisfied in order to create a sustainable business model. "The launch of this project will pave the way for a new mode of transportation in Singapore to benefit society as a whole," he said.



The Toyota Auto Body COMS ready for action. The study will use the NUS campus and University Town as a test bed



Mr Yasuhiro Kakihara (third from right), Executive Vice President, Singapore Business Unit COO, TTAP with Prof **Chan** Eng Soon (fourth from left), NUS Dean of Engineering, and Prof K C Chua (third from left), Head of Department, at the signing ceremony

'FLYING OFF' WITH THE NANO-SATELLITE PROGRAMME

Another new programme that kicked off recently at the Department was a Nano-satellite programme for first-year students. It 'flew off' the ground with some 23 students from across three Engineering disciplines: Electrical Engineering, Mechanical Engineering and Engineering Science. Thirteen of these students also belonged to the Design Centric Curriculum Initiative.



Their initial experience was to build the balloon-sat, which is a balloon-borne system carrying a digital camera and other devices such as a digital compass, temperature and pressure sensors. These balloons were deployed tens of metres above the ground and transmitted images and sensor data to a ground station below. Students worked in groups of four, supervised by Drs **Liaw** Hwee Choo, **Luo** Sha and **Sun** Jie, to develop the balloon-sat system. It was an exciting and enriching experience for all involved.

Third-year Electrical Engineering student **Chen** Shiyi spent six months, from February to August 2012, on an internship programme with NASA Research Centre at Ames, California, USA, as part of the Nano-satellite programme. Over in NASA, he worked with other student interns from Mexico and Italy to develop satellite systems using an Android phone as its central processor.

Aside from the first-year team, a number of senior ECE students also worked on projects that were related to the Nano-satellite. Five of them spent three months interning at ST Satellite Systems over the summer. Another five worked on building cube-sats for final year projects. The cube-sat is a Nano-sat system measuring no more than a ten-centimetre cube and weighing less than ten kilogrammes. "As you know, designing satellites is like rocket science, which requires engineers from multiple disciplines to work together. We are looking at different applications for the satellites – those for communications, environment monitoring, imaging and remote sensing, just to name a few. Satellites are complex engineering systems that are excellent platforms for students to develop their engineering design skills. The Department is also encouraging research in this area as well. Such programmes will naturally lead to Masters and PhD degrees being awarded," said Assoc Prof **Loh** Ai Poh, Deputy Head (Undergraduate Programmes & Student Life). The Department also plans to expand the programme to include air-borne radar systems for remote sensing and other applications.

NEW APPOINTMENTS AND PROMOTIONS

FACULTY APPOINTMENTS

We welcome the following new members into our ECE family.

- DR NITISH V **THAKOR** assumed duty as Provost's Chair Professor on 27 March 2012, with a joint appointment to the Department of Bioengineering and the Department of Medicine. Professor Thakor has also been appointed Director of the university-level neuroengineering research centre SINAPSE (Singapore Institute for Neurotechnology: Advancing through Partnership of Scientists and Engineers).
- DR **CHEN** ZHINING joined the Department as Full Professor on 1 June 2012, with a joint appointment at the Institute for Infocomm Research (I2R), A*STAR. Prior to his appointment, Dr Chen was Head of the RF & Optical Department and Principal Scientist in I2R. Dr Chen holds two PhD degrees, from the Institute of Communications Engineering, China and the University of Tsukuba, Japan. His current research interests include applied electromagnetics, in particular for medical applications, antennas for microwaves, mmW, sub-mmW and THz systems. Dr Chen is an IEEE Fellow, an honour in recognition of his significant contributions and leadership in the research of small and broadband antennas for wireless applications.
- DR MICHAEL JOSEPH **HOCHBERG** joined the Department on 5 July 2012, with a joint appointment at the Institute of Microelectronics (IME), A*STAR. Dr Hochberg is also currently a faculty member of the University of Delaware, USA, in ECE, MS and CBE. Dr Hochberg received his BS (Physics, 2002), MS (Applied Physics, 2005) and PhD (Applied Physics, 2006) from the California Institute of Technology, USA. His research interests are in the areas of silicon photonics and large-scale, photonic-electronic integration.
- DR **TAN** YAN FU, VINCENT joined the Department as Adjunct Assistant Professor on 13 April 2012. Dr Tan obtained his BA (First-Class Honours) in 2003 and M.Eng. (Distinction) in 2005 from Cambridge University, UK and his PhD in 2010 from the Massachusetts Institute of Technology, USA. Dr Tan currently holds a Scientist 1 position in the Data Mining Department, Institute for Infocomm Research (I2R), A*STAR, where he conducts research in machine learning and information theory.
- MR **SING** SENG TECK joined the Department as Adjunct Assistant Professor on 1 August 2012. Mr Sing obtained his BEng (Hons) from NUS in 1998 and his MS from Carnegie Mellon University, USA. He is currently a Principal Member of Technical Staff at the DSO National Laboratories.

LABORATORY EXECUTIVE APPOINTMENTS

- MR **LIU** BIN joined the Department as Laboratory Executive for the Nanotechnology Fabrication Facility (NTF) on 17 August 2012.

ADMINISTRATIVE APPOINTMENTS

- MS **PHUA** WEI QI, NICOLE joined the Department as Executive (Student Life) on 11 July 2012.
- MS **WONG** SOEARTI SUKMIN joined the Department as Management Assistant Officer (Finance) on 1 June 2012.
- MS **LENG** MUN TZE joined the Department as Management Assistant Officer (Research) on 2 July 2012.

DR YAN SHUICHENG RECEIVES NUS YOUNG RESEARCHER AWARD

For his outstanding contributions in computer vision, multimedia and machine learning, Dr **Yan** Shuicheng was conferred the NUS Young Researcher Award at the University Awards Ceremony on 4 May 2012.



Dr Yan Shuicheng



Dr Yan Shuicheng and his group members discussing multimedia research

Dr Yan has a Hirsch index of 22 in Scopus and his research papers have been widely cited, more than 3,000 times, as reported in Scopus. His most representative research works include: 1) technologies for analysing customer demographic data and classifying objects in media contents to provide targeted and personalised recommendations in digital signage and other advertising displays; 2) assistive multimedia technologies to help amateur users or disabled people; and 3) the pioneering work on bridging manifold learning and subspace learning research, two hot areas in the fields of computer vision and machine learning.

In 2010, Dr Yan won two best paper awards at two of the most prestigious multimedia conferences. In the same year, he was also recognised for setting a record for the highest number of papers accepted at two highly selective conferences – International Conference on Computer Vision and Pattern Recognition and ACM Multimedia. Dr Yan was again distinguished for the highest number of papers accepted at International Conference on Computer Vision 2011, and ACM Multimedia 2012.

Dr Yan's team participated in the flagship competition in the area of computer vision, Pattern Analysis, Statistical Modelling and Computational Learning (PASCAL) Visual Object Classes Challenge (VOC), and was the winner of the object classification task for both 2010 and 2011.

Dr Yan currently serves on the editorial boards of four journals including IEEE Transactions on Circuits and Systems for Video Technology (TCSVT) and ACM Transactions on Intelligent Systems and Technology (TIST). He won the 2010 Best Associate Editor award for his service to the TCSVT.

Dr Yan is a recipient of the 2011 Singapore National Young Scientist Award and the 2011 Faculty of Engineering Young Researcher Award.

SELF-POWERED WIRELESS BODY SENSOR NETWORK FOR FUTURE HEALTHCARE

According to the American Heart Association, the total direct medical costs of cardiovascular diseases are projected to triple from US\$272 – 818 billion between 2010 and 2030. This trend is expected to be the same in Asia, Europe and across the globe. As a result, remote and continuous monitoring of ECG and other vital physiological signals will become increasingly important as it can provide timely information on the state of cardiac health of individuals and improve the quality of life of patients undergoing ECG monitoring.

The NUS research team, led by Professor **Lian** Yong, has received a large National Research Foundation (NRF) grant to carry out high-impact research in the area of self-powered wireless sensors and Cloud-based wireless body sensor networks. Working with researchers from NUS' medical school, public health school and Fujitsu Laboratories, Professor Lian targets to design and develop tiny wearable sensors that can transmit patients' vital data to doctors automatically without using a battery. Such wireless sensors would allow patients uninterrupted sleep as they need not be woken up periodically for their temperature and pulse rate to be taken.



3-Lead Wireless ECG Sensor

Professor Lian explained that these sensors will be powered by energy generated from the human body. "These sensors will continuously collect vital parameters of temperature, cardiac rate and rhythm, respiratory rate, oxygen saturation and blood pressure, which will be sent to the Health Cloud through a mobile phone, where the data are stored and analysed", said Professor Lian.

The proposed system will be verified in both hospitals and homes. "In future, with the proposed technology, the mobile phone can alert us to consult a doctor before we fall sick", added Professor Lian, who is the Provost's Chair Professor and Area Director of Integrated Circuits and Embedded Systems. His team recently made the headlines when they invented an ECG chip that can be worn as a plaster. The ECG chip is now being marketed by ClearBridge VitalSigns Pte Ltd, of which Professor Lian is co-founder.



Enabling continuous patient monitoring through battery-less wireless sensors and the Cloud

TOWARDS AUTOMATIC VISUAL CONTENT CREATION

Computer graphics seeks to generate realistic pictures and animation to broaden our imagination. After decades of research, realistic results can be achieved by professionals, and are now widely enjoyed in movies and computer games. However, two important problems still remain unsolved.

Firstly, the ability for ordinary people to generate high-quality image-based media quickly remains elusive. Secondly, even for professionals, high-quality 3D content (such as 3D models and their materials) is tedious and manually intensive to prepare. Computer vision aims to provide semantic and physical interpretation of images, which brings promising solutions to these problems. Dr **Tan** Ping focusses on developing computer vision techniques to bridge the gap between ordinary people and graphics professionals, and to make high-quality 3D content easy to create. For his contribution in this field, he was awarded an inaugural TR35@Singapore award in March 2012 and the Image and Vision Computing Outstanding Young Researcher Honourable Mention Award in June 2012.

“Sketch2Photo” is an interactive tool that Dr Tan developed to allow a novice user to create high-quality images simply by sketching and specifying their content. The user needs only to provide a freehand doodle with text labels. The algorithm will automatically search the Internet for suitable image elements, and segment and compose them into a realistic picture. An example is provided in Figure 1. The core algorithm chooses images that have correct semantic meanings and are suitable for composition. This work was reported by the Daily Telegraph newspaper in the UK and was selected as one of the ten most promising digital initiatives by Netexplorateur in 2010.



Figure 1: A freehand sketch is converted into a photo-realistic picture by seamlessly composing multiple image components discovered online. The input sketch plus overlaid text labels is shown in (a). Composed pictures are shown in (b) and (c). Images used in composition are shown in (d)

Realistic computer graphics animations require high-quality 3D models. Most existing commercial 3D modelling systems still rely heavily on user interaction to manually model shape details. Dr Tan developed image-based modelling algorithms to automate the process. His algorithm automatically reconstructs 3D information from 2D images and uses it to generate realistic 3D models. This approach has been successfully applied to model streets and city blocks on a large scale (e.g. the ‘image-based façade modelling’ system in Figure 2).



Figure 2: An example result of the ‘image-based facade modelling’ system: some input images in the bottom row, the recovered model rendered in the middle row, and three zoomed sections of the recovered model rendered in the top row

RECRUITMENT OF PROFESSOR NITISH THAKOR TO LEAD SINAPSE

The Department, together with the Departments of Bioengineering and Medicine, played a key role in the establishment of a new University-level Institute: *Singapore Institute for Neurotechnology – Advancing through Partnership of Scientists and Engineers (SINAPSE)*. Its mission? To work at the frontiers of brain research, technology development as well as clinical and commercial translation.

The field of Neurotechnology is ripe and poised for explosive advances and growth. This is possible, as never before, through understanding, treating and utilizing the power of the brain and nervous system using cutting-edge technologies.

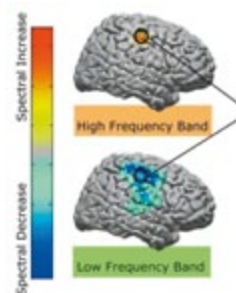
Research thrusts and focus areas of SINAPSE will involve study of the brain and its cognitive and neurobiological mechanisms. It will include building mathematical and computational models of brain cells and networks and analysis of abnormal brain rhythms. Technologies will be designed to interface with the brain and for treating brain disorders, building brain-inspired or neuromorphic computers and machines, and generating intellectual property that will result in the development of products of value to society.

Take the example of “Neuro” prosthesis. Conventional prostheses are mechanical limbs, whether for amputated arms or legs. But how are those limbs to be controlled? While current solutions are to use harnesses on the body or use muscles from the amputated limb, the future lies in using direct interface to nerves or even to the brain – to establish a true brain-machine interface to provide the most intuitive and cognitive interface to the prosthesis. This requires research and development of implantable electronics for brain interface and to decode brain signals needed to command the prosthesis. Or, take the example of an infant with injury to her arm nerves or a young person whose limb nerves were injured in an industrial accident. A direct, “bionic” interface to the nerve would provide sensory input through electrical stimulation and would potentially restore sensation of touch and temperature. To achieve these goals, it will take both basic research and its translation, and it will take the partnership between engineers and clinicians.

The funding for SINAPSE appropriately reflects the joining (“synapse”) of different organisations with diverse expertise and resources, but with the common objective of bringing intellectual, technological, medical and economic benefit to Singapore and to the world. For example, NUS brings to the table a leading engineering and scientific research institution.



The ambition of SINAPSE is to use advanced research partnerships between engineers and scientists to develop neurotechnologies that offer the breakthrough potential for scientific discovery, medical or defence needs and for commercialisation and economic benefit.



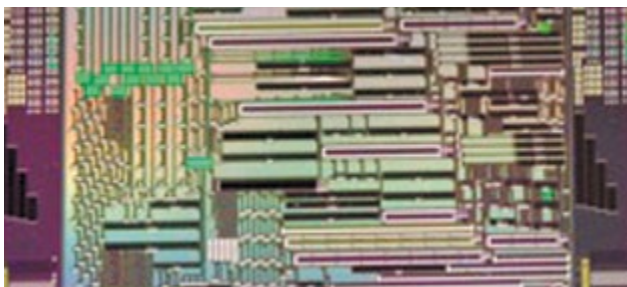
Medical organisations such as National University Hospital (NUH) bring the need and the opportunity to solve society's health problems. A*STAR provides the expertise to develop advanced technologies for economic benefit and MINDEF has the need to study the human brain and its extraordinary capabilities with the goal of enhancing cognitive capacity. The formation of an Institute with such collaboration would bring all these capabilities and needs under one umbrella.

SINAPSE is led by Professor Nitish V. **Thakor**, a highly published author in the fields of neurological instrumentation, neural signal processing, micro and nanotechnologies, neural prosthesis and clinical applications of neural and rehabilitation technologies. Besides demonstrating academic leadership and scholarship as an editor and author, Professor Thakor has also displayed entrepreneurial spirit as a co-founder of companies involved in developing medical technologies. He is a Fellow of the American Institute of Medical and Biological Engineering, Institute of Electrical and Electronics Engineers, and the International Federation of Medical and Biological Engineering, and a Founding Fellow of the Biomedical Engineering Society. He is also a recipient of the Centennial Medal from the University of Wisconsin, School of Engineering; an Honorary Membership from Alpha Eta Mu Beta Biomedical Engineering Student Honor Society; and a Distinguished Service Award from Indian Institute of Technology, Bombay, India.

Professor Thakor has been a Full Professor of Biomedical Engineering at Johns Hopkins University since 1994. He assumed his duty as Provost's Chair Professor in the Department of Electrical and Computer Engineering on 27 March 2012 with a joint appointment in the Department of Bioengineering and the Department of Medicine.

INTEGRATING OPTICS AND ELECTRONICS IN SILICON

Silicon photonics shows promise for integrating high-speed optical systems onto a single chip. To help realise this promise, the Optoelectronic Systems Integration in Silicon (OpSIS) multi-project wafer service aims to bring access to advanced foundries to researchers. Professor Michael **Hochberg**, who leads the OpSIS effort, has recently started a joint appointment in the Department, where he will be running a research group.



Photograph of optical chip fabricated at the Institute of Microelectronics (IME)

Traditionally, most optoelectronics consist of many separate bulk optical components connected via fibre optics. A typical data transmission system might include modulators made of lithium niobate, detectors in germanium, electronic driver amplifiers made in III/V's, serialisers and deserialisers made in a bi-CMOS process, control circuits made with CMOS, optical multiplexers made with doped glass waveguides, lasers in indium phosphide and MEMS-based switches.

The great promise of silicon photonics lies in integrating all of the above functions into a single package. Moreover, by leveraging existing CMOS infrastructure, silicon becomes an ideal choice for this level of integration. Altogether, silicon photonics will radically drive down the cost of moving data through fibres and create the opportunity for a variety of fundamentally new applications of photonics, where high-complexity systems can be built at very modest costs.

Beyond data communications, applications such as nano-optomechanics and condensed matter physics, biosensing, nonlinear optics, LIDAR systems, optical gyroscopes, radio frequency integrated optoelectronics, coherent communications, novel light sources, gas sensors, very long wavelength integrated photonics and many more are possible and worth exploring with this technology. Many of these applications are currently being explored in both the commercial and academic realms.

To realise many of these devices, researchers need access to advanced fabrication facilities. A key innovation in the microelectronics industry has been the development of multi-project wafer services, which made advanced processes available to the wider community.

Making production processes available to the research and development community has been a key part of the fabless ecosystem in microelectronics. MOSIS has been an essential organisation in making these processes available and accessible over the past decades.

To parallel the success of MOSIS in the microelectronics world, Dr Hochberg has established the Optoelectronic Systems Integration in Silicon (OpSIS) multi-project wafer service. OpSIS is focussed on fully integrated process flows and is currently offering a flow supporting ~20 GHz modulators and detectors as well as low-loss waveguides, in collaboration with the Institute of Microelectronics (IME), A*STAR. In addition, OpSIS is opening up the Luxtera process, including the full design kit, as well as working with BAE Systems to co-develop a process. OpSIS recently taped out its first public shuttle, with over 30 paying users in the IME process.

Dr Hochberg's nanophotonics research group, located jointly at the National University of Singapore and the University of Delaware, is working to support this service as well as design cutting-edge optoelectronic devices and systems through it. The nanophotonics group has already demonstrated world-leading silicon results, including low-drive voltage modulators and fully integrated devices with up to 20 GHz bandwidths.

Dr Hochberg received his BS (Physics, 2002), his MS (Applied Physics, 2005) and his PhD (Applied Physics, 2006) from Caltech, and was awarded the Demetriades-Tsafka dissertation Prize in Nanotechnology. As a student, he received a merit-based fellowship from Caltech, an NSF Graduate Research Fellowship and co-founded three companies, including Simulant and Luxtera. In 2007, he joined the faculty at the University of Washington, where he received an Air Force Office of Scientific Research Young Investigators Program award as well as a 2009 Presidential Early Career Award in Science and Engineering (PECASE). He recently became an Associate Professor in Electrical and Computer Engineering, Materials Science and Engineering and Chemical and Biomolecular Engineering at the University of Delaware, and has joined the Department with a joint position at the Institute of Microelectronics, A*STAR.

WINNING THE LKY GOLD MEDAL BRINGS AN EXTRA SMILE TO THIS VALEDICTORIAN'S PARENTS

An aspiring entrepreneur knows no bounds. Mr Samuel **Li** Minghui (Engineering Class of 2012) has received job offers, but he has decided not to go for the interviews because he wants to be an entrepreneur.

In this economic climate, getting job offers is reason to celebrate, but it has always been Samuel's passion to make it as an entrepreneur. He started Witsvale (www.witsvale.com), which spearheads user interface and experience for web-based, adaptive e-learning and aims to help primary school students in their mathematics by making practices fun. The start-up has received the NUS Practicum grant as well as Spring YES! Funding.

"Start-up life is definitely not easy", muses Samuel. "Every day is like fighting a war. First thing in the morning, I start wondering, am I getting in revenue today? Then what should I do so that the first dollar will come in? Do I have the skill to do it and if not, how long will I take to learn? If mistakes are made, learn and move forward. I've learnt not to harp on mistakes and make myself more miserable", said this Electrical Engineering graduate, who was the valedictorian for his class.



A proud moment for Samuel and his mum and dad

His parents were hoping that he could start earning "proper money" or further his studies. "When I completed my studies in November, I told them I wanted to work on my own thing. They replied with, 'find a good job slowly'. I was like, 'oops'. Now, I guess they are OK with my decision. The pressure now comes from my relatives, who keep asking me when I will be going to the US for my PhD", reminisced Samuel with a laugh.

Samuel shines just about everywhere he is and has a long list of awards to show for it. The Lee Kuan Yew Gold Medal, for best-performing graduate throughout the course of study and the Institute of Engineers Singapore Gold Medal Top Graduating Student in Electrical Engineering are among many awards won when he was in NUS. Samuel also achieved the Outstanding Conduct and Performance in National Service Commander of the Month when he was in National Service as well as being the top Chemistry student in Anderson Junior College, where he did his 'A' levels.

LKY Gold Medal, the only award with a name known to his parents

From all his awards, Samuel selected the Lee Kuan Yew Gold Medal as his proudest achievement. "To get an award is an extremely happy thing, but to get an award named after one of Singapore's founding fathers gives a totally different feeling. Most importantly, this is an award with a name that is known to my parents. They are not too well educated and so they only know the names of ministers. Seeing the smile on their faces when they knew I got this award, as compared to the other awards, really made my day!" he said.

Samuel attributes his achievements to his parents. "Since young, my parents and my late grandma have always told me not to be like them – uneducated and having to work very hard just to earn a few cents. I have been through hard times with them and I think this really spurred me on to work hard in whatever I do. I believe that nothing is impossible as long as we work hard. Even if we fail, it's a success as we would have learnt new and more things", Samuel reflected.

He has had his fair share of failures like when he was almost retained in Secondary two. Although his parents did not say anything about this, he saw the fear and disappointment in their faces. "From then on, I told myself not to let them down anymore, especially in my studies, which I have absolute control over, given how much they have sacrificed", he said.

ECE ALUMNI FAMILY DAY 2012

The Department held its 5th Alumni Family Day on Saturday, 25 August 2012. The event attracted more than 100 alumni and their families, some of whom have attended every alumni family day that the Department has hosted since the first one back in 2005.



From left to right: Assoc Prof LS **Tan**, Assoc Prof C **Mendis**, Prof and Mrs SC **Choo**, Prof KC **Chua** and Prof AC **Liew**

As was done in previous years, former ECE faculty members were invited to attend the homecoming to give our alumni more opportunities to meet their former lecturers and advisors. This year, the Department was very honoured to receive a very special guest, Prof **Choo** Seok Cheow, who was the second Head of Department, and his wife.

The event kicked off with sand art, balloon sculpting and a science show for the kids. Running in parallel was a guided tour of the Department's Vision and Machine Learning Lab and Centre for Integrated Circuit Failure Analysis and Reliability (CICFAR), as well as various side entertainments including face painting, a caricature artist and airbrush tattooing. There was also free flow of wine and beer for those who simply preferred to mingle with fellow alumni and ECE faculty. Poster displays showcasing some of the latest cutting-edge research led by ECE faculty provided some stimulation for alumni to engage in technical discussions.

In his presentation, Head of Department, Prof **Chua** Kee Chaing, provided facts and figures to highlight the global standing and international recognition that the Department and individual ECE faculty have earned, as well as some of the challenges that the Department faces. In particular, Prof Chua spoke about the Department's very own ECE scholarship and the first three recipients of this scholarship. Mr Melvin **Low**, Chairman of the NUS ECE Alumni Committee and CEO of Equvo Pte Ltd, then took to the stage to introduce the members of his committee before explaining the committee's mission.



The bartenders



Girl with painted face and mummy getting an airbrush tattoo



Girl with sculpted balloon



Alumni and family having a great time

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 close.



The sumptuous buffet lunch



A very happy lucky draw winner

ECE GRADUATION NIGHT 2012

The Department organised its third Graduation Night on 12 July 2012. The event attracted nearly 300 graduating students and their families as well as ECE staff members.

Graduation is a time when one looks fondly upon memories made over the past few years in the University such as the exams taken and the friends made while realising that this phase of life is coming to an end. A group of final-year ECE undergraduate students put together a programme that took us down memory lane that night on a nostalgic trip to the 'good old days' on campus.



The party at the Shaw Foundation Alumni House



The bartenders mixing a special drink for the occasion

The night began with a welcome address by the Head of Department, Prof **Chua** Kee Chaing, who congratulated all graduates and their parents. Mr **Chua** Sin Chew representing the Office of Alumni Relations, encouraged the graduates to be active alumni while Mr Melvin **Low**, Chairman of the NUS ECE Alumni Committee, exhorted them to come back to serve in the ECE Alumni Committee. The evening's entertainment programme started with a game of "Remembering ECE" with enthusiastic participation from the audience. The game involved identifying places on campus from sections of photographs.



Prof **Liew** Ah Choy leading ECE faculty to perform a creative rendition of *Gaudeamus Igitur*



Enthusiastic participation from the audience



A ballad of life in the Vietnamese countryside by Mr Kelvin **Nguyen**



The emcee Mr Ahmad **Tashrif** making his farewell speech

Next, under the gaze of a spellbound audience, Mr Kelvin **Nguyen** sang a hauntingly beautiful Vietnamese ballad while pictures of life in the Vietnamese countryside were projected onto the screen. The audience was also absolutely mesmerised by Miss **Tam** Wen Yi's solo piano recitals and enthralled by Associate Professor Marc **Armand**'s performance on the electric guitar. The highlight of the night was the ECE professors' creative rendition of *Gaudeamus Igitur*, a popular song sung mainly at university graduation ceremonies. Professor Liew Ah Choy rewrote the lyrics into a light-hearted composition with a message to the graduates: now armed with ECE knowledge, go forth, succeed and remember that you are an ECE and NUS Alumnus.



Miss **Tam** Weng Yi's solo piano recitals



Assoc Prof Marc **Armand**'s performance on the electric guitar

The finale was the group photo taking to capture this fleeting moment while flashbacks that returned us to past events on campus appeared on the screen. To all that were present, it was an unforgettable night.



The group photo

ECE STUDENT LIFE

ECE Student Life is a newly set-up portfolio under the Office of the Deputy Head for Undergraduate Programmes and Student Life. Its main aim is to enrich the ECE students' educational experience in the Department by promoting greater interaction and engagement between students and faculty members. In the process, it is hoped that students will gain a more holistic experience that also prepares them for life after graduation.

One strategy to achieve this aim is to strengthen our academic advisory service through various programmes and services. For example, ECE Student Life has recently set up a Buddy System for the 2012 freshmen. 190 freshmen were paired with 86 senior volunteers who acted as a resource for freshmen to approach for advice and useful tips to help them settle down quickly into university life. This was a great opportunity for the freshmen to form new friendships with senior buddies as well as their peers. We also hope to structure and strengthen the various levels of student advising so that we can provide more effective guidance to students. Besides peer student support, connections to faculty members are integral to a student's academic pursuits. Faculty members can provide academic advice and guidance on career planning. It is our hope that each student will get to know their academic advisor, who can share valuable experience with them.

One of the events specially organised recently was the Staff Freshmen BBQ Party held on 17 August 2012 at Town Green in University Town to promote interaction between faculty members and students. This event gathered nearly 280 freshmen, senior buddies and faculty members. It was a meaningful occasion for the freshmen to be introduced to their academic advisors. The evening was an enjoyable one filled with a series of programmes such as games and great performances put on by the acoustic soft rock band 'Sunny Side Up' and the ECE professors' musical creation, the 'ECE Freshmen Song', sung to the tune of 'The Lion Sleeps Tonight'. To top it all off, everyone was treated to a sumptuous buffet BBQ dinner with wonderful treats such as popcorn, candy floss and ice cream. Everyone had loads of fun mingling with one another.



Eagerly waiting for the start of the party



Assoc Prof **Ng** Chun Sum and his mentee



Clusters of mentors and mentees interacting with each other



Acoustic soft rock band, Sunny Side Up

ECE Student Life also plans to set up a student concierge, which is a casual one-stop station for students to seek academic advice, interact with peers and provide feedback on any issues that they encounter. A nice cosy space is also being planned for students to chill out and relax.

Another strategy is to work with industry partners, alumni members and the NUS Career Office to create more exposure and internship opportunities for students. We plan to solicit industrial visits and company open house visits for students to gain some insights on industries. Alumni sharing sessions, whereby alumni members will share their experiences in the working world, are also being planned. The idea is to start the students early in thinking about their careers so that they can plan suitable modules and work attachments to reach their desired career paths. Talks and courses pertaining to career, such as resume writing and interview skills will also be organised to help the senior students.

We hope to hear from all students on how ECE Student Life can assist in making your learning journey in the Department successful and enriching. Please provide us with your feedback and suggestions.

Contacts

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Relaxing and enjoying the performances



Head of Department Prof **Chua** Kee Chaing and Prof **Yeo** Swee Ping singing for the students



Song performance put up by some of the professors

A STINT AT NASA

Between February and August this year, EE final-year undergraduate student **Chen Shiyi** was at the National Aeronautics and Space Administration (NASA) Ames Research Centre (ARC) on an internship programme. He was part of a team working on NASA's PhoneSat project.

The goal of this project was to develop a very small satellite called CubeSat, which uses a Google Nexus S cell phone as its central processing unit. Throughout his time at ARC, Shiyi had the opportunity to work with some of the brightest minds from around the world. He was also deeply humbled to network with several key figures in the NASA administration and frontier innovators of science including Dr Pete **Worden** (ARC Chief Director) and Prof Bob **Twiggs** (inventor of CubeSat). Shiyi's work at ARC primarily involved electrical hardware and software development, which included interfacing the different subsystems' printed circuit boards. He also assisted in conducting environmental tests on the satellite as part of pre-launch preparations.

Prior to his internship with NASA, Shiyi perceived engineering as an occupation in which duties performed are highly constrained by top-down instructions, and therefore felt that an engineering job was limited to a supporting role without much room for innovation. However, this internship changed his opinion about engineering and he returned to Singapore feeling a sense of achievement and satisfaction that he had been part of a team that built a system that contributes positively to the technological advancement of humankind. He is now pursuing a final-year project to develop a nano-satellite for NUS to be launched in 2015.



Poster of NASA's PhoneSat project



Shiyi with other interns

UNDERGRADUATE STUDENTS' ACHIEVEMENTS

PLAYING SOCCER USING MULTIPLE FPGA BOARDS



The OpenHW winning team and their advisor. From left to right: **Hoo** Chin Hau, Assistant Professor **Akash Kumar** and **Koay** Zi Hao

On 1 June 2012, two final-year CPE students **Hoo** Chin Hau & **Koay** Zi Hao, under the supervision of Assistant Professor **Akash Kumar** participated in the Open Hardware (OpenHW) Competition in Beijing. The aim of this competition is to drive Xilinx-based technical innovations, promote the use of FPGA devices in embedded systems and encourage the development of the open-source hardware community. In the competition, students have the freedom to demonstrate any design that leverages on the advantages provided by a Xilinx FPGA device. The NUS ECE team took the second prize which comprised RMB 3000 (equivalent to about S\$600) in cash and certificates. The return airfare to Beijing and accommodation for the team were also sponsored by Xilinx.

The students presented a soccer system running on multiple FPGA boards. One board was responsible for emulating the physics of soccer as well as rendering of the players and soccer field. The computations related to the physics of the game were done by a soft-core processor (Microblaze) while the rendering were performed by a custom hardware core that implemented a subset of the features provided by the graphics engine of the Super Nintendo gaming system. The remaining boards handled the (artificial) intelligence of the soccer players. Communication among the boards was done through Ethernet.

A short video of the system can be found at <http://www.youtube.com/watch?v=LD0HhO4QWZo>.

ECE TEAM WINS FIRST PRIZE AT INTEL CUP EMBEDDED SYSTEM DESIGN CONTEST

From 19 to 25 July 2012, three second-year ECE students **Nguyen Anh Tuan**, **Wang Siqi** and **Xu Yang**, under the supervision of Assistant Professor Akash **Kumar** and Dr Rajesh C **Panicker**, participated in the Intel Cup Undergraduate Electronic Design Contest – Embedded System Design Invitational Contest at Shanghai Jiaotong University, Shanghai. The motivation behind this competition is to promote awareness and interest amongst undergraduate students in embedded system design and uncover possible technical solutions to various practical problems. In the competition, students have the freedom to demonstrate any design based on the Intel atom board provided by the organising committee. There were more than 150 participating teams. While most teams were from renowned universities in mainland China, there were also 15 teams from nine different countries such as Singapore, Mexico, Russia and India. The NUS ECE team clinched first prize, with each team member receiving a 500GB portable hard drive and a certificate.



The Intel Cup winning team. From left to right: **Xu Yang**, **Wang Siqi** and **Nguyen Anh Tuan**

The students built an indoor navigation system called InSINQ, an intelligent system of inertial navigation using Quick Response (QR) codes, based on the given atom board. This system was designed to provide a precise indoor navigation function in buildings where GPS signals are blocked. The main navigation algorithm consists of two key components – an inertial navigation algorithm and QR codes. For the inertial navigation algorithm, an accelerometer and a gyroscope were used to detect the number of steps and orientation of the user. A Kalman filter and Madgwick's orientation filter were implemented to eliminate noise from the sensors. In addition, various QR codes are pasted inside the building, with each QR code containing information about the absolute position of the code. As the user walks around, a camera keeps tracking QR codes, and updates the new location when it finds one.

A voice assistance system using a voice recogniser and synthesiser has also been developed to enable the visually impaired to use the system. A short video of the system is available at <http://youtu.be/VPMrcuANeFU>.

WINNING THE SINGAPORE YOUNG TALENT OUTREACH PROGRAMME VIDEO COMPETITION



Tan Han Wei and **Sanjiv Nair**

Tan Han Wei, a second-year ECE student and **Sanjiv Nair**, a medical student in NUS, grabbed the first prize in the Singapore Young Talent Outreach Programme Video Competition on 24 April 2012. The competition was organised by SEMI, Singapore Semiconductor Industry Association (SSIA) and EDB, with the objective to grow the future talent pool for the electronics industry. Participants were asked to produce a video reflecting the theme "The Impact of Electronics Innovations on Future Lifestyle, Quality of Life and Development". The pair's winning entry was a video entitled "Enlightenment 2.0: A Revolution in Learning", for which they received S\$8,000 in prize money.

Their video asserts that mankind has made a "promising start of an age of spectacular delivery of content and learning".

UPCOMING ALUMNI EVENT

To give you an early heads-up, the ECE Alumni Committee will be holding a bowling event on Friday, 22 February 2013. More details of the event will be publicised in due course. So stay tuned!

