Engineering to the rescue: Our role in humanitarian and disaster relief

Graduate Profile: Dr Chris Roberts

No 1 ranking for Engineering
From the Dean

Watching the dramatic events of the Beaconsfield mine disaster, one could not help but reflect on the role engineering plays in such rescue situations. As Professor Hebblewhite points out on page 11, the rescue highlighted the ingenuity of mining engineering, the extraordinary people skills and the advances in technology that led to the essential communication link with the two men and their ultimate safe removal from the collapsed mine.

Humanitarian and disaster relief engineering is the theme of our special feature this issue. We explore the invaluable role played by organisations such as RedR, Engineering Aid and Engineers without Borders, examine the vital role that engineers play when chaos reigns and question what more as a profession we can do to highlight the value of engineering in both the prevention and alleviation of disasters.

I noted with interest a study at an American University, in which researchers are looking to nature – specifically, to ants, bees and viruses – for ways to improve human collaboration during disaster relief efforts.

The research team, which includes biological, computer and social scientists and civil engineers, will apply their natural-world findings to three major areas: collaboration among organisations involved in disaster-relief efforts; the use of information technology to support preparedness, response and recovery tasks; and the emerging role of civil engineers as key first responders to disasters.

They say the civil engineer’s role – particularly the engineers and contractors who were involved with the original design and construction of the critical physical infrastructure – needs to be extended beyond infrastructure life-cycle management and sustainability to also involve first response against disasters.

Engineers of all specialisations have much to offer this valuable work. I hope you find the feature food for thought and enjoy the reading elsewhere in the issue.

NEWS

Back together on campus after 50 years

The second group of engineers to graduate from UNSW’s Kensington Campus have reunited at the University for the first time since receiving their degrees in 1956.

Electrical engineer Clifford Johnstone organised the group’s first official get together at Sydney’s League’s Club in 1981.

Fifty eight people, including 19 alumni, congregated in April for a convivial Golden Jubilee luncheon at the John Niland Scientia building.

Touring the modern campus with its state-of-the-art labs, the graduates couldn’t help but reflect on the campus of their day. In 1956, the campus had one main building, with huts along High Street used for student accommodation. Lectures were still held in the old Sydney Institute of Technology at Ultimo.

Electrical Engineering graduate Ronald McCarthy shared many happy memories of his University years. After captaining the University cricket team, Ronald McCarthy went on to be Chief State Engineer at Telecom for seven years, with more than 300 reporting to him. Ron has since worked in research and development innovation for Telecom and on the Visiting Committee for UNSW. He credits his knowledge of creativity and innovation to his tertiary engineering background.

Ron carries a photo of the 1956 Engineering Graduation and Graduation Ball where he proposed to his wife, Jann McCarthy, who also attended the Golden Jubilee Luncheon. When chemical engineer Alban Lynch studied engineering in the 50s there were no girls. Two of his daughters are chemical engineers but he stresses that it was entirely their choice. He has seven children, three of whom are engineers, and 21 grandchildren.

Alban converted his diploma to a degree and also attained his Masters qualification at the University’s Broken Hill Campus. He worked for Zinc Corporation (now Rio Tinto) for five years, working in the mine by day and studying by night. Alban planned to obtain his doctorate at the University of Queensland and move to Weipa but ended up staying at UQ for 35 years where he founded the University’s Mineral Research Centre. He won a centenary medal in 2003 for service to Australian society in mineral science and engineering.

These days he continues to develop research groups as a Visiting Professor in Malaysia, Brazil, Mexico, and Turkey. He and wife Barbara – whose family are long-term residents of Broken Hill – are both interested in archaeology so Turkey suits them well.

Alban reflects that while it was not a bed of roses, the 1956 graduates received great training. “We can each look back with some considerable satisfaction that we were part of a group of people that each contributed our little bit to the prosperous country that we are today. We have watched with admiration how the University of New South Wales has developed,” says Alban.

“We, the Faculty and the University are proud of the achievements of our graduates especially you who were among the first to put UNSW Engineers at the forefront of the profession and the general public,” says Tony Robinson (former Associate Dean, International).
We’re Number 1

Those who visit our website may have noticed this distinctive red logo appearing of late. It proclaims our great international standing.

The Faculty of Engineering has been named the best engineering school in Australia and ranked the 16th best in the world in the UK’s 2005 Times Higher Education Supplement World University Rankings.

In the first of a series of faculty-level analyses, the UK’s most authoritative higher education publication examined the top 100 institutions for engineering and technology.

UNSW Engineering rose from 29th to 16th place, ahead of Melbourne (18); Monash (24); Australian National University (29) and Queensland (40).

Alumni honour a mentor

A seven-year campaign by UNSW alumni to establish a chair in the name of their former mentor finally has paid off. With the help of a generous $500,000 donation from U.S.-based QUALCOMM Incorporated, former students have succeeded in establishing the John Lions Chair in Computing and was one of the key people responsible for the growth of expertise in the computer science field.

The late John Lions (left, standing) was a pioneer of computing and was one of the key people responsible for the growth of expertise in the computer science field. He was a member of the UNSW academic staff for almost 25 years. Anyone know who else is in the photo?

UNSW alumni to establish

UNSW alumni to establish

the John Lions Chair in Computing.

The A. W. Tyree Foundation Undergraduate Engineering Linkage Scholarship, offered every four years, is designed to assist high-achieving students undertake the Bachelor of Engineering program at UNSW’s Kensington Campus.

The scholarship recipient will also be invited to undertake a summer break in the field of study, to be selected by the Dean’s Advisory Committee, announced the scholarship at a signing ceremony attended by senior university staff.

Sir William Tyree has close ties to the University, with one of the most popular venues in the Scientia building named after him.

The late John Lions: Honored by his former students.

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Earlier this year, a catastrophic landslide buried the village of Guinsaugon, near the town of St Bernard in the Southern Leyte province of the Philippines. Spreading for more than three kilometres, the landslide killed an estimated 1000 people in a village of 1400, including 250 children and teachers in the local school. Tragically, many people from as far away as Manila were in Guinsaugon at the time to celebrate the anniversary of a local livelihood project.

UNSW alumna, environmental engineer Kathryn Harries, was quickly on the scene. A plant manager at Sydney Water’s Warriewood Sewage Treatment Plant, Kathryn is on the RedR (Register of Engineers for Disaster Relief) register. Run by Engineers Australia, RedR is a non-government humanitarian agency whose mandate is to select and train technical specialists to be available at short notice to work with the UN or non-government agencies.

In this case, AusAID immediately responded to the disaster, pledging $1 million and sending a team of engineers with expertise in geotechnical engineering, water and sanitation. With Kathryn’s previous experience in the Philippines through Red Cross and her role as national convenor of the Australian Water Association’s Water and Sanitation in Developing Communities Special Interest Group, she was selected as a water and sanitation (WatSan) expert.

“I was the only WatSan technical expert in the field at the time, so I was able to assist local non-government organisations develop water and sanitation recommendations.” says Kathryn. “This included developing a spreadsheet that could be used as an ongoing tool to provide fair distribution of additional latrines as evacuee numbers and the need for latrines changed. My highlight was consulting with the local rural sanitation inspectors while developing emergency latrine design.”

The whole field of humanitarian and disaster relief engineering has come a long way since the days when engineers flew in with the attitude of “we’re the white people, we see the problem, here’s the solution, see you later,” says Kathryn Harries concurs. “The most satisfying thing about being a RedR volunteer is working with local

Dr Alistair Sproul, a senior lecturer in UNSW’s School of Photovoltaic and Renewable Energy Engineering and the leader on many student projects in developing and disaster-ridden countries.

“We tend to now ask, ‘How can we be of service to you? What needs solving?’” says Alistair, who with students has brought solar lighting to a remote medical outpost in Nepal, solar-powered water pumps to tsunami-affected Sri Lanka, and solar cooking facilities in Nicaragua. “People without a lot of money can have a huge impact and whether it’s a positive or negative experience depends on consultation. Working with the local community is crucial.”

It is an approach endorsed wholeheartedly by Jeff Dobell, founder of RedR Australia, Engineering Aid and RedR International in cooperation with RedR UK. He has dedicated much of his career to providing engineers and related services to assist disadvantaged communities both in Australia and overseas. Jeff believes not just in consulting local communities but in training local people as well.

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“If you transfer skills, including management skills, to people who have not had the opportunity to obtain them, you leave a lasting legacy,” says Jeff, who has provided disaster-relief and humanitarian engineering solutions in Rwanda, Mauritania, East Timor, Eritrea, Eastern Europe, Nepal, Vietnam, Papua New Guinea and Aboriginal communities across Australia. “I’ve seen situations where engineers have installed sophisticated equipment but no-one thought to train the locals so ultimately it fell into disrepair.”
“Good interpersonal skills are essential,” says Kathryn Harries. “You are working with others, who are very committed but with a different range of skills, abilities, backgrounds and countries of origin, in a highly charged, and often sleep-deprived environment, with limited equipment and time, and uncertainty as to the cultural needs of the affected community.”

Dr Philip Crisp, a senior lecturer at UNSW, is leader of the Safe Water Implementation Group (SWIG), a coalition of interdisciplinary scientists, engineers and social analysts concerned with the lack of safe drinking water in developing countries. He has worked for years in Bangladesh on solving the problem of arsenic in the water supply and is currently finishing a safe water book to be translated in the Bangla language and distributed to villagers. Dr Crisp firmly believes success lies in holistic and self-propagating solutions as well as respect for local cultures.

“Our approach is to solve water problems while addressing social, economic and technical factors in an integrated manner...solutions to safe water problems should be socially accepted and locally organised. Our projects are designed to use minimal capital and to work within village economies, without distorting the social structure by adding to the problems of graft and corruption that have often been associated with foreign aid.”

Dr Care says the most practical answer may not always be the right one because of cultural considerations. “In the tsunami, for example, it made sense to just move people to higher ground. But you have a lot of fisherman and with that comes a whole cultural structure. You have to work in ways that can lessen the impact of future disaster while still letting people live the way they want.”

In his book Shelter After Disaster, Ian Davis of Oxford’s Disaster Management Centre points out that following disasters around the world, local people using their own ingenuity and initiative have accomplished more than 80 percent of the reconstruction themselves, even in this age of rapid transport and communications. He believes the challenge to national and international agencies is to make a genuine contribution by doing something that strengthens and extends what the people are going to do anyway on their own.

The same principle applies in development work. Jeff Dobell recalls working in the Kowanyama Aboriginal community of North Queensland one year when contractors were brought in to renovate local housing. “They’re dirty buggers here,” a carpenter remarked to Jeff after finding a dead wallaby in a kitchen cupboard. Six months later when a grant came through to build a number of houses in the community, Jeff suggested that the Engineering Aid engineer arrange for the community to engage an architect with

“Engineers without Borders, a group of young professionals involved in development projects, run socially responsible engineers programs through universities, and individuals involved in projects bone up on the language and culture before even booking an airline ticket.

Jeff believes the importance of engineers in developing and disaster regions can’t be underestimated. Doctors are sent to fix health problems. Engineers go to design ways to improve the quality of life and avoid the health problems in the first place.

“This was brought home to me when I provided engineers to work with Rwandan refugees,” says Jeff. “The situation was the equivalent of the population of Brisbane moving overnight to Albury. The infrastructure of the area was completely overwhelmed. The Rwandan crisis to me was depicted in a television picture of a small girl sitting beside a pool of black water and drinking from it with a tin can. If the cameraman had gone back the next day the small girl would likely have been dead. It portrayed to me the need for engineers in emergency situations providing clean water, sanitation and shelter, the very essentials for our survival. Engineers are needed for every aspect of any society, including refugees.”

“Improvise is invaluable in problematic circumstances where one has to innovate out of nowhere. Engineers are practical and can do things pretty quickly and easily with the normal skills set of some engineers but engineers improvise--and often in an integrated manner...solutions to safe water problems should be socially accepted and locally organised. Our projects are designed to use minimal capital and to work within village economies, without distorting the social structure by adding to the problems of graft and corruption that have often been associated with foreign aid.”

Dr Rodney Care, RedR director, CEO and chairman of ARUP Australasia and adjunct professor at UNSW, says it is the project management skills of engineers that make them invaluable in problemistic circumstances where one has to improvise.

“The supply of food, water and sanitation doesn’t fit with the normal skills set of some engineers but engineers are practical and can do things pretty quickly and easily with guidance,” he says. “An acoustic engineer wanting to volunteer for RedR would not be greatly useful as an acoustician. But his skills to manage projects would be.”

Nonetheless, it requires special people and specific interpersonal skills to succeed in difficult circumstances. No RedR volunteer is sent into the field without appropriate training, particularly in cross-cultural differences and stress management.

Engineers Without Borders, a group of young professionals involved in development projects, run socially responsible engineers programs through universities, and individuals involved in projects bone up on the language and culture before even booking an airline ticket.

As an industry we are one of the last to project ourselves as people who care.
Engineers in Emergencies

Armed conflict, drought, famine and other serious disasters create emergencies in which large numbers of people require urgent help. Engineering in Emergencies is a practical handbook for all relief workers involved in giving humanitarian assistance at such times.

Engineering without Borders

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The events of Beaconsfield were an extraordinary display of mining technology, people skills and mining engineering ingenuity. Professor Bruce Hebblewhite, Head of the School of Mining Engineering, reflects on the advances in mining that helped to make this rescue operation possible.

“Many of the things they did in Beaconsfield would have required one-off engineering. A lot of the technology employed has been around for years but not necessarily in the way it was applied in this situation.

We saw various forms of drilling technologies, from well-targeted directionally controlled pilot bore holes, through to the large raise-bored holes which provided the eventual escape route. Raise-bored holes have been used in the mining industry for quite some time, but mainly for generating large diameter holes for ventilation and access, usually vertically, during routine mine development.

In mining technology, we saw the use of infrared cameras that could be put down bore holes as heat-sensing devices. We also saw a focus on the importance of mining communications systems. In the broader field of mining communications technologies, Australia really leads the world. Huge strides are being made in novel communication systems, with ultra-low frequency electromagnetic signals that use the rock as a transmission medium so that with large antennae on the surface or another appropriate location you can provide a communications network to all parts of a mine.

Underground mining, particularly metaliferous mining, is a three-dimensional operation – very complex, as seen in some of the graphics and animations produced. Mine excavations exist as multiple openings in a range of different directions, on different vertical levels of the mine. These require a high-level surveying capability and complex computer modelling of the ore body and mining geometries. In this technology field, again, Australia leads the world with mining-related software products used for planning, design and operations reconciliation.

Mining engineering ingenuity was able to bring all these elements together to direct an appropriate rescue strategy while dealing with different rock types and mining environments.

The events were also a tremendous testimony to the ‘people’ aspects and skills within the mining industry. Apart from the amazing resilience of the two miners rescued, we also saw consideration of the much more recent developments in non-explosive fragmentation – using expanding grouts or gases to expand and fracture rock.

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School of Chemical Sciences and Engineering

Treating wastewater with top technology

The UNESCO Centre for Membrane Science is participating in a €6 million European Union research project to accelerate the use of membrane bioreactors for urban sewage treatment.

Membrane bioreactor (MBR) systems are considered state-of-the-art technology for treating municipal wastewater. MBRs treat the wastewater to a very high quality that surpasses the stringent EU requirements for discharge or water reuse. The technology is suited to either highly urbanised centres with ageing infrastructure as well as parts of the EU that require new infrastructure.

The Berlin Water Authority is the lead European agency on this project, titled “AMDEUS” – Accelerated development of membrane bioreactors for urban sewage treatment. It is coordinating research and development activities in seven EU member countries.

The Commonwealth Department of Education, Science and Training funds the UNESCO Centre’s involvement in the project through an International Science Linkage grant.

The Australian node of the project is led by Greg Leslie, an Associate Professor in Chemical Engineering and Industrial Chemistry and the deputy director of the UNESCO Centre. The UNESCO Centre is coordinating input from Australian Universities, including the University of Technology, Sydney and major water utilities such as Sydney Water, the South Australian Water Corporation and United Utilities Australia.

The role of the Australian team is to develop a computer model for the design of large scale MBR plants. The innovative software will account for both kinetic parameters as well as the complex hydraulic conditions that exist in MBRs.

By developing software to model residence time distributions in these reactors it will be possible to optimise the size of civil structures and mixing systems and identify which types of membranes promote uniform mixing and flow distribution.

To achieve this the centre will use computational fluid dynamics (CFD) techniques to construct a combined hydraulic-kinetic model for MBR design. The software will be developed and calibrated on recently installed MBR plants in Sydney (North Head), South Australia (Victor Harbor) as well as facilities in France and Belgium.

The outcome of the research will be a technique that will reduce the capital cost of MBR tankage and energy cost associated with mixing. This will allow communities to reduce the cost of producing high-quality reclaimed water that can be reused and recycled – an important factor for urban, rural and regional Australia.

School of Civil and Environmental Engineering

Managing our coastal zones

Land development in Queensland has had a dramatic impact on the growth of a potentially toxic organism that threatens coastal waters, according to a team from the Centre for Water and Waste Treatment.

Centre Director, Professor David Waite, ARC post-doctoral fellow Andrew Rose and PhD student Aurelie Godrant spent part of summer “cruising” on the Great Barrier Reef with colleagues from the Australian Institute of Marine Science in Townsville.

The ARC Discovery-funded project in which they were involved is focussed on investigation of development on growth of the cyanobacterium Trichodesmium that grows in coastal waters and is critical to the nitrogen balance in these waters.

Of particular interest is the manner in which this organism acquires the key trace nutrient, iron, an element fundamental to both photosynthesis and to the ability of this organism to obtain nitrogen from the atmosphere. It is now recognised that land management practices can modify the supply of iron to coastal waters and, in so doing, dramatically alter the ecology of these highly sensitive regions.

The project possesses an international flavour as Aurelie is undertaking her doctoral studies through a cotutelle programme at both UNSW and the Université de Bretagne Occidentale (UBO) in Brest on the west coast of France. Andrew is spending part of his time working with collaborators at the Woods Hole Oceanographic Institution (WHOI) on Cape Cod in Massachusetts.

Field work on the Great Barrier Reef is being complemented by laboratory investigations at UNSW, at UBO and at WHOI of factors controlling iron supply to Trichodesmium and other organisms of interest such as the fish-killing organism, Chattonella.

New insights into how these organisms acquire vital nutrients will assist in understanding how changes to the environment influence their growth. This knowledge will, in turn, help develop better approaches to managing our coastal zone so that we neither induce unwanted blooms of dangerous organisms nor limit growth of those critical to a healthy environment.
A 22-year-old computer engineering student from the University of New South Wales has devised a simple iconic language that will help teach children the basics of programming.

Thomas Legowski is the brains behind FUNSoftWare, an iconic programming language which he plans to release as a free open source project.

Robobal, an iconic language which is widely used in schools and international competitions to program Lego robots, was the starting point for the project.

Thomas and his supervisor Eric Martin established a list of all the features that could be improved, and spent a few months coming up with a new design that would provide kids with an easier tool to learn programming.

“Thomas did a fantastic job,” says Eric Martin. “FUNSoftWare allows a first approach to programming that is fun, effective and rigorous,” he says.

“Based on the reaction of potential users, it promises to become popular worldwide.”

Professor Paul Compton, head of UNSW’s school of Computer Science and Engineering, believes FUNSoftWare will help teachers as well as students.

“Learning programming in school can be a big turn-off as it is very difficult to find programming tasks that are easy enough for school students to manage yet interesting and challenging,” he says. “Lego robots and FUNSoftWare are one way around this.”

The University of New South Wales this year hosted the national finals of Robocup Junior and will do so again this year. The software is currently being trialled in a NSW high school.

“Another important feature is that the program doesn’t allow its users to commit illegal steps along the way. This results in a program that is free of syntax errors. FUNSoftWare also has a layout manager that automatically comes up with a great layout of the program at all times. This efficiently teaches kids the importance of good layout, especially for debugging purposes.”

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School students have taken to FUNSoftWare.

School of Computer Science and Engineering
Putting the fun back in programming

Pre-recorded CD lectures could see an end to the days of frantically scribbling notes in the classroom.

The School of Electrical Engineering and Telecommunications has successfully trialled CD lectures that feature an electronic whiteboard with the lecturer’s handwritten notes and a video of the lecturer explaining each point as it appears on the screen.

The novel teaching method was introduced to third-year undergraduate students in Signal Processing and Transform Methods and to postgraduate students in Speech and Audio Processing last year.

Associate Professor E. Ambikairajah, who developed the teaching tools and ran the trial and subsequent student survey, said 75 percent of students found the pre-recorded CDs provided a more efficient way of learning in comparison to live lectures.

“Ninety-six percent of the students liked the fact that they could review the CD-based lectures at their own pace to improve their understanding.”

“And eighty percent of the students felt they learnt more through the use of CD-based lectures.

The CD lectures are designed to be followed up with a face-to-face classroom discussion period in which any questions can be raised. Seventy-five percent of undergraduate students and 50 percent of graduate students agreed that they had more opportunities to ask questions in classes having watched the pre-recorded lectures than in live lectures without the CD.

“Overall, students found the pre-recorded lectures to be very helpful towards their learning experience,” says A/Professor Ambikairajah.

“Lectures were considered worth attending, although students wanted class discussions (as opposed to lectures) to complement the use of the CD.

Students recommended the use of pre-recorded lectures for other courses within the school. There was no great difference between graduate and undergraduate students. Both groups have found the CD lectures equally helpful.”

More than 900 engineering students filled the Clancy Auditorium at the beginning of Session 1. They were the first class in a new Faculty-wide Design and Innovation course – a cornerstone of the new flexible first-year program introduced in 2006.

ENGG1000 Design and Innovation introduces the principles and methods of engineering design, with an emphasis on creativity and innovation, through hands-on activities and engineering projects. It also helps students gain skills in written expression, introduces the way a professional engineer works and helps students learn to use information resources effectively. And it provides a team-based environment in which students experience and learn about collaboration. This student-centred learning is valuable in itself and a fine platform for later studies.

“On that first Tuesday it was exciting to see so many of the new engineering students in one place. But even more exciting was the Impromptu Design activity, also for 900 students, that ran the following Thursday,” says course coordinator Robin Ford.

“Working in teams of eight, the whole class confronted a design task in the very first week of their studies. The task was to produce a device to deliver 50ml of water in an open plastic champagne glass from a height of 2.5m, using a kit of common items such as balloons, plastic bin-liner, paper, sticky tape and string.

In just two hours, each team worked through the classical stages of design, identifying the problem, creating ideas, selecting a design, building their inventions and seeing them tested on the Physics Lawn. It was a carnival day that showcased the creativity, teamwork and skills of our first-year students for 2006.

“Not everything in ENGG1000 will happen in such a large class. To provide diversity, students will do most of their work in classes run by nine of the Schools of the Faculty,” says Robin.

“In each class the work will be project-based, centred on a task relevant to that particular engineering stream. There are 13 projects that range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable range from a solar-powered device to climb a vertical rope, a sustainable
School of Mining Engineering

Simulating flow with greater accuracy

New software that will model particle flow in block caves and sub-level caving is being developed by a former alumnus of UNSW, now a senior lecturer in the School of Mining Engineering.

Dr Glenn Sharrock, a former Coop scholar, has joined the school after years in industry to develop Cave-Sim™, a new particle flow code to help analyse the performance of different cave layout operations.

“Block caves and sub-level caving mines are now operating at much greater depths and in stronger rocks than ever before,” says Dr Sharrock.

“The rules of thumb and tools for design and layout of these mines were not developed for these environments, and the resulting cave designs are often in conflict with the operational and geotechnical requirements for large-caving operations in moderately to highly stressed environments.”

The Cave-Sim™ modelling package enables full integration of economic parameters and geological models into a three-dimensional flow model of an operating cave.

The change in technology has been made possible by the use of the Cellular Automata (CA) mathematical technique, instead of the traditional Discrete Element Method (DEM) or Finite Element Method (FEM).

Cave-Sim™ builds on the principles of CA while newly introducing particle friction, particle size distributions and stress into three-dimensional cellular automata.

“I’m playing around with coupling this software with FEM and DEM so you can model rock breakage and flow in a full working model of the actual mining operation,” says Dr Sharrock.

“The advantage of Cave-Sim™ over other techniques is its ability to efficiently simulate the dynamics of large numbers of particles, for long simulation times, in a matter of hours.

“Apart from advantages of simulation size, complexity and duration, the method is readily calibrated against observed site or problem-specific behaviours, which are represented as fundamental rules in the simulations.”

“The development of these rules and further application of Cave-Sim™ are presently underway.”

Dr Sharrock has established the UNSW Advances Numerical Modelling in Mining Geomechanics group which is comprised of academics and industry members with an interest in this area. It is expected to spearhead a dynamic new direction for research within the School of Mining Engineering.

It’s estimated that 7 billion tonnes a year of carbon dioxide emissions come from human activity – the main contributor to greenhouse effect on global climate change.

Australia’s coal-fired power stations produce about 70 percent of the nation’s total installed electricity generation capacity and emit about 190 million tonnes of CO₂/year.

One proposed method for reducing how much of the greenhouse gas ends up in the atmosphere is to store CO₂ in geological formations. There are currently three options for geological disposal of CO₂: depleted oil and gas reservoirs, unmineable coal seams, and saline formations.

In the design of an underground CO₂ disposal site, one must assess the capacity and ability of the proposed geological formation for the injection and storage of CO₂. Typical concerns that arise in a CO₂ disposal project are whether the proposed geological structure has favourable properties that allow the injection of the proposed volume of CO₂ for a certain period and whether the injected CO₂ will stay in there without any leakage. Answers to such questions can be sought by means of numerical simulation of simultaneous flow of CO₂ with the existing fluids in deep geological formations.

A part of the collaborative research at the School of Petroleum Engineering with the Cooperative Research Centre for Greenhouse Gas Technologies (CO₂CRC) aims to focus on numerical simulation of CO₂ disposal in potential Australian sites.

Simulations are run for short-term and long-term movement of CO₂ in underground structures. The short-term simulations analyze the injectivity of CO₂ into the potential formation, the migration of CO₂ towards the trapping structure which is governed by viscous, gravity and capillary forces, and also some technical issues such as how many injection wells and well spacing.

The long-term simulations investigate the post-injection movement and stability of CO₂ plume created in the formation and effects of different mechanisms on entrainment of CO₂ such as capillarity, dissolution of CO₂ in local fluids, and chemical interaction with rock matrix.

School of Petroleum Engineering

Simulating Underground Disposal of CO₂

China’s star lights way for solar

Day one of Suntech Power’s float on the New York Stock Exchange and the excitement is palpable. By day’s end, the share price has risen 41 percent, raising US$376 million for the fledgling Chinese player in the booming solar industry.

This is good news for the ARC Centre of Excellence in Advanced Silicon Photovoltaics and Photonics. It is closely associated with the Wuxi-based operator, one of the world’s most successful and fastest-growing photovoltaics companies.

Suntech and UNSW are about to launch a new solar cell technology that will overcome a fundamental weakness of cells that have been on the market for the past 20 years. Much light is wasted from the top surface of most commercial solar cells because of their grid formation.

“The new technology provides a way to eliminate the dead layer through the use of semiconductor fingers which make good contact to the metal grid and carry the generated current to where the metal is located,” says award-winning researcher Professor Stuart Wenham, a Scientia professor who consults at Suntech.

The Centre’s international reputation grows stronger all the time. In February, two high-profile leaders took time out from their tight schedules during the Climate Change conference to learn more about UNSW’s work.

Chinese Secretary General of the State Council Hua Jianmin and US Secretary for Energy Samuel W. Bodman made separate visits to meet senior UNSW staff and explore the photovoltaics laboratories.

The centre’s growing reputation in China also prompted visits from a World Bank Global Environment Fund delegation who are working on a China Renewable Energy Development Project and a separate delegation from Shaanxi Province.

Head of the School of Photovoltaics and Renewable Energy Engineering, Dr Richard Corkish, also met with Science and Technology Minister Xu Guanjia during his stay in Sydney.

“We’re delighted that leaders of the two of the world’s most powerful nations recognise the leading position of the Centre – and the role that solar energy is playing in the world today,” says Dr Corkish.

“The solar energy market is booming in places like Germany and Japan and China is about to become a powerhouse for the production and use of solar cells – due in part to UNSW technology.”

Hua Jianmin (left) on a visit to the Photovoltaics lab.

Stuart Wenham, a Scientia professor who consults at Suntech.
School of Surveying & Spatial Information Systems

Open source GPS receiver makes design flexible

A team from the School of Surveying and Spatial Information has developed the first open-source reconfigurable GPS receiver.

Based on Altera’s Cyclone FPGA, the Namuru receiver allows for more flexible design. Users can download the UNSW design and build their own GPS system for specialist use. Alternatively, they can purchase the UNSW system and adapt it accordingly.

“We believe it will be a very good platform for research development and specialist applications,” says Associate Professor Andrew Dempster.

“You can change the nature of the digital circuitry, making it easier to design your own specialised GPS receiver. Our UK company is interested in using it for automotive design,” he says.

“We believe the Namuru will also be of great interest to hobbyists. People want to position all sorts of things from pets to model aircraft.”

The Namuru receiver allows for more flexible design. Users can download the UNSW design and adapt it accordingly.

Current Role: I am currently the National Operations and Systems Manager at Bilfinger Berger Services (BBS), the services arm of the Bilfinger Berger group of companies.

Interests: I maintain a strong interest in supporting the engineering profession. I was the former Chair of Young Engineers Sydney and am currently a Director on the Centre for Engineering Leadership and Management’s national board. I am also a Director on the board of Engineers Without Borders.

Photo courtesy of Eva Hanly.

Where in the world?

Eva Hanly
Graduated: BE (Hons)/BA (International Relations), 2001.
Career Highlights: While I was still studying engineering, I worked at Thess Pty Ltd part-time and during my holidays. I joined Thess when I graduated and was promptly relocated from a comfortable office in Sydney to an underground coal mine. This was something I thought may be challenging but definitely not where I had seen myself working! However, after I settled in, I found it to be one of my most memorable times in my career to date and I met some wonderful people. The camaraderie and teamwork when everyone is living away from home is extraordinary and I got my “site experience” which is something I recommend to all engineers, even those like me who are more interested in business operations and management. I have also worked on major projects in civil engineering, telecommunications and building, with Thess and later Multiplex.

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Photo courtesy of Eva Hanly.

Graduate profile > Dr Chris Roberts

The Australian biomedical industry is unusual on a few counts. It is blessed with the ability to manufacture in Australia yet compete admirably on the world stage. And it boasts a tight-knit group of professionals, many of whom trace their connections back to UNSW.

The career of Dr Christopher Roberts, Cochlear’s chief executive officer, is a case in point.

Chris completed an undergraduate degree in Chemical Engineering in 1975. It so happened that Professor Peter Farrell, the founding director of the Graduate School of Biomedical Engineering, was then lecturing in Chemical Engineering on artificial kidneys.

Chris wrote his final-year thesis on artificial kidneys. Rather than finding work as a chemical engineer, he opted for a position with Domedica, a company importing artificial kidneys and part of the Nucleus Group of companies established by industrialist Paul Trainor, the so-called “father” of the biomedical industry.

“The concept that you could keep someone alive using fundamental chemical engineering principles was just so exciting to me,” says Chris, who soon found that he thoroughly enjoyed every aspect of the biomedical industry.

Having completed an MBA to boost his business skills, Chris returned to study at UNSW, this time doing a PhD with Professor Farrell and his successor Professor Klaus Schindhelm.

Armed and ready, Chris took off in 1984 to the US to run another Paul Trainor company, BGS Medical, which offered implantable electrical devices to stimulate bone growth.

He stayed in the US until 1989. He had a brief stint with the Nucleus Group back in Sydney, before spending time with Teletronics company in Paris (By that stage Paul Trainor had sold his Nucleus Group and Teletronics companies to Pacific Dunlop – and Dr Colin Sutton another UNSW alumnus was running Teletronics in Europe).

He left in 1992 to join Peter Farrell at ResMed, who provides breathing apparatus for sleep disorders. Chris had been one of the founding directors but had never worked fulltime in the company until then.

My connections go way back. My wife has two degrees from UNSW and my daughter is completing her final year there.

Between work, his wife and four daughters and travelling up to 40 percent of the year, there is little time for leisurely pursuits. Not that Chris minds. He feels there is much more work to be done in creating greater awareness of the marvels of implantable devices, and specifically of the opportunity to provide hearing to tens of thousands of new patients each year.

“And it’s exciting dealing with the leaders in the field globally,” he says. Not bad for a lad from UNSW.

Chris Roberts has come full circle, working with the man who inspired his career and through whom he met many other alumni also associated with the inspiring Paul Trainor.

“1’ve certainly had a close association with UNSW throughout my career – as has Professor Anne Simmons [now head of the Graduate School of Biomedical Engineering] who worked at Domedica.

“My connections go way back. My wife has two degrees from UNSW (BA LLB) – she was known as Maxine Wills then. And my daughter Charmaine is completing her final year Commerce/Law degree there.”

At Cochlear, which Chris joined in 2004, he has turned the business around. “The business fundamentals are great,” he says. “There is a large unmet clinical need, the technology works brilliantly and Cochlear is the undisputed global leader in the cochlear implant field.” In addition there are many opportunities to add other implantable devices for the hearing impaired.

My connections go back. My wife has two degrees from UNSW and my daughter is completing her final year there.

PhD – Paul Trainor (life engineering implications of cochlear implantation)

He's been there from the beginning.

Photos courtesy of Dr Roberts and Cochlear.com.
please stay in touch
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Telephone +61 2 9385 4023 > Fax + 61 2 9385 5456 > Email unswengineers@eng.unsw.edu.au

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