

# SCHOOL OF MECHANICAL AND MINING ENGINEERING PROFILE



THE UNIVERSITY  
OF QUEENSLAND  
AUSTRALIA





# WELCOME TO UQ

## THE UNIVERSITY OF QUEENSLAND

(UQ) is one of Australia's premier learning and research institutions. It is the largest university in Queensland and has produced more than 200,000 graduates since opening in 1911. Its graduates have become leaders in all areas of society and industry.

UQ is ranked in the top 100 universities in the world (Times Higher Education 2013) and is one of the three Australian members of the global Universitas 21 alliance. This group aims to enhance the quality of university outcomes through international benchmarking and a joint venture e-learning project with The Thomson Corporation.

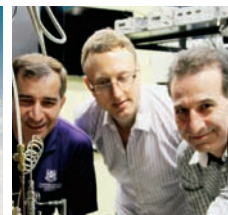
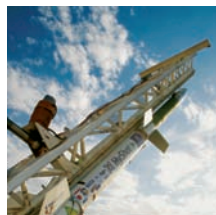
UQ is a founding member of the national Group of Eight (Go8) – a coalition of leading Australian universities. Collectively, Go8 members enrol more than half of all higher degree by research students in Australia and have nurtured every Nobel Prize winner educated at an Australian university.

UQ is committed to discovery and translational research across a broad spectrum of disciplines, ranging from bioscience and nanotechnology to mining, engineering, social science and humanities. UQ's programs and research are internationally recognised for their excellence and attract world-class researchers from around the globe.

UQ is noted for supporting early and mid-career researchers and offers undergraduate and postgraduate programs informed by the latest research, which are delivered in state-of-the-art learning spaces. Its teachers have won more Australian Awards for University Teaching than any other Australian university.

Today, the University has more than 46,000 students including 11,000 international students from 134 nations, providing the highest quality of teaching in all disciplines. UQ is nationally and internationally renowned for developing graduates to support industry and conducting fundamental and applied research to meet the ever changing needs of society.

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## MESSAGE FROM THE HEAD OF SCHOOL

The School of Mechanical and Mining Engineering is internationally renowned for its excellence in teaching, discovery and engagement, establishing Queensland as a key region for engineering innovation. Our school has educated industry leaders, and the research conducted by our staff and students defines new avenues of knowledge to address critical societal challenges.

With over 80 academic staff, including 12 professors, we provide quality programs and leadership in engineering education, research and development, and expert consulting. We deliver a comprehensive teaching program in undergraduate engineering, encompassing the disciplines of Mechanical, Aerospace, Materials, Mechatronic, Mining, and Geotechnical engineering. We have established an excellent reputation for the quality of our graduate training and research performance.

With approximately 400 students entering our undergraduate engineering plans each year, more than 150 MPhil and PhD students, and over 30 postgraduate coursework students, we maintain an unceasing commitment to help them learn, grow, and develop to realise their aspirations. Our students are taught by highly awarded lecturers, who have received Faculty, University and national awards and citations for their teaching excellence and outstanding contributions to student learning.

Our staff conduct world-class research attracting approximately \$15 million in funding each year. The Excellence in Research for Australia (ERA) initiative assesses research quality within Australia's higher education institutions using a combination of indicators and review by committees comprising experienced, internationally-recognised experts. In 2012, all disciplines in the School were ranked at above world standard with Materials Engineering classified as well above world standard.

We invest significant resources in attracting and retaining the best staff and students, ensuring that they are provided with the appropriate infrastructure and support. Strong links with industry have enabled us to establish many strategic partnerships resulting in research collaboration and commercialisation. These benefit the community by delivering visionary solutions to the challenges facing the planet.

Through our alumni, research, and teaching collaborations, the School of Mechanical and Mining Engineering has strong links with industry, on both local and international levels. We are committed to further developing collaborative relationships, and we look forward to creating many more mutually beneficial partnerships in the future.

**PROFESSOR ROSS MCAREE**  
HEAD OF SCHOOL





## Engineering research should help our industries remain competitive.

### IMPROVING TITANIUM FABRICATION FOR INDUSTRY SUCCESS

Australian manufacturers are benefiting from materials and manufacturing technology developed by a UQ research group led by Associate Professor Matt Dargusch. The research focuses on the design, materials and manufacturing challenges associated with the affordable manufacture of medical, aircraft and industrial components used in demanding high value applications. Some of these components are manufactured from titanium alloys, which is an attractive material for metal component manufacture as it is light, high strength and corrosion resistant. Cost factors have always limited the use of titanium to niche applications, such as biomedical, petrochemical and aerospace. However, it is in these particular markets that demand for titanium is rapidly growing.

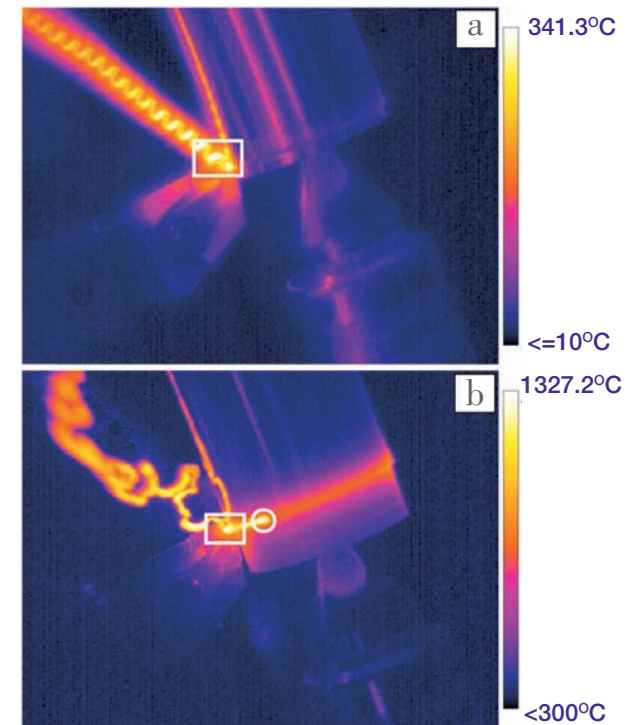
Since 2005, the research group has developed and transferred technologies that achieve affordable manufacture of metallic aircraft components through the Centre for Advanced Materials Processing and Manufacturing (AMPAM) and its Cooperative Research Centre (CRC) partners, including CAST CRC aerospace, titanium fabrication and extreme applications programs. In 2008 the team partnered with the Defence Materials Technology Centre (DMTC), which has a major program associated with aircraft component manufacture. The AMPAM and DMTC programs work with Australian small and medium enterprises (SMEs) involved in the metals manufacturing industry including conducting

technology transfer and process improvement projects with over 30 manufacturing companies. These partnerships include projects with BAE systems, Cook Medical and Seco Tools.

AMPAM and DMTC projects with companies such as BAE systems have been highly successful in developing techniques to manufacture titanium components for the F-35 Joint Strike Fighter— a defence force combat aircraft being developed by the United States of America, Australia and eight other partner nations. The Joint Strike Fighter aircraft is the centrepiece of a \$300 billion program with 6,000 aircraft expected to be produced. In transferring these new technologies, UQ's research team has worked with SMEs and major aircraft prime contractors, including BAE Systems and Lockheed Martin, to develop the light metals technology needed to win supply contracts for the Joint Strike Fighter.

Recently, the team was recognised in the ATN Go8 EIA Trial National Report by Senator The Hon Chris Evans, Minister for Tertiary Education, Skills, Science and Research as having “outstanding impacts in terms of reach and significance with the adoption of the research producing an outstanding social, economic, environmental and/or cultural benefit for the wider community, regionally within Australia, nationally or internationally.”

“This capability in titanium fabrication is currently being applied to other supply chains such as those associated with medical devices through a new partnership with Cook Medical,” Associate Professor Dargusch said.





# Engineering research that delivers innovation to benefit Australia and the world.

## RISE OF THE MACHINES

It is well known that mining is Australia's largest industry; however, the fact that it is also one of Australia's most high-tech industries is lesser known. Within 20 years the mining industry is expected to be transformed by automated machines that will replace the equipment currently operated by people to make the industry safer and more productive.

"Innovation is the lever that allows our industries to remain competitive," Smart Machines Group research leader, Professor Ross McAree said. "Our research looks to develop automated machines that are safer and more productive. The work involves multi-disciplinary engineering activities in control theory, sensing and perception, planning, state and parameter estimation, software engineering, reliability engineering and human factors."

Operating through the Cooperative Research Centre for Mining (CRCMining), the Smart Machines Group focuses on the automation of mining equipment – specifically the large excavators, trucks and bulldozers that are the work horses of the mining industry.

## RESEARCH HIGHLIGHTS

In 2005, Joy Global Surface Mining (JGSM), the world's leading manufacturer of electric mining shovels embarked on a program to develop a semi-autonomous shovel, partnering with Professor Ross McAree and his research team.



Following a technology roadmap developed jointly by the partners, a number of technologies have since been designed, which when combined, produce a semi-autonomous shovel. The multi-million dollar project is supported by the Australian mining industry through ACARP (Australian Coal Association Research Program) and CRCMining.

An accurate way to measure payload was the first technological innovation to emerge from the partnership between UQ and JGSM. The measurement of weight might seem a simple problem, but a reliable means for measuring payload has been a holy grail earnestly pursued since the 1950s. Sophisticated ideas from the theory of estimation were used to reliably estimate payload within a range of 2%. An economic assessment has determined the value of the technology to the mining industry to be between \$107 million and \$354 million.

The second technological development was

collision-avoidance technology, which prevents machine operators from driving the bucket of the shovel into the tracks the machine sits on – a surprisingly common and expensive error. In 2012, JGSM rolled out Track Shield as a feature on new shovels and a retrofit to old shovels. RMD-STEM, an independent technology evaluation company, identified the value of the technology to the mining industry at between \$202 million and \$742 million.

The team is currently extending the Track Shield system to help operators avoid collisions with trucks, and also allow operators to automatically load trucks with the push of a button. "These are both exciting technologies" Professor McAree said. "The way we've approached this is to break the whole problem down into smaller, more manageable problems whose solutions through commercialisation will benefit the industry."

The potential benefits are truly significant.

## We have a critical mass of expertise to conduct research of the highest quality.

### NEED FOR SPEED

For the past 25 years, hypersonic aerodynamics has been a major research activity at UQ. The great potential for scramjets to revolutionise hypersonic flight by removing the need to carry an on-board oxidiser has been clearly recognised since the concept was first proposed in the 1950's. The technical difficulties of overcoming the challenges of sustained atmospheric flight at extreme speeds with intense aerodynamic heating have so far precluded practical application. However, in recent times, breakthroughs in critical areas such as drag reduction, thermal protection systems and materials, and advanced combustion technology are bringing it closer to reality.

The study of scramjets began at UQ in 1980 when the first Professor of Space Engineering in the country, Emeritus Professor Ray Stalker, received the first ever grant in Australia for scramjet research. This work led to the development of UQ's Centre for Hypersonics in 1997 and cemented the University's position as an international leader in the hypersonics field.

The Centre has pioneered the development of laboratory test facilities for hypersonic flow, and the unique shock and expansion tunnels developed by the group form the platform of our research program, the concepts of which have been copied extensively overseas.

The T4 shock tunnel designed by Emeritus Professor Ray Stalker and commissioned in 1987 has performed more scramjet tests than any other facility in the world, and was used to test and perfect the operation of all our engine combustors before flight.

"Hypersonic flight is an essential step for reaching and returning from orbit, and detailed understanding of the complex physical processes involved is needed to fully realise the potential benefits that space based activity holds for mankind. Scramjet propulsion in particular has the potential to greatly reduce the costs and risks associated with access to space, and represents transformational technology when it becomes engineering reality," says Richard Morgan, the Director of the UQ Centre for Hypersonics. "The mission of the Centre is to address the critical scientific and engineering issues associated with all aspects of hypersonic flight, and to



provide the educational and collaborative framework required for Australia to play a major role in the future of space exploration and utilisation".

The Centre aims to conduct excellent hypersonics science that underpins the realities of flight at extraordinary speeds, and to do so in cooperation with strategic partners including the Defence Science and Technology Organisation (DSTO), other universities in the Australian hypersonics network, Australian industry and international partners. Working in collaboration with these partners, UQ has the largest university group in the world dedicated to hypersonics research, with approximately 50 academics, postdoctoral students and technical staff.

UQ established itself as an international player in the hypersonics industry, when a research team led by Emeritus Professor Ray Stalker, Adjunct Professor Allan Paull and Professor David Mee conducted the world's first successful ground tests to 'fly' a scramjet in 1993 in UQ's T4 shock tunnel ground test facility.

Six scramjet flights have now been hosted in Australia, with further experiments to test the technology in the US\$50million Hypersonics International Flight Research (HiFIRE) series scheduled at Woomera and Andoya, Norway over the coming years. Members of the Centre received the prestigious ICAS von Karman Award for International Cooperation in Aeronautics in 2012 for the HiFIRE scramjet flight program.

The Centre has provided international leadership and collaboration on major international projects, fundamental and applied research, as well as training opportunities of the highest international standards for graduate and undergraduate students.



# AEROSPACE ENGINEERING FLIES AHEAD - THANKS TO UQ STUDENT



Australian breakthroughs in techniques for welding composite materials are changing the future of aerospace engineering by cutting aircraft construction time and cost.

University of Queensland PhD student Luigi Vandì has worked on a new process that allows carbon-epoxy composite materials to be welded by incorporating a thin layer of weldable material during the manufacturing process.

"Composite materials have become the material of choice for modern aircraft structures," Mr Vandì said.

"More than 50 per cent of the new Airbus A350XWB structure, including the fuselage and wings, is made from composite materials."

The European-based company Airbus is one of the partners in the Co-Operative Research Centre for Advanced Composite Structures (CRC-ACS), which developed and patented the 'Thermoset Composite Welding' technique for implementation in aircraft construction.

Mr Vandì, whose work is refining the technique, said that unlike metals, carbon-epoxy materials normally could not be welded, making their assembly "challenging".

"This new process can significantly reduce the assembly time for aircraft made from composite materials – and consequently the cost," Mr Vandì said.

"Using this process, welding composite materials takes only 15 minutes, compared to a typical two-hour process for conventional adhesive bonding methods."

Mr Vandì said his research involved unravelling the molecular mechanisms at the interface between the composite and the weldable material. Understanding the molecular process ensured the technology could be safely implemented in aircraft engineering and construction.

"Aircraft manufacturers increasingly are using composites to help make their planes lighter, more fuel efficient and more comfortable for passengers," he said.

"Composites offer significant advantages over metal, as they are not susceptible to fatigue and corrosion, and because they are reinforced with fibre, they rarely develop large cracks."

Mr Vandì said the new welding technique had the potential to save billions of dollars in coming decades for airline manufacturers, which could then make new aircraft cheaper to buy, and reduce air

travel costs for passengers.

Due to his breakthrough work on the new composites welding process, Mr Vandì won the annual 'Early Career Researchers' showcase prize at the CRC Association Annual Conference 'Innovating with Asia 2014' in Perth this month.

The Co-Operative Research Centre for Advanced Composite Structures (CRC-ACS), the UQ Composites Group's research partner, is a company funded by industry partners and the Australian Government, and works to advance composites technology in Australia and around the world.

Over its 22-year history, the CRC-ACS has been recognised worldwide as Australia's foremost research and development centre in advanced composites. It has won awards for its success in technology development and implementation across market sectors – ranging from aerospace to oil and gas.

The 24 participants in the CRC-ACS include leading universities, major international businesses and Small to Medium Enterprises from Australia and six other countries.

We maintain an uncompromising focus on ground breaking engineering research.

#### FIBRE-OPTIC BASED SENSORS IN MINING

Fibre Optic Sensing (FOS) has been a relatively untapped technological resource in the mining industry both in Australia and abroad. In 2010, a group of researchers from the Mining Engineering and Quantum Optics Laboratory at UQ established a collaborative research team

to develop fibre-optic based sensors for mining applications. The research has received financial support from Australian Coal Association Research Program (ACARP) and CRCMining Australia.

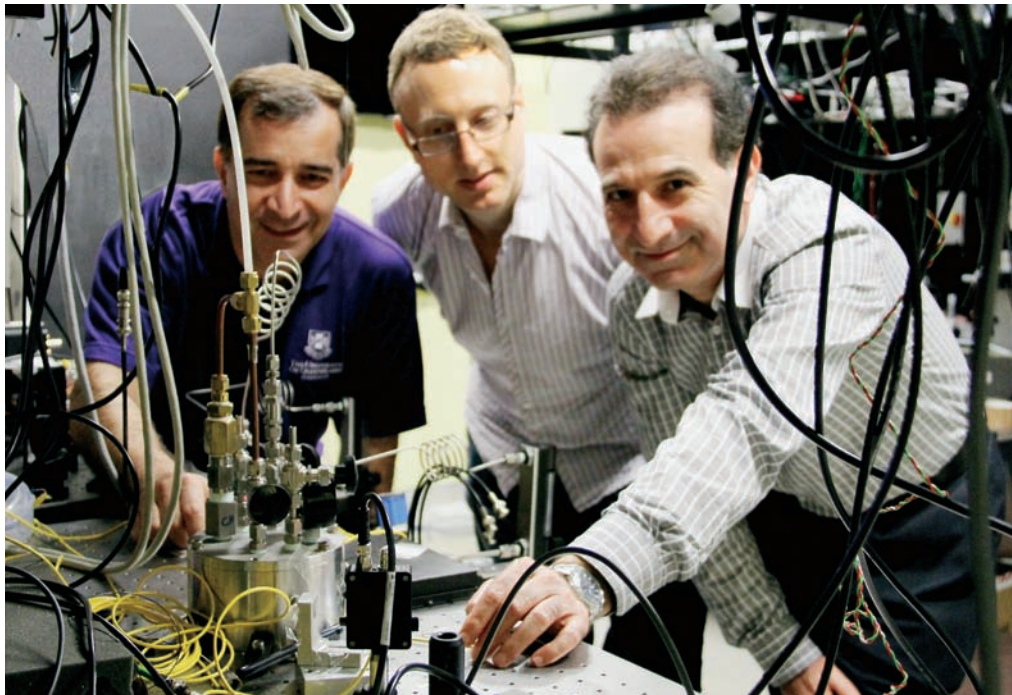
"The scope of our research includes the investigation of potential mining applications of existing fibre optic sensing technology in

areas such as ventilation, borehole monitoring, health and safety, geotechnical and condition monitoring. We are also conducting research on the development of new fibre optic sensors especially in the area of gas sensing," Project Leader Dr Saïed Aminossadati said.

"The presence of methane gas in underground coal mines poses many challenges for the mine workers and companies including health and safety, and impact on the greenhouse. Fibre optic sensing technology will provide an intrinsically safe, fast, reliable, accurate and cheaper method of gas detection and monitoring," Associate Professor Mehmet Kizil said.

"The capacity of optical fibre to transmit light over many kilometres makes it a natural candidate for remote sensing applications. Recently, it has become possible to microstructure optical fibre and thereby produce microscale air pockets which, if exposed to gas molecules, allow sensitive measurement of gas concentration. This is one of the key techniques we are applying in our collaboration," Leader of UQ Quantum Optics Laboratory Associate Professor Warwick Bowen said.

One of the first successful projects was the environmental monitoring in UQ's Experimental Mine using a Distributed Temperature Sensing (DTS) system where approximately one kilometre of a graded-index multimode optical fibre was installed. The longest running optical fibre sensing project at CRCMining Australia successfully proved that the DTS can be used as a tool to monitor pre-drainage boreholes. Other projects include the development of a microstructure fibre optic gas sensor that measures the methane concentration in underground coal mines as well as a real-time fibre-optic based temperature monitoring system that predicts costly failure of conveyor idlers.



Dr Aminossadati (left) and his team conduct methane sensing experiments using drilled hollow-core fibres in the UQ Quantum Optics Laboratory.



We aspire to become leaders in emerging areas of national importance.

### A GLOBAL HUB FOR GEOTHERMAL ENERGY RESEARCH

UQ and the Sunshine State are leading the field in Geothermal Energy research.

Through the Queensland Geothermal Energy Centre of Excellence (QGECE) in the School of Mechanical and Mining Engineering, we are establishing ourselves as the global hub for geothermal energy research, technology development and job creation.

The Queensland Government has made a major investment along the path toward a clean energy future. Responding to a proposal from UQ, the Government committed AU\$15 million to the Queensland Geothermal Energy Centre of Excellence, which is focused on the research and development of energy derived from subterranean hot rocks. The \$15 million is being met by a \$3.3 million contribution of expertise and other resources from UQ, making this the largest investment in geothermal energy research in Australia.

The Australian continent has abundant unexploited reserves of hot rocks, which are fractured granites at least three kilometres beneath the Earth's surface, heated to up to 250°C. The Cooper and Eromanga Basins of Queensland and the neighbouring state of South Australia have particularly strong prospects because they are believed to have some of the world's hottest fractured granites, which hold sufficient water to supply the needs of a power plant without depleting the natural



Natural draft dry cooling towers will save Queensland millions of tonnes of water every year. The air flow through a tower is reproduced in the QGECE laboratories.

aquifer. The resource is large enough to supply Australia for 6000 years at current levels of demand.

Geothermal energy will become price-competitive vis-à-vis conventional power when the cost of mitigating greenhouse gas emissions is factored in, and it is estimated that the Cooper and Eromanga Basins could generate 4000MW of baseload by 2030. This will make geothermal power a realistic element of a mix of energy sources to supply industry, government and households.

"The Australian geothermal energy sector is currently small. However, it is expected to grow reflecting the rapid growth other countries like USA has been experiencing in recent years. The QGECE is the largest geothermal energy centre in Australia and one of the very few centres around the world developing technologies to convert geothermal heat to electricity. The QGECE technologies are also applicable in other renewable power generation areas such as solar thermal power engineering," Centre Director, Professor Hal Gurgenci said.

## We investigate fundamental problems to support the transition of new technologies to practical applications.

### SAFE AND COST EFFECTIVE OPERATION OF HIGH VALUE INFRASTRUCTURE

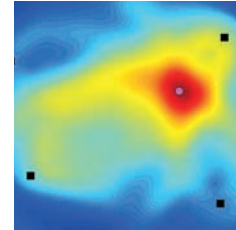
Composite materials are increasingly being used in structural applications due to their low weight-to-strength or weight-to-stiffness properties compared to traditional materials.

The UQ Composites Research Group investigates three project themes, namely (i) manufacturing, in particular joining of dissimilar materials and thermomechanical performance of thermoplastics; (ii) bio-composites, in particular biorefinement and surface optimisation; and (iii) sustainment, in particular imaging damage and structural health management.

“Monitoring safety-critical structures over their lifetime in order to improve reliability and availability, and reduce life-cycle costs is a key requirement in all engineering fields, especially for high-value assets industry sectors such as aerospace, land and water transport, power generation as well as civil and mining infrastructure,” leader of UQ’s Sustainment Research team, Associate Professor Martin Veidt said.

Like any other material, the performance of composite structures can be affected by degradation, resulting from exposure to severe environmental conditions or damage resulting from external conditions such as high service loads, impact, operator abuse or neglect. Detection and characterisation of damage in composite structures can be more difficult compared to metallic structures. For example low-velocity impacts may leave no visible indication of damage but may have caused extensive internal damage or bearing stresses in bolt holes.

Investigating fundamental aspects of robust, accurate and effective structural health management is the focus in the sustainment area of the UQ Composites Research Group. They do this through research programs in the Cooperative Research Centre of Advanced Composite Structures (CRC-ACS) and collaborations with national and international partners, such as the Defence Science and Technology Organisation (DSTO) and University of Bordeaux. The ultimate aim of the research is to support the transition of new concepts and techniques to practical applications.



### RESEARCH PROJECTS

Guided wave ultrasonics is a promising technique for damage detection and evaluation of thin-walled structures. Associate Professor Veidt and his research team have developed imaging techniques such as guided wave beamforming and diffraction tomography to detect and characterise delamination and disbond damage in composite laminates.

They have characterised the complex interaction between the interrogating waves and damages, which is essential to design robust sensor networks with optimal probability to detect damage and at the same time avoiding transducer failures.

The group is investigating the concept of encapsulating piezoceramic transducers in protective polymer films with the aim to improve the durability of the sensors, which is a major reason for the slow transition of structural health management to become common practice.

“ In 2001, I started my own firm ‘Engineering Analysis and Design’ (EAnD). The mainstay of our work has been to use our mill system methodology to predict the behaviour of many of the world’s largest mill installations during design. This work has been extremely successful. EAnD has developed a world-wide reputation for mill system analysis work since 2001.

EAnD has developed into a specialist company that provides a “vertically integrated” approach to mine owners who wish to purchase large comminution equipment. By vertically integrated, I mean that we provide a full technical service from specifying the mechanical equipment, then analysing the design for conformance to the specification, developing and/or analysing the complete mill or crusher system model and finally providing quality inspection and non-conformance resolution during manufacture. The work I have undertaken at EAnD has led to the award of Doctor of Engineering from UQ last year.

The most interesting thing I’ve found is that almost all the subjects I undertook as an undergraduate and postgraduate have been useful in my professional life. Also, my postgraduate training in analysis and measurement has been most useful as we used this combination to develop models of equipment that agree well with measured data instead of relying purely on analysis as most of the industry has been doing. ”

**DR CHRIS MEIMARIS**  
DOCTOR OF ENGINEERING



We aim to foster  
outstanding performance  
by young researchers.

#### **FLIGHT EXPERIMENT GOES BOLDLY FORTH TO ADVANCE NEW TECHNOLOGY**

A hypersonic flight experiment at eight times the speed of sound, led by a UQ PhD student, was safely launched in Norway. PhD student Dillon Hunt, a senior mission systems engineer with Australia's Defence Science and Technology Organisation (DSTO), was the scientific and technical lead for the trial. It involved scientists from four nations and was held at the Andøya Rocket Range, 300km inside the Arctic Circle.

The flight was the fifth in a series of nine flight trials being conducted in the Hypersonics International Flight Research Experimentation (HIFIRE) program. The HIFIRE program aims to learn more about hypersonic flight (speeds

above Mach 8), and consists of a series of experiments flown on several sounding rockets. The experiments compare flight data with information from experimental ground test facilities and computer models.

Mr Hunt said the mission was successfully conducted without incident and was a technical success in testing software and hardware, and obtaining extensive data. "Overall it was a collaborative success, with DSTO working with US Air Force Research Laboratory, UQ, the Andøya Rocket Range and the German Aerospace Center, which provided the mobile launcher," Mr Hunt said. "There are many triumphs and failures encountered in delivering this complex technology which pushes the boundary of human knowledge. However, this experiment was a great experience for everybody and has made a significant contribution towards hypersonic flight, even before the flight test started."

In the latest experiment, an air-breathing scramjet engine and its support module with a two-stage rocket booster were launched to an altitude of 350km above the Earth.

Mr Hunt said the scramjet experiment was conducted during descent at speeds of up to Mach 8 (9000km an hour). The experiment was planned for a precious few seconds at altitudes between 32km and 25km above the Earth. Measurements taken during the flight were transmitted to four ground stations, three in Norway and one in Sweden.

Mr Hunt is part of the Pullenvale, Brisbane-based DSTO team that had its origins in the Centre for Hypersonics. He has been involved in seven hypersonics flight experiments, including being the technical lead for the UQ-led HyShot III and HyShot IV flights in Woomera, South Australia, and conducting experimental tests at UQ's T4 ground test facility and at the University of Southern Queensland. With the inclusion of UQ Masters, PhDs and postdoctoral fellows on research teams in ground, computer and flight tests over the years, hypersonics programs have also helped train the next generation of aeronautical scientists. "I feel extremely fortunate that my UQ studies have aided me in my career in literally one of the fastest moving fields in the world," he said.



We provide opportunities for our postgraduate students to reach their academic goals.

## SHOWCASING POSTGRADUATE RESEARCH

In 2009 the School initiated a postgraduate research conference for our students. Since that time, the conference has grown to involve research higher degree (RHD) students studying within the Schools of Mechanical and Mining Engineering, Civil Engineering, Chemical Engineering, Information Technology and Electrical Engineering. Through this collaboration, the conference provides a chance for attendees to gain an overview of research across the different engineering schools and interact with other students studying a research higher degree at UQ.

Winner of the Professor Don Nicklin Prize, Peter Beasley, was recognised for having the best presentation relating to Mining Engineering. "The Postgraduate Engineering Conference provides an opportunity for students to learn the skills of presenting, explaining and defending their research to a wider audience other than their usual research group," Peter said.

The Postgraduate Engineering Conference is coordinated by a student committee from the Postgraduate Research Engineering Student Society (PRESS) at UQ. These students gain valuable experience in the organisation of a conference, managing the

editorial process through to the finances and marketing of the event.

"The postgraduate engineering conference was a small step for us to ensure that our students have a chance to develop their presenting skills for specialist and non-specialist audiences," says Associate Professor Rowan Truss, the School's Postgraduate Coordinator. "These skills will be vital in their post-study activities and ensure that all RHD students are equipped with the knowledge and skills to reach their goals."

Prize winning students from the 2012 Postgraduate Engineering Conference (from left): Peter Beasley, Rajinesh Singh, John Dudley and Dekui Mu.



## AWARD FOR EXCELLENCE IN RHD SUPERVISION

The School is committed to excellence in research supervision, and awards have been presented to our staff that lead and inspire UQ research higher degree (RHD) candidates.

Professor Richard Morgan and Associate Professors Rowan Truss and Martin Veidt have all been awarded for their excellence in research higher degree supervision in recent years.

These advisors were commended for their efforts to expose students to best practice in research management and facilitate opportunities for candidates to build international networks.



We provide pathways for our undergraduate students to get involved in world-class research activities.

## RESEARCHING A WORLD OF POTENTIAL

“UQ has a number of great opportunities for students to get involved with research projects. One of these is the Summer Research Program, which I had the honour to participate in during the summer of 2012. Throughout the course of this research project, I worked with Associate Professor Martin Veidt and PhD student Mitchell Dunn to conduct experiments that can assist with characterisation of weak bonds in composite repairs, which are common in the aerospace industry.

The advantage of research especially for undergraduate students is that it allows us to work with things that we don't have the chance to work with during the normal day-to-day university life. During the Summer Research Program, I had the opportunity to work with ultrasound transducers, pulsers and impact hammers equipped with sensors. I also worked with a National Instrument Sound and Vibration Toolkit and advance data acquisition systems to record the ultrasound signals throughout a period of time. I was then able to move the measured data onto MATLAB for signal processing.

The whole process was greatly educational and enjoyable – being able to conduct an experiment, record the signals, and then analyse the data using the appropriate software. This allowed me to implement my theoretical learning into practical applications while learning more about signal processing

techniques, ultrasonic structure monitoring and several softwares.

In addition, through the meetings I had with Associate Professor Martin Veidt and Mitchell Dunn I learned a lot about how to approach a practical problem, how to break it into sub-problems and solve it. This is something that everyone has to learn for their knowledge to be effective. This is why the problem solving strategy was certainly one of the important lessons that I took away from the Summer Research Program and these are not lessons which I will forget over the course of a couple of months or years. These are the lessons that will form the backbone of my problem solving for the rest of my career as an engineer or researcher.

At the end of the Summer Research Program, I finished my research with days of professional work experience, practical knowledge of signal processing and data acquisition, and the valuable experience of working with an academic like Associate Professor Martin Veidt. Looking into what I have gained over summer research, I highly recommend the Summer Research Program to other students who are passionate about learning, and are interested in furthering their research knowledge and skills in a certain area.”

**KIANOOSH SOLTANI NAVEH**

BACHELOR OF ENGINEERING (MECHATRONIC)



## We foster opportunities for students beyond the classroom.

### START YOUR ENGINES

Tinkering with engines and chassis are all in a day's work for the members of the UQ Racing team. Established in 2001, UQ Racing has served as a means for students to hone their engineering and mechanical skills, and has provided an avenue for networking with industry, peers and academics.

Boasting a team of approximately 40 students, the UQ Racing team is open to all students with its members studying a diverse range of programs.

The students work together to design and build a vehicle that is eligible for entry into the Australasian Round Formula SAE (Society of Automotive Engineers) competition that is held in December each year. The group also manage their own finances, marketing, sponsorship, administration and OH&S requirements.

At the competition, teams compete in design and presentation categories as well as track events including acceleration, endurance and autocross.

UQ Racing Operations Director, Mitch Timms said being a part of the team gave students a chance to get hands on experience in a real engineering project. "Being involved with UQ Racing, I've been able to witness a design move from its conceptual stage, through detailed design, and then on to manufacturing, assembly, testing, and ultimately competing against scores of other university teams. UQ Racing has given me the chance to apply and extend upon what I have learnt in coursework."

## profile

"One of the biggest highlights from my time at UQ would be joining and participating in the UQ Racing team, an extra-curricular activity where a group of motorsport enthusiasts completely design, fabricate, test and race an F1 style racing vehicle. I have learnt so much in my short time within the team, including project management, systems, and design, as well as practical manufacturing and fabrication skills.

I was fortunate enough to receive a University of Queensland Excellence Scholarship – an academic scholarship given to students graduating Grade 12 and about to enter their first year of full time University study. I am extremely grateful for this scholarship, as it has allowed me to invest much more focus and time into my studies, rather than working a part time job. From this scholarship I also received the RWH Hawken scholarship, which has also opened up many opportunities for networking and industry related advice. I have attended events such as formal dinners and seminars, which have allowed me to connect with industry

representatives, as well as gain knowledge and passion for the field of Engineering.

The advice I would give to future students would be to not let any opportunity pass by. Studying at UQ will be the best time of your life, especially with all it has to offer in terms of quality of education, lecturers, social events and societies. The life experience you will gain during you're time at UQ will be tremendous if you immerse yourself in every opportunity that arises."



### RACHEL PURDIE

BACHELOR OF ENGINEERING (MECHANICAL)





We offer an engineering education that builds memorable and liberating experiences.

### **RWH HAWKEN SCHOLARS TAKE ON THE WORLD**

The RWH Hawken Scholars program emulates the vision of Professor RWH Hawken (a founding Professor of Civil Engineering at UQ) who believed that the complete student should have an education that takes in a combination of wide-ranging and cultural insights, coupled with academic excellence.

It encourages academically gifted scholars in selected faculty course work degrees in engineering, architecture and information technology – to aspire to take their degree to the highest possible level.

The Hawken Scholars Program membership is open to full-time students who are high academic achievers and comprise the top 5% of academic performance (as measured by Grade Point Average) in the Faculty's course work student cohort.

The program provides Hawken Scholars with enhanced academic, industry and cultural experiences. Through exposing this motivated and elite group of the faculty's top 200 students to new networks and opportunities, we aim to further develop their skills, knowledge and experiences, in preparation for long-term leadership positions.

For our industry program partners, this is an outstanding and exclusive opportunity

to engage with the best students in engineering, architecture and information and communications technology. We have designed an annual program to provide Hawken Scholars with a range of exciting and stimulating industry engagement experiences.

For our limited number of program partners it is an excellent opportunity to position your organisation as a premium destination for truly world-class graduates, whilst encouraging and influencing future pathways for this cohort.



We provide state-of-the-art facilities for our students and researchers.

#### GREEN STAR APPROVAL FOR NEW ENGINEERING FACILITY

The new Advanced Engineering Building (AEB) will provide state-of-the-art teaching and research facilities, all housed within an environmentally sustainable design which has been given the national green star tick of approval.

The Advanced Engineering Building, with a “live building” design that allows monitoring of ongoing sustainability performance, was awarded a 5 Star Green Star – Education Design v1 Certified Rating from the Green Building Council of Australia. The rating signifies Australian excellence in environmentally sustainable design and construction of buildings.

Professor David St John, Faculty Director of Major Projects, noted that environmental sustainability was an important goal in the design of the \$133 million facility from day one. “The future of engineering requires that engineers develop technologies that are more sustainable with reduced carbon footprints. It was a priority that as a training ground for the next generation of engineers, the AEB building exemplified this approach,” he said.

The AEB will be a feature of the engineering precinct at UQ’s St Lucia campus that provides innovative spaces and blended learning laboratories for 3600 students.

Because it has been designed as a “live building”, with operational data made available, students will eventually be able to monitor its environmental performance as part of the curriculum. For example they can assess elevator, air conditioning and the building’s structural performance over time.

The AEB will also house the Centre for Advanced Materials Processing and Manufacturing (AMPAM), whose researchers played a key role in the sustainability design of the building.

#### AMPAM

AMPAM provides a focus for UQ’s materials engineering and manufacturing activities, and those of its partners in major successful national collaborative ventures. AMPAM will capitalise on emerging trends in manufacturing research where innovations in material developments are driving new combinations of metals, polymers, ceramics and composites that have not before been economically possible.

With industry and research members working together within AMPAM, the blending of technologies and processes will create new unique opportunities for materials development, processing and manufacturing.



We provide opportunities for our students to gain industry skills and knowledge.

### ENGINEERING HEATS UP

Safeguarding the future of the mining industry, Newcrest Mining Limited has partnered with UQ, establishing the Newcrest Heating, Ventilation and Air Conditioning (HVAC) Laboratory.

Funded by a \$270,000 contribution from Newcrest, the Newcrest HVAC Laboratory enhances UQ's delivery of courses to develop specialised mining skills and knowledge in the application of fluid mechanics, thermodynamics and heat transfer in various heating and cooling processes.

"They conducted experiments on psychrometry, air ventilation and refrigeration with a high level of accuracy using the advanced equipment and instrumentations," Dr Saiied Aminossadati said.

Funding for the HVAC laboratory equipment is part of Newcrest's \$2.5 million long-term commitment to UQ, which includes significant funding in scholarship support for engineering students, as well as support for mining engineering research.

Newcrest's Executive General Manager of People and Communications, Debra Stirling said that Newcrest had a long and rewarding partnership with UQ. "Today's students are tomorrow's graduates and the next generation of mining technology engineers to lead the resources sector into the future. The partnership between Newcrest and UQ is an excellent example of University-industry collaboration to provide improved education to graduates. This in turn will enable them to develop the skills and capacity for innovation they need to help build a stronger, more sustainable mining industry," Ms Stirling said.



## MINING EDUCATION AUSTRALIA

MEA delivers a national curriculum to third and fourth-year undergraduate students studying mining engineering at its four member universities.

MEA is a collaborative joint venture between several Australian universities and is financially supported by the Minerals Council of Australia (MCA), with development funding of \$1.325 million through the Federal Government Collaboration and Structural Reform funding scheme.

The industry-endorsed program aims to increase the number of mining engineers in industry, support quality teaching and learning through the sharing of best practice, and enhance the career options and mobility of graduates.

The program has won a prestigious Australian Learning and Teaching Council 'Educational Partnerships and Collaborations with Other Organisations' award. Associate Professor Mehmet Kizil said that "MEA has delivered an impressive 90% of mining engineering graduates in the country since it began in 2006 and the program will continue to be the leading avenue for the development of high quality mining engineers for industry".

We aim to enhance our teaching and research programs with strong industry connections.

## 50 YEARS OF ASSOCIATION

The School has produced many notable alumni and Dr Russ Morrison is one that has made significant contributions to engineering in Queensland.

Dr Morrison completed his PhD at UQ in Mechanical Engineering in 1969 after which he founded the Engineering consulting firm WBM, now known as BMT WBM. Dr Morrison's professional interests cover all areas of engineering.

Currently the director at BMT WBM, Dr Morrison has been involved in many innovative and challenging engineering projects from the design of hypersonic wind tunnels, jet engine test facilities, to robotic machines.

Dr Morrison was made a Member of the Order of Australia in 1998 in recognition of his services to industry, and was awarded a Centenary Medal in 2000. Honouring his contributions to the engineering profession, Dr Morrison has also been awarded a Fellow of the Australian Academy of Technological Science and Engineering, and was also awarded the 2004 Engineers Australia A.G.M. Michelle Medal for his contributions to mechanical engineering.

BMT WBM has been an employment destination for many of the School's research graduates over the last 40 years and continues to provide a strong connection between the School and engineering industry.

Dr Morrison continues to have a significant involvement with the School of Mechanical and Mining Engineering as Chair of the Industry Advisory Board.

## INDUSTRY ADVISORY BOARD

The School's Industry Advisory Board meets twice a year to discuss the quality of graduates, the content of our curriculum and its relevance to industrial and societal needs. The Board also advises on ways to strengthen teaching and research links between the School and industry.

The Board's membership includes the Head of School, Heads of Division, Chair of the Research Committee, Chair of the Teaching and Learning Committee and local industry representatives from each of the School's major areas of activity.

The School is always looking for leaders of industry to contribute through activities such as involvement on the Industry Advisory Board.







From left: Mr Llewellyn Best, Business Development Manager of ABB; Mr Axel Kuhr, CEO of ABB; and Professor Graham Schaffer, Executive Dean of EAIT.

We engage in sustainable relationships with key partners and communities that enhance the student experience.

#### INDUSTRY PARTNERSHIP DRIVES STUDENT EXPERIENCES

A five-year agreement was signed with ABB Australia to provide UQ's engineering student cohort with a wide range of technological resources. The partnership with ABB has enabled the provision of a student-centered learning experience, focused on hands-on, active learning approaches. This will ensure that our graduates have industry relevant skills and are well prepared for the professional working environment.

Under the agreement, ABB is providing over \$500,000 to UQ in the form of laboratory equipment and scholarship funding. The scholarships funded by ABB are available to students undertaking study within the disciplines of mechatronics, mining, electrical and mechanical.

As a result of the generous support from ABB, students now have access to the ABB Mechatronics Teaching Laboratory, complete with ABB's System 800xA control system, ABB ACS800 variable speed drives and AC motors, an ABB DCS800 variable speed drive with a Baldor DC motor and an IRB 20 industrial robot.

In addition to the laboratory equipment, ABB will also provide support in the form of undergraduate scholarships for low socio-

economic or indigenous students. ABB has partnered with UQ to award a minimum of one three-year annual scholarship, providing these students with the opportunity to undertake tertiary education.

Chief Executive Officer of ABB, Mr Axel Kuhr said ABB was excited about the future of engineering at UQ and in Australia. "We see the opportunity to work closely with UQ as rewarding for both the students and ABB," Mr Kuhr said. "ABB will also support a number of full-time Research Higher Degree students with scholarships as well as offering paid internships over the lifetime of the sponsorship. Our vision for this collaboration is to help the University develop industry-ready, highly skilled and globally focused graduates."

#### INDUSTRY CHAIRS

The School has industry funded chairs covering Hypersonics, Mining and Mechanical Engineering, all of which further engagement between the School and industry organisations, assisting to position the university and the nation as world leaders:

- BMA Chair of Mining Engineering
- Chair of Hypersonics funded by DSTO
- P&H Chair of Mechanical Engineering

We aim to provide activities for student development through industry engagement.

## RIO TINTO DIG DEEP ON LEARNING AND SKILLS

UQ and Rio Tinto have signed a multi-million dollar five-year agreement designed to create a sustainable future pipeline of graduates for the mining industry. The Corporate Education Agreement focuses on developing academic leadership, building skills and capability for the mining industry, and increasing diversity levels by targeting female and Indigenous students.

The partnership features educational initiatives including 39 scholarships, two post-doctoral fellowships, the creation of a new dual major in geotechnical engineering, and initiatives to increase female engineering enrolments by 15 per cent. Within the School, the agreement is helping to fund the appointment of two mining academics and field trips in third and fourth year as part of the Bachelor of Engineering (Mining) program.

The agreement is helping to inspire the next generation of students to pursue their career aspirations by offering a five day engineering camp to Indigenous Australian students entering into years 11 or 12. The InspireU Engineering Summer Experience allowed 20 Aboriginal and Torres Strait Islander students to experience campus life. Students had the opportunity to undertake site visits, experience laboratory work, climb the Story Bridge, and experience the thrills of Dreamworld from an engineer's perspective.



High school students experience campus life at the InspireU Engineering Summer Experience Camp.

Executive Dean of the Faculty of Engineering, Architecture and Information Technology (EAIT), Professor Graham Schaffer said the camp was a great success. "The initiative has proved to be a successful collaboration between the Faculty of EAIT, UQ's Aboriginal and Torres Strait Islander Studies Unit and Rio Tinto," Professor Schaffer said.

## XSTRATA COAL SUPPORT TO ADDRESS SKILLS SHORTAGE

The Xstrata Coal Scholarship Program continues to boost the quality and numbers of students studying in disciplines related to the mining industry. The Program is designed to provide encouragement and support to promising university students and assist them with the costs associated in gaining a tertiary education, enabling them to fulfil their personal and professional potential.

A fundamental part of the scholarship program

is the commitment to the Vacation Employment Program where students are given the opportunity to build relationships and networks within the mining industry to foster growth, development and a natural progression into a career in mining.

Financial support from Xstrata Coal has grown to support 15 scholarships, laboratory equipment and other student activities. These scholarships open up a world of teaching and research for students who may otherwise have struggled to fund their studies.

Bachelor of Engineering student, Courtney Kelly said she was extremely grateful to mining group, Xstrata Coal for their support. "The Xstrata Coal Engineering Scholarship has enabled me to progress through my studies independently whilst living a long distance from home. I am extremely grateful for the support of Xstrata Coal to help me develop professionally on site through summer work placement," she said.



We create strong relationships with our industry partners to achieve mutual goals.

#### **CENTRE OPENS DOORS TO ELECTRONIC MATERIAL ADVANCEMENTS**

Soldering and brazing technologies supplier Nihon Superior has joined forces with the School to provide a world-class research centre for the manufacture of electronic materials.

The Nihon Superior Centre for the Manufacture of Electronic Materials (NS CMEM) supports research into materials for electronic and electrical application and energy storage with joining and soldering a major focus. The Centre's Director Associate Professor Kazuhiro Nogita said the Centre would contribute to industry through the development of proprietary materials and advanced technologies.

"It will also contribute to the development of human resources through the involvement of students and researchers in the work of the Centre," Associate Professor Nogita said. Nihon Superior is the major partner in the NS CMEM and provides approximately \$400,000 per year across several projects with additional support provided by the University. The company will also provide in-kind support in the form of materials and services.

In the nine years that Nihon Superior sponsorship has been undertaken at UQ, there have been some major breakthroughs in the understanding of the properties and behaviour of lead-free solders that have earned global recognition. Even greater achievements are

expected with the joint research and exchange of personnel that will now be possible.

Nihon Superior President Tetsuro Nishimura said the creation of the Centre was the result of a long partnership between his company and the University. "With the leverage this partnership provides both Nihon Superior and The University of Queensland will certainly get much more from their efforts than they would if they pursued these goals separately," Mr Nishimura said.



Professor Kazuhiro Nogita, Centre Director, NS CMEM



Researchers inspect a next generation lead free solder, under development in the NS CMEM.

# DISCOVERY – LEARNING – ENGAGEMENT

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