

DES News

Department of Engineering Science

December 2010 | Alumni and Friends quarterly newsletter | Number 09

Dear Alumni and Friends

Another year is now rapidly coming to an end, but there is still a lot of activity in the Department. There are now a number of summer students in the department working on a variety of projects with various staff members. Also, summer school is fast approaching with the first lectures due to be given on Jan 6th. Combine this with the examiners meeting, a course review day, a couple of locally run conferences, and of course the all-important research, and you can see why the staff are all still very busy.

We have also finished judging the entries in the 2010 "NZ's Next Top Engineering Scientist" competition and announced the winners – congratulations to Westlake Boy's High School. You can read more about this in this newsletter.

This is my final newsletter as HOD. My 3-year term has just about come to an end, and I will be taking a sabbatical and concentrating on my research in 2011. It has been a very busy 3 years but I can honestly say it has been a privilege being HOD of what is truly a very special Department. The new HOD will be Associate Professor Matthias Ehrgott (see his profile inside this newsletter) and he will be writing these columns from 2011.

I would like to take this opportunity to wish all of you in the extended DES family a safe and happy Christmas break. A very special thank you to the many alumni, students, and friends that have, in one way or another, supported the Department during the last 3 years.

Professor Andrew Pullan, Head of Department
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Changing of the Guard

DES leadership passes from Andrew Pullan to Matthias Ehrgott

Andrew Pullan's three year term as Head of Department (HoD) comes to an end at the end of this year. As the University, School and Department continue to grow, the demands on the HoD and the complexity of the organisation's structure are both increasing exponentially. Andrew has met these challenges, head on, and the Department has functioned very smoothly under his leadership.

The Department has always prided itself on its friendliness and its excellent staff/student relations. However, Andrew has raised these attributes by several notches. He has



taken a keen interest in the students' welfare and progress, and knows most of them by name - an attribute which brings much praise from the student body.

Andrew has significantly increased the Department's links with the local community and local industry. Perhaps in part as a consequence of him having spent one year in local industry after completing his PhD. He is also very

active in the local education scene, being on the Board of Trustees of Auckland Grammar School. He has met every crisis with a cool head and seems never to get flustered. We thank his family for "lending" him to us, and we wish them all a well deserved break and to Andrew some productive years of research.

Matthias has already played an important role within the department and faculty as Chair of the Faculty Timetable Committee. There can be no doubt that Matthias' expertise in multicriteria optimization is going to be seriously tested in very practical ways during the next three years as he follows Andrew into the HoD role and continues the task of balancing many competing priorities. We are certain that his quiet, determined and efficient manner will serve our Department well, and we look forward to providing him with our support and commitment to maintain the standards of excellence that we have enjoyed for many years.



In this issue

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News in brief...

Staff win Marsden grants

Matthias Ehrgott has won a full Marsden grant for "Multiobjective Network Equilibria - From Definition to Algorithms". Richard Clarke has won a Marsden Fast-start for "A novel approach for probing unsteady boundary layer separation". **FOR MORE...**



Incoming Head of Department

A/Prof Matthias Ehrgott

Matthias grew up in the Palatinate region of Germany. He studied mathematics, economics, and computer science at the University of Kaiserslautern, where he obtained his Master's (1992) and PhD degrees (1997). During his term as assistant professor of mathematics at that institution he decided to spend a year overseas.

Matthias joined the DES in February 2000 as a lecturer on a two year contract, originally planning to stay for one year. In 2001 he completed his Habilitation, the prerequisite for an academic career in Germany, but eight years later, now Associate Professor (2004), he still works in Engineering Science as a member of the Operations Research (OR) group. Like for so many other staff, the emphasis on using mathematics to solve real world problems has been the big attraction.

Matthias' expertise is in multicriteria optimisation which can, e.g., be used to improve the planning of radiotherapy treatment of cancer. He has published more than 50 journal and proceedings papers, written and edited several books and special issues of journals. He is currently vice president of the Operational Research Society of New Zealand.

It may be hard to believe but there's also a life outside the department. Matthias enjoys travel, hiking, photography, collecting stamps and books (much to the dismay of his partner Judith) and has hardly missed any performance of Shakespeare's plays in the last ten years.

Poul Nielsen - new James Cook Research Fellow

Associate Professor Poul Nielsen (Class of 1980) has received a James Cook Research Fellowship in Engineering Sciences and Technologies for 2011-2012. The award covers full salary for two years and will allow Poul to concentrate on his research. James Cook Fellowships are administered by the Royal Society of New Zealand on behalf of the Government, and are widely regarded as New Zealand's most prestigious Science and Technology awards.

Only six of these particular fellowships have been awarded, four of them to DES staff; Associate Professor Poul Nielsen, Associate Professor Martyn Nash (2009), Professor Andrew Pullan (2004), and Professor Peter Hunter (now Director of the Auckland Bioengineering Institute) in 1999. The other two recipients have been Professor Wei Gao from the Department of Mechanical Engineering and Professor Jos Arrillaga from the University of Canterbury.

New Zealand's Next Top Engineering Scientists And the winners were from... Westlake Boys' High School

New Zealand's Next Top Engineering Scientist (NZNTES) 2010 ran in mid September, commencing at 8am and finishing at 5pm. It is a problem solving competition for Year 12 or 13 students working in teams of 3 or 4, who have interests in mathematics and science.

This years winning team were Danny Kwok, Jeffrey Mei, Benjamin Tan and Yuanye Xu, students from Westlake Boys' High School (pictured on the right, named left to right). The runners-up were from Hawera High School and Birkenhead College. First prize was \$6000, and the runner-up teams won prizes of \$2000 per team. In addition to the prize money, all members of the top three teams are guaranteed a paid summer internship at Orion Health, Fonterra or the Department of Engineering Science if they choose to study with us after they leave school.



The competition question was "How much fuel is required for a manned mission to Mars?" The winning team produced a well written high quality report that presented a clear answer to the question. Their answer was based on some excellent mathematical analysis of important factors such as the most fuel efficient orbit, the supplies necessary to keep the astronauts alive and the energy required to launch their chosen spacecraft on its trip to Mars. Their modelling skills were also excellent, with sensible assumptions and in depth investigations of the key factors, without getting bogged down in trivial details. They also included the return journey in their model, ensuring their astronauts were not left to die on Mars.

We had 108 teams compete this year, made up of 405 students from 58 schools located throughout the country, from Gore in the deep South up to Whangarei in the North. We even had 6 teams from Christchurch, despite the quake (they had to contend with after shocks on competition day).

NZNTES was established in 2009 to provide school students an opportunity to tackle an interesting Engineering Science problem in a team environment. We wanted to provide them with a taste of the kinds of things Engineering Scientists deal with, using computers and mathematics to solve real world problems. DES runs it, and it is kindly sponsored by Fonterra and Orion Health. [READ MORE](#)

45th Annual Conference of the ORSNZ

The Auckland Branch of the Operational Research Society of New Zealand (ORSNZ) and DES hosted ORSNZ10 on the last weekend of November. The two plenary speakers, Professor Tava Olsen ([UOA](#)), and Professor Martin Savelsbergh (CSIRO and the University of Newcastle in Australia) delivered high quality thought provoking presentations on demand management and integer programming search respectively. Tava's address provided an opportunity to formally welcome back one of our own graduates to New Zealand's shores. [continued on next page](#)

Award winning postgraduates

GI Joes win in major university entrepreneurial competition

The GI Joes were awarded third equal place for their novel medical method and software package that records the bioelectrical activity in the human stomach. The UoA Spark \$100K Challenge believes that the package will be a catalyst of change in the diagnosis of stomach disorders in patients around the globe.

The Gastric Electrical Mapping System (GEMS) can investigate potential 'gastric dysrhythmias' – abnormal electrical behaviours in the stomach that may contribute to highly symptomatic diseases including indigestion and heartburn – which affect up to 30% of the population and inflict a major burden of suffering and healthcare costs.

These diseases currently sustain a multi-billion dollar pharmaceutical industry, and the GI Joes included a panel of prominent experts in gastrointestinal clinical research, biomedical engineering and commercialisation in their development of the system.

Led by **PENG DU**, the GI Joes are postgrad students of Andrew Pullan. See July issue **FOR MORE**

Honorable Mention in COSP Student Paper Competition

Dr Ziming Guan has been awarded an Honorable Mention for his paper 'A multistage stochastic programming model for the New Zealand dairy industry' in the 2010 COSP Student Paper Competition. Ziming's achievement is even more notable as the only entry from the southern hemisphere to reach the finals. Ziming's PhD supervisor was Professor Andy Philpott.



The Committee on Stochastic Programming is part of the Mathematical Optimization Society, and competition is international. American universities dominated with eight of the twelve finalist entries. The other three universities represented were European.

Poster wins Department category in Postgraduate competition

Tim Angeli has won the DES award in the Engineering Postgraduate Poster Competition with his poster, 'Making sense of gut motility: In vivo high resolution mapping of small intestine bioelectrical activity'. The aim of his work is to record, classify, and quantify the bioelectrical activity of the small intestine in health and disease, through the use of high-resolution, multi-electrode mapping.

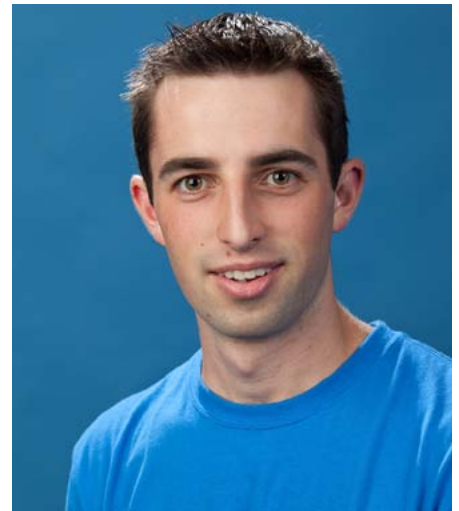
Originally from the US, when Tim finished his BE and ME in biomedical engineering at the University of Michigan, he planned further study, but wanted to go somewhere new to do it. An advertisement for a PhD position as part of a gastrointestinal research group with a strong research background and international recognition led him here. Tim is now one year into his PhD at the Auckland Bioengineering Institute, studying with Andrew Pullan.

continued from previous page **ORSNZ10**

Attendance at the conference was excellent, and included delegates from Derceto, Fonterra, the Optima Corporation and most major NZ universities, and overseas visitors from India, Melbourne University and the University of Newcastle in Australia, and the National University of Singapore. There were 52 presentations, with the student presentations representing some of the best contributions, as they have previously.

The 2010 ORSNZ Young Practitioner Prize (YPP) was sponsored by Derceto, and open to all presenters at the conference under 30 years of age on the first day of presentations. The postgraduate winner was Anthony Downward (BE, PhD (EngSci)) for his paper 'Risk Aversion and Retail Electricity Markets'. First equal in the undergraduate category were Jason Drake for his paper 'Design of Road Networks', and Jason Undan for his paper 'Optimisation of Demand-Side Bidding'. All three are from DES.

This year also saw the awarding of two inaugural University of Auckland Energy Centre prizes. In addition to first equal in the YPP undergraduate category, Jason Undan won the Energy and Resources prize, and Uttara Nataraj won the Transportation prize for her paper 'Selecting a Portfolio of Cycling Projects'. Uttara is also from DES. For **MORE ON THE YPP**



Featured Alumni

Ed Bulog, Class of 2009 Segedin Postgraduate Scholarship winner in 2009

Since finishing my undergrad degree with the department in 2009, I've been working on the nurse rostering problem for my Masters degree. This is a well known optimisation problem whereby we try to assign shifts to nurses in order to meet demands and minimise the weighted combination of a number of costs and performance measures, subject to a number of constraints.

In particular, I've been looking at making use of a set of instances which were provided as part of a timetabling competition earlier in the year. I've been modifying the framework to solve these instances and I will be able to use the best solutions found by the competitors to benchmark the results I get, both in terms of speed and quality. I am also looking to test and incorporate a number of heuristic measures into the framework, in order to improve efficiency.

The department recently hosted the 45th Annual ORSNZ conference, which I was lucky enough to participate in. It was the second time I've spoken at an ORSNZ conference, and it was great fun. I really appreciated how highly the society values its younger members, as the entire first day of the conference consisted only of Young Practitioners presenting.

Other than that, I've been keeping busy with sport and music. Playing indoor soccer on Thursdays with the other graduates and staff from the department has been a highlight, and we are always looking for new players, so don't be shy if you're ever keen for a kick!

Part IV Project Presentation and Dinner

Part IV Project successfully culminated again this year with two days of project presentations in early October, which saw fifty two students present their work through talks and posters. Topics ranged from models of structural uplift during earthquakes, to improvement of cycle route planning in Auckland. Once more, the quality of presentations was high, with the students clearly investing a huge amount of personal pride and effort into their year-long investigations. Especially high audience attendance over both days, by students, parents, staff and industrial partners, all added to the sense of occasion. As in 2009, both Jill Segedin and Rob Kirkpatrick were on-hand to judge the top three posters in Biomedical Engineering and Engineering Science.

These awards - along with the prizes for best talks as decided by the academic staff - were presented at the Part IV Dinner which, for the second year running, took place in the Waitemata Room of the Langham Hotel. This provided a fitting finale to the Part IV projects, with many of the second and third year students also taking up the opportunity to attend. The speech given by the out-going Head of Department, Professor Andrew Pullan, noted the poignancy of seeing the current class through the entirety of their time within the department. The speeches given by the Part IV students (whilst naturally more irreverent) clearly echoed this sentiment, and reflected in no uncertain terms their appreciation of the department, and their strong personal attachment to it.

and the winners were...

	Best PIV Project Poster		Best PIV Project Talk	
	BME	EngSci	BME	EngSci
1st	Linda Feng	Gemma Mathieson	Linda Feng	Christopher Vogel
2nd	Kevin Cheong	Jerry Gao	Nicholas Stringer	Iain Dunning
3rd	Rebecca Pullan	Candice Zhou	JeeLean Lim	Jerry Gao

Hot from the Examiners Meeting, congratulations to...

Tessa Paris

Winner of the Auckland Bioengineering Institute Prize in Biomedical Engineering

Christopher Vogel

Winner of the Cecil M Segedin Prize in Engineering Science

These prizes are for the most meritorious research in Part IV.

NZGS win for undergraduate EngSci student

Xiaoyang Qin (Gary), a fourth year Engineering Science Student has been awarded The New Zealand Geotechnical Society student award for the



Left: Luke Storie, Director of NZGS
Right: Xiaoyang Qin

Northern Region for 2010. This is a highly prestigious award. Gary's work was based upon his final year Engineering Science project, supervised by Professors Nawawi Chouh (Civil Engineering) and Ian Collins (Engineering Science). A strong field of four students competed for this award. Gary's research is aimed at improving the design of structural foundations by improving our understanding of soil/structure interactions during earthquakes.

The title of Gary's presentation was "A numerical and experimental investigation of foundation material and geometric non-linearity". It represents an excellent example of inter disciplinary research. The Judges commented that "He knows what he is talking about" and "His presentation was very clear". Gary hopes to continue this line of research at PhD level.



Featured Alumni

Christopher Vogel Part IV 2010

When I started university, I had not heard of Engineering Science and assumed that upon completing four years of studying I would find a 9-5 job somewhere in New Zealand and climb the corporate ladder. Faced with the challenge of choosing a specialisation at the end of first year, through a process of elimination I settled on a rather esoteric specialisation known as Engineering Science. Apparently there was free printing, which I was assured would be something I would find immensely useful.

The past three years of Engineering Science have been an excellent experience, and I have developed a great interest in mathematical modelling, computational techniques and continuum mechanics, as well as making many good friends. Having done summer research studentships and the part IV project have changed my post-graduate study intentions from getting a job to continuing my university experience. I will be travelling to the UK next year to take up a scholarship with the Tidal Energy Research Group at Oxford University and begin a D.Phil in Engineering Science.

The Tidal Energy Research Group is part of a European Union-wide project to make tidal energy generation a more widely used renewable energy resource. The key challenge for this goal is that current generators only generate useful levels of energy in high quality water flows, thus limiting them to only a few areas around the world. The aim of my D.Phil is to undertake modelling of fluid flow around and between new types of tidal generators in an effort to make tidal energy more feasible.

Teaching Update

Engineering Science Wind Power

Students have been very busy this past semester designing and building wind turbine rotors. This was for the practical design component of ENGSCI363 (Modelling and Design). The project leader Iain Anderson provided lectures on wind turbine aerodynamics and design methods. To prepare them for prototyping and testing, students were given some preliminary assignments in which they practiced rotor blade design calculations: specifying chord length and twist angle for a given airfoil, power requirement, and wind speed.

Each group of 4 students produced a turbine rotor to drive a generator powering a small (50W) lighting system. This ambitious project was streamlined in the following way: The Department purchased a commercial turbine system complete with its own generator, conditioning electronics, and rotor. Each student group was given a hub (fabricated in the ABI workshop by Peter Blythe) that could be easily fitted onto the shaft of the generator, in the place of the supplied rotor.

Students were given the torque-speed curve for the commercial system for their design calculations. The curve was measured by our technical officer Michael Byrne who used a lathe to drive the generator, under electrical load, at different speeds while simultaneously measuring torque; quite a difficult task! The students used this information to design their turbine rotors for a specified rotor speed (140 rpm) and wind speed (5m/s). Rotor blade fabrication involved them in some fast-prototyping experience: airfoil profiles for their turbine blades were cut under Michael's supervision, using the laser cutter on floor 5.

Prototypes were tested at the University's Tamaki "Twisted Flow" Wind Tunnel, on Friday 15th October. Managed by David Lepelley, this facility is the world's major testing facility for high performance yacht sails.

David helped us to get our power vs windspeed data. It was a great experience to see such a world-class facility in operation. For the students, the most satisfying moment came when they saw their own creation start to rotate, as the giant fans of the wind tunnel got up to speed. And all rotors equaled or surpassed the power output of the commercial rotor!

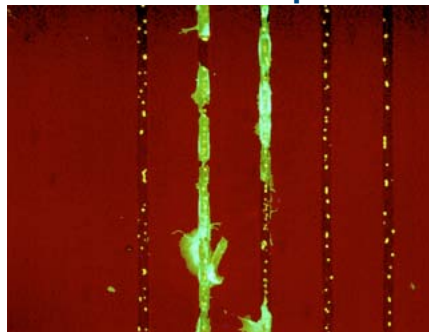
The winning group was made up of Jonny Munden (leader), Matt Kingston, Nicholas Simmons and Chris Zeng.

And from the students...

The project was very interesting and challenging (new topic for this year, used to be design a flipper). Our group worked extremely well to design, build and test the turbine, and it was thoroughly enjoyable. Special thanks to lab technicians Michael Byrne and Peter Blythe, and lecturer Iain Anderson. We were very impressed with everybody's turbine and their success during testing at the Tamaki wind tunnel. Good luck to next years students - they will need to be very good to beat ours (haha).

Research Update

Patterning Human Brain Cells on Silicon Chip



Lines of human hNT neurons cultured on a silicon chip. Dr Charles Unsworth (Engineering Science), and Dr Scott Graham (Pharmacology and Centre for Brain Research) have recently succeeded in "patterning" the first adult human hNT brain cells on a silicon chip published in the Journal of Neuroscience Methods.

The breakthrough in patterning such cells on a silicon chip has widespread implications and value as a platform technology as it will allow scientists to

perform detailed studies of adult human brain circuits for a range of brain disorders, such as epilepsy and Alzheimer's disease.

Charles' main research interest is to understand and mathematically model the synchronisation effects that neurons undergo in the brain during epilepsy. He developed the chips during his sabbatical to the University of Edinburgh earlier this year, where he worked with collaborators who pioneered this technology using rat neurons. The aim of the sabbatical was to extend this technology to pattern the human hNT neuron on chip as it provides a very close model to adult human neural tissue.

This platform technology will allow human neurons to be patterned to regular networks such that they can be stimulated and recorded from using microelectrodes which are embedded in the chip design. This will allow us to study the behavior of these cells at the single cell level, and could eventually lead to potential new treatments and to the development of new drug assays.

The sabbatical research was initially sponsored by the UK's EPSRC Visiting Fellowship Scheme Award of \$82,000. Since then together with Dr Cather Simpson (Chemistry/Physics and Director of the Photon Factory) and Michelle Dickinson (Chemical & Materials) have been awarded a \$150,000 grant from the Faculty Research Development Fund (Faculty of Engineering, Technologies for Health theme) to develop the new technology further. Recently, the work has further been supported by the Maurice & Phyllis Pakek Trust and the Royal Society of New Zealand's International Mobility Fund. Furthermore, the work raises no ethical concerns as the neurons are differentiated from a cancer stem cell line rather than embryonic tissue.

Next edition

New IT Staff

Johnny Lu and Laxman Sunkari

Backissues

Available at

<http://www.des.auckland.ac.nz/uoa/home/for/alumniandfriends>

For future editions

Do you have news to share?

News on current Department members is easy to include, because they're right here. News on wider family members - alumni and former staff - doesn't necessarily reach us. If you have something to share, email it to desnewsletter@auckland.ac.nz

