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The year 2009 was a very transitional year for the School, marked with many challenges. As the new Head of School, I believe that these challenges provided the opportunity for change and positive growth. I am pleased to report that 2009 has been an important stepping stone in the School’s history, with many positive transformations.

We established a new administration, including Prof. Chee Yee Kwok as Deputy Head of School and Dr Ray Eaton as Director of Academic Studies. Eight new internal committees were set up, all of whom have been very active and instrumental in the strong development of the School.

As a School this year, we increased research publications by our staff – resulting in having the largest amount of refereed conference publications in the Faculty in 2009. We obtained significant amounts of strategic funding and improved teaching quality. The newly appointed Industry Advisory Board has made valuable suggestions to help us ensure that all our graduates have industry relevant knowledge and experience. We received approval for our new 3+2 BEngSc/ME structure, which was a great stepping stone in our program offerings. We revamped the infrastructure in the School to provide an encouraging learning environment for our students and our vibrant undergraduate student society ELSOC, along with the newly established postgraduate student society, have created a great sense of community within the School. I am also pleased to say our strong promotional activities of the School, together with the dynamic nature of the School’s growth in 2009, have resulted in an increase in both our undergraduate and postgraduate student enrolments, which are expected to continue to rise.

Our key collaboration with the Australian Power Institute (API) this year has greatly helped to improve our lab facilities and allowed us to appoint an API funded position. The School’s strong partnership with the National Information and Communications Technology, Australia (NICTA) ATP Laboratory has been instrumental in helping the School provide scholarships for many of our research postgraduate students and Taste of Research students, and has also led to several NICTA sponsored School events.

It was wonderful to see our staff be recognised for their outstanding work both on the national and international scales. In particular, Prof. David Taubman is to be congratulated on winning the 2009 Inventor of the Year Awards for his Kakadu™ software and Dr Wei Zhang for the 2009 IEEE Young Researcher Award. Dr Iain MacGill was a recipient of the 2009 UNSW Staff Excellence Awards, which was a great acknowledgement of his contribution to the School. Our alumni also excelled in 2009, with Adrian Clark being named Australia’s Young Professional Engineer of the Year and Susan Angus being awarded the Malcolm Chaikin Prize for Research Excellence in Engineering.
New staff play an important role in the future of the School and this year we made 2 new appointments: Dr Stephen Redmond in Biomedical Systems and Dr Tara Hamilton in Microsystems. The School also recognises the importance of women in engineering, still a relatively untapped market of great potential, and increased the number of female staff and mentors this year.

Key members of our academic staff concluded their long service to the School this year – including former Heads of School Prof. Branko Celler and A/Prof. Tim Hesketh. Senior Lecturer Mr Edward Spooner and Professional Officer Mr Jeff Lee also retired in 2009. I would like to take this opportunity to thank all of them for their invaluable contribution to the School over the years and for the impact that they made.

The groundwork for growth and positive change has been set in 2009. Our goals for the future are to build on this foundation and to meet our high performance targets across all aspects of the School. We have a committed and dynamic team of staff, eager and energetic students, and I believe that the School is well positioned to make great strides, wonderful achievements and build a strong national and international reputation in 2010.

**GOALS OF THE SCHOOL**

- The Reference Site for research & teaching of Electrical Engineering & Telecommunications in Australia and to be recognised as such internationally
- A Research Intensive School where every academic staff member has the ability to attract competitive research funding
- Be the School that the best undergraduate students choose, above other universities in the region, based on our reputation for research, teaching, use of educational technology, care of individual students, facilities
- Provide a secure and satisfying work environment for all staff with adequate recognition of individual achievements and work performance

**VISION OF THE SCHOOL**

The UNSW School of Electrical Engineering and Telecommunications will continue to offer a well balanced education in the field of Electrical Engineering and Telecommunications that is of the highest standard to Australian and international coursework students, propagating the opinion that this is the School of Choice for this field of study and that graduates from this School are equipped with the attributes required for industry.

We will also be conducting basic and applied Electrical Engineering and Telecommunications research projects, generating results that are unanimously respected in the international engineering community and attracting funding from Government and Industry sources. This will provide a high repute research training ground for our postgraduate research students. As a consequence, the community and engineering profession at large will be endowed with information, analysis, consultation and active participants in professional activities.
## SCHOOL ORGANISATIONAL STRUCTURE AND COMMITTEES

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<tr>
<th>Role</th>
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<tr>
<td><strong>Head of School</strong></td>
<td>Professor Eliathamby Ambikairajah</td>
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<td><strong>Executive Management Team</strong></td>
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<td>Professor Eliathamby Ambikairajah, Head of School</td>
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<td>Professor Chee Yee Kwok, Deputy Head of School</td>
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<td>Dr Ray Eaton, Director of Academic Studies</td>
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<td>Mr Gordon Petzer, School Executive Officer</td>
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<td><strong>Postgraduate Coursework Coordinator</strong></td>
<td>Dr Deep Sen</td>
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<td><strong>Postgraduate Research Coordinator</strong></td>
<td>Professor Jinhong Yuan</td>
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<td><strong>Head of School Advisory Committee</strong></td>
<td>Professor Eliathamby Ambikairajah, Chair</td>
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<td><strong>OH&amp;S Committee</strong></td>
<td>Dr Iain Skinner, Chair</td>
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<td><strong>Academic Executive Committee</strong></td>
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<td><strong>IT Committee</strong></td>
<td>Dr Tim Moors, Chair</td>
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<td><strong>Research Committee</strong></td>
<td>Professor Andrey Savkin &amp; Professor David Taubman, Chairs</td>
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<td><strong>Marketing, Website, &amp; Alumni Committee</strong></td>
<td>Associate Professor Robert Malaney, Chair</td>
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<td><strong>Services and Finances Committee</strong></td>
<td>Dr Elias Aboutanios, Chair</td>
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<td><strong>Administrative Committee</strong></td>
<td>Mr Gordon Petzer &amp; Dr Ray Eaton, Chairs</td>
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<td><strong>School Laboratory Manager</strong></td>
<td>Dr Ming Sheng</td>
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<td><strong>School Office Manager</strong></td>
<td>Ms Gladys Fong</td>
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Each committee chair reports to the Head of School. Minutes are published on the School website and made available to all School staff.
CURRENT STAFF

During 2009, the School of Electrical Engineering and Telecommunications (EE&T) had 33 full time academic teaching staff, 23 research staff, more than 20 visiting and conjoint academics plus 28 technical and other support staff. This makes EE&T at UNSW one of the largest schools of its kind in Australia.

School staff provide their expertise to various national and international committees, technical associations, specialised societies and conferences, editorial boards and Standards Australia Committees in addition to engaging as consultants for government and private industry.

Staff conduct groundbreaking research across multiple disciplines leading to several centers within the School in addition to inter-school and inter-faculty centers.

MANAGEMENT

Prof. Eliathamby Ambikairajah
Head of School
Professor in Signal Processing

Prof. Chee Yee Kwock
Deputy Head of School
Professor, Head of Microsystems Research Group

Dr Ray Eaton
Director of Academic Studies
Lecturer in Systems and Control

Mr Gordon Petzer
School Executive Officer

ACADEMIC STAFF

Dr Elias Aboutanios
Senior Lecturer in Signal Processing

Prof. Branko G.Celler
Professor in Systems and Control

Dr David Clements
Senior Lecturer in Systems and Control
Associate Dean (Academic)

Prof. Andrew Dzurak
Professor in Microsystems
Director, Semiconductor Nanofabrication Facility
NSW Node, Australian National Fabrication Facility (ANFF)

Dr Julien Epps
Senior Lecturer in Signal Processing

Dr Tara Hamilton
Lecturer in Microsystems

A/Prof. Tim Hesketh
Head of School, until March 2009
Associate Professor in Systems and Control
Director of Education, NICTA

A/Prof. Tuan D. Hoang
Associate Professor in Systems and Control

Dr Branislav Hredzak
Senior Lecturer in Microsystems
Associate Dean (Academic)

A/Prof. François Ladouceur
Associate Professor in Photonics

Dr Torsten Lehmann
Senior Lecturer in Microsystems

A/Prof. Robert Malaney
Associate Professor in Telecommunications
Dr Iain MacGill  
Senior Lecturer in Energy Systems 
Joint Director, Centre for Energy and Environmental Markets

Dr Tim Moors  
Senior Lecturer in Telecommunications

Dr Andrea Morello  
Senior Lecturer in Quantum Nanosystems 
Program Manager, Centre for Quantum Computer Technology

Dr Hadis Nosratighods  
Postdoctoral Fellow (Lecturing in Signal Processing)

Prof. Gang-Ding Peng  
Professor in Photonics and Optical Communications

Dr Toan Phung  
Senior Lecturer in Energy Systems

Prof. Faz Rahman  
Professor, Head of Energy Systems Research Group

Prof. Rodica Ramer  
Professor in Microsystems

Dr Stephen Redmond  
Lecturer in Biomedical Systems and Signal Processing

Prof. Andrey Savkin  
Professor in Systems and Control

Dr Deep Sen  
Senior Lecturer in Signal Processing 
Postgraduate Coursework Coordinator

Prof. Aruna Seneviratne  
Professor in Telecommunications 
Australian Technology Park Laboratory Director and Education Director, NICTA

Dr Vijay Sivaraman  
Senior Lecturer in Telecommunications

Dr Iain Skinner  
Senior Lecturer in Photonics

Prof. Victor Solo  
Professor, Head of Systems and Control Research Group

Mr Edward Spooner  
Senior Lecturer in Energy Systems

Prof. David Taubman  
Professor, Head of Telecommunications Research Group

Dr Alex Von Brasch  
Postdoctoral Fellow (Lecturing in Telecommunications)

Prof. Jinhong Yuan  
Professor in Telecommunications 
Postgraduate Research Coordinator

Dr Wei Zhang  
Senior Lecturer in Telecommunications

Mr Philip Allen  
Professional Officer

Mr Jong An  
Administrative/Education Technology Officer

Mr Gordon Bates  
Laboratory Manager, ANFF

Mr Yin Hang Cheung  
Administrative Assistant

Mrs Silvana Collings  
Personal Assistant to Head of School

Mr Doug Davison  
Procurement Officer
Mrs Mervat Farah  
Financial & Procurement Assistant

Ms Gladys Fong  
School Office Manager

Dr Eric Gauja  
Microfabrication Manager, ANFF

Ms Karen Jury  
Operations Manager, ANFF

Mr Albert J. McMaster  
Technical Officer, ANFF/SNF

Mr Tom Millett  
Professional Officer

Ms May Park  
Administrative Officer

Ms Michelle Price  
OHS Officer, ANFF/SNF

Mr Zhenyu Liu  
Technical/OHS Officer

Mr Gamin Liyadipitya  
Senior Technical Officer

Mr Chris X. Lu  
Professional Officer

Ms Nelly Wijaya  
Administrative Assistant

Mr Joe C. Y. Yiu  
Senior Technical Officer

Mr Roy X. Zeng  
Senior Technical Officer

RESEARCH STAFF

Dr Albert S. Canagasabey  
Post-Doc Fellow

Dr Gregory Chan  
Research Associate

Dr Teddy M. L. Cheng  
Research Fellow

Dr Nicholas J. Cutler  
Post-Doc Fellow

Dr Ashay Dhamdhere  
Senior Research Associate

Dr Fay E. Hudson  
Senior Research Fellow, CQCT

Dr Baburaj Karanayil  
Professional Officer

Dr Daniel Krcho  
Professional Officer

Jeff Lee  
Professional Officer

Ms May Park  
Administrative Officer

Ms Bamini Pratheepan  
Administrative Assistant

Mr Subash Puthanveetil  
Mechanical Tradesperson

Dr Ming Sheng  
Professional Officer/Laboratory Manager

Ms Joanna Szymanska  
Process Engineer, ANFF

Mr Richard Tuck  
Laboratory Craftsman

Mr Syed L. Rahman  
Technical Officer

Ms Michelle Price  
OHS Officer, ANFF/SNF
Dr Chaofeng J. Li
Research Fellow

Dr Jun Li
Post-Doc Fellow

Dr Wee H. Lim
Research Fellow ANFF

Dr Linda D. Macks
Senior Research Fellow, CQCT/ANFF

Mr Reji K. Mathew
Senior Research Associate

Dr Aron W. Michael
Senior Research Assistant

Dr Eun H. Min
Research Associate

Dr Ido Nevat
Post-Doc Fellow

Dr Maria I. T. Retnanestri
Research Associate

Mr Shuai Wang
Research Assistant

Dr Kok H. Wong
Post-Doc Fellow

Dr Floris A. Zwanenburg
Senior Research Fellow, CQCT

Dr Jim Basilakis
Senior Research Fellow

Dr Christopher C. Escott
Research Fellow ANFF

Dr Syed A. Pasha
Research Associate

Dr Robert J. Passey
Senior Research Associate CEEM

Mr Paul H. M. R. Prevot
Research Assistant

Roksana Boreli
Conjoint Associate Professor

T. W. Whitbread
Visiting Fellow

Rod G. Clark
Visiting Professor

Steven. G. Duvall
Professorial Visiting Fellow

M. Elkashlan
Visiting Fellow

C. Hales
Visiting Fellow

W. Harvey Holmes
Senior Visiting Fellow

W. R. Lachs
Visiting Research Fellow

S. G. Leon-Saval
Visiting Fellow

P Mallon
Visiting Fellow

G. S. Morrison
Visiting Fellow

Peter D. Neilson
Visiting Professor

Saeid Nooshabadi
Senior Visiting Fellow

Vojin G. Oklobdzija
Professorial Visiting Fellow

K. K. Paliwal
Professorial Visiting Fellow

C. J. E. Phillips
Visiting Fellow

Graham A. Rigby
Emeritus Professor

D. Siu
Visiting Fellow

M. E. Smith
Visiting Fellow

R. A. Zakarevicius
Visiting Fellow

Neville W. Rees
Emeritus Professor

Hugh R. Outhred
Professorial Visiting Fellow

Trevor R. Blackburn
Visiting Associate Professor

Colin Grantham
Visiting Associate Professor
<table>
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<tr>
<th>Committee Chair</th>
<th>Head of School</th>
<th>Academic Executive Committee</th>
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<td>Committee Members</td>
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<td>Philip Allen</td>
<td>Zhenyu Liu</td>
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<td>Philip Allen (Marketing Chair)</td>
<td>Silvana Collings</td>
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<td>Daniel Krcho</td>
<td>Chris Lu</td>
<td>Branislav Hoedzak</td>
<td>Deep Sen (Website Chair)</td>
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Each committee outlines a set of semester and yearly goals that will contribute to the progress and development of the School. The committees’ functions are to achieve each of their outlined goals within the agreed budget and time frame.

Key Tasks across the School Committees for 2009

Academic Executive Committee
1. Prepare Engineers Australia accreditation document for new 2 year Masters program
2. Prepare School Learning & Teaching Plan

Research Committee
2. Prepare School Strategic Research Plan
3. Develop strategies to increase number of competitive grant applications and success rates

IT Committee
1. Review School IT position and prepare report on appropriate equipment replacement plans
2. Include School IT and maintain School IT Business Unit Recovery Plan (BURP)

Services & Finance Committee
1. Report on equipment and facilities expenditure proposals
2. Prepare School Operational Plan (with other committees)

Marketing, Alumni and Website Committee
1. Establish and develop a relationship with EE&T alumni – professional guest lectures and set up Industry Research Forum with alumni
2. Review, update and re-produce School marketing material & promote to increase future enrolment in our programs
3. Full overhaul of School website. Collect, update and report news on website on regular basis

Occupational Health & Safety Committee
1. Implement all aspects of the UNSW OHS management system by the end of 2009
2. Set up OHS awareness campaign in School

Administrative Committee
1. Maintain overall appearance and functioning of the School
2. Organise social events, manage School scholarships, responsible for the School’s Show & Tell

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<th>Women in Elec &amp; Telecom Engineering Coordinators</th>
<th>Industrial Training Coordinators</th>
<th>ELSOC Liaison Coordinators</th>
<th>Thesis Coordinators</th>
<th>Summer Courses Coordinators</th>
<th>PG Research Society Coordinator</th>
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<th>Assessment Committee Coordinator</th>
<th>NICTA Coordinator</th>
<th>BlueSat Coordinators</th>
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- Toan Phung

Thesis Coordinators
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- Vijay Skvaraman

Summer Courses Coordinators
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PG Research Society Coordinator
- Ray Eaton

Co-op Coordinator
- Vijay Skvaraman

Assessment Committee Coordinator
- Iain Skinner

NICTA Coordinator
- Chee Yee Kwik

BlueSat Coordinators
- Julien Epps
- Elias Aboutanios
ACADEMIC PROMOTIONS

RODICA RAMER and JINHONG YUAN were both promoted to Professor in 2009.

Rodica Ramer has been with the School of EE&T since February 1993, when she was appointed as a Lecturer in Microsystems. Rodica's research interests cover various aspects of high frequency engineering with emphasis on the design and fabrication of microwave devices. Her current research lies in the areas of RF MEMS and reconfigurable structures. Within the School, she currently teaches RF Electronics, Microwave Engineering as well as Electromagnetics and Antennas.

Jinhong Yuan came to UNSW in 2000 also as a Lecturer in Telecommunications after spending time as a Research Fellow at the University of Sydney. Jinhong's primary research and teaching interest is in Mobile and Wireless Communications, information theory, error control coding, and digital modulation. He has published two books, two book chapters, over 170 papers, three patents, over 20 industrial reports, and along with his students, is the recipient of several best paper awards.

INTERNAL APPOINTMENTS

With the change to the Head of School in April 2009, the following additional internal appointments were made:

Deputy Head of School: Professor Chee Yee Kwok
Director of Academic Studies: Dr Ray Eaton
Postgraduate Research Coordinator: Professor Jinhong Yuan
Postgraduate Coursework Coordinator: Dr Deep Sen

RETIREMENTS

The year 2009 saw the retirements of several long serving members of staff. The School acknowledges their valuable contribution to its success over many years.

Professor Branko Celler (BSc ’69, BE Hons ’72, PhD ’78 UNSW)

Professor Branko Celler came to UNSW as an undergraduate student completing a BSc in computer science and physics in 1969 and a BE with honours in electrical engineering in 1972. In 1978 he received one of the University's first PhDs in the emerging discipline of biomedical engineering. After a period of postdoctoral research in the United States, and then as Director of Research and Development at Sydney's Medicheck Referral Centre, he rejoined UNSW as a Lecturer with the School's Department of Systems and Control in 1981, which was followed by promotions to Senior Lecturer in 1985 and Associate Professor in 1996. During the early 1980s Dr Celler was instrumental in establishing the School's Biomedical Engineering Laboratory. With the establishment of the Graduate School of Biomedical Engineering in 1995, he also served as an Adjunct Professor in the Graduate School until he accepted a full professorship in the School of Electrical Engineering in 1997.

Professor Celler was appointed Head of School in 1998. During his eight-year headship, Professor Celler led an extensive review of the School's staff, programs and facilities with a view to revitalising the School's activities. As part of this process, he successfully applied for University and federal funding to develop a ‘virtual classroom’ within the School. The establishment of this facility has contributed to the School's reputation as a leader in the use of educational technology for collaborative teaching and distance education. In 2006, Professor Celler stepped down as Head of School to become CEO of the TeleMedCare Group, which he established to commercialise telehealth

SERVICE AWARDS

Special congratulations go to Philip Allen, who was recognised for a Long Service Award, after having provided 25 years of valuable service to the School. As a Professional officer within the School, Philip has contributed to the School in many ways, including teaching and research support in the areas of photonics and networking, and has also provided tremendous input in IT support and marketing for the School.
technologies for managing chronic illness and for aged care. Since stepping down as Head of School, Professor Celler continued his association with the School as a research Professor, until retiring from UNSW at the end of the year and taking up a position as Executive Dean of the College of Health and Science at the University of Western Sydney.

**Associate Professor Tim Hesketh** (BSc Hons ’70, MSc ’72 Cape Town, PhD ’83 Massey)

Associate Professor Tim Hesketh joined UNSW in 1987 and was appointed as a Senior Lecturer within the School of Electrical Engineering and Computer Science. Since joining the School, he has taught subjects in control, real-time systems, digital systems, signal processing, electronics and computer-aided design, while his research has focused on control theory and its applications in areas such as embedded systems, real-time computing and linear output feedback systems.

In 2000, Associate Professor Hesketh took up a post as Deputy President of the Academic Board, and also was appointed Associate Dean (Academic) of the Faculty of Engineering, a role which he continued until 2005, at which point he was seconded as project director for the University’s UNSW Asia project. In 2001, he also served a year as Acting Dean of Engineering. In 2006, he returned to the School of Electrical Engineering and Telecommunications as Head of School, which he continued until April 2009. Associate Professor Hesketh has now retired from the School and is currently NICTA’s Director of Education.

**Mr Ted Spooner** (BE UNSW, ME UNSW)

Ted Spooner joined the School in 1974 as a professional officer and provided invaluable contributions to a number of research projects within the School. He was instrumental in using UNIX for its first real application in Australia when he was working on the digital protection project. He was heavily involved in the development of power electronics teaching facilities in the School and then, after being appointed to the academic staff and developing his activities in renewable energy he became a leading influence in developing testing methods and standards for PV inverter systems in Australia. He was also responsible over the last few years for significant developments and in the teaching of the first year electrical engineering program in the School.

**Jeff Lee** (BE ’72, MEngSc ’74, ME ’84, UNSW)

Jeff Lee retired at the end of 2009 after 37 years of service to the School. He started, and faithfully remained, within the Systems and Control group where he provided real-time computer hardware implementation and software support to undergraduate and postgraduate students and staff for that discipline. He was more widely known throughout the School for his management of the School’s data and telecommunication network services, essential services for all business operations of the School. Jeff was around (with Peter Ivanov) when the School’s first serial network, which sped along at 9600 Baud, was commissioned, and has guided and overseen the continual development of the school’s network ever since.

In addition, Jeff’s broad expertise was also valuable in providing logistic and technical support for conference sites and more general engineering support to both staff and students.
NEW APPOINTMENTS

With several retirements during both in 2009 and from previous years, the School started to embark on a significant recruiting process to bolster the research and teaching strengths in key areas. In particular, for 2009, appointments were made in the areas of Biomedical Engineering, Embedded systems and Signal Processing.

We welcomed the following lecturing academic staff:

Dr Stephen Redmond, July 2009, Biomedical Systems and Signal Processing.

Dr Tara Hamilton, December 2009, Microsystems.

The School also undertook recruitment in the area of Energy and Power Systems, with appointments made in the latter half of the year. These new appointments will join the School in 2010.

CURRENT RESEARCH STUDENTS

The number of commencing research students steadily increased in 2009 from 2008, with 16 new PhD and 4 Master of Engineering (research) students starting. Overall, the total number of research students in 2009 declined slightly to 85 from the 2008 level of 99. A total of 45 local and 40 international students make up this total.
Students enrolled in research degrees in 2009 include:

- Allan Aaron
  Energy Systems
  Supervisor: Prof. Hugh Outhred

- Abdullah Al-Hafiz
  Microsystems
  Supervisor: Prof. Chee Yee Kwok

- Syed Taha Ali
  Telecommunications
  Supervisor: Dr Vijay Sivaraman

- Abdul-Hakeem Alomari
  Systems and Control
  Supervisor: Prof. Andrey Savkin

- Mohammad Abdul-Hameed Al-Rabayah
  Telecommunications
  Supervisor: A/Prof. Robert Malaney

- Mohammad Yusuf Mohammad Ghias Amer
  Photonics
  Supervisor: Prof. Gang-Ding Peng

- Chakrapani Aravind Surapura
  Telecommunications
  Supervisor: A/Prof. Robert Malaney

- Asrul Izam Azmi
  Photonics
  Supervisor: Prof. Gang-Ding Peng

- Marwan Hadri Azmi
  Telecommunications
  Supervisor: A/Prof. Jinhong Yuan

- Mitra Bahadorian
  Systems and Control
  Supervisor: Dr Ray Eaton

- Dur-E-Zehra Baig
  Systems and Control
  Supervisor: Prof. Andrey Savkin

- Youmna Borghol
  Telecommunications
  Supervisor: Prof. Aruna Seneviratne

- King Yuk Chan
  Microsystems
  Supervisor: A/Prof. Rodica Ramer

- Kok Wai Chan
  Microsystems
  Supervisor: Prof. Andrew Dzurak

- Ge Chen
  Microsystems
  Supervisor: Dr Saeid Nooshabadi

- Jiefeng Chen
  Telecommunications
  Supervisor: Prof. Aruna Seneviratne

- Shigang Chen
  Photonics
  Supervisor: Prof. Gang-Ding Peng

- Lester Chong
  Energy Systems
  Supervisor: Prof. Faz Rahman

- Ho Sung Chun
  Microsystems
  Supervisor: Dr Torsten Lehmann

- Kushal Das
  Microsystems
  Supervisor: Dr Torsten Lehmann

- Anton Delprado
  Systems and Control
  Supervisor: Dr Ray Eaton

- Thanh Thinh Doan
  Signal Processing
  Supervisor: Dr Julien Epps

- Gilbert Hock Beng Foo
  Energy Systems
  Supervisor: Prof. Faz Rahman

- Sara Hakami
  Telecommunications
  Supervisor: Prof. Aruna Seneviratne

- Michael Hoy
  Systems and Control
  Supervisor: Prof. Andrey Savkin

- Ronny Kurniawan Ibrahim
  Signal Processing
  Supervisor: Prof. Eliahtamby Ambikairajah

- Ahmad Ali Iqbal
  Telecommunications
  Supervisor: Prof. Aruna Seneviratne

- Faizan Javed
  Systems and Control
  Supervisor: Prof. Andrey Savkin

- Philip Ji
  Photonics
  Supervisor: Prof. Gang-Ding Peng

- Md. Anisul Karim
  Telecommunications
  Supervisor: A/Prof. Jinhong Yuan

- Muhammad Khalid
  Systems and Control
  Supervisor: Prof. Andrey Savkin

- Nazeer Khan
  Telecommunications
  Supervisor: Prof. Aruna Seneviratne

- Hamood Ur Rahman Khawaja
  Microsystems
  Supervisor: A/Prof. Rodica Ramer

- Phyu Phyu Khing
  Signal Processing
  Supervisor: Prof. Eliahtamby Ambikairajah

- Chul Kim
  Microsystems
  Supervisor: Dr Saeid Nooshabadi

- Jia Min Karen Kua
  Signal Processing/NICTA
  Supervisor: Prof. Eliahtamby Ambikairajah

- Alexander Kurusingal
  Telecommunications
  Supervisor: Dr Vijay Sivaraman

- Kai Xian Lai
  Energy Systems
  Supervisor: Dr Toan Phung

- Nai Shyan Lai
  Microsystems
  Supervisor: Prof. Andrew Dzurak

- Ngoc Phu Le
  Signal Processing/NICTA
  Supervisor: Prof. Eliahtamby Ambikairajah

- Qim Yi Lee
  Systems and Control
  Supervisor: Prof. Andrey Savkin

- Hiscocks Mark
  Photonics
  Supervisor: Prof. Gang-Ding Peng

- Graeme Wilson Lowe
  Microsystems
  Supervisor: Prof. Andrew Dzurak

- Phillip Maher
  Telecommunications
  Supervisor: A/Prof. Robert Malaney

- Goran Marjanovic
  Systems and Control
  Supervisor: Prof. Victor Solo

- John William Matthews
  Telecommunications
  Supervisor: Dr Vijay Sivaraman
CURRENT UNDERGRADUATE STUDENTS

A similarly healthy increase in 2009 commencing undergraduate students was experienced, with 153 new students starting compared to 128 in 2008. The total undergraduate student enrolment in 2009 was 634, up from 613 the previous year.

STUDENT PROFILE

Stefanie Brown completed her undergraduate degree in 2009 with first class honours, specialising in Signal Processing. She has been a UNSW Co-op Scholar for the duration of her degree and has been the recipient of a Dean’s Award in two separate years. Stefanie has been provided valuable service to the School, firstly as an active member of ELSoc in the role of Vice-President for two years, and as a popular and sought after lab demonstrator for courses in 1st to 3rd years, where she particularly enjoyed assisting newer electrical engineers through their university experience.

“The best thing about the EE degree is that it is so broad; I’ve concentrated on DSP, but have been able to learn a bit about electronics and computing at more detailed levels too.”

STUDENT PROFILE

Richard Sofatzis grew up in Sydney, moving from Earlwood to Hurstville in 2000, and completing his HSC at All Saints Grammar School, South Belmore. Richard is studying Electrical Engineering and is also a Co-op scholar, inspired to apply after seeing the benefits which resulted for his older brother, who studied Engineering. Outside of university life, Richard in involved in a leadership capacity at Convivio, a congress for school-aged youth, as well as Reasons for Hope, a motivating weekend away for young adults. He is a keen tennis player and teaches piano to young budding pianists, and has an interest in reading philosophy.

When asked about why Richard chose Electrical Engineering, he states “… because I enjoy fiddling with things, getting them to work and I have a good eye for detail. I have always been interested in electrical devices, gadgets and computers, and I wanted to study a course that not only used computers or equipment but one in which I could understand, design, and make things work.”
ELSOC ANNUAL REPORT

ELSOC is the student society for the School of Electrical Engineering and Telecommunications of the University of New South Wales. Our aim is to provide to the students everything the school is unable to; from social activities to help liaising with industry.

2009 was a very successful year for us. We were responsible for the organization and running of the Engineering Sports Day, an event which draws in 1000 students from the whole Faculty of Engineering to compete in a sporting competition and enjoy a free barbeque. The event also included the Defence Force landing a Navy Helicopter on the oval at the university. For our role in this ELSOC was awarded a prize for the best event of any society in the university. We were also able to secure awards for the most improved constituent society in the university.

2009 also saw a dramatic increase in student attendance of social events including the drinks night and barbeques. At these barbeques the students were introduced to industry representatives from Cochlear and Renesas. We also pioneered a new website design which actively encourages students to interact via forums, as well as provided a wiki page where students were able to share their knowledge with the rest of the school. Students were also able to purchase from a new range of merchandise including new t-shirt designs and a jersey.

THE 2009 COMMITTEE

Perry Stephenson  President
Stefanie Brown  Vice President
Cassie Davies  Secretary
Matan Livson  Treasurer
Simon Lewis  Industry Liaison
Andrew Hankins  Publicity Officer
Dinesh Mohan  ARC Delegate
Sam May  Mascot & Webmaster
Not Elected IET Liaison
Scott Macarthur-King  4th year Representative
Will Rowley  3rd year Representative
Marty Hemphill  3rd year Representative
Leon Oriti  2nd year Representative
Aff Abdullah  2nd year Representative
Evan Stephenson  1st year Representative
Brendan Dundas  1st year Representative
GRADUATIONS

Abdul Halim, III Shairah
MEngSc, Microelectronics and Microsystems

Abdullah Jalani, Faizah
MEngSc, Systems and Control

Agbi, Omotola Olawunmi
MEngSc, Telecommunications

Ahmad Khairi, Ahmad Farhan
BE (Electrical)

Ahmed, Syed Sohaib
MEngSc, Telecommunications

Allom, Justin
BE (Electrical)

Altvater, Bernhard Herbert Engelbert
MEngSc, Telecommunications

Azmi, Aimie Nazmin
MEngSc, Energy Systems

Bhatti, Abdul Wahab
MEngSc, Telecommunications

Brown, Stefanie
BE (Electrical), Honours 1

Brunero, Adam Alessio
BE (Electrical), Honours 2 Division 1

Bushan Gunasekaran, Saravana Kumar
MEngSc, Telecommunications

Bye, Robin Trulsen
PhD, Systems & Control

Cao, Shuang
MEngSc, Signal Processing

Cassidy, Benjamin
BE MBiomedE (Electrical), Honours 1

Chan, Gabriel
BE (Electrical)

Chen, Szu-Ming Mike
MEngSc, Microelectronics and Microsystems

Chen, Zhiyao
MEngSc, Microelectronics and Microsystems

Cheng, Kenneth Ying Kit
BE (Telecommunications)

Cheng, Gong
MEngSc (Extn), Energy Systems

Chiang, Shih-Hao Michael
MEngSc, Microelectronics and Microsystems

Choudry, Muhammad Omer
MEngSc, Telecommunications

Chung, Hang Ming
BE (Electrical), Honours 2 Division 1

Chung, Li Jing
BE (Electrical), Honours 1

Cohen, Lance
BE MBiomedE (Electrical), Honours 2 Division 1

Conyers, Susan Jane
MEngSc, Electric Power Engineering

Couch, Joseph Daniel
BA (Electrical), Honours 2 Division 2

Cutler, Nicholas Jeffrey
PhD, Energy Systems

Dangar, Jack
BE (Electrical), Honours 2 Division 1

Dejbakhsh, Hossein
MEngSc, Energy Systems

Dejbakhsh, Hossein
MEngSc, Telecommunications

Dela Fuente, Anna Katrina
BE (Electrical)

Djamniko, Mentari Puteri Ning
BE. BSc (Telecommunications), Honours 1

Doumit, Antoine
MEngSc, Energy Systems

Efi n, Efi n
BE MBiomedE (Electrical), Honours 1

Ezzy, John Edward
BE (Electrical), Honours 2 Division 1

Farley, Justin Kirk
BE (Electrical), Honours 2 Division 1

Farooqi, Abdullah Tayyab
MEngSc, Telecommunications
Fazeel-Ur-Rehman, Hasan
MEngSc, Telecommunications
Fernando, Kasun Devinka
BE, BCom (Electrical), Honours 1
Foster, Lindsay David
BE (Electrical), Honours 2 Division 2
Gerrand, Robert James
BE (Electrical), Honours 1
Gong, Zhexing
MEngSc, Microelectronics and Microsystems
Goon, Chin Soon
BE (Electrical), Honours 1
Gunawan, Jeff
BE (Electrical), Honours 2 Division 1
Gunawan, David Oon Tao
PhD, Signal Processing
Guruge, Rukshan Tharanga
BE (Electrical)
Ham, Yean Choon
BE (Electrical), Honours 1
Hankins, Andrew
BE (Electrical), Honours 1
He, Zhen
BE (Electrical), Honours 1
He, Yufeng
MEngSc(Extn), Energy Systems
Hoang, Hung Gia
PhD, Systems & Control
Holcroft, Joshua Michael
BE, BSc (Electrical), Honours 1
Hsu, Judy Pi-Shen
BE, MBiomedE (Electrical)
Huang, Weizhong
BE (Electrical), Honours 2 Division 2
Huang, Wenqi
BE, MBiomedE (Electrical), Honours 2 Division 1
Huang, Wei-Chen
MEngSc, Telecommunications
Huang, Yan
MEngSc, Systems and Control
Humphrey, David Eric
PhD, Signal Processing
Hussain, Muhammad Istafa
BE (Electrical)
Jabbar, Atif
MEngSc(Extn), Energy Systems
Jalaludeen, Mohammed
MEngSc, Telecommunications
Jamil, Fahd Bin
MEngSc, Telecommunications
Jenkins, Christopher
BE, MBiomedE (Electrical)
Jian, Jhitian
BE, BA (Telecommunications)
Johnson, Alison Maree
BE (Electrical)
Johnstone, Patrick
BE (Electrical), Honours 1
Joon, Sanjeev Kumar
MEngSc, Microelectronics and Microsystems
Karantonis, Dean
PhD, Systems & Control
Kazi, Tanzil Kabir
BE (Electrical), Honours 2 Division 1
Kdeiss, Wahib
GradDip, Telecommunications
Kentse, Thabo
MEngSc, Energy Systems
Khan, Qasim
MEngSc, Telecommunications
Khattak, Adnan Nawab
MEngSc, Telecommunications
Kodila Srikanth, Pallavi
MEngSc, Telecommunications
Krishnan, Jagindran
BE (Telecommunications)
Kuttambakam Narasimhulu, Pradeep
MEngSc, Systems and Control
Lam, Kenneth Yau Shing
BE (Electrical)
Law, Garth
BE, BSc (Telecommunications)
Lee, Joel
BE (Electrical), Honours 1
Lee, Joan Hsiao Hui  
MEngSc(Extn), Microelectronics and Microsystems

Leong, Melody Jessica  
BE (Telecommunications)

Li, Jiajie  
MEngSc, Energy Systems

Li, Ke  
MEngSc, Telecommunications

Li, Sen  
MEngSc, Systems and Control

Lim, Rolene Yanni  
BE (Telecommunications)

Lin, Mingcong  
MEngSc, Systems and Control

Liu, Dunrui  
BE (Electrical)

Liu, Fanye  
BE MBiomedE (Electrical)

Liu, Chao  
MEngSc, Telecommunications

Liu, Weike  
MEngSc(Extn), Telecommunications

Loo, Poh Suan  
BE (Telecommunications), Honours 2 Division 2

Low, Han Lip  
BE (Electrical)

Lu, Dan  
BE (Electrical)

Lu, Lei  
MEngSc, Energy Systems

Luong, Dung Viet  
ME, Systems & Control

Maalouf, Amin  
MEngSc, Energy Systems

Macarthur-King, Scott Alexander  
BE (Electrical), Honours 1

Manzar, Jawad  
BE (Electrical), Honours 1

Marashdeh, Maram  
BE (Electrical)

Mathew, Reji Kuruvilla  
PhD, Signal Processing

Meng, Zi Fan  
BE (Electrical)

Mohammad, Ian Taufiq  
BE (Electrical)

Mohd Hassan, Siti Lailatul  
MEngSc, Microelectronics and Microsystems

Moro, Kaushik Vinayak  
BE (Electrical), Honours 1

Mudannayake, Chathura Prasanna  
PhD, Energy Systems

Muhamad, Nor Asiah  
PhD, Energy Systems

Muhammad Usman Ghani,  
MEngSc, Energy Systems

Munim, Sohaib  
MEngSc, Energy Systems

Munir, Irfan  
MEngSc, Energy Systems

Mursidi, Edwin Arnan  
BE (Electrical)

Nagel, Jeremy  
BE (Electrical), Honours 1

Narashevich, Lars  
BE (Electrical), Honours 2 Division 1

Nelson, Steven Nicholas  
BE (Electrical), Honours 2 Division 1

Nevat, Idoo  
PhD, Telecommunications

Nguyen, Duy Duc  
MEngSc, Telecommunications

Nguyen, Nam Thai  
MEngSc, Telecommunications

Noh, Azaryna  
MEngSc, Microelectronics and Microsystems

Ouyang, Jun  
MEngSc, Telecommunications

Pan, Jinjiang  
BE (Electrical)

Papapetros, Emanuel Isidor  
BE BCom (Electrical), Honours 2 Division 1

Pasha, Syed Ahmed  
PhD, Systems & Control

Paul, Allen  
MEngSc, Telecommunications

Phoopattanakul, Theerasit  
MEngSc, Signal Processing

Popadic, Milos  
BE BCom (Electrical), Honours 1

Qazi, Sameer Hashmat  
PhD, Telecommunications

Rabbani, Khawaja Shazad  
MEngSc, Telecommunications

Rahman, Sajeed  
BE (Electrical)

Rahman, Tanjim  
BE (Electrical)

Ramachandran, Prem Jude  
BE (Electrical)

Reid, James Campbell  
BE (Electrical), Honours 1

Rifkin, David  
BE MBiomedE (Electrical), Honours 2 Division 2

Romanos, Raymond  
BE MBiomedE (Electrical), Honours 2 Division 2

Rosli, Anis Diyana  
MEngSc, Systems and Control

Ruan, Yuan Yuan  
MEngSc, Systems and Control

Saeed, Chaudhary Bilal  
GradDipEngSc, Telecommunications

Saidina Omar, Ahmad Zainul  
BE (Electrical)

Samat, Safwan Syariff  
BE (Telecommunications)

Santhakumar, Venuganan  
BE BSc (Electrical), Honours 2 Division 2

Sastra, I Gede Oka Caraka  
BE (Electrical)
Sayeef, Saad Mohammad
PhD, Energy Systems

Serhan, Hassan
BE (Telecommunications)

Sethu, Vidhyasaharan
PhD, Signal Processing

Shah, Zawar
PhD, Telecommunications

Shakarchi, Aiden
MEngSc, Energy Systems

Shankar, Rahul
BE (Electrical), Honours 2 Division 1

Shen, Chen
MEngSc, Telecommunications

Shi, Chao
BE MBiomedE (Telecommunications), Honours 2 Division 2

Shi, Quan
BE (Electrical)

Siddiqui, Muhammad Amin
MEngSc, Telecommunications

Sivapalan, Sutharsan
BE (Electrical)

Sun, Kai Ken
BE (Electrical)

Tadilo, Bewketu
BE (Telecommunications)

Tan, Alvin Meng Wei
BE (Electrical)

Tan, Jun Yang
BE (Electrical), Honours 2 Division 2

Tan, Ken Seong
MEngSc, Telecommunications

Tan, Lauren Nerine
MEngSc, Electric Power Engineering

Tan, Shihao Wan
MEngSc, Telecommunications

Tang, Tiffany Chung Yan
BE BA (Electrical), Honours 2 Division 2

Tang, Chenping
MEngSc(Extn), Systems and Control

Taylor, Andrew Bryan
BE (Electrical), Honours 1

Teimoori Sangani, Hamid
PhD, Systems & Control

Thiruvaran, Tharmarajah
PhD, Signal Processing

Thornercraft, Stuart Russell
PhD, Energy Systems

Tran, Douglas
BE (Electrical)

Tufanooglu, Okan
BE (Electrical)

Venkatraman, Roshan
BE (Electrical)

Vu, Victor
BE (Photonics)

Walsh, Chris
BE BSc (Electrical), Honours 2 Division 2

Wang, Chao
BE (Electrical), Honours 1

Wang, Xin
BE (Electrical), Honours 1

Wang, Jun
MEngSc, Telecommunications

Wang, Liang
PhD, Signal Processing

Wang, Zhe
MEngSc, Telecommunications

Ward, Christopher
BE (Electrical), Honours 2 Division 2

Wee, Jun Yuan
BE (Electrical)

Weitzel, Jonathan
BE (Electrical), Honours 2 Division 2

Wong, Chan Kit
BE (Telecommunications), Honours 1

Wong, Nicholas
BE (Electrical), Honours 1

Wong, Siu Wai
BE (Telecommunications), Honours 2 Division 1

Wong, Wilkin Wai Kit
BE (Electrical), Honours 2 Division 2

Woo, Boiqiang Dennis
BE (Telecommunications), Honours 2 Division 1

Wood, Clare Louise
BE (Electrical), Honours 1

Woon, Kenny
BE (Telecommunications)

Wrigley, Andrew Philip
BE (Electrical)

Xue, Minjie
MEngSc, Telecommunications

Yang, Chih-Hwan Henry
BE BSc (Electrical), Honours 1

Yang, Yi Xiu
BE (Electrical), Honours 2 Division 1

Yeung, Anson Chi-Ming
PhD, Photonics

Yin, Bo
PhD, Signal Processing

Yu, Zheng
BE (Electrical)

Zgliniecki, Michael
BE (Electrical)

Zhai, Bo
MEngSc, Energy Systems

Zhang, Henry Xin
BE (Electrical), Honours 1

Zhang, Yu
MEngSc, Energy Systems

Zhao, Haibo
MEngSc, Telecommunications

Zhou, Munan
MEngSc, Telecommunications

Zhou, Weiou
MEngSc, Telecommunications

Zhu, Michael
BE (Telecommunications)
03. RESEARCH

In keeping with the School of EE&T's strong history of research, 2009 once again saw research from the school gaining recognition in conference and journal forums worldwide. This is summarised below.

School Research Publications Output

<table>
<thead>
<tr>
<th>Year</th>
<th>Conferences</th>
<th>Journals</th>
<th>Total</th>
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<td>63</td>
<td>230</td>
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</table>

School of Electrical Engineering and Telecommunications publication output from the seven years to start of 2009

RESEARCH GROUPS: ENERGY SYSTEMS

The Energy Systems Research Group conducts research in a wide range of areas associated with the generation, transmission, storage and utilisation of electrical energy, as well as in measurement, materials and electrical equipment. There are three main research themes, namely,

1. High-voltage engineering, Power system equipment, condition monitoring of equipment, energy efficiency, on-line partial discharge detection.
2. Electrical machines, power electronic converters, and variable-speed drives.

High-Voltage Engineering (Dr Toan Phung)

- High voltage generation, testing and measurement techniques.
- Electrical Insulation - characteristics of gaseous, liquid and solid dielectrics; study of insulation ageing mechanisms; diagnostic methods.
- Partial Discharge Measurement - advanced computer-based data acquisition, conventional and ultra-high frequency discharge detection, acoustic methods, noise and interference reduction using signal processing.
Partial Discharge Analysis - application of modern digital analysis methods for discharge characterization and pattern recognitions for fault diagnosis.

Power System Equipment - on-line condition monitoring of strategic plant items such as HV cables, power transformers, generators and switchgear.

Intelligent systems – data mining techniques, neural networks, fuzzy logic for pattern recognition, smart grids.

Power Electronics and Drives (Professor Faz Rahman)

- Power electronic converter circuits and their control techniques for application in power supplies, electric drives, active power filters, and in other applications such as power factor correction, resonant circuits for lighting, grid connection of inverters, modeling of power electronic circuits; active filters; DC, brushless DC, AC induction, synchronous and stepping motor drives;
- High performance control techniques such as rotor flux oriented control (RFOC) of induction motors, direct torque control (DTC) of permanent magnet motors, sensorless estimation of stator and rotor flux linkage, speed estimation techniques, cogging and ripple torque minimization schemes for permanent magnet brushless DC magnet motor drives, field weakening controllers for interior permanent magnet motors.
- High-performance and variable-speed drives and their controller design issues, Machine dynamics and control system design issues for such machines such as interior permanent magnet (IPM), switched reluctance motors (the buried magnet motor), and induction motors; modeling and control characteristics of drives when driven from various types of power converter circuits under different control techniques.
- Induction and permanent magnet machines and drive systems for automobile traction, energy conversion/generation system design and associated power converters and their control.

Interior Permanent Machines (Professor Faz Rahman & Dr Rukmi Dutta)

- Finite element analysis and design of power equipment.
- The optimal design of the interior permanent magnet machine for high field weakening range; with application in vehicle traction and wind power generation systems.
Segmented, multilayer and concentrated winding designs of IPM machine structures for high field weakening range, high power and torque density.

**Power System Dynamics and Control, Integration of Wind Energy Systems (Dr Jayashri Ravishankar)**

- Analysis of the impact of interconnecting wind turbine generators to the utility grid.
- FACTS controllers for grid connected wind energy conversion systems.
- Dynamic stability analysis of renewable energy systems interconnected to the power grid.
- Electrical power delivery systems, power systems dynamics and control.


- Renewable energy - Integration of renewable energy sources into the electricity supply system – technology and wider institutional and policy frameworks.
- Renewable Energy Industry development - Technology, market, financial and institutional drivers of this industry’s development, policy options to maximize and direct its growth.
- Power system operation - Theoretical and computational approaches for coordinating the operation of emerging power systems with independent participants and distributed resources.
- Energy industry restructuring - Electricity market structures and pricing for investment and operation. Cooperative, competitive and strategic participant behaviour, market frameworks at the distribution system level, competition and distributed resources.
- Distributed, renewable and demand-side resources - Operational characterization and modeling of renewables, novel small-scale generation, distributed energy storage and demand-side options.
- Renewables applications - Large-scale wind power developments, Building integrated PV, RAPS systems. Renewable options for the developing world.
- Distributed Artificial Intelligence - Evolutionary computation, intelligent agent approaches for complex, uncertain, problem domains.
- Technical standards for PV systems and associated Balance of System equipment for grid connection.
RESEARCH GROUPS: MICROSYSMENS

MEMS based optical cross-switch(OXC) (Prof. Chee Yee Kwok)

This project is about the development of an all-optical cross switch using MEMS technology for applications in provisioning and restoration of optical communication networks. Whilst many silica fiber based optical switches have been reported, this development uniquely addresses the monolithic integration of the switch within the fabric of planar silica waveguides on a silicon substrate. This is facilitated by the successful development of two novel and critical components: (1) An low voltage bistable actuation mechanism for out-of-plane actuation of the micromirror which is monolithically integrated onto the actuator. (2) A pair of planar silica focusing element for low loss free-space propagation within the switch. The actuator consist of a bimorph microbridge with special spring attachments at the ends and additional ‘leg’ supports on the sides to control the beam axial stiffness, torsional stiffness and torsional moments. The main microbridge structure is multilayered where the residual stress and thickness of the layers have to be judiciously controlled during the microfabrication process in order for the microbridge to exhibit the desired bistable behaviour. Microfabrication of the bimorph bistable micromirror actuator is highly complex and involves both surface and bulk micromachining. The planar silica focusing element consist of a graded-index variation of the silica film in the vertical direction and appropriate curvature of the lens front in the horizontal direction. Further details can be obtained from http://www.eet.unsw.edu.au/staff/kwok/profile.htm including a video demonstration of the bistable actuator. Research was funded by the ARC and microfabrication work conducted in the Semiconductor Nanofabrication Facility,UNSW.
Optical interconnect for 3D integration of integrated circuits  
(Prof. Chee Yee Kwok)

This project is about the development of optical interconnects for 3D integration. In 3D integration of integrated circuits, the silicon chips are stacked on top of each other. Aggressive dimensional scaling has brought us into the 32nm node. 3D integration will allow the era of gigascale integration to meet the ever growing demands of greater functionality in integrated circuit systems. Dimensional scaling does not scale the time constant delays along metal interconnects which is now seen as one of the roadblocks, amongst many others, for high speed operation in high performance chips. Optical interconnect is considered as a strong candidate to address this roadblock. Investigations include both free space and guided optical interconnects. Since the chips are stacked, establishing an optical bus through the stack and having optical access at each chip level is essential. On the board level, optical interconnects are in the form of polymer waveguides. On the silicon level, silicon photonics is the dominant approach. This project aims to develop an optical bus that would permit optical communication between the board level and individual silicon chip levels in the 3D stack. One key component is 45° micromirrors. We have successfully developed novel techniques for fabricating such micromirrors with ultra smooth surface (<4nm roughness), pairs of upward facing and downward facing 45° micromirrors and means of enlarging the effective 45° micromirror surface. Research is continuing on establishing guided optical path in through-silicon-vias and efficient optical coupling to silicon photonics. Research is funded by the ARC and microfabrication work conducted in the Semiconductor Nanofabrication Facility, UNSW. Further details can be obtained from publications in http://www.eet.unsw.edu.au/staff/kwok/profile.htm
Integrated Quantum Computer Devices (Prof. Andrew Dzurak)

Professor Andrew Dzurak leads a number of research projects within the Integrated Quantum Computer Devices Program of the Centre for Quantum Computer Technology (CQCT). The Program provides engineering design, modelling and nanofabrication of fully-configured Si:P qubits and associated pathway devices, making extensive use of the Semiconductor Nanofabrication Facility (SNF). The Program’s development of a MOS-compatible Al multi-layer gating technology has been a critical step in the development of a fully MOS spin qubit architecture in recent years. This technology has been successfully applied to the production of a range of devices which delivered significant research milestones in 2009, including fully tuneable Si quantum dot devices which have been operated in the single electron limit, transport devices in which tunnelling through single-P-donor states has been studied and spin qubit devices in which single shot spin readout has been demonstrated. The latter marks a major milestone in the development of a Si quantum computer.

Research projects currently taking place within the Program include:
- Si MOS Spin Qubits
- Spin Dependent Tunnelling through Single P Atoms
- Si MOS Quantum Dots
- Si:P Spin Qubit Control Using Cavity ESR

Quantum Measurement (Dr Andrea Morello)

The Quantum Measurement & Control Chip Program within the Centre for Quantum Computer Technology (CQCT) is managed by Dr Andrea Morello. The research projects within this program focus on the coherent control and readout of single-P-atom electron spin qubits in silicon. Throughout 2009, a new donor spin qubit architecture developed within the Centre was investigated in depth, achieving one of the most important milestones in solid-state spin qubits research - the single-shot readout of an electron spin.

Research projects currently taking place within the Program include:
- Tunnel rates in qubit structures
- Single-shot spin readout
- Fast Electrically Detected Magnetic Resonance (EDMR) of P donors
- Devices for local electron spin resonance
- Low-temperature integrated circuits for qubit readout
Development of RF MEMS Technology for Modern Wireless Communications Systems – (Prof. Rodica Ramer)

In modern wireless communication systems, information data transmission has to be able to handle multiple frequency bands and to provide multiple channels for different signals. The solution is to combine the increase in bandwidth (ultra-wide bandwidth) and speed, thus develop technologies for the transceiver architecture. This, in turn, requires new technologies and fabrication processes for circuits, devices and components, as well as the development of new materials. We focused our research to develop RF MEMS technology for reconfigurable communication systems with multifunctional capabilities.

One solution to handle multiple frequency bands and signals is to provide physical routing capability to the transceiver. While signal routing at low frequencies could be easily achieved, this becomes progressively more complex as frequency increases. Switch matrices existed for many years, however, due to the technology limitation provided by solid state semiconductor FET and PIN diodes, they cannot support the requirements for the next generation wireless communications. We concentrated on the advantages of RF MEMS and developed switch matrices that overcome the bandwidth limitation and outmatch the RF performance provided by all existing technologies. We also developed novel reconfigurable filters using RF MEMS that can switch filter band without using several separate different filters.

Novel RF MEMS crossbar switch matrices topologies have been developed and 3x3 switch matrices have been fabricated as a proof of concept. The fabricated switch matrices exhibit RF performance that is superior to any other existing technologies, with an operating bandwidth from DC to 40 GHz. These developed topologies have the potential to replace the large coaxial-based systems in use on satellites for system redundancy. These designs could also be applied to mobile phone transceiver frontend in order to switch between frequency bands.

Novel reconfigurable three pole band pass filters have also been developed. They have been designed using RF MEMS contact switches. Our unique reconfigurable filter design technique allows designs that can switch between three different frequency bands located at 8, 9 and 10GHz, while maintaining the desired bandwidths of 1GHz.
Ultra-low temperature electronics (Dr Torsten Lehmann)
This research is motivated by the need for controlling and observing spin-based silicon quantum computing processors in future quantum computers. Such quantum computing processors will be operating at temperatures below 1K. To facilitate the quantum processor control, conventional electronic circuits are required operating at temperatures below 4.2K. While bipolar junction transistors are inoperable at such temperatures, fully-depleted CMOS transistors are capable of such low-temperature operation. Their behaviour are somewhat modified, though, and we have investigated the transistor characteristics under such operating conditions. Such gained knowledge of the transistor characteristics have further enabled us to design integrated circuit functions for ultra-low temperature operation; notably fast, programmable pulse generators and ultra-sensitive current amplifiers used for interfacing to single-electron transistors.

Circuits for biomedical implants. (Dr Torsten Lehmann)
This research is motivated by the strict power and reliability requirements of electronic implants and capsules, such as cochlear implants, vision prostheses and wireless endoscopes. The available power in such systems is very limited: either due to limits on safe trancutaneous power transfer or the limited capacity of installed batteries. The main focus of this research is therefore to reduce the power dissipation of the required circuit functions. Examples of circuits we have investigated include low-power data-receiver circuits, low-power, ultra-wideband radio transmitters, efficient trancutaneous power transfer, highly efficient on-chip power supplies, and ultra-low stand-by current electrode stimulator circuits. When electronic circuits are placed inside humans, and especially when such circuits stimulate nerve tissue, the reliability and correct operation of the electronics become paramount. For this reason we have also investigated active safety circuits, that can detect faults in stimulation activity and thus ensure patient safety.
RESEARCH GROUPS: SYSTEMS AND CONTROL

Nonlinear Control (Dr D Clements)

Research projects include:

▷ Reliable Numerical Algorithms for Control
▷ Chemical Process Control

Nonlinear Control and Robotics (Dr R Eaton)

This research deals with autonomous and precise navigation of robotic vehicles, and is done in collaboration with the Mechatronics group within the School of Mechanical and Manufacturing Engineering at UNSW. In particular, the research focuses on the application of precision farming, whereby the aim is to automate and robustly control agricultural machinery. This work is motivated by a need in the Australian farming industry to compensate for a dwindling labour workforce and to be more globally competitive. The team is currently working on an articulated system comprising an autonomous tractor pulling an agricultural seeding implement. Here, control inputs are inadequate to ensure the system follows a specified path with precision, given the varying and difficult operating conditions on the land.

Research projects include:

▷ Kinematic Modeling of Articulated Systems
▷ Nonlinear Control Design for Articulated Systems
▷ Robust Control Design for Autonomous Vehicles Under the Influence of Slip

Computer Aided Design and Real-time Control (A/Prof. T Hesketh)

Research projects include:

▷ Testable Design
▷ Modelling, estimation, simulation and control for intransient systems
▷ Learning and Adaptive Control
▷ Sliding mode and adaptive control in steel making

Control Methods for Actuator Systems in Hard Disk Drives (Dr B Hredzak)

This research is motivated by a recently developed track-seek and track-following method for dual-stage actuators in hard disk drive which provides a unified servo-control framework for track seeking and track following. High-performance hard disk drives use dual-stage actuators to compensate for vibrations caused by the disk, spindle motor, suspension, slider, or the head. Dual-stage actuators consist of a primary voice-coil-motor (VCM) actuator and a secondary, high-bandwidth piezoelectric (PZT) actuator. During track seeking, the servo actuator is moving from the current track to the required target track in order to read or write the
Once the target track is reached, the track following mode ensures reliable reading or writing of the data. So, seeking performance in a hard disk drive is a very important parameter that determines how fast the user can access the data. A few novel solutions to improve the seeking performance have been developed. Introduction of anti-windup compensation for secondary control loop improves settling duration, disturbance rejection, recovery from saturation in the secondary actuator loop, and design flexibility. An alternative to improve the short-seeking performance is to replace a constant saturation non-linearity in the secondary loop of the dual-stage control system by a dynamic saturation non-linearity. The dynamic saturation ensures secondary actuator signal boundedness while modulating the control error fed to secondary control loop. This yields significantly faster response of the secondary actuator giving faster settling time and hence faster access to the data.
Communication Limited Control (Prof. A Savkin)
In many distributed control systems communication bandwidth limits can compromise system stability and performance and a communication control tradeoff must be managed.

Research projects include:
- Information and Control
- Networked Control Systems
- Robust Control under Limited Capacity Constraints

Multi-Agent Systems (Prof. A Savkin)
Research projects include:
- Control of Mobile Robots
- Missile Guidance Algorithms
- Control of Mobile Radio Systems

Control Applications (Prof. A Savkin)
Research projects include:
- Diabetes Control
- Control of Wind Power Systems
- Vision and Control

Neuroimaging (Prof. V Solo)
Functional Magnetic Resonance Imaging (fMRI) is less than two decades old but has had a profound influence on the study of the brain and its diseases. This technology has in turn generated a fast growing demand for advanced statistical signal processing tools and thrown up novel problems in signal processing, distributed state estimation and multimodal imaging. This research is carried on mostly with colleagues at Harvard Medical School in the USA but also with colleagues in UNSW’s Prince of Wales Medical Research Institute (POWMRI).

Research Projects include:
- Modeling of Intrinsic Brain Networks
- Joint fMRI/MEG modelling
- Information Theoretic Causality

Neural Coding (Prof. V Solo)
In the last decade and a half new micro measurement technologies involving multi-unit electrode recordings from the brains of awake animals such as monkeys and rats are allowing scientists to pursue fundamental studies of brain function. A potential engineering application is the development of true neural prosthetics. But the resultant need to analyse large volumes of data are generating new kinds of statistical signal processing and control problems that require new analysis tools. This research is carried on mostly with colleagues in the USA but also with colleagues at the University of Western Australia Medical School.

Research Projects include:
- System Identification for Multivariate Point Processes
- State Estimation for Point Process Systems
- Joint System Identification of Point Processes and Time Series

Geometric Signal Estimation (Prof. V Solo)
Many signal processing and control problems involve constraints that force parameters and or processes to lie in manifolds. Differential geometric methods are required to solve signal estimation, optimization and parameter estimation problems in such settings.

Research Projects include:
- Geodesic Principal Components Analysis
- Stochastic Attitude Estimation
- Construction of Stochastic Processes on Manifolds
Econometrics (Prof. V Solo)

In Econometrics the advent of large data sets has put stress on traditional methods of empirical dynamic analysis. New tools of analysis are under rapid development falling under the rubric of ‘dynamic factor models’.

Research Projects include:
- State Space approach to Dynamic Factor Models
- Sparse State Space Models
- Random Matrix theory for Stationary Processes

Cognitive (4G) Communication (A/Prof. H D Tuan)

Research Projects include:
- OFDM - orthogonal frequency division multiplexing
- Random multiple access techniques
- Channel estimation and equalization
- Relay and cognitive communication networking
- MIMO coding, beamforming and optimisation based techniques
- Information theory for network capacity

Cognitive (4G) communication aims at providing high bandwidth to mobile users via heterogeneous wireless architectures and dynamic spectrum access techniques. The inefficient usage of the 3G spectrum is substantially improved by opportunistic access to the licensed bands without interfering with the existing users. Therefore, the broad range of available spectrum and diverse Quality-of-Service requirements impose research challenges in communication networking and access protocol

Bioinformatics (A/Prof. H D Tuan)

Research Projects include:
- Microarray expression data processing,
- Gene profiling and prediction/interaction
- Statistical learning for clustering and classification.

Bioinformatics is the application of statistics and computer science to the field of molecular biology, particularly in those areas of genomics involving large-scale DNA sequencing. It now entails the creation and advancement of databases, algorithms, computational and statistical techniques and theory to solve formal and practical problems arising from the management and analysis of biological data.

Nonlinear control and filtering (A/Prof. H D Tuan)

Research Projects include:
- Robust and adaptive control with applications in vehicle control, guidance in aeronautics and robotics
- Nonlinear estimation and filtering with applications in multi-target tracking, data fusion and sensor networking
- Kalman filters and nonlinear extensions
- Gaussian mixture approximation and dynamic Bayes network

The aim of this research is to develop a systematic and efficient approach to address fundamental challenges in emerging areas within nonlinear control and filtering. These challenges arise in almost all areas of target tracking, navigation and guidance of wheeled and flying vehicles, missiles and mobile robots, control of biomedical systems.

Signal Processing and Compressed Sensing (A/Prof. H D Tuan)

Research Projects include:
- Low-complexity one-dimensional and multi-dimensional digital filter design
- Compressed sensing with applications in image processing
- Less-powered digital filter bank for wireless transmission
- Statistical signal processing for bio-signals
The aim of this research is to develop a systematic and efficient approach to address fundamental challenges in analysis and synthesis of sparse systems in the emerging areas of wireless communication and sensor network, and distributed signal processing.

**Optimization (A/Prof. H D Tuan)**

Research Projects include:

* Fast convex optimization for online computation
* Nonsmooth spectral optimization for large scale and nonconvex problems

The key developments in all areas of system and control, signal processing, digital communication and information at the end are down to solutions of complex optimization problems, which certainly require new tools and ideas for their effective solution.

**Estimating energy expenditure using triaxial accelerometry (Dr Stephen Redmond)**

Traditional methods of energy expenditure estimation, in the free-living environment, attempted using accelerometry operate without knowledge of the slope of the terrain which is being traversed. The ability to recognise the gradient of the walking surface will most likely improve upon these simplistic energy estimates. We have investigated the benefit of step-by-step segmentation of the accelerometry signal in classifying the various gradients. Future work will incorporate this slope classification information with traditional tri-axial accelerometry energy expenditure estimation techniques, using a linear least squares model, and compare the results to the gold-standard measure provided by gas analysis of oxygen uptake.

**A shear force transducer for use in robotic manipulator digits (Dr Stephen Redmond)**

It is often difficult to grasp and manipulate fragile and slippery objects with prosthetic or robotic arms. One significant problem faced is controlling the amount of grip force to apply. If the force applied is too small the object will slip, but too great force will damage it. In a human hand, mechanoreceptors provide feedback and help control the amount of force applied; however, it can be difficult to provide this feedback in a robotic hand because a single sensor is unable to compete with the thousands of afferent nerves present in the human finger pad. Typically the glabrous skin of the hand is able to detect the distribution of forces and any changes therein. It has been shown that in a human model localised incipient slip events provide information critical to controlling the amount of grip force excreted on the object being manipulated. While developing a sensor capable of dynamically detecting slip is the desired endpoint, a sensor with the capacity of detect static shear forces may demonstrate some utility, where the coefficient of friction between the tactile sensing surface and the object being manipulated, is known. This would allow for a suitable amount of normal force to be applied to the surface, as indicated by the shear force detected at the gripping interface. We have prototyped an initial design for a robust capacitive static shear force sensor, that can easily be produced at a low cost for all volumes. The sensor design is fabricated directly onto a printed circuit board. The device has been characterised both with and without a silicone skin covering the capacitor plates, demonstrating considerable utility in estimating the shear force applied to the sensor surface.
RESEARCH GROUPS: TELECOMMUNICATIONS

Telecommunications Research Group at the School of Electrical Engineering and Telecommunications consists of research and teaching in the areas of Wireless & Network Communications, Signal Processing, and Photonics. Our research activities include:

**Wireless and Network Communications**

**Wireless Broadband for the National Broadband Network for Rural and Bush areas (Prof. J. Yuan, Dr W. Zhang, A/Prof. R. Malaney, Dr T. Moors)**

One of the crucial challenges for the NBN is that a relatively small population is currently spread over vast Australian regions (especially in the remote and rural areas). We are working on how to establish novel and emerging solutions to the problem of this ‘wireless tail’ or ‘last mile’ to the national broadband network, for the practical situations of high density housing (cities) and low-density, rural communities, bush areas.

**Multiuser MIMO Communications (Prof. Jinhong Yuan)**

Recent research shows that with multiple antennas placed at both the transmitter and receivers, referred to as multiple-input/multiple-output (MIMO) systems, wireless communication is able to increase the data rate significantly. This is a breakthrough in communications system design, since the multipath reflection in wireless channel, traditionally a pitfall of wireless communications, can be turned into a benefit, in increasing the wireless link capacity. Research is being conducted into novel transmission and multiple access signalling techniques with the aim of dramatically improving the reliability, throughput, and power efficiency of wireless downlink packet data services. This work is called the multiple-input/multiple-output (MIMO) spatial division multiple access (SDMA) technique and it will enable a breakthrough in multi-user multimedia services in the ICT industry sector. Potential applications of the project outcomes are in future 4G cellular mobile networks.

**Cooperative Wireless Communications and Network Coding (Prof. J. Yuan, Dr W. Zhang, A/Prof. R. Malaney)**

The Wireless & Data Communications Research Group is working on developing novel transmission and receiving techniques with the aim of dramatically improving the reliability and throughput of wireless packet data services. In particular, by exploring the space resource of multiple users, we develop cooperative multi-user communication techniques where multiple users or multiple base stations cooperate with each other to transmit their information. This can thoroughly exploit the space resource of multiple-users and user cooperation diversity in wireless networks to largely improve the reliability, and spectrum and power efficiency. With users cooperating with each other, we can significantly reduce the transmission power/energy, making the systems more “green”. Potential applications of the project outcomes are in future wireless systems, such as mobile broadband wireless access (MBWA 802.20 or WiMAX 802.16).
Cognitive radio networks (Prof. J. Yuan, Dr W. Zhang)

The Wireless & Data Communications Research Group aims to develop novel spectrum agile radio communication techniques which can opportunistically exploit the spectral resource of licensed systems and utilise the amount of unused spectrum in an intelligent way. The School’s current research outcomes in this area include robust cooperative spectrum sensing and whispering radio technique which enable to break the spectrum-availability bottleneck and significantly improve the spectrum utilisation. The ultimate aim of the research is to dramatically improve the network’s spectrum efficiency, power efficiency and reliability, without interfering with other incumbent devices in the same frequency bands.

Wireless Sensor Networks and Applications (Dr Vijay Sivaraman)

Wireless and ad-hoc sensor networks continue to be an area of focused international research. The Biomedical Systems Laboratory (BSL) Wireless Sensor Network (WSN) project is a novel application and integration of wireless mesh networking using ZigBee, Bluetooth and Wireless LAN low power modules with Ethernet access points. Current research is focused on embedded network technology, microprocessors, power and storage, microsensors, operating systems, disruption tolerant networks, privacy, security and data fusion and error reduction algorithms. Other research is exploring mobile nodes based on active asset tracking technology (active RFID) which leverage existing Wi-Fi infrastructure and Internet/Intranet facilities to measure location by measuring signal strength using triangulation and Received Signal Strength Indication (RSSI).

Reliable Communications for Vehicular Networks (Dr T. Moors, Dr A. Tabatabaei)

In order to reduce traffic accidents, effective solutions are required. Vehicular Ad hoc Networks (VANETs), or Vehicular Communication (VC) systems, have potential to provide solutions and are likely to be ubiquitous in the not-too-distant future. In such systems, equipment exists on board the vehicles as well as in road-side infrastructure. DSRC is the method of communication for this network. DSRC is an alternative solution to a GPS-only-based solution, where the GPS in the vehicle may have access to an INS. By using DSRC, it can also use positioning information from other nearby cars and road-side infrastructure to enhance its own position accuracy and availability.

Wireless Mesh Networks (Dr Tim Moors)

EE&T have focused on WMNs that span cities and are used for gathering data about vehicular traffic flows on roads and for controlling traffic signals on those roads. Unlike vehicular communication described elsewhere, these WMNs do not communicate to mobile devices but do have tight timeliness and reliability requirements. Our contribution has been in the area of novel routing algorithms that use multiple paths through the mesh network to provide spatial diversity and so enhance reliability, without adding delay that would be incurred from temporal diversity from retransmission. These techniques are applicable to a wide variety of industrial control applications (e.g. chemical and manufacturing plants) that require reliable timely delivery, but where it is infeasible to lay cables.

Enabling Optical Packet Switched Networks with Minimal Buffering (Dr Vijay Sivaraman)

This research develops novel tools and techniques that help Internet service providers overcome the fundamental limitations of optical storage technology in order to deploy all-optical packet switching in the future Internet. Our work paves the way towards adoption of a cost-effective and green technology to aid the Internet backbone and meet future growth requirements. Our collaboration with a major international Internet equipment manufacturer allows us to develop a holistic framework for network-wide design, deployment, and operation, incorporating new traffic management techniques and service models that can readily be adopted by Internet service providers world-wide.
Quantum Communications (A/Prof. R. Malaney)

Quantum Communications is an emerging cross-disciplinary field of growing global significance. Research into advanced quantum protocols is being pursued that will dictate the key operations of emerging quantum networks. Specifically, we are investigating the optimal quantum repeater protocols for a range of network architectures in which quantum information transfer through a multihop environment occurs. We will also determine near-optimal versions of our protocols that will give engineers the ability to trade off quantum complexity with communication throughput. New applications of quantum communications are also being researched that will bring enhanced security and communications advantages not possible in classical networks. Our work will result in new applications and services that will have a major impact on the ongoing global efforts to develop the quantum internet.

Body-Area Networks for Healthcare Monitoring (Dr Vijay Sivaraman)

This research develops energy-efficient communication protocols for body-wearable wireless sensor devices to be used in pervasive medical monitoring. Today’s healthcare systems are struggling to cope with the needs of an ageing population exhibiting an earlier onset of chronic conditions that need long-term monitoring. Wearable wireless sensors can relieve this pressure by providing intelligent, non-intrusive, continuous monitoring at dramatically reduced cost, with round-the-clock diagnostic and intervention capability. Our work in this area is developing the highly energy-efficient, light-weight, flexible, and robust communication protocols that are an integral part of such a system.

Photonics

Structural Health Monitoring of Civil Infrastructures (Prof. Gang-Ding Peng)

This work develops highly multiplexed fibre sensor systems for structural health monitoring and risk assessment of critical transport infrastructures. This work is in collaboration with Sydney University and industry partner RTA.

Fibre Ring Laser Based Intracavity Gas and Chemical Sensors (Prof. Gang-Ding Peng)

Fibre laser based sensor systems have great potential for high sensitivity gas and chemical detection. We develop fibre ring laser based sensor systems in collaboration with Tianjin University, China.

Fibre-based Photoreactor for Photoinduced Processes (Prof. Gang-Ding Peng)

This research looks to address issues faced by solar induced photocatalysis through integrating improved particle and optic systems to increase photon efficiencies and harness a greater portion of solar/visible light. In collaboration with researchers in Chemical Engineering and Industry Chemistry, we develop an optical fibre photoreactor system that would effectively allow for improved utilisation of photons by the semiconductor surface.

Photosensitive Polymer Optical Fibres and Gratings (Prof. Gang-Ding Peng)

Polymer optical fibre Bragg gratings are useful for strain sensor applications for large dynamic range. We develop polymer optical fibres with higher photosensitivity and fabricating POF gratings for various industrial applications.

Porphyrin Technologies for Sensing in the Energy and Mining Industries (Prof. Gang-Ding Peng)

The project works on the next generation of “extreme” gratings and chemical sensors, both passive and active, primarily for applications in sensing within the petroleum and gas industries (but applicable across the mining industry). This is an international collaboration project in partnership with University of Sydney, Institute of Photonic High Technology, Germany and the Federal University of Technology, Brazil.
Diamond-based photonics (A/Prof. Francois Ladouceur)

A/Prof. Ladouceur directed the research effort at UNSW that led to the first scalable all-diamond integrated circuits using a combination of photolithography, reactive ion etching (RIE) and focused ion beam (FIB) techniques with important application in Quantum Key Distribution and Quantum Computing. This important work has been highlighted in New Scientist: “Diamond ‘wires’ – quantum computing’s best friend”.

New photonics materials (A/Prof. Francois Ladouceur)

A/Prof. Ladouceur’s research effort is centred on the development of new photonics materials for display, biomedical and telecom applications. Of particular interest is the development of hydrogel-based electronics ink for conformal (flexible) displays, chiral (co)polymers for polarisation control and manipulation of polarisation in optical fibres, self-assembly of polymer for photoreceptors (pixels) definition in artificial retina and semiconducting polymers for artificial skin (tactile sensors).

Signal Processing

Image and video compression (Prof. David Taubman)

Since 2000, the School has been conducting world-leading research in the area of compression of digital media. Specific outputs from this work include: 1) Adoption of the EBCOT algorithm proposed by Taubman into the JPEG2000 standard (IS15444-1) for scalable image compression; 2) Development of the Kakadu software for JPEG2000 and related technologies, which is in use by over 200 commercial organizations; 3) Development of Motion Compensated Wavelet Lifting, a core video transformation technology for scalable video compression, to which we hold important patents; and 4) Development of novel hardware implementation strategies for JPEG2000, including a complete ASIC implementation of the JPEG2000 block encoder (the key computational element), achieving up to 5 times the throughput of existing comparable designs. Current projects include: 1) Development of advanced motion compensation techniques for video compression; 2) Novel strategies for the compression of depth and elevation imagery; 3) Theoretical and practical contributions to distributed coding techniques, with an emphasis on the relatively unexplored area of distributed arithmetic coding; and 4) Ongoing development and proposal of new technologies for inclusion in the JPEG2000 series of standards.

Multimedia communication (Prof. David Taubman)

Major contributions in this area are: 1) Proposal and adoption of the core paradigm for interactive image/video communication into the JPIP standard (IS15444-9) for internet imaging; and 2) The development of a family of highly efficient and computationally tractable hybrid-ARQ protection strategies for scalable compressed multimedia, collectively known as LR-PET (Limited Retransmission Priority Encoding Transmission). Current ongoing projects are focussed on the following themes: 1) Intelligent client-server distribution of scalable video, in which some of the temporal redundancy is exploited through the network communication process itself; 2) Novel techniques to transport and exploit metadata in conjunction with imagery and video content; and 3) Ongoing development and proposal of new technologies for inclusion in the JPIP standard for internet imaging.

Inverse problems in imaging (Prof. David Taubman)

This topic is concerned with the enhancement and/or robust reconstruction of imagery from incomplete, blurred and noisy observations. In the context of this project we have developed an important solution to a classic chicken-and-egg problem in inverse imaging. Specifically, a common problem is that the reconstruction process would be made much easier if a good segmentation of the scene into discrete objects were available, while such a segmentation generally requires the availability of high quality reconstructed images. Joint solution of these two problems...
(reconstruction and segmentation) have been difficult, plagued by the additional difficulty that segmentation is not generally a well defined problem. We have developed an approach which provides an implicit segmentation and also lends itself to problems involving very complex observation models, which usually prove computationally challenging. Our approach demonstrates outstanding performance when applied to the problem of colour image demosaicing, which is fundamental to practically all modern digital cameras.

3D Imaging and video (Prof. David Taubman)
Since 2004 we have been collaborating with the University of Padua, Italy, on a project involving interactive communication of 3D scenes, based on images and depth maps. We are currently assembling our own equipment for the capture and creation of 3D video content, based on up to 8 high definition scientific video cameras. Ongoing projects in this area will explore problems related to 3D TV, spatio-temporal sensor fusion and distance education based on 3D scene surveillance methods.

Objective QoS measurements of speech synthesis systems (Dr Deep Sen)
Monitoring and automatic assessment of speech transmission quality is of paramount importance in telecommunications networks. This research is focused on supplanting human subjective testing of speech quality which remains the most reliable means of testing speech synthesis systems. While intrusive algorithms are the thrust of this work, the fundamental theoretical contributions of the work supports non-intrusive environments such as Text-to-Speech synthesis. Aspects of this research are being considered for standardisation by the International Telecommunications Union as part of the new P.OLQA standard. This research is conducted in collaboration with AT&T Laboratories (Florham Park, NJ).

3D soundfield acquisition, analysis and synthesis (Dr Deep Sen)
This project is concerned with inventing parametric representations of 3D soundfield synthesis systems. Soundfield synthesis is an advanced sound reproduction technology that overcomes the inherent incapabilities of currently deployed stereo and multi-channel audio systems. The superiority and novelty of the proposed approach is due to its foundation in fundamental acoustics. The absence of this foundation in existing deployed systems contributes directly to their flawed ability to render accurate spatial audio. Benefitting applications include consumer audio systems, highly-directional beamforming for surveillance and tele-presence.

Cochlear modelling (Dr Deep Sen)
The accurate physiological modelling of cochlear hydromechanics and electro-physiology is a multi-disciplinary field which spans basic science, medicine and engineering. Not only does it facilitate fundamental understanding of cochlear physiology but also finds engineering applications such as in auditory prosthetics (both implants and hearing aids) as well as automatic prediction of human listening behaviour and speech/audio coding. Currently research is focused on modelling the outer-hair-cell electromotility and non-linear innervation at the hair cell synapse. The work is carried out in joint collaboration with University of Illinois (UC), Australian National University and the MIT-Harvard Health Science Technology department.

Biological Inspired Signal Processing (Dr Elias Aboutanios)
A collaboration between UNSW and a team from the Institute for Digital Communications at the University of Edinburgh (UoE) under the Biologically Inspired Signal Processing (BIAS), aims to develop novel algorithms for the study of non-stationary signals in general and bat echolocation calls in particular. Many of the engineering (and more specifically signal processing problems) we face have been addressed in nature, sometimes with astonishing degrees of specialisation and success. It is hoped that an improved understanding of natural systems would inspire novel technologies.

Signal Processing for Nuclear Magnetic Resonance Spectroscopy (Dr Elias Aboutanios)
This project is a collaborative effort with a group from the department of Biochemistry at the University of Cambridge and more recently with the Graduate School of Biomedical Engineering, and has the goal of investigating novel approaches for the processing of Nuclear Magnetic Resonance Spectroscopy data in order to enhance the detection and study of biologically active compounds such as metabolites and heparin. This can lead to the unmasking of low concentration metabolites in a biological sample thereby contributing to the study of disease, toxicity, gene expression as well as drug development.
Language Identification and Dialect Identification (Prof. E. Ambikairajah)

Around the world, the identification of languages and their dialects is a pressing problem for government agencies, who need to support cross-cultural services in order to satisfy their universal access obligations to the community. A language identification system dealing with more than two or three languages requires a front-end that will route the speech to the correct interpreter. This research analyses the acoustic and phonetic content of the wideband (0-7 kHz) speech signal to determine what language is being spoken. Many of the approaches to spoken language identification draw upon techniques used in current speaker-independent speech recognition systems.

Automatic Speaker Recognition and Forensic Applications (Prof. E. Ambikairajah, Dr J. Epps and Dr M. Nosratighods)

The automatic determination of a person’s identity from their speech signal has a range of applications in authentication, security, defense and forensics. In 2009, the research group focused on the development of new frequency modulation (FM) features, which have shown great promise for characterising the speech signal in speaker recognition applications. In particular, the group has shown FM features can perform comparably to the mel frequency cepstral coefficients (MFCCs), which have been the uncontested standard front-end for speaker recognition systems, and that MFCC and FM subsystems can be fused to provide substantial gains in recognition accuracy, when evaluated on contemporary standard databases. This work is conducted in collaboration with the Institute for Infocomm Research (Singapore) and the Australian National University.

Paralinguistic Speech Processing (Prof. E. Ambikairajah and Dr J. Epps)

Processing and recognition of the linguistic content of speech has been a major focus for speech processing research for some decades, however more recently attention is shifting towards non-linguistic speech information, such as automatic language determination, speaker emotion, cognitive load and level of interest. The research effort within the school aims to characterise this information accurately, and results in emotion recognition have challenged the state of the art. Cognitive load measurement from speech is a collaborative project led by National ICT Australia.

Genomic signal processing (Dr Julien Epps)

This project concentrates on developing new period estimation techniques and significance measures for characterising structure within symbolic sequences such as DNA, in particular the nucleosome, whose function in evolutionary dynamics is a current area of major research interest in biology. Jointly with the John Curtin School of Medical Research at ANU, the new approaches are being evaluated on whole-genome data.

Signal processing methods for triaxial accelerometry (Prof. Eliathamby Ambikairajah)

In this project, models and analysis methods are developed for automatically determining the type of terrain and gradient being traversed by a subject wearing a triaxial accelerometer. This information is critical to the accurate determination of the energy expenditure of the subject, which in turn has important applications in biomedical engineering and clinical medicine.

A decision support system for telehealth applications (Dr Stephen Redmond)

At the Biomedical Systems Laboratory (BSL) we are currently developing a decision support system to enable clinicians, monitoring vast amounts of remotely acquired telehealth data, to manage their telehealth patients effectively. A trial is currently underway in Blacktown, Western Sydney, remotely gathering data recorded in the unsupervised environment. A record is also kept of the patient’s state of wellbeing for later retrospective training of the decision support system.
Signal quality algorithms for unsupervised electrocardiogram, pulse oximetry and blood pressure measurement (Dr Stephen Redmond)

The noisy nature of unsupervised telehealth recordings has highlighted the necessity for signal quality measures of some commonly performed telehealth measurements, such as the electrocardiogram, pulse oximetry and blood pressure. Since these data are destined for automatic interpretation, ignorance of the signal quality will dramatically affect the accuracy of any physiological parameters extracted from the raw data waveforms. This project has progressed significantly, with several papers published on work relating to the electrocardiogram, Thesis students performing work on blood pressure signal quality algorithms, and a PhD student addressing the automatic identification of quality issues in the pulse oximetry photoplethysmogram.

Triaxial accelerometry-based falls risk estimation among the elderly population (Dr Stephen Redmond)

Falls among the elderly population are a major cause of morbidity and injury - particularly among the over 65 age group. Validated clinical tests and associated models, built upon assessment of functional ability, have been devised to estimate an individual’s risk of falling in the near future. Those identified as at risk of falling may be targeted for interventive treatment. The migration of these clinical models estimating falls risk to a surrogate technique, for use in the unsupervised environment, might broaden the reach of falls risk screening beyond the clinical arena. We have characterised the movements of 68 elderly subjects performing a directed routine of unsupervised physical tasks; the movement characterisation is achieved through the use of a triaxial accelerometer. By extracting a number of falls related features from the accelerometry signals, combined with a linear least squares model, we can map to a clinically validated measure of falls risk with a correlation coefficient of 0.81 (p<0.001), proving the utility of such unsupervised assessment of falls risk.

Wireless sensor networks to detect falls and estimate falls risk (Dr Stephen Redmond)

This project aims to investigate the extension of the previously mentioned project, which uses a directed routine assessment, to unobtrusive estimation of falls risk among the elderly community. The technique will employ the combined use of a single wireless body-worn accelerometer sensor and indoor localisation technology, to characterise the movements of the elderly subject and hence estimate their risk of falling in the near future. Again, once those at risk of falling are identified, a preventative strategy implemented by allied healthcare providers may be initiated. Leveraging existing asset tracking technologies, such as active RFID, ultrasound or infrared, would provide information regarding the subject’s location within the home and hence enable the estimation of walking speeds, average durations of particular activities (such as toileting, or stair climbing) and identification of sit-to-stand transitions; all of which are known to correlate with a risk of falling. Similarly, analysing patients movements, it may be possible to detect falls events at night time, when the subject is not wearing a more traditional falls detection wearable device.
Interpretation of accelerometric, gyroscopic and barometric signals for falls event detection
(Dr Stephen Redmond)

A falls detection system, employing a Bluetooth-based wearable device, containing a triaxial accelerometer and a barometric pressure sensor, has been developed at the BSL. The aim of this study is to evaluate the use of barometric pressure measurement, as a surrogate measure of altitude, to augment previously reported accelerometry-based falls detection algorithms. The accelerometry and barometric pressure signals obtained from the waist-mounted device are analysed by a signal processing and classification algorithm to discriminate falls from activities of daily living. This falls detection algorithm has been compared to two existing algorithms which utilise accelerometry signals alone. A set of laboratory-based simulated falls, along with other tasks associated with activities of daily living (16 tests) were performed by 15 healthy volunteers (9 male and 6 female; age: 23.7 ± 2.9 years; height: 1.74 ± 0.11 m). The algorithm incorporating pressure information detected falls with the highest sensitivity (97.8%) and the highest specificity (96.7%).

Classification of finger pad afferent nerve activity in monkeys under the influence of force and torque stimulation (Dr Stephen Redmond)

While the characteristics of afferent nerve responses to tactile stimuli are well understood, the nature of how vast arrays of these various nerve types, located in the finger pads, contribute information to encode more complex stimuli, such as surface curvatures, force magnitudes and force directions, are poorly understood. We have investigated the application of some pattern recognition procedures to spike counts recorded from an ensemble of afferent nerves, in monkeys, subjected to several combinations of normal force and twist (torque). A microelectrode was placed into the median nerve; the technician listens to the amplified signal to detect a successful implantation. Once implanted, the technician searches for the exact location of the nerve unit, on the finger pads, which is generating the spike train. Once located its exact location is recorded. The afferent nerve is then characterised as being a slow or fast adapting nerve of type. Employing a Parzen window classifier with a feature selection procedure, we can show that 100% classification accuracy is achievable across a range of different normal forces and torques, given only few select afferent nerves.
AWARDS AND PRIZES

Dr Wei Zhang won the IEEE Communications Society Asia-Pacific "Outstanding Young Researcher Award" for 2009. This award honours researchers who have been very active in IEEE ComSoc publications and conference activities over the last 2 years. This year, IEEE received a large number of applications and Wei was one of 6 researchers to win this award, the only recipient from Australia. Dr Wei Zhang won the award for his contributions to his spectrum sensing algorithm and spectrum sharing solutions for cognitive radio. He has 3 US patents (filed) and one ARC Discovery Project on cognitive radio research. Cognitive radio is an exciting emerging technology, which has potential for dealing with problems posed by the stringent requirements and scarcity of the radio spectrum. Potential applications of Dr Wei Zhang's research outcomes allow co-existence of various wireless communication systems working in the same spectrum band, leading to new services and open markets for new players.

Prof. David Taubman - 2009 Inventor of the Year Awards, Information and Communication Technology category for his image and video compression software, known as Kakadu™

Dr Susan Angus, an EE&T and Co-op alumnus and PhD graduate, was awarded the Malcolm Chaikin Prize for Research Excellence in Engineering.

This award recognises the best PhD thesis (high quality thesis, strong ability to convey the excitement of her field of research to the scientific community and raising the profile of Engineering to the community at large) in the calendar year.

After completing honours in the Centre for Quantum Computer Technology, she decided to continue at UNSW as a PhD student under the supervision of Prof. Andrew Dzurak. Susan's research involved the construction of silicon quantum dots and silicon single electron transistors in the Semiconductor Nanofabrication Facility; and the subsequent electronic characterization of these devices at mK temperature (~-273C). Susan is now a Research Fellow in the School of Physics at the University of Melbourne, responsible for establishing a hybrid electrical-optical characterisation platform at mK temperature.

RESEARCH COMMERCIALISATION

Patents


RESEARCH PUBLICATIONS (2008*)

Book Chapters - Scholarly Research


Journal Articles - Scholarly Refereed


Chen, KY., Daneshmand, M., Fomani, AA., & Ramer, R., 2008, 'Monolithic MEMS T-Type Switch for Redundancy Switch Matrix Applications', in Proceedings of the 38th European Microwave WEEK, eds., Amsterdam, Amsterdam, pp. 1513 - 1516


Xu, Y., Michael, AW. & Kwok, CY., 2008, ‘Fabrication of smooth 45 degrees micromirror using TMAH low concentration solution with NCW-601A surfactant on <100> silicon - art. no. 8B001FW, in Optical and IR Telescope Instrumentation and Detectors', eds., Canada Australia, Bellingham, p. 8B001


Conference - Full Paper Not Refered


Conference - Abstract


High spatial resolution microphone array with eight omnidirectional microphones

Microphone array in anechoic test chamber

ANNUAL REPORT 2009
RESEARCH HIGHLIGHT: QUANTUM COMPUTING

The arrival of superfast quantum computing is closer following recent breakthroughs by an international team led by researchers Professor Andrew Dzurak and Dr Andrea Morello from the School of Electrical Engineering and Telecommunications and the Centre for Quantum Computing Technology.

Quantum computing relies on being able to control and observe the behaviour of quantum particles – for instance individual electrons - to deliver enormous processing power. In the two new breakthroughs, written up in the international journals Nano Letters and Applied Physics Letters, researchers have for the first time demonstrated two ways to deliberately place an electron in a nano-sized device on a silicon chip.

The achievements set the stage for the next crucial steps of being able to observe and then control the electron’s quantum state or “spin”, to create a quantum bit. Multiple quantum bits are coupled to make up the processor of a quantum computer.

“Individual phosphorus atoms have been deliberately introduced in a nanometre-size silicon transistor. This special ‘single-atom transistor’ works by letting single electrons hop on and off the phosphorus atom, one after the other in a controllable way. A quantum bit can be formed by choosing to leave the electron on the atom, and using its spin as carrier of quantum information,” Dr Morello says.

Dr Morello describes the two breakthroughs as “very important results” and, while it is still hard to say when a quantum computer will become reality, recent progress is very encouraging.
RESEARCH COMMITTEE REPORT

The Research Committee plays a key role in realising the following research goals of the school:

- Increasing research income, particularly via the ARC Discovery and ARC Linkage schemes
- Increasing the number of journal and conference publications, particularly the number of papers published in peer-reviewed journals of high international standing
- Increasing the number of higher degree research students and research student completion rate
- Increasing the number of postdoctoral and research fellows
- Recruiting outstanding researchers to add to the critical mass in the School’s focused research theme areas

A new initiative in 2009 was the organisation of a new seminar series by Research Committee members to assist early career researchers to improve their ARC Discovery proposals. The first of these was given by Prof. Victor Solo, a former ARC Panel Member. Seminars directed towards ARC Linkage proposals are also planned.

STUDENT RESEARCH CONFERENCE

With a view to the next generation of EE&T researchers, the purpose of the Student Research Conference was to provide undergraduate students an introduction to the research activities and strengths in the school and encourage high quality students to consider pursuing postgraduate research degrees at the School.

The conference, held on the 22nd of September, 2009, was attended by over 60 registered students, predominantly 4th year students, with a healthy attendance by 3rd year students also. The program included research overview talks, poster presentations, lab visits and a Q/A session, and was a great success in terms of student attendance and enthusiasm.
CONFERENCES AND WORKSHOPS HOSTED BY EE&T

Prof. Jinhong Yuan

General Chair, 10th Australian Communications Theory Workshop 2009

The 10th Anniversary of the Australian Communications Theory Workshop was held on 4-7 February 2009, at UNSW, Sydney. The workshop offers three research overviews by three invited speakers – Prof. David Taubman (University of New South Wales), Prof. Mike Faulkner (Victoria University), and Prof. Daniel Palomar (Hong Kong University of Science and Technology), and 12 invited technical talks presented in four technical sessions. In addition to the core technical program, it also includes a one-day tutorial session on Convex optimizations given by Prof. Daniel Palomar, sponsored by ACoRN.

The workshop was sponsored by UNSW, CSIRO ICT Centre, NICTA, ITR and ACoRN. There were over 110 attendants.

General Chair, Third ACoRN Cooperative Wireless Communication Workshop.

ACoRN Workshop on Cooperative Communications was held at ATP, Sydney, in July 2009. It was jointly held with other ACoRN three day events. It brought together the leading researchers in Cooperative Wireless Communications in Australia to provide a comprehensive overview of current research interests, and hopefully result in future collaborative links.

The workshop provides a forum for Australian researchers to present and discuss recent research developments in the area of cooperative communications, such as the fundamental principles, analysis and design of cooperative communications, with special emphasis on advanced cooperative transmission and receiving techniques. The workshop covers: • Cooperative relay algorithms: decode and forward, amplify and forward, compress and forward, distributed antenna arrays, parallel relaying, multi-hop transmission. • Analysis of cooperative communication systems: Capacity analysis, outage performance analysis,
diversity analysis, system performance analysis with varying degrees of channel state information.

- Coding techniques: cooperative space-time coding, soft-information relay, cooperative LDPC codes, differential cooperative coding, turbo codes.
- Advanced transmission techniques: relay selection, power allocation techniques.
- Advanced receiving techniques: iterative receivers, channel estimations.
- Multi-terminal relay networks: spatial multiplexing, transmission precoding and interference cancellation at relays, MAC scheduling.

Prof. Gang-Ding Peng


This workshop brings together Australian and Chinese researchers and engineers who are involved in several related international and industry collaborative projects in optical fibre and photonic sensors and their industrial applications. In recent years, these collaborative projects have been sponsored by the Australian Government Department of Innovation, Industry, Science and Research (DIISR) and its Chinese counterpart, the Ministry of Science and Technology (MOST), the Australian Research Council (ARC) and its Chinese counterpart, the National Natural Science Foundation of China (NNSFC), and industry partners RTA and RailCorp.

The workshop was sponsored by DIISR and MOST and attended by representatives from RTA, RailCorp, Tianjin University, University of Science and Technology of China, Sydney University and University of New South Wales. Prof. Ambikairajah addressed and welcomed the guests at the workshop. The workshop featured 12 industrial and research presentations reporting on the latest progress in fibre-optic and photonic sensing technologies.

This workshop was attended by about 40 Australian and Chinese researchers and engineers who are involved in several related international and industry collaborative projects in optical fibre and photonic sensors and their industrial applications.
KEYNOTES
AND TUTORIAL PRESENTATIONS

Prof. Gang-Ding Peng presented “Applications of Fibre Laser Based Sensors”, Tutorial in 14th OptoElectronics And Communications Conference: Workshops, Hong Kong, Monday, 13 July 2009

Prof. Gang-Ding Peng presented “Spectrally Coded Multiplexing For Fibre Grating Sensor Systems”, Invited talk at 20th International Conference on Optical Fibre Sensors, Edinburgh, UK, Wednesday, 7 October, 2009

Dr Tuan Phung presented “Partial Discharge and Partial Discharge Measuring on Inverter Driven Motors” as an invited lecture to the 2009 Lecture Program of the Joint Electrical Institutions (Engineers Australia, IEEE, and IET), Engineers Australia, Sydney Division, 30 April, 2009

Prof. Jinhong Yuan presented “An overview of coded cooperation techniques” at the ACoRN Cooperative Wireless Communication Workshop

KEY RESEARCH INFRASTRUCTURE

Photonics

A new MCVD lathe facility, funded by the Australian Research Council, has been installed in POCG, UNSW. This facility will enable new generation of structured and doped optical fibres to be fabricated. The new facility installed at UNSW is supported by more than eight partner universities.

The lab has also received a new LIEF grant that completes the upgrade and establishment of a new National Fibre Facility at UNSW for fabricating the next generation of advanced optical fibres specifically tailored for remote optical fibre sensing and other novel applications. Remote optical fibre technologies are the way forward for effective and safe monitoring of many industries, and will play a big part in the sustainability and safeguarding of Australia’s core oil, gas and alternative energy sectors. They are equally important to health industry applications, particularly in medical and imaging technologies. This facility brings together world-class Australian expertise—from across nine universities—in advanced structured optical fibres, complex fibre diagnostic systems, nanoscale imaging, and environment monitoring, to design and implement the next generation of technologies required to develop these sectors.

UNSW is the home of Australia’s first optical fibre fabrication capabilities in both silica and polymer. In a long historical tradition of bringing parties together, the facility will be underpinned by 5 local Schools – bringing Electrical Engineering & Telecommunications, Materials Science and Engineering, Chemical Science and Engineering, Civil and Environmental Engineering, Mechanical and Manufacturing Engineering – and will bring together leading researchers, both nationally and internationally, for the common good of Australia’s optical fibre research and technology capability, which has over several decades grown to be world class.
The Australian National Fabrication Facility (ANFF) was established under the National Collaborative Research Infrastructure Strategy (NCRIS) in 2007 to provide Australian researchers from both the public and private sectors with access to nano- and micro-fabrication equipment and research support. The NSW Node of ANFF is hosted within the Semiconductor Nanofabrication Facility (SNF), which has been a key laboratory within the School of Electrical Engineering & Telecommunications since 1994. The ANFF-NSW laboratory now supports over 100 leading nanotechnology researchers from around Australia and positions the School as a key national hub for this important enabling technology.

They are a key participant in ANFF with Professor Andrew Dzurak serving as Director of the ANFF-NSW Node and also SNF Director. The facility supports the numerous research activities within the School, in areas as diverse as nanoelectronics (Dzurak) and microsystems (Kwok/Lehmann), micro-electro-mechanical systems or MEMS (Kwok), quantum computing (Dzurak/Morello), photonics (Peng/Ladouceur) and biomedical engineering (Lovell/Ladouceur). Over 20 of the School’s PhD students utilize the ANFF laboratory, which provides a world-class research environment for device engineering.

Now in its 17th year of operation, the SNF contains equipment for fabricating a range of semiconductor and other devices in a cleanroom environment. Key instruments include two high resolution electron beam lithography (EBL) systems, an atomic force microscope, high temperature silicon oxidation and diffusion furnaces, a range of metal deposition systems and plasma tools, UV lithography equipment and wet chemical process lines. SNF service equipment includes the Special Gases System which stores and distributes process gases to the laboratory. A rooftop gas enclosure houses gas cylinders, distribution pipes, exhaust extraction and environmental control equipment. Gas monitoring and automatic safety interlocks are incorporated due to the hazardous nature of some gases.

In 2009, the ANFF-NSW Node completed a major cleanroom construction project delivering two new cleanrooms which have been validated with particle counts equivalent to ISO5 and ISO6. This represents a doubling of the laboratory space available within the SNF (now totalling 600m²). Commonwealth and State government investments under ANFF will also deliver approximately $7m worth of new fabrication tools to the NSW Node. Among these are the flagship Raith 150TWO high resolution electron beam lithography system and a Lesker e-beam evaporator, both of which were installed and commissioned in 2009. Installations scheduled throughout the period 2010-12 include: a mask aligner, silicon furnace stack and associated tools supporting 6” wafer processing; an ion implanter (for Si dopants); a range of new metal and insulator deposition and plasma processing tools (including PECVD, LPCVD and ALD systems); and a suite of metrology tools (including ellipsometer, profilometer and optical microscopes).
04.

RESEARCH FUNDING AND RESEARCH CENTRES

RESEARCH FUNDING

2009 was another very strong year for research funding in the School of Electrical Engineering and Telecommunications, with a total of around $3.4m in external funding. Listed below are the new sources of funding awarded during 2009.

ARC Discovery Grants

Prof. David Taubman - “Approved Non-Parametric Modelling of Motion and Depth fields with Boundary Geometry for Scalable Compression and Dissemination” - $376,000

Dr Wei Zhang (with Prof. Xia) - “Efficient Signal Transmission Techniques for future Wireless Communications Systems” - $150,000

Dr Iain MacGill (with Regina Betz) - “Climate change and energy policy: elements of a robust policy mix” - $300,000

Dr Andrew Dzurak (with Prof. AB Rozenfeld et al) - “Development of innovative radiation detectors and computational techniques for improving quality of life” - $310,000.

ARC Linkage Grants

Dr Deep Sen - “Parametric Soundfield Representation” - $210,000

A/Prof. Francois Ladouceur “Diamond based Ultra Violet emitting devices” - $750,000

ARC LIEF Grants

Gang Ding Peng, Chee Yee Kwk, Rodica Ramer and Deep Sen (with other 8 universities - administering organization UNSW) “Advanced facility for next generation sustainable energy, biomedical and nano-imaging optical fibre technology” - $600,000

Victor Solo (with 8 CIs; lead CI Prof. Caroline (Lindy) Rae of POWMRI (Prince of Wales medical Research Institute) - “State of the art upgrade to multi-transmit multi-receive technology for research dedicated 3 Tesla MRI Scanner” - $400,000.

Andrew S Dzurak (with 6 more CIs the lead CI Dr Julie M Cairney (University of Sydney) “Advanced focused ion beam (FIB) / scanning electron microscopes (SEM) for nanometre scale characterisation and fabrication” - $1,200,000

Francois Ladouceur (with 20 more CIs, the lead CI Dr Pali Thordarson, Chemistry, UNSW) “A unique soft matter high-performance scanning probe microscopy (HP-SPM) facility” - $450,000

Rodica Ramer (administered by Professor S.X. Dou of Wollongong) “Combined scanning tunneling microscope system of materials characterization and manipulation at nano scale” - $400,000

Julien Epps and Eliathamby Ambikairajah (with with other 11 universities - administering organization UWS) - “The Big Australian Speech Corpus: An audio-visual corpus of Australian English” - $650,000

Industry Grants

“Development of new techniques for partial discharge monitoring and location in high voltage underground power cables”, $150,000 from 2007-2009, funded by the ASTP (Australian Strategic Technology Program). UNSW investigators: A/Prof. T.R. Blackburn and Dr T. Phung. The ASTP is part of the Energy Networks Association of Australia (ENA) which is the peak national body representing gas and electricity distribution businesses throughout Australia. The ASTP itself is composed of 18 electricity transmission and distribution utilities, including most of the largest utilities in Australia.

UNSW – INTERNAL

Deep Sen, “Multidimensional Objective Measure of Speech Quality”, Vice-Chancellor’s Proof of Concept - $48,000

Phil Allen, Tim Moors, Rob Malaney, Vijay Sivaraman, “Wireless Network Modelling and Implementation”, UNSW IT Investment Plan - $89,000

Goldstar Awards:

▷ Tuan Hoang, “Exploring newly emerging techniques in nonlinear control and filtering” - $40,000

▷ Tim Moors (with Mahbub Hassan, CSE chief investigator), “Towards Safer Roads: Reliable Wireless Networking for Vehicles” - $30,000

▷ Vijay Sivaraman (with Sanjay Jha, CSE chief investigator), “Flying Networks: Airborne Sensing for Environmental Monitoring and Disaster Response” - $30,000
Faculty Research Grants / Early Career Research Grants:

- Julien Epps, Hua Ying (ANU), and Gavin Huttley (ANU), "Investigation of nucleosome structure using signal processing based periodicity measures" - $30,000.
- Ashay Dhamdere, "Real-Time Communication Protocols for Body-Worn Sensors Monitoring Athletes in Field Sports" - $25,000

Major Research Equipment Infrastructure Initiative Grants:

- Andrew Dzurak “SNF Special Gases System: Toxic/Flammable Gas-Handling Infrastructure for Nanostucture Device Processing” - $78,500
- Andrey Savkin, Nigel Lovell, Branko Celler, Eliathamby Ambikairajah, and Stephen Redmond "Ambulatory monitoring equipment for assessing physiological function" - $118,000

AUSTRALIAN DEVELOPMENT RESEARCH AWARD

The School of Electrical Engineering & Telecommunications of the University of New South Wales (UNSW) was awarded an Australian Development Research Award in the area of Environment, Forest and Climate Change (ADRA Project EFCC011) on Overcoming Barriers to Renewable Energy in Rural Indonesia by Community Capacity Building. The ADRA EFCC011 Project is an interdisciplinary research project involving UNSW staff in conjunction with Indonesian collaborators. The UNSW research project team includes: Prof. Hugh Outhred (Principal Investigator), Dr Maria Retnanestri (Research Leader, Indonesia researcher), Dr Stephen Healy (Research Supervisor), Dr Muriel Watt (Research Supervisor) and Ms Long Seng To (PhD Research Student, China researcher).

The research project is funded by AusAID, totaling AUD 310,000 over three years (2008-2011), through its 2007 ADRA funding round. Additional funding was sought and obtained from photovoltaic (PV) companies (in Indonesia, Australia and Japan) and other institutions including the e8 and STTNAS Jogjakarta, to run the project activities in Indonesia. The funds also partly support a related project in China.

Main activities in Indonesia in 2009 include:

- January 2009: Workshop in Renewable Energy & Sustainable Development in Indonesia (jointly funded by the e8), aimed at understanding and formulating strategies to overcome barriers to renewable energy in Indonesia and other developing countries.
- April-May 2009: 9-day STTNAS student Renewable Energy study tour (jointly funded by BP Solar & STTNAS Jogjakarta), in which students visited various RE sites, factories, laboratory & research agency in Indonesia. This is aimed
at facilitating RE learning and model design for capacity building as well as fostering students interest in a future career in renewable energy and RE stakeholders networking.

Jakarta, 19-20/2/09, Workshop on RE & Sustainable Development in Indonesia: Past Experience – Future Challenges, attended by more than 100 workshop participants from various institutions (government, embassies, donors, research bodies, universities, private companies, NGOs and local communities) and countries (Australia, Canada, Finland, France, Germany, Indonesia, Japan, Switzerland, UK, and the USA).

23 April – 1 May 2009, STTNAS College RE study tour, visiting various RE (geothermal, PV, microhydro and bio-energy) sites, factories, laboratory and research agencies in West Java and Jakarta.

RESEARCH CENTRES

Centre for Energy and Environmental Markets (CEEM)

The UNSW Centre for Energy and Environmental Markets (CEEM) was established in 2004 as an interdisciplinary research collaboration between the School of Electrical Engineering and Telecommunications (EE&T) and the School of Economics within the Faculty of Commerce and Economics. Dr Iain MacGill of EE&T is one of the two joint directors for CEEM, and Mr Ted Spooner is the Research Coordinator (Engineering). Professor Hugh Outhred was the founding director of CEEM and is now a Visiting Professorial Fellow in EE&T.

The Centre undertakes research in three primary streams – sustainable energy transformation including energy technology assessment, renewable energy integration and energy services in developing countries; energy and environmental market design including electricity industry restructuring, emissions trading and renewable energy policy; and distributed energy options including energy efficiency, distributed generation and smart grids.

CEEM has provided a valuable platform for interdisciplinary work in the energy area at UNSW with joint publications and submissions across five Faculties, and a valuable model for such interdisciplinary research efforts at UNSW. Funding is now approaching $2m in research funding obtained over the last five years, while post-doctoral and PhD Student numbers have expanded. Research funding success in 2009 included an Australian Energy Market Operator (AEMO) post-doctoral fellowship supporting Dr Nick Cutler’s PhD research on wind integration, an ARC Discovery grant on robust energy and climate policy mixes, and Commonwealth Environmental Research Facilities (CERF) support for work on the impact of renewable energy on the National Electricity Market. The Centre has an active seminar and workshop program. Events in 2009 included a CERPA funded workshop on renewable energy deployment opportunities for Australia and a NSW Government funded workshop on German-Australian renewable energy integration challenges. CEEM also contributed to two Australian Academy of Technological Sciences and Engineering (ATSE) workshops on sustainable energy technologies over the year.

EE&T hosted three CEEM post-doctoral fellows in 2009 – Dr Maria Retnarestri, Dr Fushuan Wen and Dr Robert Passey, and five PhD students – two of whom successfully completed their programs during the year. CEEM academics also supervised eight EE&T honours thesis projects over the year.

Industry and community engagement included CEEM contributions to the work of Standards Australia, the Australian Energy Market Commission, the AEMO Wind Energy Research Reference Group, the Environmental Defenders Office Technical Experts Group and the Climate Institute Strategic Council. CEEM academics gave invited presentations at over a dozen industry conferences, jointly ran several industry workshops, provided around ten submissions to government energy policy processes, made numerous media contributions and appeared before three Senate Committees. Consultancy work in 2009 included projects energy and climate technology and policy issues for the Federal and NSW State Governments and a number of Non-Government Organisations and Industry Associations. The Centre was a joint winner of the UNSW Excellence in Community Engagement (Groups) Award for 2009.
Centre for Quantum Computer Technology (CQCT)

The ARC Centre of Excellence for Quantum Computer Technology (CQCT), headquartered at the University of New South Wales, comprises 19 Research Programs across eight Australian and two international research institutions. All Programs are engaged in coordinated research in line with the Centre’s mission “to position Australia as a leader in quantum computer technology, a field which will play a crucial role in the future of information technology”.

The School participates in the Centre’s experimental efforts in silicon-based quantum computing via the Integrated Quantum Computer Devices Program led by Professor Andrew Dzurak and the Quantum Measurement and Control Chip Program led by Dr Andrea Morello. These two Programs interact closely on a number of research projects leading towards the key goals of: demonstrating the coherent control of a single spin-based qubit in silicon; and demonstrating coupling between two qubits. Longer-term goals seek to integrate control electronics and scale up to multi-qubit operation.

The Centre receives significant funding from the Australian Research Council and the US Army Research Office as well as support from host institutions and State governments, with an annual research income of order A$7m.

National ICT Australia (NICTA)

NICTA is Australia’s Information and Communications Technology (ICT) Centre of Excellence. We are an independent company in the business of research, commercialisation and research training. With over 700 people, NICTA is the largest organisation in Australia dedicated to ICT research.

NICTA aspires to be one of the world’s top-ten ICT research centres by 2020. Our long-term contribution will be to create new ICT industries for Australia.

NICTA’s four research themes are:

- Networked Systems – technologies that connect the ‘smart products’ of embedded systems together to form ‘smart networks’.
- Making Sense of Data – finding ways to make sense and extract value from the growing amounts of data created by ICT systems.
- Managing Complexity – developing efficient and reliable tools and processes to solve complex ICT problems.

As a founding member of NICTA, UNSW has a large-scale, long-term strategic partnership with NICTA. In 2009, NICTA’s total funding support to UNSW included $1,522,000 including joint appointments, scholarships and prizes, of which a substantial proportion was received by the School of EE&T.
05.

INDUSTRY, PARTNERS, COMMUNITY AND OUTREACH

INDUSTRY ADVISORY BOARD

The School’s Industry Advisory Board provides a critical link with example major stakeholders of the school’s teaching and research outcomes. We herein express the sincere gratitude of the School for their energy, advice and interest in the future of the school.

Objectives:

- To ensure our programs and courses are valuable to high school students and that our graduates are equipped with the appropriate skills as approved by industry
- To develop industry based courses with the School
- To advise the School on changes and innovation in industry so that they can be accommodated into our courses and programs so that we produce better graduates
- To provide a link for staff to have industry experience, especially while on sabbatical from their academic career
- To assist in the school’s marketing to increase interest in our programs

Board meetings are also attended by the Head of School, heads of the research groups, the Director of Academic Studies, and the School Executive Officer.

Some outcomes during 2009 included:

- Agreement to develop an industry based Systems Engineering course – Raytheon
- Extended Industry Internships for high-performing 3rd year students. NICTA has already pledged to provide 4 internships when this program is in place.

<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Steven G. Duvall</td>
<td>Consultant</td>
</tr>
<tr>
<td>Mr Nevill Inglis</td>
<td>Technical Manager, Avaya Labs Australia</td>
</tr>
<tr>
<td>Mr Jim Metcalfe</td>
<td>Director, General Manager, Applied Technology Division CISRA (Canon Information Systems Research Australia Pty Ltd)</td>
</tr>
<tr>
<td>Mr Steven Jones</td>
<td>Manager Design &amp; Construct, Projects TransGrid</td>
</tr>
<tr>
<td>Mr Don Parker</td>
<td>Director/Principal Engineer, Provecta Process Automation Pty Ltd</td>
</tr>
<tr>
<td>Mr Grant Garraway</td>
<td>Systems Engineering Manager, Raytheon Australia</td>
</tr>
<tr>
<td>Mr Glenn Wightwick</td>
<td>Director, Australia Development Laboratory Chief Technologist IBM Australia</td>
</tr>
<tr>
<td>Mr Quentin Goldfinch</td>
<td>Director, R&amp;D Avaya Labs Australia</td>
</tr>
<tr>
<td>Prof. Aruna Seneviratne</td>
<td>Director, ATP Laboratory, National ICT Australia</td>
</tr>
<tr>
<td>Mr Neil Roberts</td>
<td>Manager, Professional Development Energy Australia</td>
</tr>
<tr>
<td>Dr Kim Jaggar</td>
<td>Principal, Sydney Boys High School</td>
</tr>
</tbody>
</table>
STAFF VISITS AND SECONDMENTS

Prof. Gang-Ding Peng  
Visiting Professor, Tokyo University

Prof. Gang-Ding Peng  
Guest Professor, Tianjin University

Prof. Eliathamby Ambikairajah  
Visiting Scientist, Institute for Infocomm Research, Singapore, Jan 2009

Prof. Jinzhong Yuan  
Visiting Associate Professor, ITR, UniSA, 2009

Prof. Jinzhong Yuan  
Visiting Scientist, CSIRO ICT Centre, 2009

Dr Toan Phung  
API-sponsored (Australian Power Institute) academic sabbatical appointment with EnergyAustralia (EA), Engineering Transmission and Technology, Network Test, 2009

Dr Wei Zhang  
Visiting Professor, Chinese University of Hong Kong, Nov. 2009.

Dr Wei Zhang  
Visiting Research Collaborator, Princeton University, July 2009.

Dr Wei Zhang  
Visiting Professor, Hong Kong University of Science and Technology, April 2009.

Dr Julien Epps  
Senior Researcher (Joint appointment with UNSW), National ICT Australia, 2009-2012

INDUSTRY PROJECTS

A/Prof. Ladouceur, “Development of bistable hybrid solid state memory devices”, joint project with Sillana Pty Ltd, Brisbane, Australia.

Note that funded industry-related projects are listed in the Research Funding section of this report.

Dr Toan Phung, “On-site insulation condition monitoring of HV cables in Integral Energy and EnergyAustralia substations”.

Dr Toan Phung, “Partial Discharge in inverter driven low-voltage motors”, with in-kind equipment support from Toshiba. A presentation was given in the 2009 Lecture Program of the Joint Electrical Institution Sydney (Engineers Australia, IEEE, IET).

SEMINARS FROM INDUSTRY

“Towards a Smarter Planet”, Glen Wightwick, Director of the IBM Australia Development Laboratory & IBM Australia Chief Technologist, Wednesday 30th September 2009

“The National Broadband Network - It’s Much More Than Fast Internet!”, John Turner - Vice President of Alcatel-Lucent’s National Broadband Network Program in Australia

Mr Philip Mallon, RTA, Optical Fibre Sensors in Transportation

Mr Greg Won, RTA, Fibre Optic Monitoring of Road Pavement Infrastructure Affected by Underground Mining

As part of ELEC4445 Entrepreneurial Engineering

Guy Pross, Better Inc, “Better Place”

P. Lightbody, NICTA, “IP: A primer for the entrepreneur”

Mr Nick Cuevas, PlantWeave Technologies, “Start-up life”

Dominik Mersch, Dominik Mersch Gallery Pty Ltd, “Art in Intellectual Property”

Dr Jim Katsifolis, Future Fibre Technologies (Melbourne), “Fibre Optic Intrusion Detection Systems”
CO-OP SCHOLARSHIPS

In 2009, the School had twenty-three Co-op Scholars spread over the five years of the program, including five new scholars who commenced in year 1. Co-op scholars are students sponsored by a pool of companies and who complete their BEs over 5 years while simultaneously completing 68 weeks of full-time industrial training at these same sponsors. In 2009 the year 4 scholars completed their respective extended (24-week) placements at Alcatel-Lucent, Cochlear, Downer EDI, Sydney Water and TEMCO (a division of BHP Billiton).

The highlight of the year was the very successful annual Poster Presentation and Reception in August. At this event, the year 4 scholars presented on the projects they had completed during these placements. Also, it is worth noting that all four of the graduating year 5 scholars gained honours: Stefanie Brown, Andrew Hankins, Jeremy Nagel and Claire Wood.

At the end of November, the School, together with representatives of the sponsors, interviewed 25 school-leavers to fill the 4 new scholarships for 2010. There had been 78 written applications.

For more information about Co-op Scholarships see www.coop.unsw.edu.au

RESEARCH VISITORS

Prof. Alexey Matveev
St. Petersburg University, Russia, visiting Prof. Andrey Savkin.

Prof. Romeo Ortega
the Laboratoire de Signaux ET Systemes of Supelec in Gif-sur-Yvette, France, visiting Prof. Andrey Savkin

Prof. Xiang-Gen Xia
University of Delaware, USA, visiting Dr Wei Zhang

Dr Yang Yang
University College London, UK, visiting Dr Wei Zhang

Prof. Aria Nosratinia
University of Texas at Dallas, USA, visiting Dr Wei Zhang

Prof. Manos Tentzeris
Georgia Tech., Atlanta, USA, visiting Prof. Rodica Ramer

Prof. R. Mansour
University of Waterloo, Canada, visiting Prof. Rodica Ramer

Prof. Hong Chen
Tongji University, visiting Prof. Gang-Ding Peng

Prof. Byoungho Lee
Seoul National University, visiting Prof. Gang-Ding Peng

Prof. Yimo Zhang, Prof. Tiegan Liu, A/Prof. Dageng Jia, A/Prof. Hongxia Zhang, Dr Kun Liu
Tianjin University, visiting Prof. Gang-Ding Peng

Dr Ming Xiao
KTH Sweden, visiting Prof. Jinhong Yuan

Dr Andrew Zhang
NICTA, ANU, visiting Prof. Jinhong Yuan
INDUSTRIAL TRAINING

The industrial training requirement in all undergraduate engineering degree programs continues to provide an essential complement to university coursework. Many EE&T students elect to do more training than the minimum 60 days, widening their practical experience and increasing their value as graduate engineers to prospective employers. Below is a list of some companies who provided Industrial Training placements to EE&T students during 2009. Although the list is not exhaustive, the school would like to thank all companies who provided training to our undergraduate students.

- Cochlear
- Teleplan
- Lake Technology
- CAP-XX (supercapacitors)
- Cisco
- Big Switch Projects
- Downer EDI
- Energy Australia
- TransGrid
- National Instruments
- Mike Rectifiers
- Orion Integration
- NSW Dept of Commerce (Gov’t Chief Information Office)
- Honeywell
- China Telecom
- Alcatel-Lucent
- Alstom
- Eraring Energy
- Country Energy
- GHD
- PT Chevron Pacific Indonesia
- Qualcomm
- Canon Information Systems Research Australia (CISRA)
- Partners in Productivity
- TeleMedCare
- Northrup Consulting Engineers
- ResMed
- HPM
- Institute of Microelectronics, A*STAR, Singapore
- NEC Shanghai
- Optical Fibre Technology Centre
- Tianjin Electric and Power Company
- National ICT Australia
- Actew-AGL
- CSIRO
- Renewable Energy Systems Australia
- United Group Limited, Infrastructure

THESIS POSTER COMPETITION

As in previous years, the 2009 thesis poster competition was a premier event, well attended by UNSW academic and executive staff, industry representatives and guests from external research organisations.

Thesis Poster Competition

In addition, as a part of the final year thesis course, students prepare and present posters at the conclusion of their project. For the past 11 years, the School has held a poster competition, where the best posters during the year are judged by academics and industry representatives. The best three are awarded a certificate and monetary prize, to be awarded on the day of the graduation ceremony.

NICTA Telecommunications Prize

Each year, NICTA generously sponsor a prize for students in each stage of an electrical engineering or telecommunication degree, who have shown outstanding academic performance in telecommunications.

Results:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Student</th>
<th>Supervisor</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Macarthur-King, Scott</td>
<td>Prof. David Taubman</td>
<td>Laser Pointer Driven Computer Mouse</td>
</tr>
<tr>
<td>2</td>
<td>Wong, Nicholas</td>
<td>Prof. Jinhong Yuan</td>
<td>Network Coding Schemes for Wireless Communications</td>
</tr>
<tr>
<td>3</td>
<td>Cassidy, Ben</td>
<td>Prof. Victor Solo</td>
<td>Functional Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>4</td>
<td>Hankins, Andrew</td>
<td>Dr Elias Aboutanios</td>
<td>Novel Ink Drop Watcher</td>
</tr>
<tr>
<td>5</td>
<td>Grenet, David</td>
<td>Dr Gregg Suaning; Dr Richard Fitzparick</td>
<td>A Wireless Mobile Neurostimulator</td>
</tr>
<tr>
<td>6</td>
<td>Tang, Tiffany</td>
<td>A/Prof. Francois Ladouceur; Dr Peter Reece</td>
<td>Applications of Microstructured Polymer Optical Fibers in Optical Micromanipulation</td>
</tr>
<tr>
<td>7</td>
<td>Bhardwaj, Rohan</td>
<td>Prof. Nigel Lovell</td>
<td>Optimal Image Processing for Retinal Prosthesis</td>
</tr>
<tr>
<td>8</td>
<td>Brown, Stefanie</td>
<td>Dr Deep Sen</td>
<td>Beamforming with the Eigenmike</td>
</tr>
<tr>
<td>8</td>
<td>Choon, Ham Yean</td>
<td>Dr Julien Epps; Dr Yu Shi</td>
<td>Smart Cameras as Embedded Systems</td>
</tr>
<tr>
<td>10</td>
<td>Walsh, Chris</td>
<td>Prof. David Taubman</td>
<td>Hardware Error Detection &amp; Correction for Harsh Environments</td>
</tr>
</tbody>
</table>
SCHOOL ADVERTISING

In 2009, EE&T embarked on some new initiatives to increase the exposure of its program offerings to the community. These included bus advertising and online advertising via Google AdWords.

Open Day in 2009 was well attended, and EE&T produced one of its largest ever stands. In all, around 20 staff, 10 alumni and 30 students combined their efforts to make this a highly successful event.
06. TEACHING

OVERVIEW

The School offers a range of both undergraduate and postgraduate programs to cater for the varying requirements of our students. The School remains committed to providing students with the best possible educational experience while equipping them with the necessary skills and attributes required when they graduate.

The School is very proud to consistently be at the forefront of teaching innovation. It continues to lead the way in the design, implementation, and adaption of educational technology, highlighted by the Virtual Classroom environment, designed and implemented within the School, and used increasingly by staff to heighten the educational experience for the students. In 2009, several courses made use of such technology, which also aided in the implementation of 3 courses run in online video-based and block mode over the summer period.

At the undergraduate level, we deliver single degree programs in each of areas of Electrical Engineering, Telecommunications, and Photonics. A suite of combined degrees are also available to students, as listed below. These programs require an additional 1-2 years on top of that required completing the normal single degree. At the postgraduate level, a range of coursework programs are delivered, including the Master of Engineering Science (MEngSc), and Graduate Diploma (GradDip).

At both the undergraduate and postgraduate level, each of the programs allows the students to specialise in one of the key specialisation areas of communications, systems and control, signal processing, energy and power systems, microsystems, photonics, and biomedical engineering.

<table>
<thead>
<tr>
<th>Single Degree</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE (Electrical Engineering)</td>
<td>4</td>
</tr>
<tr>
<td>BE (Telecommunications)</td>
<td>4</td>
</tr>
<tr>
<td>BE (Photonics)</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Combined Degrees</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE BA (Elec Eng/Tele/Phot)</td>
<td>5</td>
</tr>
<tr>
<td>BE BSc (Elec Eng/Tele/Phot)</td>
<td>5</td>
</tr>
<tr>
<td>BE MBioMedE (Elec Eng/Tele/Phot)</td>
<td>5</td>
</tr>
<tr>
<td>BE BCom (Elec Eng/Tele)</td>
<td>5.5</td>
</tr>
<tr>
<td>BE LLB (Law) (Elec Eng/Tele)</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Postgraduate Coursework Degrees</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GradDip</td>
<td>1.5</td>
</tr>
<tr>
<td>MEngSc</td>
<td>1.5</td>
</tr>
<tr>
<td>MEngSc (Ext)</td>
<td>2</td>
</tr>
</tbody>
</table>

School coursework degree programs

2009 saw a healthy increase in commencing undergraduate students, with 153 new students starting compared to 128 in 2008. The total undergraduate student enrolment in 2009 was 634, up from 613 the previous year. Commencing and total enrolments by degree program are tabled below:

<table>
<thead>
<tr>
<th>Commencing undergraduate students</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elec. Eng.</td>
<td>75</td>
<td>89</td>
</tr>
<tr>
<td>Telecom.</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>Photonics</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>EE/MBiomed</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Tele/MBiomed</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>EE/Science</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Tele/Science</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Photonics/Science</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>EE/Arts</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Tele/Arts</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>BE/BCom</td>
<td>14</td>
<td>7</td>
</tr>
</tbody>
</table>
SCHOOL OF ELECTRICAL ENGINEERING & TELECOMMUNICATIONS

Total Coursework Master Students 2005-2009

<table>
<thead>
<tr>
<th>Year</th>
<th>Local</th>
<th>International</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>41</td>
<td>113</td>
<td>154</td>
</tr>
<tr>
<td>2006</td>
<td>38</td>
<td>113</td>
<td>151</td>
</tr>
<tr>
<td>2007</td>
<td>32</td>
<td>96</td>
<td>128</td>
</tr>
<tr>
<td>2008</td>
<td>30</td>
<td>92</td>
<td>122</td>
</tr>
<tr>
<td>2009</td>
<td>25</td>
<td>172</td>
<td>197</td>
</tr>
</tbody>
</table>

Total Undergraduate Students 2005-2009

<table>
<thead>
<tr>
<th>Year</th>
<th>Local</th>
<th>International</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>631</td>
<td>333</td>
<td>964</td>
</tr>
<tr>
<td>2006</td>
<td>507</td>
<td>253</td>
<td>760</td>
</tr>
<tr>
<td>2007</td>
<td>453</td>
<td>207</td>
<td>660</td>
</tr>
<tr>
<td>2008</td>
<td>410</td>
<td>203</td>
<td>613</td>
</tr>
<tr>
<td>2009</td>
<td>403</td>
<td>231</td>
<td>634</td>
</tr>
</tbody>
</table>
The AEC is a committee responsible for overseeing the academic programs within the School, both undergraduate and postgraduate. This involves many aspects, such as monitoring and implementing quality control of teaching, discussing short term and longer term teaching plans for the School, discussing and recommending new course and program proposals and course revisions, providing a forum for new and innovative teaching and learning strategies to improve the student learning experience.

The committee underwent a change in membership in April 2009 coinciding with the appointment of the new Head of School, Professor Eliathamby Ambikairajah. Professor Ambikairajah, previously the Chair of the AEC, appointed new Deputy Head of School, Professor Chee Yee Kwok, as its new Chair.

In 2009, members of the AEC included:

- Dr Torsten Lehmann
- Dr Toan Phung
- Dr Deep Sen
- Professor David Taubman
- Associate Professor Jinhong Yuan

Normally, during any calendar year, the committee meets on five or six occasions, and also depending on whether there are more urgent issues to discuss. Due to the transitional period for the School during 2009, the committee met formally on three occasions after the appointment of the new Head of School in April. Outside these meetings, the committee members were also involved in providing academic advice at information and open days, and at the various visits at which High School students attended the School.

Among the agenda items that were discussed and dealt with by the AEC during 2009 were:

- The Quality Assurance of our programs and of our teaching. This took the form of several factors, among them an external audit by Professor David Wilcox, the piloting of a Collaborative Peer Review process for teaching, the quality of 4th year honours thesis and assessment, and the quality of final examinations
- The introduction of summer courses for the end of 2009, run in block-mode and supported by online pre-recorded videos.
- Continued improvement in the quality of course outlines, to ensure more consistency across the School and completeness and clarity of graduate attributes.
- Introduction of several undergraduate and postgraduate elective courses, increasing the flexibility for students, and exposing them to new technologies.
- The approval of the new 2-year Master of Engineering (ME) program as well as the initial planning of its accreditation.
- Reporting of the outcomes of new and innovative 4th year Design Proficiency course, run for the first time in 2009.
HIGHLIGHTS OF TEACHING AND LEARNING IN 2009

Summer Session Courses
As a part of the School’s learning and teaching strategy, it is progressively introducing summer courses as a means of providing increased flexibility in student learning, encouraging and promoting self-directed learning for students, and reducing teaching load for academic staff during normal session time.

The following courses were delivered over the summer session (November 2009-January 2010), with enrolments limited to 25 students for each course, running for a total of eight weeks in block-mode, split up into two 4-week periods before and after Christmas.

- ELEC1111 Electrical and Telecommunications Engineering (Year 1)
- ELEC2133 Analogue Electronics (Year 2)
- ELEC3104 Digital Signal processing (Year 3)

All courses were delivered with the aid of:
- Online and pre-recorded video lectures;
- Quizzes used at the end of each lecture set to enable progression to the next set of lectures;
- Laboratories and tutorials (each 3-4 half days per week) run in block-mode over Week 4 and 8 allowing Week 1-3 and Week 5-7 for independent learning;
- One mentor (senior PhD student) to assist each course and liaise with students online and face-to-face in Weeks 4 and 8.

Quality Assurance
The School is active in ensuring the quality of our programs and of our teaching is of a superior standard, thus maximising the learning experience for our students. During 2009, the School engaged in several new Quality Assurance processes which proved to be very beneficial and will thus be implemented into the future.

External Examiner for Quality Assurance Assessment
An external examiner was invited to visit the School and evaluate the School’s undergraduate programs. The purpose of the visit was to carry out Quality Assurance assessment on the programs, course, facilities and staff. For this task, Emeritus Professor Professor David Wilcox was selected and visited the School in November 2009. Prof. Wilcox originally came from the National University of Ireland Galway (NUIG), however has recently retired and spends much of his time in Melbourne with a visiting appointment at Monash University. The assessment involved (but was not limited to):
- Analysing and assessing the program content for each of the School’s programs.
Assessing the undergraduate examination papers and providing feedback.

Assessing some of the School’s laboratory materials.

Moderating a selection of undergraduate theses.

Meeting undergraduate students from varied cohorts.

Meeting and having discussions with, the staff and the AEC.

Observing some of the various teaching activities within the School.

Professor Wilcox is to return in early 2010 to complete his assessment and provide documented feedback and recommendations.

Collaborative Peer Review (CPR) of Teaching

In 2009, the School piloted a new program initiated by the Learning and Teaching Unit (LTU), and designed to provide constructive feedback to staff on their methods of teaching. From academic staff, 10 volunteered to participate, with each academic observing, and providing feedback on, one (or some) of the teaching activities of another. A pre-observation meeting was held for each activity whereby the aims of the teaching activity were stated for the observer. Feedback was given on not only the methods of teaching, but also how effective the method of teaching was in delivering the stated aims.

Overall, this process proved quite effective, such that the intention of the School is to carry out similar peer reviews each teaching session.

Student Focus Groups

The School held a student focus group in the latter half of semester 2. Student representatives from each of the 4 stages of the undergraduate degree were invited to attend to provide feedback on various aspects of the School, including:

- The quality of the programs in general.
- The quality of courses in each of the 4 stages.
- The quality of the teaching facilities and the learning environment within the School.

Present at the meeting was Chair and Head of School, Professor Eliathamby Ambikairajah, Director of Academics Studies, Dr Ray Eaton, as well as 9 student representatives spanning all stages. Feedback from the students on each aspect was constructive and mostly positive, in particular with respect to the improved School environment. In addition, the students also indicated areas of potential and additional improvement.
A comprehensive workshop was organized by Julien Epps and Eliathamby Ambikairajah for all new and existing sessional teaching staff (tutors, lab demonstrators and casual teaching staff). The workshop covered aspects of the UNSW Guidelines for Teaching and Learning, expectations of students, expectations of sessional staff, student and staff evaluation, occupational health and safety issues, and administrative matters.

Several new or revised courses were either approved or run for the first time in 2009.

**ENGG9758 Network Systems Architecture**
This new postgraduate course is to be run in 2010 as a result of collaboration with CISCO Systems and The School of Computer Science and Engineering.

**GSOE9510 Ethics and Leadership in Engineering**
A course on ethics and leadership is currently offered to undergraduate 4th year students in the School. This new course to be run in 2010 is catered for postgraduate students and will form a part of the Engineering and Technical Management courses within the Faculty postgraduate coursework programs.

**ELEC9716 Electrical Safety**
This course existed previously before 2005 and has been re-introduced due to popular demand. It is to be offered in 2010 to postgraduate students and also undergraduate students with approval of the program authority.

**ELEC4445 Entrepreneurial Engineering**
This is an existing course offered as an L4 elective to our 4th year students. Due to its broader applicability to postgraduate coursework students, approval in 2009 was granted for it to be included in the list of Engineering and Technical Management courses within the Faculty postgraduate coursework programs.

**The following courses were run for the first time in 2009:**

**ELEC2146 Electrical Engineering Modelling and Simulation**
This course primarily addresses a need for elective courses at stage 2/3 of the current and future BE programs in Electrical Engineering. ELEC2146 addresses a long-standing need for generic analytical and simulation skills associated with many electrical engineering theses undertaken at honours or masters level. In terms of relevance to the existing program, skills developed in simulation and modelling will be directly applicable to coursework in the area of systems and control and signal processing, and practical work will include simulation in nearly all other major areas of electrical engineering, including energy systems, electronics and computer networks.

An ambitious lab program (entirely in MATLAB, but not using specialised commands) tightly geared around the lecture content and emphasising numerical computing was constructed, and this was given serious weight in the assessment. Students commented that the course was helpful not only...
towards applying fundamental 1st and 2nd year principles to higher engineering but also towards their thesis. Student survey feedback indicated all felt that the lab program was quite challenging, however also that their programming skills improved as a result of the course.

**ELEC/TELE/PHTN4123 Electrical/Telecommunications/Photonics Design Proficiency**

These new 4th year courses were designed as a part of the current program which started in 2006. Hence 2009 marks the 4th year for the first intake of students into current program, and also the first year to run these courses. The design proficiency courses essentially bring together the fundamental knowledge gained in each of the core sub-disciplines within the School and tests students’ proficiency or competency in each. Constructive student feedback for the courses will allow the improvement of the course and its assessments in 2010, however students agreed that the courses were unique and challenging.

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**Cisco Certified Networking Academy Courses**

A Cisco Certified Networking Academy, established and located within the School of Electrical Engineering & Telecommunications, has been running courses that have enabled many students from both the University of NSW and industry to become qualified as industry recognised Cisco Certified Network Associates (CCNA). This local Academy is part of a “global education program that teaches students how to design, build, troubleshoot, and secure computer networks for increased access to career and economic opportunities in communities around the world”. Students are also able to pursue additional training such as the CCNA Security curriculum which provides “a next step for individuals who want to enhance their CCNA-level skill set and help meet the growing demand for network security professionals.

The CCNA courses, which consist of online material, interactive tools, and hands-on learning activities, complement the School’s degrees and help individuals prepare for networking careers in particular. During 2009, approximately 50 students undertook CCNA courses.
THE NEW 2-YEAR MASTER OF ENGINEERING (ME)

The School has introduced a new 2-year professional Master of Engineering (ME) coursework program in Electrical Engineering or Telecommunications, which received approval in early 2009, and is expecting its first intake of students in semester 1, 2010.

For a number of years now, there has been increasing motivation for new Engineering program structures which augment the traditional Australian 4-year Bachelor of Engineering. This has been driven by several factors, including student desire for increased flexibility, a desire for increased specialisation within the profession, compatibility with European models for engineering education, and improved, flexible pathways leading to accredited engineering degrees for students with non-accredited Bachelor degrees. The Master of Engineering degree was constructed specifically to address these needs. This articulated program structure has been designed specifically to supplement our existing 4-year BE, and provide alternative and flexible pathways to accredited postgraduate education.

Features of the new program include:

- Professional accreditation: The School is seeking and anticipating accreditation of the program with Engineers Australia, such that students with non-accredited 4-year Bachelor degrees may receive a professional accredited postgraduate qualification.
- A professional development pathway: Apart from accreditation, the program offers provides industrial training, management courses, and the ultimate skill set for any technology-based career.
- Greater specialisation: Students may choose to specialise to a greater depth in a particular discipline within electrical engineering or telecommunications, or select course across a huge range of course offerings.
- Increased flexibility: the program comprises approximately seventy percent electives, and a substantial engineering project, affording students maximum choice and a valuable exposure to research.
NEW EDUCATIONAL TECHNOLOGIES

The School boasts the use of innovative teaching methodologies with the increasing utilisation of educational technology. Proprietary software developed within the School, VCPlayer (short for Virtual Classroom Player) affords students the ability to review lectures at their own pace with all the realism of a live lecture theatre. This, coupled with state-of-the-art teaching laboratories, provides an innovative and much appreciated learning experience for students. The technology, located in rooms G3 and 214 within the Electrical Engineering building, allows course content to be presented in a manner that is more self-paced, caters to individual student needs and preferences, and which can be revisited as needed.

2009 saw an increased use of the technology, with five courses featuring recorded lectures in this fashion. Such utilisation also facilitated the pre-recorded “live” lectures which were central to the running of the three summer courses.

In addition to the use of existing educational technology, the School’s laboratory manager, Dr Ming Sheng, initiated a proposal for implementation of state-of-the-art distributed teaching laboratory facilities, with the aim of guaranteeing more efficient use of the laboratories and further enhancing the learning environment within the labs for students.
AWARDS, PRIZES, AND SCHOLARSHIPS

University Medal

The University Medal is awarded by the university to students who have exhibited outstanding academic performance during their program. Within the School in 2009, the university medal was awarded to Patrick Johnstone.

The recipients of awards and prizes during 2009 are summarised below.

<table>
<thead>
<tr>
<th>Award</th>
<th>Recipient</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Medal</td>
<td>Patrick Johnstone</td>
</tr>
<tr>
<td>Thesis Poster Competition - 1st</td>
<td>Scott Macarthur-King</td>
</tr>
<tr>
<td>Thesis Poster Competition – 2nd</td>
<td>Nicholas Wong</td>
</tr>
<tr>
<td>Thesis Poster Competition – 3rd</td>
<td>Ben Cassidy</td>
</tr>
<tr>
<td>NICTA Telecommunications Prize – Stage 1</td>
<td>Gian Frez</td>
</tr>
<tr>
<td>NICTA Telecommunications Prize – Stage 2</td>
<td>Ni Ding</td>
</tr>
<tr>
<td>NICTA Telecommunications Prize – Stage 3</td>
<td>Voon Hian Lee</td>
</tr>
<tr>
<td>NICTA Telecommunications Prize – Stage 4</td>
<td>Nicholas Wong</td>
</tr>
</tbody>
</table>

The Dean's Awards

UNSW Engineering recognises its highest achieving students with the Faculty’s annual Dean’s Awards. These awards are given each year to students whose results are in the top two per cent of overall marks.

In an exceptional achievement, Electrical Engineering students Adrian Ratter and Yu Zhu received their fourth award in as many years.

Dean of Engineering, Professor Graham Davies, said the students had demonstrated outstanding ability.

“These awards are the Oscars of undergraduate achievement and it’s very special to be able to celebrate the achievement of our top students,” he said.

Adrian Ratter, now in the final year of a combined Electrical Engineering and Science degree, said he was passionate about his chosen career path.

“Engineering is a challenging and interesting field where you have real potential to do something good for the world,” he said.

Yu said he was finding Engineering to be an interesting and inspiring field and he was enjoying studying at UNSW.

“UNSW has a recognised reputation in Engineering teaching and research,” he said.

Student from EE&T to receive a Dean’s Award include Manas Bellani, Chi Cheng, Thomas Cooney, Fergal Cotter, Duncan Edwards, Gian Frez, Sam Jiang, Rachpon Kalra, Raymond Lao, Voon Lee, Adrian Ratter, Richard Sofatzis, Yu Zhu and Di Yan.
Scholarships

2009 saw the introduction of three new Scholarships and awards in recognition of academic achievement. A brief description is offered for each, and the recipients are due to be announced in 2010.

The Ron Stillman Award
This award was established in recognition of the late Ron Stillman, to encourage and reward elite students coming into their first year of study at the School of EE&T in 2010. Nine awards, each of $1000 value are available.

The Doble Undergraduate Engineering Scholarship
This scholarship was created to recognise and support outstanding academic achievement from continuing students in their 3rd or 4th year of study in EE&T. Three scholarships, each $10,000 in value, will be awarded.

The Ross Mackellar Award
This award, sponsored by alumni Ross Mackellar, was created to recognise academic achievement by a student showing outstanding improvement in his/her first 5 semesters of study within the School of EE&T. One award valued at $1000 will be given.

<table>
<thead>
<tr>
<th>Name</th>
<th>Scholarship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew Brodie</td>
<td>Faculty of Engineering Rural Scholarship</td>
</tr>
<tr>
<td>Luke D’Anna</td>
<td>Faculty of Engineering Rural Scholarship</td>
</tr>
<tr>
<td>Michael Riordan</td>
<td>Faculty of Engineering Rural Scholarship</td>
</tr>
<tr>
<td>Tim Davison</td>
<td>Faculty of Engineering Rural Scholarship</td>
</tr>
<tr>
<td>Sam Shan Jiang</td>
<td>A &amp; D Gotthard Scholarship in Electrical Engineering</td>
</tr>
<tr>
<td>Jaclyn Egan</td>
<td>Vida Balshaw Women in Engineering Scholarship</td>
</tr>
<tr>
<td>Deeksha Dhananjaya Murthy</td>
<td>Xstrata Coal Undergraduate Electrical Engineering Award for 3rd Year Students</td>
</tr>
</tbody>
</table>
Olivier is a welcome first year addition to the School of Electrical Engineering and Telecommunications in 2009 on a UNSW scholarship scheme to support students from disadvantaged backgrounds and who excelled in high school. Olivier is already showing signs of continuing to excel, promising a successful university life and Engineering career.

Olivier was born and raised in Rwanda, Africa, where he undertook most of his secondary schooling at Ecole Technique Officielle de Gitarama. He came to Australia as an exchange student, spending a year at Kinross Wolaroi School in Orange, NSW. Olivier chose electrical engineering as a field of study because he “was always amazed by electronics and electricity” since he was very young. He also recognises that electrical engineering provides a foundation or “stepping stone” for all new technologies which have changed, and will continue to change, people’s lifestyle every day.

Outside his university life, Olivier enjoys sports, and in particular plays soccer and enjoys dance. He is also involved in several associations and services including Orange Rotary Club, the African Student Association UNSW, Rwanda Diaspora in Australia and Rotaract UNSW.

We wish Olivier success in his studies at EE&T!