

DES News

September 2009 | The Newsletter for Engineering Science Alumni and Friends

Welcome to the September edition of DES

The inaugural "NZ's Next Top Engineering Scientist" competition was launched on Saturday Sept 19th. The idea for such a competition arose out of a desire to improve brand recognition for the Department in and around NZ. In particular, we wanted to make more high school teachers and students aware of the Department and the opportunities that exist for using mathematics to solve real world problems. The competition involved teams of 3 or 4 people working together at their school to solve an open-ended problem that was made known to them at 8am on the day of the competition. Solutions consisted of 15 pg (max) reports, which all had to be uploaded onto our website by 5pm. There is \$10,000 total prize money on offer, which was made possible with the generous support from two of our Alumni (Ian McCrae of Orion Health, and Maury Leyland of Fonterra). Furthermore, we also offered guaranteed summer studentships (at either Orion Health, Fonterra or the Dept) for any members of the winning teams who end up enrolling in the Dept.

Time will tell just how successful this competition is at promoting Engineering Science, but the initial indications are very positive. Overall we had 363 contestants in 98 teams with 63 teachers from 58 schools all over NZ. The current challenge is now to assess the reports and declare the prizewinners by the end of October. Thoughts will then turn to planning the event again for 2010. For those interested, full details of the competition, including the problem statement, can be found on our website (<http://www.esc.auckland.ac.nz/competition>).

On another note, the Part IV students are nearing the end of their final year projects. As you will all remember, this is a very stressful time of year for the students but the results are often very impressive. The Dept are all looking forward to the presentations and to the dinner that follows.

As always, please feel free to provide feedback and/or suggestions for next months newsletter, which will be out early December, using desnewsletter@auckland.ac.nz or the email below. In addition, if any of you have suggestions for problems that we could use to form the basis of next year's "NZ's Next Top Engineering Scientist" competition please let me know.

Professor Andrew Pullan, hod_des@auckland.ac.nz

Do you know someone who is missing out on the newsletter?

If you have DES friends that aren't getting the newsletter and would like to, contact desnewsletter@auckland.ac.nz.

Your Department needs YOU!!!

Can you help with summer studentships and/or summer work?

In the current work environment, a number of undergraduate students have expressed difficulties in finding summer work suitable for the practical work requirements of their degree. If you can help with summer studentships and/or summer employment please contact Prof Andrew Pullan, hod_des@auckland.ac.nz

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In Short

MacDiarmid Young Scientist of the Year awards

Tobi Vaudrey (class of EngSci 2004) was Runner-up in the 'Future Science and Technologies' category.

Tobi is currently a PhD Candidate in the Faculty of Science, and is researching a high-tech system for cars to help their drivers avoid accidents. The system could eventually detect the location of pedestrians and other vehicles, and predict where they will move and how fast. Alarms could sound or the steering wheel might vibrate to alert the driver to an impending collision.

IET Sir Henry Royce Award winner

PhD candidate Anita Walbran won the IET Sir Henry Royce Award Aug 2009 for her contribution to Epileptiform Transient Detection in the EEG using signal processing techniques in order to identify Hypoxic Ischemia in Newborn Infants.

The Sir Henry Royce Award is presented annually to the Young Professional who is judged to have shown excellence in the previous year in their work in industry or for the profession. The winner is to attend the IET's Awards Ceremony on 25 November 2009 at The Pavilion, Lords Cricket Ground, London.

OCCAM Visiting Fellowship

Dr Edmund Crampin was awarded (and is currently on) a Visiting Fellowship from OCCAM (Oxford Centre for Collaborative Applied Mathematics).



Featured Alumni – Kailin Lee, Class of 2008

I had the chance to study abroad for a year at the University of British Columbia, Canada during my degree and it was one of the most valuable learning experiences I have had. Not only was it an opportunity to learn from students and lecturers in UBC's faculties of applied sciences and business, but it was an eye opening cultural exchange. I highly recommend doing an exchange to anyone who considers it!

I did my fourth year project on modelling an economic approach to security of supply in the New Zealand electricity market. Following on from the interests developed over the course of my undergraduate study, I took up a job working as a policy analyst for the New Zealand Treasury in the climate change and energy team.

Day to day we analyse government policy related to energy and climate change and provide advice to the Minister of Finance. We work in conjunction with the private sector, other government ministries and Crown entities to develop and assess the impacts of government policy in New Zealand. Projects have involved; developing models to assist in international climate change negotiations, analysing the economic and wider implications of domestic climate change policy, analysing issues in the New Zealand electricity market and helping to develop long term strategies for the energy sector. I also worked on the 2009 budget, and receive training in economic, financial and policy analysis.

It's been interesting and full of challenges in these initial months, especially in the current economic environment and with the recent change in government.

DES Alumni at Harvard, Oxford and Cambridge

Josie McVitty



I have spent the past year since leaving Auckland completing a Masters in Engineering Sciences, specialising in Environmental Engineering, at Harvard University. The opportunity to study at Harvard has been both humbling and incredibly stimulating. Harvard's encouragement of interdisciplinary studies meant that I had the opportunity to take courses and undertake research in a wide range of global environmental issues of interest to me, including water resource management, renewable energy technologies, atmospheric sciences as well as environmental economics and policy.

However, the aspect I have valued the most has been the exposure to a variety of fields beyond engineering, in the humanities, public policy, and urban planning, that were accessible either through "auditing" classes or attending the numerous public lectures and events offered by all the schools within Harvard. Spending a day hurrying between talks by brilliant academics, high-ranking public officials or journalists and professionals sharing their experiences and insights was commonplace yet always enriching, albeit often overwhelming.

Integral to my experience in the U.S. were the relationships I formed through my funding agencies, both the Fulbright program and the Frank Knox Fellowship. Both scholarships were very active socially, which gave me exposure to many impressive scholars from around the world, and an extremely inspiring network of friends.

After such a challenging year, I am currently assessing my options for the future. I am committed to becoming involved in global development challenges, with a particular focus on assisting poorer countries develop in a more sustainable manner and am currently making preparations to gain hands-on experience in grassroots community organisations in South Asia.

Liren Li

After I finished my degree in Biomedical Engineering from Auckland, I had to make a choice between going to another country or staying in New Zealand where I had settled and made so many friends over six years of studying. After much debating, I decided to go somewhere else to gain more life experiences and see a different part of the world.



Liren (centre) with friends

Now I have been studying for a DPhil (what Oxford and Cambridge call a PhD) in Oxford for two years. The past two years has been an exciting journey for me, to get to know Oxford, both the university and the city, and to love my life here.

My DPhil project is about developing an experimental-based electrophysiology model of the mouse heart and use the model to interpret experimental observations from genetic knock-out mice. It has been a challenging and fulfilling project, which has given me the privilege to talk to many experimentalists and bridge the gap between experiments and mathematical models.

The social life in Oxford (DPhil students are allowed to have a life too), during the terms consists of endless bops (a kind of party organised by the various colleges, usually with certain theme), formal dining in the college where everyone dresses up in formal attire and enjoys a three course meal in the magnificent dining hall (a unique experience but too time-consuming to go too often), visits to the numerous pubs scattered all around and almost in every corner of the city, and day trips to London, etc. However, during holiday times, it is much quieter, when most undergraduate students are away, and there are much fewer social activities in the colleges, so we really get a lot more work done!

I think I made the right choice two years ago. I miss New Zealand a lot, but I am also enjoying my life here, if not the weather. However, there are plenty of sunny spots in Europe that help me to get through the miserable winter.

continued overleaf...

Brendon Qu



I came to Cambridge University to do a PhD program in micro-mechanics after graduating at the University of Auckland with a BE/BCom in Engineering Science/Accounting and Finance. My research topic is Fibre Waviness Defects in Composite Structures. While being greatly satisfied today to study at one of the world's top universities, I can still remember the day when I chose Engineering Science as my major and the opportunities it provided to me.

Studying in Cambridge is not only about getting a degree from a world leading university, but also experiencing different life styles and culture. Although Churchill College is a relatively new college in Cambridge, it has a lot of traditional events from which I can experience the cultural richness of an 800 year old university. Having formal dinners with all the friends dressed up is just a remarkable experience in one's life.

Every day, I walk along the river Cam to the Engineering Department, where I pass all the traditional chapels and come to a modern brick building. Working in a new environment on a new topic is not easy - especially as the project I am doing involves a lot of experiments, which is new to me. But I think that is the reason I am here - to learn new skills, experience a new culture and to meet new people.

Four years back when I just completed my first year study in the Faculty Engineering at Auckland, I had no idea of what career I was going to pursue and was so unsure about which specialisation I should choose. I decided to learn Engineering Science simply because I am a "Maths Person" and this degree is probably the most challenging one people can get in New Zealand. Now when I look back, I have to say that I was so lucky to make that simple but important decision. The diversified knowledge I have learned in the department allowed me to have a great variety of opportunities after graduating, ranging from working at big engineering companies in Auckland to pursuing higher education in the world leading universities in UK and the US.

As a student, it is a great honour for me to be here when Cambridge is celebrating its 800th birthday. With the strong theoretical background and technical skills I have gained in my undergraduate degree, I am confident that there will be more moments like this in my future career.

New Staff

Dr Keri Moyle



Keri finished a BE (Mech) in 1999 and a PhD in 2003, both from the University of Auckland. She travelled to London, Ontario, Canada to work in the Steinman group at the Robarts Research Laboratories, before moving to the University of Oxford, to work in the Fluidics and Biocomplexity group. There she taught undergraduate engineering as a member of Pembroke College, and completed a Postgraduate Diploma in Learning and Teaching in Higher Education in 2008 with a dissertation entitled "Seeing and believing: intuition and visualisation in undergraduate engineering". Her research field is computational haemodynamics, including techniques for dynamic repair of unstructured meshes, fast mesh motion and adaptation. She is currently interested in finding physically based quantitative risk measures for acute aortic syndromes.

Keri plays french horn in the Auckland Symphony Orchestra and St Matthews Chamber Orchestra, as well as running a small photography business at www.signsoflife.co.nz <<http://www.signsoflife.co.nz>>, and, whenever possible, running and tramping.



Featured Alumni - Alistair Landels, class of '91

Alistair's professional career path has followed his sports career for much of the last 20 years. After graduation he was sponsored to compete in Orienteering in Japan and Europe and has since been unable to escape the icy grip of Sweden where he currently lives. The highlight of his sporting career was returning to New Zealand in 1994 to win a stage of the World Cup series that year.

Professionally, the last 14 years have been spent working for Triona in Sweden, a medium sized software and project management consultancy. His projects have been mostly road or postal service related. Road wise he has designed large systems for the maintenance of road networks and data. A recent project involved the building of a dynamic real-time system for the publishing of speed limits and other information to GPS equipped cellphones. He is currently in the process of starting a Norwegian project to try and bring their road software systems up to European standards. He also worked recently for a postal service project designed to optimize the merging and sorting of mail in order to minimize the postage cost in this newly deregulated sector.

One rather insignificant encounter from his time in the department back then has in later years come back to haunt him. He remembers talking to Masters Student Greg Sands back in about 1991 about the hip resurfacing shell model he was developing for his thesis. A technique involving just replacing the surface of the joint instead of the traditional prosthesis down the femur. Last year, after a few years of pain Alistair himself had such an operation done on his left hip. After only 5 months however he is already back orienteering again even though it's only really on a recreational level nowadays.



**Associate Professor
Matthias Ehrgott**

Matthias joined DES in 2000 as a lecturer. He works in Operations Research and is especially interested in optimisation and decision aid with multiple conflicting criteria. He is vice president of the Operations Research Society of New Zealand. Matthias also acts as area editor for Decision Analysis and Decision Making Techniques of the Asia-Pacific Journal of Operational Research (APJOR) and is on the editorial board of 9 other international scientific journals.

Before moving to New Zealand, Matthias obtained MSc and PhD degrees in mathematics from the University of Kaiserslautern in Germany, where he also worked as assistant professor from 1997 to 2000. In 2004 he was promoted to Associate Professor.

Research Update

This edition features the Operations Research work of Associate Professor Matthias Ehrgott.

Individuals, companies and other organisations make many decisions every day. Some of them may be simple, some of them will be complex, e.g. involving the investment of many millions of dollars, or the well-being of people. Operations Research is a scientific discipline that uses mathematics and computing to assist with decision making processes. Operations Research involves a process of formulating a mathematical optimisation model of the decision problem, developing algorithms and computer software to solve it and translating the mathematical results back to the real world to make the best possible decision. However, what "best" means is not always clear because decisions often involve achieving contradictory goals. Dealing with these difficulties is the research field of multiple criteria decision making.

This is the area Matthias is working on with postgraduate students and colleagues around the world. One stream of research covers the medical problem of planning radiotherapy treatment of cancer. The goal of radiotherapy is to kill cancerous cells by radiation, but naturally healthy tissue must be protected from damage due to irradiation – obviously two conflicting goals. Matthias and PhD student Lizhen Shao have developed new methods and software that allows physicians to carefully select a treatment plan taking into consideration the trade-offs between treatment of the tumour and possible damage to healthy tissues. With colleagues in Germany and the USA, he has also worked on the optimisation of the irradiation directions in radiotherapy and the delivery of radiotherapy treatment to reduce treatment times without compromising the quality of treatment.

In a completely different application, we consider crew scheduling and aircraft routing for operating flights at Air New Zealand. The traditional approach to this problem is to route aircraft and crew in such a way that the operating cost for the airline is minimised. It turns out that this may have a negative effect by eliminating buffer time between flights that allows for catching up with delays. So the problem in fact becomes that of minimising cost but also minimising the potential for accumulating delays when scheduling aircraft and crew (robust scheduling). Starting from 2001 a sequence of research projects, jointly supervised with Professor David Ryan, have been carried out to address this. First, only the inclusion of the goal of robustness for crew was considered. Following on, in his PhD, Oliver Weide (featured in the last issue of this newsletter) combined the solution of the crew scheduling and the aircraft routing problem into one big optimization problem and showed that it is possible to reduce cost as well as improve robustness of the schedules. His system is now in production at Air New Zealand. PhD student Bassy Tam is looking at solving crew scheduling problems for pilots and cabin crew jointly to avoid splitting crew, which may result in a snowball effect of accumulating delays. Finally, PhD student Imran Ishrat works on the problem of recovery from disruptions.

The third area to be mentioned is transportation. In her PhD thesis, Andrea Raith (now a lecturer in DES) has looked at problems of modelling road usage. Here it turns out that people do not always behave as economic theory prescribes (namely evaluating all costs and benefits in monetary terms). Attempts are made to achieve better models by considering e.g. travel time separately from monetary costs and other factors of route choice, an approach which allows much greater flexibility in modelling road user behaviour. In work on railway transport, PhD student Richard Lusby (now at Danmarks Tekniske Universitet) has developed a new approach dealing with the difficult (at least in Europe, maybe not really in NZ) problem of routing trains through railway junctions in a non-conflicting way.

An interesting aspect of research in multicriteria decision making is that it delivers new insights into an application (it seems counterintuitive that it is possible to reduce cost while at the same time increasing buffer times in airline scheduling) as well as progress in the theory and methodology of multicriteria optimisation, which is progressing rapidly. Matthias has written a textbook on this, published by Springer, which will soon go into a revised third edition and is used as a textbook in universities around the world.

Associate Professor Ehrgott has been a joint editor for two books published this year.

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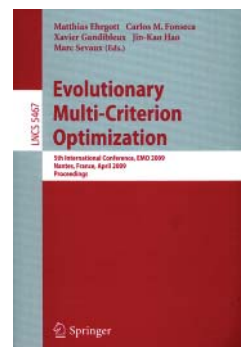
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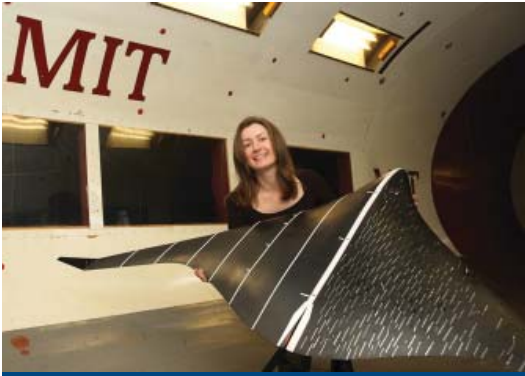
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Karen Willcox, Class of '93

From Star Wars to airplanes, Karen has had a passion for aerospace for as long as she can remember. After finishing her BE, this passion took her to graduate school in the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology (MIT).

Following completion of her PhD, Karen worked at Boeing Phantom Works with the Blended-Wing-Body aircraft design team.

She returned to MIT, where she is now a tenured Associate Professor of Aeronautics and Astronautics. Her research program is developing new computational methods for the design, optimisation and control of aerospace systems, with a broad set of applications ranging from active flow control, to turbomachinery aeroelasticity, to astronaut motion control, to tools to support international policy-making for aviation environmental impact.

Along the way, she has been lucky enough to spend three months working at NASA Dryden Flight Research Center, and to have two flights aboard the NASA Microgravity 'Vomit Comet' Aircraft. Karen is currently in New Zealand, at the tail end of a years sabbatical leave in Engineering Science.

Two births on one special day

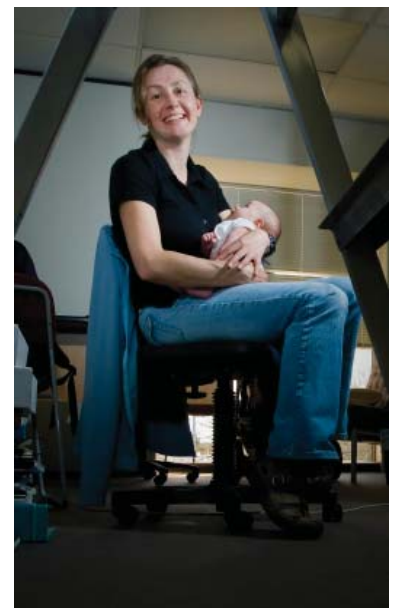
Two of our highest flying women graduates - Karen Willcox and Carly Arnold (nee Albon) - gave birth on Monday 20th July.

The arrival date of the babies coincided with the 40th anniversary of the moon landing, Sir Edmund Hillary's birthday (he would have been 90), and the 2nd anniversary of the first flight of the X48-B (which is the test prototype of the Blended-Wing-Body aircraft Karen worked on while she was at Boeing).

Congratulations to Karen and Jacob, and Carly and Joshua.



Carly with Jacob William James Arnold
born 1.17am
weighing 8lb 1oz (3.67kg)



Karen with Pieter Willcox Pretorius
born 10.34am
weighing (7lb 4oz, 3.29kg)



Carly Arnold (nee Albon), Class of '99

Carly's final-year project gave her exposure with Air New Zealand as she developed an optimisation tool for their long-haul flight schedule. Having been interested in aviation and wanting to become a pilot as a child, the opportunity to continue working with the airline after graduating seemed like a dream come true. So Carly then spent an enjoyable two and a half years in the Air New Zealand OR team developing in-house crew rostering optimisation systems.

However, the travel bug got the better of her and so Carly and her husband, Joshua, moved to the UK to start their 'OE' in early 2002. She was fortunate to have arrived just as easyJet and the BA subsidiary Go were merging, and the company needed someone to integrate the core operations system. After a busy and successful five years in five different roles (including General Manager of the London Luton base), Carly left easyJet to join Infratil Airports Europe. Over the last 18 months before becoming the very proud mother of Jacob, her role as Group General Manager Performance was responsible for the identification and delivery of new products and efficiency improvements, sharing best practice across the three European airports (Glasgow Prestwick, Kent and Hamburg Luebeck) and strategic organisational development. Carly's current focus is looking after her British-born, Kiwi-at-heart son, but is planning to embrace the challenge of being a working parent in due course.