THE UNIVERSITY OF AUCKLAND
FACULTY OF ENGINEERING

DES News

Department of Engineering Science

August 2013 | **Alumni and Friends quarterly newsletter** | Number 19

Dear Alumni and Friends

Semester 2 is now well underway, which means our Part IV students are getting towards the "business end" of their Part IV projects. We have had a record number of students join us for the Postgraduate Certificate in Geothermal Energy - 39 students at last count!. The Faculty's Part I class is large, so we are expecting a lot of interest in places in Part II Engineering Science and Biomedical Engineering next year.

The Next Top Engineering Scientist competition is being held this coming Saturday, August 10th, and over 140 teams have registered so far. Orion and Fonterra continue their support as sponsors, and we may have a third sponsor joining them. I am going to visit some of the participating schools while the contest is in progress, to see how the teams of student problem solvers get on. After that it will be back into town for the Engineering Ball that evening. It's a pretty classy affair these days!

I have had the pleasure of welcoming four new staff to the Department (see page 3). We also expect to hire a new staff member in Operations Research soon. As you will see on page 3, Professor David Ryan now has Emeritus status. We will miss him around the Department – however I have been assured that the fact he's no longer on payroll will not keep him out of the office altogether.

There is a lot happening in the wider Faculty of Engineering right now, with the development of the former Lion Brewery site at Newmarket. A lot of engineering research labs will move there over the next year or two. We will also shortly have a new "boss" since Professor Nic Smith will be joining the Faculty as Dean on August 19th (more below). As a graduate of our Department, Nic will definitely understand the unique nature of the degrees we offer.

Associate Professor Rosalind Archer, Head of Department

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Introducing the incoming Dean of Engineering

Professor Nicolas Smith

Nic Smith, BE Class of 1992 and PhD 1999, is shortly to become our new Dean of Engineering, commencing August 19th.

After a postdoctoral fellowship at the University of Oxford, Nic came back to DES as an academic staff member. In 2006 he returned to Oxford and in 2008 was appointed to a Chair in Computational Physiology. In 2010 he was recruited to lead the formation of a new Biomedical Engineering Department at King's College London. He also continued his connection to the University of Oxford as visiting Professor of Computational Physiology.

His research group is focused on the development of computational models of the heart with the capacity to integrate multiple measurement types. The goal of this work is to use these tools to develop new ways to assess patients and personalise treatments based on information about the individual. Research applications include the imaging of coronary blood flow, embedding pacemakers and understanding flow in the heart.

In this issue

News in brief...

AeroAstro team awarded funds for DiaMonD Center

A team co-led by MIT Aeronautics and Astronautics Department Professor Karen Willcox has been awarded a US $12.5 million grant by the Department of Energy to create the multi-institutional DiaMonD Center. The center, funded under DoE's Advanced Scientific Computing Research program, will address applied mathematics challenges in modeling and simulation for complex problems, with a focus on research at the interfaces of "data, models, and decision-making" (deriving its name from these three terms).

see full article by William Litant in the MITnews: http://web.mit.edu/newsoffice/2013/aeroastro-team-awarded-funds-for-diamond-center.html

Do you have news to share?

News on current staff and students is easy to obtain, 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 des-newsletter@auckland.ac.nz

Aorere College honours Andrew Pullan

Aorere College has dedicated its new science centre to the memory of former dux, Professor Andrew Pullan. Andrew grew up in Mangere, and went to Aorere College in Papatoetoe after attending Mangere Intermediate. He maintained strong ties with Aorere College and in 2009 donated the school's dux trophy, the Pullan Cup.

Andrew's wife Patti unveiled a plaque for the new Professor Andrew Pullan Science Centre at the official opening on Friday 28th of June.

The ceremony was attended by Andrew's family and friends, as well as college and university staff, including Associate Professor Donna Rose Addis from the School of Psychology and Professor Ron Paterson from the Faculty of Law (both of whom spoke at the dedication), and Associate Professor Rosalind Archer from DES.

"He was a well-loved and respected son of Aorere College", said Principal, Pat Drumm. "He was one of a few students to get the trifecta of dux, university scholarship and onto the college honours board when he gained his PhD."

"It was his special combination of qualities that set him apart; he was a dedicated scientist, a great human being and he was very much a member of the Aorere community'', said Donna Rose Addis, who is also a former student. "Andrew was a wonderful mentor to many up-and-coming scientists, and made a huge contribution in his field, as a member of both national and international scientific communities.

"This new science centre will inspire the next generation of scientists and there is no better person to name it after, than Andrew", she said.

Ron Paterson, a close friend, spoke on behalf of the Pullan family, especially Patti and their two children Zeke and Xanthe who were all at the ceremony.

"Andrew would have thought it was fantastic to have this centre named after him," said Ron Paterson. "Everything he did, he did with a zest for life and an infectious enthusiasm. He was a keen mentor of students here at Aorere College, and loved to present the Pullan Trophy for dux every year."

"If he were here he would be encouraging students to aim high, to set themselves the highest standards, and discover the mysteries of science" said Ron. "It's great that the Professor Andrew Pullan Science Centre will inspire generations of Aorere College students".

Above: Family and friends at the dedication. Left to right: Emeritus Professor George Ferguson, Dr Libby McLean, Associate Professor Rosalind Archer, Quentin Apelu, Catherine Pullan, Professor Ron Paterson, Patti Jessop-Pullan, Zeke Pullan, Xanthe Pullan, Nick Nihotte, Susan Nihotte.

Top left: Patti Jessop-Pullan (left) unveiling the plaque with Associate Professor Donna Rose Addis, and Aorere College Principal, Pat Drumm (right) looking on.

Photos and the original article are by Suzi Phillips, Media Relations Adviser, UOA

Featured Alumni

Zabin Farishta, Class of 2012

My Masters in Management and Regulation of Risk (now known as Risk and Finance) at the London School of Economics (LSE) now has one month remaining. I am the first New Zealander to take this one year Masters course.

Starting out in a class of 30 or so students (ironically, not one of them British), we had a field trip just like our DES field trip to Rotorua. From there on we were bombarded with the usual course work and practitioner seminars. What was unique about LSE, and as I now gather, the British education system, was that course work usually is formative (does not contribute to the final grade) and exams (which place at the end of the year) are 100% of your final grade.

The full LSE experience is not just the academia. Extra-curricular life and the social scene give you a chance to engage with some extremely driven and visionary individuals, and unparalleled opportunities to hear from and question some of the big names ranging from Kofi Annan to Eric Schmidt.

It has definitely been an amazing year, so much learned, so much experienced. I have done my fair share of travel visiting 9 countries in the last month, that too within a student budget! Now, I am in my final month crunching away at my 10,000 word thesis on the Banker's Bonus Cap and its impact on Risk Culture within banks.

I plan to return to home sweet home NZ this September, and will take up a graduate position in Management Consulting with LEK in Melbourne next February, bracing for another new city, another experience, another adventure!

New staff

Dr Thor Besier

Thor completed a PhD in Biomechanics at the University of Western Australia in 2000, investigating the mechanics of non-contact knee ligament injuries. He then went on to join the Bioengineering Department at Stanford University as a post-doctoral research fellow, investigating the mechanism of patellofemoral (anterior knee) pain. In 2006 he became a faculty member in the Department of Orthopaedics at Stanford, where he established and directed Stanford's Human Performance Lab.

Thor returned home to NZ in 2011 after accepting a strategic appointment at the Auckland Bioengineering Institute to lead the musculoskeletal biomechanics group (www.abi.auckland.ac.nz/uoa/musculoskeletal-modelling). He is now a Senior Research Fellow with the ABI, and a Senior Lecturer with DES.

Thor's undergraduate degree was in Sport Science, at Otago University.

Dr Justin Fernandez (Class of 1999)

Justin graduated with a BE in Engineering Science and a PhD in Bioengineering. His PhD was on musculoskeletal modelling and was funded by an enterprise scholarship from the Foundation for Research Science and Technology (FORST). He graduated with a Vice Chancellors Prize for Best Doctoral Thesis.

Justin has been a postdoctoral researcher at Melbourne University and a research scientist at the CSIRO in Australia. He is a Senior Research Fellow in the ABI Musculoskeletal Modelling Group, and now holds a joint appointment with DES, where he is a Senior Lecturer.

Justin's research interests are in computational biomechanics (soft tissue and bone), orthopaedics, finite element modelling and more recently particulate methods. His aim is to develop diagnostic tools that can better inform the medical field. See page 4 for more on Justin.

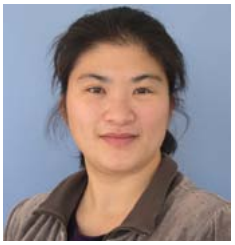
Dr Bryan Ruddy

Bryan graduated from the Massachusetts Institute of Technology in the USA, with a Bachelor of Science (2004), Master of Science (2006), and PhD (2012), all in Mechanical Engineering. Supervised by Professor Ian W. Hunter in the MIT BioInstrumentation Laboratory, his doctoral research focused on the design and modelling of compact, high-force linear electric motors for use in robotics and in medical devices.

Bryan joined the Auckland Bioengineering Institute as a Research Scientist upon the completion of his PhD, in July 2012, to continue his work on actuator design and control with particular application to biological instrumentation, and became an ABI Research Fellow. Bryan has now joined DES as well, as a Lecturer.

Bryan's work focuses on the development of miniaturized actuation and control systems for use in muscle work-loop calorimetry (the Cardiac Myometer), as well as on the design of improved Lorentz-force motors for needle-free jet injection.

Yuting Zhu



Yuting started with us in May as our new Technical Officer, and supports the Biomedical Engineering programme.

Yuting is an experienced Electronic Engineer with a strong background in instrumentation, biomechanics and other useful things. Her previous position was in the School of Sports and Recreation at Auckland University of Technology.

Emeritus Professor David Ryan

Following David Ryan's decision in April to retire, the University has awarded him the title of Emeritus Professor in recognition of David's contribution to the field of operations research, and his service to the university.

Until recently, David was Professor of Operations Research in DES. He is New Zealand's leading authority on operations research and this country's most influential contributor to the field. David came to us in 1975 with an MSc from Otago and a PhD from the Australian National University.

David was DES Head of Department from 1997 to 2001, and Deputy Dean of Engineering from 2004 to 2011. He has also been a member of numerous committees at both Faculty and University level.

David is a Fellow of the Royal Society of New Zealand (RSNZ), and in 2011 was awarded the Royal Society's Pickering Medal that recognises excellence and innovation in the practical application of technology.

He is also a Fellow of the Institute of Professional Engineers New Zealand (IPENZ) Institute for Operations Research, and the Management Sciences (INFORMS) Fellow.

David is best known for developing the innovative 'Ryan-Foster constraint branching' technology which is now a fundamental component of optimisation software used worldwide for solving complex logistics problems. This technology revolutionised the optimisation landscape by dramatically increasing the range and size of problems to which optimisation could be applied.

Emeritus Professors are members of the University for life.

Featured Alumni

Justin Fernandez, BE Class of 1999, PhD 2004

My final year was a mix of operations research, continuum mechanics and statistics. I could have gone in many directions but it was a summer studentship in the bioengineering group and later the formation of the ABI that was the catalyst. So I did a PhD in musculoskeletal biomechanics. Interestingly I didn't do any biomechanics until my PhD.

After completion in 2004 and a year as a research assistant (waiting for my oral exam) I decided to return to Australia. A postdoc opportunity at Melbourne University looked promising in the newly formed biomechanics group in Mechanical Engineering. I spent 4 years in rigid body biomechanics working in a gait lab - the first lab to have an x-ray fluoroscopy system in Australia. I also supervised my first PhD student.

At this point I decided to try commercial research in Australia's largest Crown Research Institute, CSIRO. I joined the division of Mathematics, Informatics and Statistics. Work was a blend of contract projects in mining and minerals engineering with biomechanics in the background (an unusual mix).

After 2 years as a CSIRO science officer I found I missed academia, and decided to return. The ABI was the best place in Australasia for that. So I bid farewell to Aussie one more time and returned to the ABI. Three years on an Aotearoa fellowship helped me find my feet and the opportunity of a faculty position with two hats (ABI and DES) was the icing on the cake.

Bone response to the environment

Justin Fernandez

One of the major themes of my research is how bones respond to our environment whether that is exercise, disease or drugs. I have a number of research projects that address this theme from different angles.

A major HRC funded study underway is a pilot investigation to assess how bone responds mechanically to anabolic treatments, in particular fluoride. In conjunction with Professor Jillian Cornish who leads the Cell & Molecular Biology Bone Research Group in the Department of Medicine, we are creating computer models of bone biopsies informed from CT derived material properties. We can evaluate bone strength virtually without physically destroying samples. We are testing this framework in both human and mice bone (see image below).

Justin Fernandez (right) working with two of his team members looking at stress in human bone biopsies. Left is summer student Corina Chilibeck and in the middle is PhD student Dharshini Sreenivasan.Photographer: Matthew Wilson, IT Manager ABI.

How bone regenerates and interacts with scaffolds and artificial implants is another area of interest. I am part of a Marie Curie International Research Staff Exchange Scheme (IRSES) looking into skeleton regeneration using experimental methods and computer modelling. Ultimately we hope to understand the communication between muscle and bone in both the natural and artificial joints and how tissues integrate with engineered cartilage and bone scaffolds. One role I play is to simulate the loading environment around these implants, which ultimately dictates how they are adopted by the body.

How bone remodels and adapts using computer simulation is a theme I have focussed on since my time at CSIRO. At CSIRO I adapted SPH methods to bone remodelling and now test this on a variety of species. Human bone from the Australian Synchrotron, equine bone from the Melbourne Vet School and mice bone from the ETH in Zurich, Switzerland. A three month fellowship to the ETH allowed me to work with international bone imaging expert Professor Ralph Muller. We collected unique in vivo bone remodelling data from mice. This information is being used to create computer models that predict bone growth and loss. Ultimately, real insight is only gained by looking across the spatial and temporal scales of bone. Hence, multiscale methods play a large role in my work into understanding how cellular level mechanics manifests at the whole bone level; and how whole bone loading stimulates cell response.

Integrating clinical imaging with computational tools is a theme I have focussed on since my PhD. New imaging modalities were initially used to obtain accurate information such as Diffusion Tensor Imaging for muscle fibres or X-ray Fluoroscopy for bone movement. Now I am working with colleagues at CAMRI, Auckland Hos pital and Mercy Private to use NaF (Sodium Fluoride) PET CT to highlight sites of bone turnover and remodelling in the spine. This can be used to link sites of remodelling with mechanical stress and highlight causal effects or possibly explain sources of pain in the clinic. Ultimately, the end point of my research is seeing useful diagnostic tools in the clinic and adding further insight into current imaging methods is one way I aim to achieve this.

Visitor from another island

Peter Johnson

I originally hail from the island of Saba, a small, 13 km^2 Dutch territory in the northeast Caribbean. Originally a pirate hideaway in the late 1500s / early 1600s, Saba is an island of about 1,500 people of mixed European and African descent. I am descended from some of those pirates (Johnson the Terror was one of my better known ancestors). My first known ancestor arrived on the island from the nearby island of St Thomas in 1645.

Saba is a volcanic island and has the potential for geothermal power, which is why I am interested in the topic. I plan to eventually return there to help develop our geothermal resource. We currently get our electrical power from diesel generators which cost about US $0.50 per KWh. Not only would geothermal power be a more environmentally friendly alternative, but it is a real possibility that geothermal power could be a more economical choice as well.

I am a Masters student in Mechanical Engineering at Virginia Commonwealth University in Richmond, Virginia, and will graduate with my degree this December. Last September I applied for the East Asia and Pacific Summer Institutes (EAPSI) scholarship which is offered by the US National Science Foundation (NSF) which places US graduate students in the science fields at universities and research institutes across seven East Asia and Pacific locations, one of which is New Zealand.

In New Zealand, it is a joint scholarship offered by both the NSF and the Royal Society of New Zealand. I was in charge of finding a host researcher, and Professor Mike O'Sullivan was willing to host me in Engineering Science.

I'll be here for 9 weeks in total, from June 10th to August 9th. I've been continuing the work of the geothermal reservoir modelling group under the direction of Professor O'Sullivan. I've been improving the accuracy of the computer model of the geothermal field under Rotorua through inverse modelling using the computer programs AUTOUGH2, PyTOUGH and PEST.

Above: Saba's main town of Windwardside
Top right: Peter off the coast of Saba, hunting the invasive lion fish with the Saba Conservation Foundation
Photos courtesy of Peter Johnson

Staff News

Sadiq Zarrouk

Sadiq Zarrouk was elected last month to the International Geothermal Association (IGA) board of directors for a term of three years.

Founded in 1988, the IGA is a scientific, educational and cultural organization established to operate worldwide. It has more than 5,200 members in over 65 countries. The IGA is the highest geothermal authority in the world, and is a non-political, non-profit, non-governmental organization.

The objectives of the IGA are to encourage research, development, and utilization of geothermal resources worldwide through the publication of scientific and technical information among the geothermal specialists, the business community, governmental representatives, UN organisations, civil society and the general public.

Sadiq is also an elected member of the board of directors of the New Zealand Geothermal Association and Head of Education and R&D.

from Elke Beca, Class of 2003

Opus looking for a new or recent EngSci graduate

The person we are looking for would initially be part of the Road Asset Management Team, most likely based in Manukau. The role will involve systems development, data interrogation/analysis, pavement deterioration modelling and possibly traffic modelling and plenty of report writing in all likelyhood.

Opus typically employ Civil grads but there is a real need for EngSci skills so we are trying to build our numbers. Operations research inclined would probably be more interested in this type of work - two years ago we employed Scott Dakers and last year Gemma Matheison.

There are loads of opportunities within Opus as we now have offices all over the world. It you are interested, contact myself or our HR team.

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