THE UNIVERSITY OF AUCKLAND
FACULTY OF ENGINEERING
Department of Engineering Science

DES News

December 2009 | **Alumni and Friends quarterly newsletter** | Number 05

Dear Alumni and Friends

The year is now rapidly coming to an end and planning is well under way for 2010. The Part IV Project presentations, and subsequent dinner, were recent highlights of 2009. It was one of the biggest project groups we have ever had, with nearly 60 oral presentations being delivered over 2 days. At the dinner, the students made some interesting presentations to the staff, and showed a very interesting video entitled "After Dark The Adventures of Muscle Man" that they had created just before the dinner. For those interested it can be found on Facebook at http://www.facebook.com/home.php?#/video/video.php?v=508817241188

We have also finished judging the entries in the inaugural "NZ's Next Top Engineering Scientist" competition and announced the winners – congratulations to Kristin School. We know that at least one member of the winning team is planning on enrolling in Engineering Science next year. Only time will tell at how successful this competition is at increasing the Department's profile around the country but the initial signs are encouraging.

I would like to take this opportunity to wish all of you in the extended DES family a safe and happy Christmas break. To the many of you that have, in one way or another, supported the Department through the last little while I offer a special thanks and I look forward to engaging with you all again in 2010.

Professor Andrew Pullan, Head of Department
hod_des@auckland.ac.nz

In this issue

New Zealand's next top Engineering Scientist

In September, we ran the inaugural "New Zealand's Next Top Engineering Scientist". The competition drew a remarkable response, attracting entries from 363 pupils in 98 teams, from 58 different high schools across New Zealand.

Year 12 and 13 students worked in teams of three or four, and were challenged to solve an open-ended mathematical modelling question, released online on the morning of 19 September. Teams were then given just nine hours to write a report tackling the question: "Could New Zealanders save enough electricity via energy efficiency improvements in homes to avoid New Zealand requiring an additional power station being constructed?".

Teams were encouraged to channel their expertise in mathematics, physics, logical thinking, computer skills, writing and teamwork to address the problem. Each team was allowed a "teacher coach" to help them prepare for the competition and negotiate the rules, but they could not provide any help in answering the question.

Kristin School were the winners, receiving $5,500 to be shared equally among all team members, and their teacher coach will receive $500. The runners-up were from James Hargest College, and Nelson College, each winning $2500. The event was sponsored by Orion Health and Fonterra, where a number of engineering science graduates work.

Full details, and the winning entry, can be found at

http://www.esc.auckland.ac.nz/competition

Featured Alumni

Bob Hannaford, Class of '89

Looking back, it doesn't seem like 20 years ago since I graduated from the Department of Engineering Science. As a fresh graduate in early 1990, I took a few months to find my feet in the real world. By the end of 1990, I had landed a role in the IT services at the Comalco Research Centre in Melbourne.

After 18 months, I shifted into one of the research groups where my skills in mathematical modelling and implementation could be better used. For the next four years, I exploited a large proportion of my engineering science background, including Finite Element modelling, boundary element modelling, statistics and various optimisation techniques.

After a year travelling, I arrived in London and secured a software development role working on a performance reporting product for the telecoms market. As luck would have it, I arrived as the company rode the wave of the internet/ telecoms bubble. This afforded me the opportunity to gain a lot of experience of team and people management, through both the heady times of expansion and less exhilarating times when the market and the company was shrinking.

Currently, I am working for Getty Images in London, responsible for the development and operations of a couple of their internet services. This includes co-ordinating the efforts of several out-sourced vendors.

Now happily settled just south of Wimbledon, with my partner Paula, I look forward to time I can spend not working. This time is generally taken up with work on our house, foreign travel, scuba diving and skiing. (I have to work on more time for these last two.)

Students do well in programming competitions

New Zealand Programming Competition winners

Teams of three from around the country met at university computer labs in August for this 5 hour long competition. There were a wide variety of problems, with 3 point problems taking only a few minutes, and 100 point question taking considerably longer.

The problems were all text input from the command line, and teams must output the correct data. Each team had access to only one computer, with no internet connection, so teams had to manage their time and themselves wisely.

Bojan Blazevic and Iain Dunning (Engineering Science, Parts IV and III respectively) made up the team *Two and a Half Men* with David Olsen (Software Engineering, Part III). Together, they won the Tertiary-Open Category and also scored higher than everyone in the Open category, which is open to professionals and includes teams from software companies.

Iain Dunning was also in the team that won the 2008 Tertiary-Intermediate category.

IEEExtreme, Part IIs well placed

Run by the IEEE, IEEEXtreme is a 24-hour programming competition for undergraduate and postgraduate university students. This year, 700 teams across 40 countries participated when the competition ran in October.

Teams were set 12 coding problems to solve in the fastest time possible within the 24 hours, submitting answers as they went to an electronic judge. Any wrong solutions incurred a time penalty.

Engineering Science undergraduates Paolo Edgerton Bachmann, Jeremy Minton and Matt Kingston competed in a team called "I'm easy" and finished ranked 84th in the competition, and 3rd out of the 15 teams from our university. Their achievement is all the more impressive because all three are Part II (second year) students, and the competition included teams composed of senior undergraduates and doctoral candidates.

Final year student wins award and scholarship

Part IV Engineering Science student Yu Sian Tan has won one of the Association of Consulting Engineers New Zealand (ACENZ) prizes for best Practical Work Report, and a scholarship from the Auckland University Engineers Association (AUEA).

Yu Sian's work report covered her time with Castalia where she did financial modelling and research work on a couple of projects, and assisted with writing up expressions of interest and preparing documents for the project procurement process.

ACENZ offers three prizes to the best Practical Work reports written by Engineering students finishing their fourth year of study to encourage the next generation of consulting engineers to develop good written communication skills. The competition is open to students at all New Zealand universities offering IPENZ accredited BE degrees.

Yu Sian went on to win an AUEA Scholarship. Students entering must be in either Part III or IV of their BE (Hons) degree at Auckland, and the basis of selection was academic achievement, commitment to professional engineering, community and/or sporting involvement, teamwork and financial need.

2009 Operations Research Society of New Zealand (ORSNZ) Young Practitioner Prize

Engineering Science graduate recognised for achievement with vaccination rescheduling software

After completing his BE and ME here with us, Faram Engineer undertook a PhD at Georgia Tech, USA. While at Georgia, Faram completed an extra project in which he developed a software program that uses smart optimisation and operations research techniques to determine what vaccines should be given to children that have fallen behind in their vaccination schedule. This software has since been used extensively in the United States.

Earlier this year, Faram recieved an honourable mention in the US-based "Doing Good with Good Operations Research" competition for this work. This month, Faram won the ORSNZ Young Practitioner Prize at the 44th Annual Conference of the ORSNZ. His paper and presentation at the conference were titled *Catch-up Scheduling for Childhood Immunisation*.

Left to right: John George (ORSNZ YPP Judge), Faram Engineer, Andrew Mason (President, ORSNZ)

The judges said of Faram's work that "It tackles the problem of being both rigorous and practical as well as making it accessible. To the user the complexity of the solution algorithm is hidden and they would be forgiven for believing it is easy. The expert OR practitioner knows otherwise and that is its beauty."

Current Engineering Science undergradutes also did well at the Young Practitioner awards. Qi-Shan Lim recieved '1st Undergraduate' for his presentation *Trim Loss and Inventory Optimisation in Paper Mills,* with the judges noting both the ingenuity of the approach and the immediate applicability of the results and its benchmarking with reality".

Antony Phillips recieved '2nd Undergraduate' for his presentation *Optimisation Models and Methods for the Container Positioning Problem in Port Terminals.* The judges said of Antony's work "This captured our attention for it's up-staging of a PhD student's research using interesting ideas that resulted in a major advance in the field."

Photo above left left: Qi-Shan Lim
Photo above: Antony Phillips
Photographs taken by Don McNickle of Canterbury University

New Staff

Peter Bier gained a BSc in computer science and mathematics and then worked as a software developer during the dot com boom. In 2001 he joined the Auckland Bioengineering Institute as a Masters student and completed a thesis on modelling the human vocal tract.

Since 2003 he has spent much of his time working as a tutor for the Department of Engineering Science and as a software engineer for the Bioengineering Institute. Peter is passionate about teaching and is looking forward to being able to focus on educating future engineers.

He is a very keen juggler and unicyclist. His lectures often include a "half time" act, to give students a break, where he demonstrates a circus skill of some description. He also helps run the New Zealand branch of Unicycle.com, an online unicycle store.

News in brief...

Professor Peter Hunter awarded the Rutherford Medal

Peter has been awarded the prestigious Rutherford Medal, New Zealand's top science honour.

He was presented the medal by the Minister of Research, Science and Technology, the Hon. Dr Wayne Mapp, at the Royal Society of New Zealand annual Science Honours Dinner in Auckland on November 18th.

Professor Andrew Pullan made RSNZ Fellow

Andrew is one of ten this year to be elected a member of the Royal Society of New Zealand. His work on modelling current flow in the torso for clinical applications in electrocardiography was recognised at the Society's AGM.

Andrew has recently extended his work to look at electrical activity of the human digestive system. Earlier this year his new project was awarded $1.3 million in Health Research Council funding.

Andrea Raith passes PhD

On December 2nd, Andrea Raith successfully defended her PhD thesis at her oral examination. The thesis was on "Multi-objective Routing and Transportation Problems", and was supervised by Associate Professor Matthias Ehrgott, Dr Judith Wang of the Energy Centre and Dr Stuart Mitchell.

Dancing Queen

Rosalind Archer revealed her "non-engineer" side in a dance concert held at Musgrove Studio Theatre on Saturday December 5th. Children taught by Rosalind danced in the first half of the concert and Rosalind performed five solo pieces in the second half.

In her spare time Rosalind runs Arioso Dance Studio which teaches contemporary creative dance classes to children from age three up.

Featured Alumni

James Deaker, Class of '93

The reason I chose to study Engineering Science was to develop skills that would allow me to apply analytical and quantitative insights to real world problems. I focused on Operations Research and in 1995 I completed my Masters at Auckland University and was lucky enough to be accepted to Stanford University for a PhD.

Following the completion of my PhD, I worked for the Boston Consulting Group (BCG) in San Francisco as a management consultant. This afforded me the opportunity to get exposed to lots of different companies, industries and business models.

In 2003 I left consulting and joined a small San Francisco software start-up called Rapt that developed software to help companies with their pricing. My first role at Rapt was as a "Decision Engineer". In this capacity I helped to tune and customize the implementation of the software for each client company. This role leveraged both my academic training (the underlying analytics used a non-linear programming model) and my consulting skills.

Over time I took on more senior roles and eventually became the Vice President of Advisory Services. In April of 2008 Rapt was acquired by Microsoft. In my current role, as the head of Microsoft Advertising Publisher Advisory Services I help websites to maximize the value of their display advertising assets. The projects are often short and rarely involve deploying complex models, but they employ a structured analytical approach to problem solving that draws heavily on the skills I learnt in Engineering Science.

Teaching update

Bringing back postgraduate geothermal training

Engineering Science has recently played a leading role in the rejuvenation of training in geothermal science and technology at The University of Auckland. In 2007 Mike O'Sullivan activated the dormant Postgraduate Certificate in Geothermal Energy Technology. It started with a modest enrolment of 8 students from Indonesia, Philippines, USA, Slovenia, and New Zealand. There were 8 students again in 2008 but this year enrolments have reached 24.

The PGCert replaces the year-long Diploma course that was run very successfully by the Geothermal Institute from 1979-2002. Because of a change in foreign aid priorities the New Zealand Government withdrew funding for the Institute and the Diploma course was terminated at the end of 2002. The timing was most unfortunate as geothermal energy is now undergoing a boom in New Zealand and worldwide.

The new PGCert is a one semester program consisting of two compulsory courses, one aimed at geoscience and the other at engineering, one elective and an industry focused project. The program is taught by three people in Engineering Science (Mike O'Sullivan, Sadiq Zarrouk, Juliet Newson) and various geologists, geochemists and geophyscists. We have had good support from industry through some guest lectures and help on field trips. In the first two years Contact Energy and MB Century provide scholarship support.

The course is intensive and demanding but the students seem to enjoy it, particularly the two field trips to the Taupo Volcanic Zone. If you are looking for some mid-career re-training in geothermal engineering please contact us.

Mike O'Sullivan
m.osullivan@auckland.ac.nz

Part IV Projects 2009: and the winners were...

Best Biomedical Engineering talk: Callum Johnston, *A vapor-pressure temperature transducer for use in a calorimeter*

Energy consumption measurements on single muscle fibres require temperature sensors that can resolve temperature changes of less than one milliKelvin. In the past, these temperature sensors have usually been based on arrays of thermocouples. An interesting alternative is to utilise the change in vapour pressure of a liquid as a measure of change in temperature. Callum was assigned the task of developing a sub-milliKelvin temperature transducer for use in the Auckland Bioengineering Institute's muscle calorimeter, under the supervision of Dr Andrew Taberner and Associate Professor Poul Nielsen.

Callum's project required him to create analytical and finite element models of several different sensor designs, in addition to constructing and testing miniature (~ 1mm) temperature sensors in the Bioinstrumentation Laboratory. Callum used an extraordinarily sensitive laser interferometer to measure the performance of his temperature sensor, and demonstrated a close match between the predictions of his models and the sensors he constructed and tested. His exceptional academic ability, creativity, and hard work resulted in a sensor design that he intends to develop, optimise and protect during a PhD with the Auckland Bioengineering Insitute.

Callum's presentation of his work was outstanding. He very clearly and succintly articulated his progress, conclusions and achievements and was justly recognised with the award for best BME talk.

Best Engineering Science talk: Grace Meyer, *Helping patients out on a limb*

Grace Meyer's project was motivated by Nikki Sturrock, a lower limb amputee who approached Engineering Science academics for assistance with exploring and optimising her novel idea for relieving the pain she experienced while wearing her artificial limb. Nikki's invention called for the development of a mathematical model of a magnetic device for transferring weight directly from her femur to her artificial limb, thereby relieving the load being supported through her pelvis.

Grace was assigned this project under the supervision of Dr Andrew Taberner, with additional guidance from Dr Iain Anderson and Dr Rocco Pitto. Grace tackled the problem with enthusiasm, using careful laboratory measurements to develop, inform and verify finite-element models of various magnetic designs. During her project work she displayed a strong work ethic and positive attitude, which resulted in some very interesting and valuable findings. In her subsequent interactions with Nikki she very quickly demonstrated her ability to clearly and simply articulate the sometimes complex findings of her experiments and measurements.

Grace's final project presentation exemplified her outstanding ability to explain her work in clear and simple terms. Her poise, articulation and professionalism was recognised by her being awarded the best EngSci talk.

Best Biomedical Engineering poster: Elizabeth Theakston, *The heart under the mathematical microscope*

Elizabeth's research project involved preliminary development of simulation software for creating computer models of organelles within a heart cell. This included the identification of different modelling techniques to represent complex cell membrane networks, implementation of identified techniques using object-oriented programming, and visualization and analysis of resulting models. This project had a high intellectual component requiring good analytical skills and competence in computer programming, as well as a substantial technical component.

Elizabeth showed initiative throughout the project and quickly grasped new concepts in physiology, computer programming and operations research (a subject not taught in the BME specialisation) with relative ease. Her work was presented at the internationally renowned International Congress of Physiome Sciences (IUPS) this year and received very positive feedback.

Elizabeth's poster design succeeded in communicating clearly the modeling process followed to successfully complete the project, as well as the relevance of the work in a larger research framework. Sufficient detail was given at each step of the process to interest the viewer and make clear the complexity involved.

On a personal level, Elizabeth has been positive and good-humoured in her approach to work and in her interaction with her supervisors. She is currently continuing this work as part of a summer research studentship, and is intending to enrol in a PhD next year.

Best Engineering Science Poster: Bojan Blazevic, *Modelling induced dilation in granular media*

Bojan's project was a very challenging one. Granular materials, such as powders, sands and soils exhibit behaviours quite different to those of 'normal' solids or fluids. For example, when sheared, dense granular materials dilate and their volume increases. A familiar example is that, when walking on a damp, sandy beach, a dry patch appears around the foot; hence the footprint in the poster! The explanation is that the extra pressure exerted on the sand forces the grains to move, and also move apart as the individual grains ride up over each other. The size and number of voids hence increases and the surface water drains down into them as a result of gravity. This dilation is also accompanied by a change in strength of the assembly, which is of prime importance to geotechnical engineers.

A number of conceptual models have been proposed to predict this phenomenon, none of which is totally satisfactory. The particular dilation mechanism in Bojan's study is the increase in volume resulting from the collapse of "force chains". As shown in the poster, the force system in a granular assembly is highly inhomogeneous, and the applied loads are transmitted along "force chains", whose strength and position are changing continuously.

Bojan used a recently formulated procedure for model construction, based upon the laws of irreversible thermodynamics, to produce an "engineering theory", which predicts such collapse and the corresponding dilation and strength changes. Whilst further studies need to be made to tie together the various dilation mechanisms, Bojan has made a major contribution to our understanding of a very complex phenomenon.