

RESEARCH | INSIGHTS



Future Trees

Inside

- Western Sydney Growth
- Larrikins Go Global

RESEARCH | INSIGHTS

The University of Western Sydney is a major metropolitan institution with a strong and growing reputation and standing for its research.

The Australian Universities Quality Agency has described UWS as 'a university of the people', a term that UWS embraces and continually strives for. UWS is a major driving force in its region, as a vital hub for new knowledge and innovation – making a difference to the lives of individuals, businesses, government bodies and communities within Greater Western Sydney and beyond. This extends across all aspects of the University's portfolio, and particularly emerges from our high-impact research.

UWS's research portfolio has grown rapidly over the last decade. This publication presents a snapshot of some of our most interesting and worthwhile recent research successes.

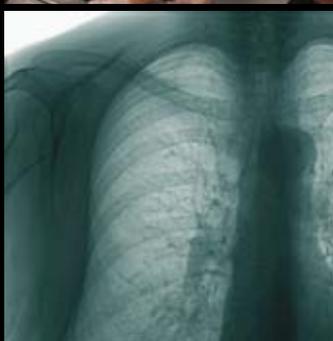
The stories cover a broad range of disciplines and activities: from climate change and exciting applications of nuclear magnetic resonance, to finding gender differences in experiences of pain, through to engaging children in research and improving hospital workflows. It is a diverse collection that I am sure you will find of great interest.



Vice-Chancellor Janice Reid AM

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FUTURE TREES

UWS's Hawkesbury Forest Experiment (HFE) is helping Australia to tackle climate change by showing how industry can best adapt to future environmental conditions as well as how successfully forests will be able to help reduce levels of carbon dioxide (CO₂) in the atmosphere.

This large-scale experimental facility features 10-metre high chambers that each enclose a eucalypt tree in a sealed environment. Researchers from the Centre for Plants and the Environment (CPE) can control variables such as CO₂, temperature, light, soil conditions, nutrients and water to test climate change scenarios.

The data that the HFE is producing is invaluable to policy-makers, the forestry industry, conservationists, researchers and the growing number of businesses engaged in carbon accounting. Australia's forestry industry is worth \$2.2 billion and eucalypts are a major feature of the nation's landscape. Meanwhile carbon accounting will require accurate information on sequestration in forests.

The HFE is yielding answers to such questions as:

- How fast- and slow-growing eucalypts respond to different combinations of drought, pre-industrial and future CO₂ emissions, and increasing day and night temperatures
- How much carbon can be captured by forest soil and the microbes that live there, taking account of drought and elevated atmospheric CO₂.

CPE research has found eucalypts that may use about 20% less water than today's eucalypts in the climate conditions that can be expected 40 years from now. Less water-use in the future would reduce the conflict that is currently found between sustainable water management and growing trees.

Forestry and catchment managers and hydrologists regard the HFE as providing 'amazing results you could not get any other way', according to Professor David Ellsworth, one of the key researchers behind the HFE.

'The tree chambers are grand technologies that really excite people,' David says. 'They enable us to approach climate change in forests scientifically, without



waiting for it to actually happen in the real world.'

The HFE was established in 2005 but UWS has been investigating CO₂ in forests since the early 1990s, when Professor Jann Conroy, now an emeritus professor, produced its initial paper on CO₂ fluxes in trees. CPE researchers have produced more than 100 publications on climate change since 2001.

Alongside experiments and publications is a busy schedule of meetings with end-users and advice to governments. David, for example, gives invited presentations to diverse groups at a rate of more than one a month. The first results from the HFE's operation have been internationally published and the CPE has also advised the Intergovernmental Panel on Climate Change.

The CPE is internationally recognised and has attracted some of the world's most highly cited researchers in the field. David was one of these, drawn

from the USA specifically by the potential of the HFE.

The Australian Government in 2009 granted UWS \$40 million to expand the HFE and establish Australia's first forest Free Air CO₂ Enrichment (FACE) facility, which can expose hundreds of native trees in a realistic environment to elevated CO₂. The grant will also fund the construction of eddy covariance flux towers, to measure exchange of carbon and water by ecosystems spread over more than three square kilometres of woodland and paddocks at Hawkesbury. The result is a National Environment and Energy Research Facility which involves all five public universities based in Sydney, the Australian National University, the NSW Department of Industry and Investment and the Swedish Agricultural University, working with a growing network of researchers and users.



LISTENING TO EXPERIENCES WITH ANOREXIA

When UWS's Centre for Educational Research (CER) began a major study of teenage girls with anorexia nervosa and their families in 2002, there was no research on the subject despite Australia's relatively high levels of anorexia, the average seven-year duration of the illness and the crucial role that families play in recovery.

The CER study, led by Professor Christine Halse, was based on interviews with teenage girls who were suffering with anorexia, and their families. It led to a book – *Inside Anorexia: The experiences of girls and their families* co-authored by Christine, Dr Anne Honey, and Dr Desiree Boughtwood. Aimed at the everyday reader it broke new ground in using the biographies of families with different experiences of anorexia as the framework for discussing a comprehensive range of information drawn from a variety of disciplines.

'The most gratifying outcome from the book has been the letters we have had from families,' Christine says. 'But our research has also led to significant changes to clinical practice. Clinicians are now trying to tune into how young girls with anorexia and their parents see things.'

For clinicians it was a revelation, for example, that some girls with anorexia regarded undergoing force-feeding as an affirmation that they were 'good anorexics', and viewed the feeding-tube as a 'badge of honour'. The project has also enabled schools to think through issues around health, diet and well-being more sensitively, and to realise that the messages that they and parents present are interpreted differently by teenagers.

New approaches to research ethics were needed in the project to address the difficulties of working with people who are chronically ill and their families.

'There were many theoretical and epistemological issues that did not fit the biomedical view of ethics,' explains Christine. 'This population is very vulnerable, many girls do not recognise their diagnosis, and discussing the experience of anorexia can be very traumatic. We had to work out how to capture girls' voices and experiences while also ensuring we were sensitive to these issues.'

The team developed a technique of 'recurrent consent' throughout interviews to ensure that participants were happy to continue. This has since been taken up in other qualitative research by adolescent medicine units in the research partner hospitals. The paper describing the ethical issues of working with girls with anorexia was published in a special issue of the prestigious journal *Signs: Journal of Women in Culture and Society* and was reproduced by Routledge in a handbook on the latest

advances in qualitative research methods.

Girls and their parents whose family biographies appear in this book were also invited to read a draft of their story. In doing so Christine was very conscious that only about 50 per cent of people diagnosed with anorexia recover and those who did had to be treated with respect if they wanted to put the experience behind them.

As a result of this work, CER has become a member of the National Eating Disorders Collaboration and a hub for research that brings together eating, the body, health and education.

The project was funded through a three-year ARC Linkage grant, in collaboration with the Centre for Digestive Diseases and the Children's Hospital Education Research Institute. Participants were recruited through the Children's Hospital at Westmead and Westmead Hospital, and the CER has continued to work collaboratively with clinicians and staff in both hospitals.

As well as the book and two book chapters, the project resulted in 11 articles in high-impact journals and eight refereed conference papers. The journals ranged across education, health, medical and social science fields while the book has run to multiple reprints.



ENGAGING CHILDREN IN RESEARCH

Over the last 14 years as a professor at UWS, Jan Mason has been a leader in a movement that is changing the way children are listened to in research, considering them as experts in their own lives.

In November 2009, a decade after a landmark national workshop at UWS on 'Taking Children Seriously', the University hosted a major international conference on measuring and monitoring child wellbeing. The conference was preceded by a symposium that included a presentation by primary school students, facilitated by Dr Ainslie Yardley, an expert in creative methodologies. The children chose as their topic *Concepts of maturity: Some children's views on what adults researching children need to know.*

'When I and my colleagues involve children as research participants we aim to have a real impact on policy and practice in areas of children's welfare and wellbeing,'

Jan explains. 'The voices of children and their ideas are being made known as a result of this research.'

'While adults can have knowledge about children's lives, children themselves are the experts on their lives as they are living them right now. We hope that hearing the voices of children in this way will help those making decisions about children to avoid mistakes about their welfare.'

Children's views can be counter to adults' views in important ways, as Jan and a colleague, Jan Falloon, demonstrated when they asked children and young people what they regarded as abuse. The children's answers were more about inequality in relationships and emotional hurt, than about physical harm. For example, being smacked but not being able to smack back was more significant to them than the physical aspect of the smack. This research was published in an edited book with international

contributions, *Conceptualising Child-Adult Relations*.

Jan leads a theme in UWS's Social Justice Social Change Research Group. She and her colleagues have been at the forefront in finding ways of enabling children to express their views and have them heard, using techniques such as friends-based focus groups, visual prompts and cameras. Those doing the research typically go into a research situation with a 'toolkit' of various techniques from which children can choose.

'We need to find out how best to hear children,' Jan explains. 'As researchers working with children, we need to engage with them and reflect on our own role in the research process. Most importantly we need to bridge the power difference between child research participants and ourselves as adult researchers.'

Partnerships with a broad range of child welfare organisations, government and non-government agencies have been key to the impact of this research. For example, findings from research with the NSW Commission for Children and Young People, on children's views on child wellbeing, were used in developing a policy framework and translated into indicators. In the area of out-of-home care policy, both the research methods and the findings from

a project on which Jan was the chief investigator have, along with the research of others, informed the Office of the Children's Guardian in developing benchmarks to guide practice in NSW.

When she joined UWS from a career in child welfare, Jan had begun to critique the way in which an adult-centric construction of childhood influenced social policy, social work and child welfare practice. She argued that children and their advocates lacked the concepts they needed to assert the validity of children's knowledge of their own lives and their capacity to participate in decision-making.

The conference and symposium marked a milestone for Jan before she formally retired in early 2010. Nonetheless she plans to continue research activities, including as a chief investigator on an ARC Linkage project with the ANU and the Benevolent Society, and a co-author of a book on child wellbeing.



Children from Picnic Point Public School at the 2009 conference on measuring and monitoring child wellbeing

NOT FEELING EACH OTHER'S PAIN

It isn't just a truism to say that men and women are equal and complementary: research by Professor Vaughan Macefield in the School of Medicine on how we process pain has found significant gender differences which disappear in averaged results.

Vaughan, a neurophysiologist, has been studying the human nervous system since 1986 and always sought to have a balance of males and females as research subjects, although in the past he would pool the results. His findings of gender differences emerged after he and his collaborator, Dr Luke Henderson of the University of Sydney, thought it might be interesting to separate male and female results of experiments that they had undertaken to image how the brain processes pain originating in muscle and skin.

Using functional magnetic resonance imaging (fMRI), they found that in certain areas of the brain the response patterns in men and women were almost mirror-images of each other, which meant the patterns cancelled each

other out when averaged. This research was published in the high-profile journal *NeuroImage* in 2008 and has attracted considerable attention internationally.

Pain is multidimensional: it brings about changes in the brain as well as the body. Vaughan and his colleagues more recently published a study in *Experimental Brain Research* in which they show that acute pain causes a decrease in skin blood flow in males, yet an increase in females. And as the idea of personalised medicine gains momentum, knowing that there are significant gender differences in pain processing might affect treatment decisions.

'We and others are increasingly interested in gender differences concerning medicine,' Vaughan says. 'People have been shy talking about genders and races. But it's known that, for example, men and women tend to develop different types of chronic jaw pain and there are differences in disease patterns between indigenous and non-indigenous Australians.'

As Foundation Chair of Integrative Physiology at UWS, Vaughan is interested in how physiological systems work together.

'By conducting experiments in awake human subjects I am holistic in my approach but use reductionist principles (such as recording from single nerve fibres) to guide my research,' he says.

The fMRI experiments were conducted at the 3T MRI facility at Prince of Wales Medical Research Institute, where Vaughan is a Conjoint Principal Research Fellow. He has also been imaging the brain during experimental pain in the 3T scanner at Blacktown Hospital, a major teaching hospital of the School of Medicine.

fMRI is a powerful technique that allows non-invasive imaging of the operation of the brain. When neurones are more active they need more glucose and oxygen, which is delivered by blood diverted into areas of increased neural activity. This results in a change in the signal detected by MRI, due to the paramagnetic qualities of iron-containing haemoglobin in the blood.



PEARLS IN MARINE ADAPTATION RESEARCH

Oysters are a prized shellfish around the world, and nowhere more so than in Sydney. With climate change threatening to make oceans warmer and more acidic, UWS research on how oysters may be affected and the potential for genetic adaptation to mitigate those effects has attracted strong interest globally.

Oysters are the most valuable fishery in New South Wales, accounting for 2000 jobs in rural areas, and nationally the oyster industry is worth \$35 million a year.

Internationally, 4 million tonnes of oysters are produced each year. The ecological value of oysters is even higher than their economic value: oysters filter out particulate material and send nutrients into the sediments of rivers where they are used by other animals.

Despite this financial and ecological importance, little has been known about how oysters

will be affected by climate change and its anticipated effects on water salinity, acidity and temperatures. Significant results in this area have been produced by a research collaboration comprising UWS's Associate Professor Pauline Ross, Laura Parker and Dr Wayne O'Connor, senior research scientist in charge of mollusc research at Industry and Investment NSW.

They found that elevated CO₂ significantly hinders oysters' reproduction and early development and that this was exacerbated when temperatures were warmer. The results were surprising, because oysters breed in estuaries where conditions of acidity and temperature can vary widely, and so it had been thought that they would not be especially sensitive to these environmental stresses at this stage of their life cycles. However, it appears

that oysters want ideal conditions to reproduce.

The team's initial research findings were published in *Global Change Biology*, a high-impact journal, and led to a flurry of interest. Laura, who began this research as part of her PhD studies, went on to win awards for best student presentation at two international ocean climate conferences.

Pauline has undertaken research on oysters since the 1990s and began to examine multiple stresses in barnacle larvae in 2003. At that time, no-one was looking at multiple stresses in oysters. After preliminary work on the UWS campus, she approached the Port Stephens Fisheries Institute, an Industry and Investment NSW research centre. This led to Wayne's involvement.

'We have formed a collaborative team where the strengths of each member are valued,' Pauline says. 'This combination has led to us winning international awards.'

The research program began by looking at the Sydney rock oyster, but globally the oyster industry is dominated by the Pacific oyster, and so Wayne encouraged its inclusion in the program. Within Australia, Pacific oysters are also an important research subject as they are an introduced species

and tremendous efforts are made to contain their spread.

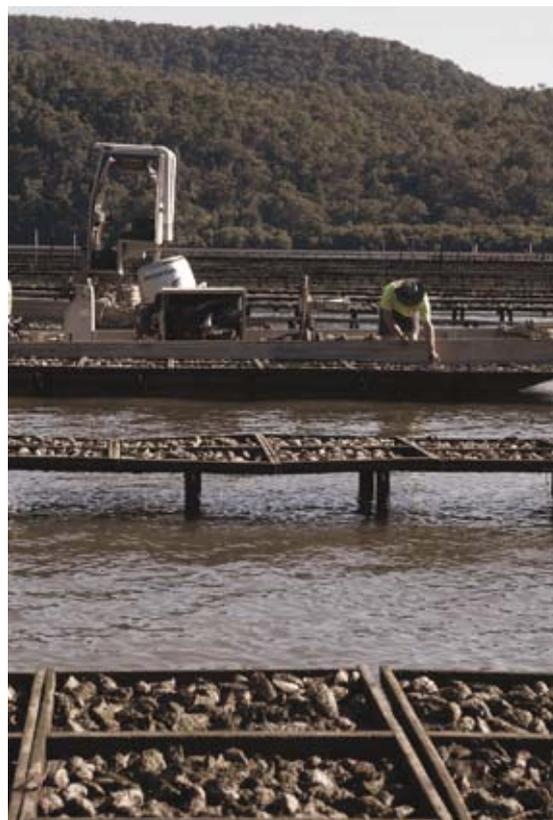
Pacific oysters were less affected by the multiple stresses applied to them than were the Sydney rock oysters. The team then looked at two closely related species: normal Sydney rock oysters and a species bred to resist the oyster disease called QX and winter mortality. These selectively-bred lines were less vulnerable to elevated CO₂, suggesting for the first time that genetic adaptation could lessen the impact of climate change on oysters – and perhaps other calcium-carbonate shelled species as well.

Such is the level of interest in this UWS research that the US National Science Foundation asked for a copy of research that had not even yet been peer-reviewed to present to a US Congress committee.

'What I find especially exciting about Pauline's and Laura's research is that they are working at the coalface, where very little work has been done before,' Wayne says. 'This is really useful research that provides baseline data beginning to show what some of the ecological impacts of climate change might be in estuarine systems.'

Laura Parker was awarded an ARC Discovery Indigenous Researchers Development grant for 2010–11 to undertake Australia's first study on the chronic impact of ocean acidification and whether oysters can adapt over a long time-scale.

Laura Parker (Photo Gary Warrick)



IT'S TRUE: BABIES DO DIRECT THEIR MOTHERS

It is only within the last decade that it has become possible to diagnose hearing impairment within days of birth. This means there is a huge gap in understanding of how parents and other carers communicate in the earliest stages of social, emotional and language development in children with impaired hearing.

Research at the MARCS Auditory Laboratories involving mothers talking to their infants showed that when infants cannot hear properly, mothers adjusted their speech in a way that could hinder language learning. The mothers responded to feedback cues from their infants, not their perceptions of what was good for their baby.

In this research, Christa Lam, a PhD candidate with the MARCS Baby Lab, video-recorded mothers and babies as they played with a toy shark, sheep and shoe. She tested how the mothers said the words 'shark', 'sheep' and 'shoe' – whether the vowels

were hyper-articulated, which is thought to help children learn language, and whether the speech had exaggerated pitch and slowed duration, which helps maintain infant attention.

In the experiments, pitch and duration did not change regardless of how much or little the babies could hear. However, mothers failed to enunciate their vowels as well when their child could not hear them. This means that if a carer has difficulty maintaining an infant's attention, which is often the case with hearing loss, they are sacrificing linguistically relevant information.

Christa arrived at these findings through two experiments.

The first was with year-old twins: one with normal hearing and one with impaired hearing, playing face-to-face with their mother.

The second experiment was with 48 pairs of mothers and babies aged six months, placed in different rooms in the MARCS Baby Lab. The mothers and babies could

see each other using a double video set-up. Christa could simulate normal hearing, moderate hearing loss or profound hearing loss by changing how much sound from the mother reached her baby. In addition, for half the experiment the mothers were told their baby could hear them, and for the other half they were told that the baby could not hear them.

This enabled Christa to test mothers' perceptions of how to respond to loss of hearing compared with feedback from the baby. It emerged that the mothers were not affected by what they were told, which dispelled the myth that mothers respond to a diagnosis of infant hearing loss by communicating differently.

'The most significant finding was that infant feedback drives mothers' behaviours,' Christa says. 'Infants are not passive recipients: they are the ones directing mothers' speech behaviour.'

'Using the double video camera set-up was a stroke

of genius,' explains Christa's doctoral supervisor, Dr Christine Kitamura. 'It came about because we couldn't get enough hearing-impaired babies for a valid experiment, and decided to simulate the presence or loss of hearing.'

This research has attracted international interest from practitioners and researchers. The knowledge gained from these MARCS experiments will feed into interventions taught and used in hearing centres, such as teaching mothers to try to override their responses and enunciate their speech sounds.



PAIN RELIEF FOR WOMEN USING CHINESE HERBS

As many as 50 per cent of women of child-bearing age suffer menstrual cramps that do not have any identified medical cause. Research in UWS's Centre for Complementary Medicine Research (CompleMED) has shown promising evidence that Chinese herbal medicine can help relieve this common condition, called primary dysmenorrhoea.

Treatments used today include painkillers and contraceptive pills. However, many women would prefer non-pharmaceutical treatments and contraceptives do not suit women who want to conceive or are concerned about side effects. Moreover, the failure rate for conventional treatment for primary dysmenorrhoea is 20–25 per cent.

Dr Xiaoshu Zhu, who lectures in Chinese medicine at UWS, established through analysis of 39 clinical trials including a total of 3,475 women that Chinese herbal medicine compares well to conventional medicine, acupuncture and

heat compression for treating primary dysmenorrhoea and does not have significant adverse effects.

This analysis was undertaken for a Cochrane systematic literature review. These are produced and disseminated by The Cochrane Collaboration, an international organisation that aims to make up-to-date, accurate information about the effects of healthcare interventions readily available worldwide.

'A Cochrane systematic literature review has very demanding procedures, especially for statistical analysis,' Xiaoshu explains. 'I undertook this review as part of my PhD study, prior to conducting a double-blind, randomised, placebo-controlled clinical trial on the use of Chinese herbal medicine for primary dysmenorrhoea. The findings from the review definitely provided scientific guidance and confidence for the later clinical trial.'

Her doctoral supervisor, Professor Alan Bensoussan,

founding Director of CompleMED, describes her first study as 'really important research in which Xiaoshu proved that Chinese medicine worked for this condition and that it is feasible to undertake a trial of Chinese herbs where the medicines are tailored but subjects are kept blind as to what they are taking.'

When her study was published on the Cochrane Database, the findings were printed in major newspapers in Australia and overseas, including the *Wall Street Journal* and the *South China Morning Post*, as well as being carried on internet news sites around the world. This strong interest is understandable given the prevalence of primary dysmenorrhoea and the growing demand for evidence bases for healthcare treatments.

Nevertheless, Xiaoshu cautions the quality of trials included in the systematic review may not have been rigorous enough for drawing conclusions.

The high quality of the publication of this study led to Xiaoshu receiving the Bernard Lake award from the University of Sydney's Medical School in 2009. This award is for a publication in a peer-reviewed journal in the preceding two years that is significant original work undertaken in Australia in complementary medicine, holistic medicine, exercise rehabilitation, nutraceuticals, aromatherapy or a multi-disciplinary whole-patient approach to medical problems.

The Menstrual Disorders and Sub-fertility Group, one of international groups for the Cochrane Collaboration, also offered Dr Zhu an editorship.



POPULATION RESPONSES TO POTENTIAL DISASTERS, PANDEMICS AND TERRORISM

Understanding how populations might respond to pandemics, terrorism, drought, bushfires and climate change has become a major public policy concern over the past decade – and this is an area in which UWS has developed unique understanding.

UWS's Disaster Response and Resilience Research Group (DRR) has carried out surveys leading to high quality, broad-based data sets and survey tools that measure how the public perceives hazards and has modified, or would modify, behaviours. With funding from Emergency Management Australia and NSW Health, the Group has developed a survey module called SAFE – Secure Against Fear Exposure – that can reliably measure population responses to threats.

SAFE was included in the NSW Adult Population Health

survey in 2007 and late 2009, with the other health survey components. SAFE questions can be repeated over time, are positioned in the context of health and need not be driven by specific events. The survey covers a representative cross-section of the State's adult population, so the research team can assess patterns of characteristics such as employment status, gender, culture/linguistic group and age and how responses vary across these groups.

The results of this research can be used to plan responses to potential incidents or threats. These survey findings have also informed the development of emergency management training and information kits for emergency workers, such as pocket incident response cards that the research team developed with funding from

the National Security, Science and Technology Unit of the Australian Government and other emergency agencies.

The pandemic component of the SAFE survey showed that vaccinations were widely acceptable but that respondents were much less willing to wear facemasks. Young adults were particularly disinclined to wear facemasks. Senior Research Fellow Dr Melanie Taylor has further progressed the understanding of how human factors or behavioural aspects of biosecurity relate to responses to pandemics and has extended her studies into animal epidemics, such as equine influenza, and their human impacts.

'These surveys have shown that people do consider such threats, what they would do in response should they be likely

to occur, and indeed some have already made changes to their lives because of this,' the leader of the Research Group, Professor Beverley Raphael, explains. 'These findings are important in providing baseline data for ongoing planning and against which any subsequent reactions and behaviours can be assessed.'

NSW Health's support for this research extended to providing a researcher, Margo Eyeson-Annan.

A variant of SAFE focuses on threats of terrorism. Results will help disaster responders better understand individuals' behaviour, such as willingness to evacuate if requested.

'Detailed information about the views and potential responses of sub-groups within this threat context remains rare internationally,' says Garry Stevens, a UWS Adjunct Senior Research Fellow.

This work has extended to the development of resources to help emergency responders to deal with psychological aspects of terrorism and disaster response.

'People being surveyed were surprised sometimes by terrorism and drought questions', Melanie recalls. 'Nevertheless they saw it as important that their views were being sought. We see real benefits in having good psycho-social baseline data regarding these threats.'

<EXIT>



TRACKING TB THROUGH CROSS DISCIPLINARY BREAKTHROUGH

A chance conversation in 2002 led to Andrew Francis, an associate professor with UWS's School of Computing and Mathematics, and Dr Mark Tanaka from the University of NSW's Evolution and Ecology Research Centre embarking on a collaboration to take advantage of the rich biological data that has become available in recent years. Their research has resulted in new approaches to tracking one of the world's most widespread diseases, tuberculosis (TB).

Biology does not use mathematics nearly as much as physics and chemistry do. New tools and techniques have generated a wealth of data but analysing this requires a high level of statistics and mathematics.

Andrew and Mark brought their combined expertise to bear on investigating the progress of TB outbreaks using molecular markers. Because bacteria change constantly, the history of an outbreak can be

mapped in a tree diagram that shows the number of people with a particular bacterial genotype at a point in time. The collaborators, together with a postdoctoral fellow, worked back along this tree.

'Before we began this work there had been primitive measures of how bad an outbreak was,' Andrew explains. 'A 'bad outbreak' was regarded as accounting for a large proportion of the total number of cases. If there were many patients with a particular genotype that was thought to mean a fast spreading variety. This was simple and intuitive but it actually didn't reflect whether the cluster was from a rapid spread over a short time or from a slow mutation that had been spreading for a long time.'

Andrew and Mark developed a method for telling whether one strain of TB is spreading faster than another. Their first publication on this subject appeared in the high

quality journal *Proceedings of the National Academy of Sciences (PNAS)*. It also was cited very quickly in a TB textbook and the research team has seen usage of the previous approach decline.

In 2008 their methodology was published on the web to maximise dissemination to public health bodies, researchers and practising biologists. It has diverse applications, being taken up by microbiologists testing their data, for example.

Their next target was the growing problem of resistance to TB drugs. The key idea was to model transmission by looking at the contemporaneous mutation of the genotype of strains that are either sensitive or resistant to drugs. Bringing together an interdisciplinary team including their postdoctoral researcher Fabio Luciani and statistician Scott Sisson, Mark and Andrew applied a complicated simulation model to data from Venezuela, Cuba and Estonia, where mutant strains of TB are prevalent.

This research, also published in PNAS, overturned the view that strains that gain drug resistance lose some fitness relative to other strains, which would hinder their spread. 'We estimated that the fitness cost of drug resistance is mild, which is alarming,' Andrew says. 'The resistant strains

are spreading at a similar rate to the drug sensitive strains and are evolving a kind of compensation for the fitness cost they have acquired.

'This makes for a very transmissible bacteria that cannot be treated – and TB is a very deadly bacteria if it's untreated.'

The other major finding was that person-to-person transmission accounts for most appearances of resistant strains, rather than treatment failures in which the bacteria develop resistance. This suggests that health policy-makers and clinicians should place more emphasis on reducing the rate of transmission.

'My dream is to find good biology problems that I can use algebra in,' Andrew says. In 2009 he and Mark began a five-year ARC Discovery Project called 'Mathematical models and bioinformatic analyses of bacterial genome evolution', looking at evolution processes of bacteria in general.

Andrew and Mark developed a method for telling whether one strain of TB is spreading faster than another ... their first publication on this subject appeared in the Proceedings of the National Academy of Sciences.



Dr Andrew Francis

REDEFINING WORKPLACE BULLYING

Ground-breaking research from UWS is changing understandings of what bullying really is and how it is able to continue in organisations.

A major study of bullying in the nursing profession by a team from the Family and Community Health (FaCH) Research Group broke new ground internationally in its analysis of the systemic nature of bullying.' The findings can relate to any large organisation, especially hierarchical ones.

Earlier research on the subject was largely based on psychology and focused on individuals or small groups. The result was a typecasting of bullies and targets and a widespread perception that the problem was about interpersonal conflict.

'It is much more complex,' states UWS Professor of Management Margaret Vickers, who led the project. 'This means it is not enough for an organisation to have anti-bullying policies and training.'

The researchers argue that bullying in organisations is a form of corruption as it involves individuals misusing their position and access to resources for personal power and political gain.

'The use of power in organisations was one of the most interesting aspects of our work,' explains Professor Debra Jackson from the School of Nursing and Midwifery, who leads the FaCH Group. 'Organisational contexts can allow bullying to happen and to go unchecked.'

Patterns emerged in interviews that led the researchers to identify 'predatory alliances' of people who protected, promoted and supported each other. These alliances were often invisible and were a major antecedent of bullying.

The team also identified 'circuits of power' running through organisations.

Legitimate processes in performance and change management can be used

in bullying, for example by moving targets out of a team, making them redundant or giving them work that is demeaning or beyond them.

The stereotype that targets are downtrodden and lack assertiveness was not supported by the evidence. Most targets were highly qualified and likely to speak out about things that were not working. However, the nurses who participated in the study were fearful due to their past experiences.

The project had its origins in concerns that bullying was one reason that nurses left their profession. Sydney West Area Health Service agreed to partner with the FaCH team in its research on the topic. The research effort began with a national survey before interviews were conducted with nurses from two healthcare organisations.

Much of the project was undertaken as part of a PhD candidature by Dr Marie Hutchinson, who her colleagues agree was 'an outstanding student'. A fourth core team member was Lesley Wilkes, Clinical Professor of Nursing at the Clinical Nursing Research Unit of Sydney West Area Health Service, located at Nepean Hospital.

The team sees their research as both leading a shift around the world in discussion

of bullying and helping to shape better workplaces.

'We are proposing approaches that can help healthcare move forward, to make it more employee-friendly, to reduce opportunities for bullying and to empower people to explore options for support in their workplaces,' Debra says.

The research has been published extensively in nursing, healthcare management and management publications, attracting considerable interest and a high number of citations: one publication being the most downloaded article in the *Nursing Inquiry* journal.

'It is very unusual to cross those three fields,' Margaret says. 'Interdisciplinary research is not easy: for example, nursing and management journals have quite different requirements.'

Margaret is now routinely asked to review nursing journal articles on organisational subjects. This project also led to her being invited to edit a special edition on bullying, mobbing and violence in organisational life in a public administration journal, *Administrative Theory and Praxis*.



SEEING THE OPPORTUNITIES

The Industry and Innovation Studies (CInIS) Research Group has helped Campbelltown Hospital in Sydney's south-west to improve patient flow in the Emergency Department (ED) by developing an innovative virtual model of the working environment which helped hospital personnel to 'see' issues and identify feasible opportunities.

The visualisation of space and processes – rather than presenting analysis in charts, tables and words – enables people who deeply understand their workplace and who will implement change to be engaged in the development of ideas. Changes to policy and procedures become more informed by evidence, and solutions can be considered and tested in a virtual model without the need to implement the change.

'This is the most innovative part of this research,' explains Associate Professor Anneke Fitzgerald from CInIS, who led the Campbelltown Hospital project. 'Our strong working relationship with the hospital allowed us to consider new ways to address recurring challenges.'

The visualisation of work processes enables staff to understand better how processes are connected across departments. This was pivotal to the improvements at the hospital: after the project began, it quickly became clear that the flow of ED patients was hindered by bottlenecks elsewhere, including the Sonography Department.

Research staff recorded patient arrival and procedure times, patient flow through the departments, and levels of activity. This was complemented by data from patient case mixes, bookings, schedules, wards, rosters and staff awards. The team paid close attention to outliers in data, as this is often where causes of bottlenecks can be discovered. The substantial set of data that was gathered was used to map processes, which were validated with hospital personnel who held an array of positions.

The researchers then identified parameters for change, such as the sequencing of and timeslots for sonography procedures. For example, although each procedure was allocated

60 minutes, less than 50 minutes was typically required. The team therefore simulated various ways in which processes within the Sonography Department could be changed and whether those changes would bring real improvements.

'We showed clinicians visually how solutions would function, based on real patients', Dr Ann Dadich, a CInIS Research Fellow, explains. Staff could identify the changes they wanted to implement and suggest solutions which the researchers used their high-level skills to represent visually. Even before the project concluded, some of the UWS recommendations had been implemented.

'There is always a tension between the business and practice of healthcare,' Anneke adds. 'At higher levels of management, a key question is affordability. At the operational level, it is patient flow. Our research helps to strengthen the relationship between these two levels – by identifying how to improve the way departments function, we can ensure that policy and procedures are practicable.'

The Group's research developing and using visualisation in the healthcare system rests on merging several disciplines – organisational research, business culture, information visualisation and data analytics. Anneke is a registered nurse and worked in health management for many years, while Professor Simeon Simoff, who heads UWS's School of Computing and Mathematics, is an international leader in visual data mining. UWS's Office of Engagement supported the project through seed funding.

The scale of the visualisation research effort at UWS is boosted by several PhD candidates as well as staff and student exchanges with the University of Twente in The Netherlands. The University of Twente is sharing its expertise with the process information visualisation software that CInIS uses. This software is not used anywhere else in Australia, and the University of Twente also has considerable experience in health management research.

Hospital Entrance →

← Emergency



BUILDING CAPACITY TO MAKE ETHICAL SEXUAL DECISIONS

A research program that began at UWS more than 10 years ago has shown an unrivalled level of success in enabling young people to negotiate ethical sexual relationships and stand up against sexual violence in the community.

‘I come from a practice background: I am interested in research that impacts on the real lives of people,’ Associate Professor Moira Carmody of UWS’s Centre for Educational Research says.

Unlike many other violence prevention programs, Sex & Ethics focuses on developing skills that assist young people to negotiate sexual intimacy positively.

‘For example, many programs talk about the importance of consent but this program is unique in

showing people how it can be negotiated,’ Moira explains.

The Sex & Ethics program does not tell young people what they should do but rather provides an ethical framework to help them make decisions in a range of situations. A long-term goal is to prevent sexual assault and to reduce unwanted, coerced sex in casual and ongoing relationships.

The evidence base for the program comes from measurements taken at its beginning, then six weeks and six months after completion. After six weeks participants reported significantly greater confidence than before in articulating their own needs in a sexual encounter or relationship and in understanding their partner’s needs. After six months 82%

said they had used ideas learnt in the group, 74% that they had used skills they had learnt and 61% that they had already used the ethical bystander skills they had learnt.

‘The evaluation shows the program meant something to people and they took it into their lives,’ Moira notes.

The Sex & Ethics research program was initially supported by two UWS grants, which enabled Moira to attract an ARC Linkage grant for 2005–08, in partnership with the NSW Rape Crisis Centre. She has since secured additional funding from the Commonwealth Government under the Respectful Relationships Program.

The basis for the program came from interviews with women and men aged 16–25 from rural and metropolitan NSW, to understand how they negotiated sexual relationships and their views on current sexuality and sexual assault prevention education. A key theme that emerged was that education failed to prepare young people for the complexity of sexual intimacy.

Findings from the interviews resulted in the six-week education program. Moira trains educators from youth services, sexual assault and violence prevention services to deliver the program with young people. Some sporting codes have taken

up the program and the New Zealand Ministry of Justice has funded a three-year series.

In early 2009 Palgrave Macmillan published two books by Moira: one on the research itself and the other a training package. Findings are also being disseminated on the World Wide Web. Visitors to www.sexualethics.org.au can buy the books and learn how to arrange training programs.

The books are being extensively cited and the theoretical framework developed by Moira in this research is the basis for several PhD projects under way around the world. Meanwhile youth workers and educators are applying the framework with individual clients who have experienced sexual violence or who are offending. Moira sees the framework and program as meeting a widespread need for a practical way to reduce violence against women and children.

‘People often don’t know how to negotiate in this complex area of life,’ she explains. ‘It’s a life-long challenge for all of us. But we are learning more and more about how each of us can participate in preventing intimate violence.’



WHY GOOD BOSSES NEED THE LARRIKIN PRINCIPLE

The often-derided figure of the larrikin offers a model for management that embodies a can-do attitude, flexibility, integrity and a willingness to by-pass rules, according to researchers from UWS's Centre for Cultural Research and School of Management who undertook an interdisciplinary, cross-cultural study of the contemporary larrikin.

'Organisations really need the larrikin perspective,' explains project leader Professor Bob Hodge. 'Larrikins represent an irreverent attitude to authority and a commitment to getting the job done. If that means bending or breaking rules, they will do that, while being critical of criminal rule-breakers.'

Larrikins are also able to blow the whistle on poor practices in an informal way through jokes and a light style, which avoids the isolation that whistleblowers can suffer.

The larrikin has evolved

since the sexist image of the 1950s and earlier. The UWS study looked at larrikins of both genders: Germaine Greer being an exemplar alongside Paul Hogan and Steve Irwin.

While larrikins are found equally in men and women, the researchers found the bosses that most needed a larrikin perspective were overwhelmingly male – particularly rigid, traditional authoritarians.

'Linearity, rigidity and a will to control produce dysfunctional organisations that require alternative practices in order to survive,' Bob says. 'We gathered these alternative practices under the rubric of the Larrikin Principle.'

The study juggled taking a critical view of the larrikin figure and drawing on its popularity. The larrikin is well known and widely regarded as typically Australian.

The study found that larrikin qualities are, in fact, not as

distinctly Australian as usually thought. The Brazilian idea of *jeitinho* roughly translates as 'cutting through red tape' to get things done while 'mates rates' resemble the Mexican concept of *hazme un favor* (do me a favour).

'One of the exciting things that we found is that Australia's larrikin is a global figure, not simply located in Australia's rural past,' Bob says.

The Council on Australia-Latin America Relations was among stakeholders that valued the work of the project. The team produced two chapters for a COALAR book that aims to improve business and cultural relations between Australia and Latin America, especially with the economic powerhouses of Brazil and Mexico.

Funding for the project came from an ARC Discovery Project grant for 2005–07. It brought together expertise in cultural studies and organisational studies, having as its chief investigators Bob Hodge from the Centre for Cultural Research, and Drs Gabriela Coronado, Fernanda Duarte and Greg Teal from the School of Management's Organisation Studies program.

The team conducted some 100 interviews – about half of them in Australia and half in Latin America – from senior levels to ordinary people who could see the

absurdity of what they are sometimes asked to do.

The major findings have been brought together in a new book, *Chaos Theory and the Larrikin Principle: Working with Organisations in a Neo-Liberal World*, published internationally as part of the Advances in Organisation Studies series. As an innovative complement to the book, the team has created a website that presents the entire book in bite-size pieces connected by hyperlinks. Visitors to the site can add their own views, stories and ideas, which over time will form an archive.

The book and website were preceded by a number of journal and conference papers that have been well received.

'Looking at the larrikin figure is a light way of being critical of managerialism while connecting to a popular audience,' Bob says.

'Managerialism has been challenged by the global financial crisis. Larrikins meet the global need for an alternative.'

'This research plugs into the long-standing tension between ideas of leadership and ideas of management,' he adds. 'There are many examples of larrikin leaders and larrikin qualities are prized in leaders but a larrikin manager is almost a contradiction in terms.'

Ernie Dingo captures the style of the contemporary Australian larrikin
Image courtesy Getty Images



HOW CULTURAL POLICIES TRAVEL

Research from UWS's Centre for Cultural Research and School of Social Sciences is providing some cautionary tales about taking cultural policies from other countries and contexts.

Professors Deborah Stevenson and David Rowe received a Discovery Project grant from the ARC in 2005–08 to explore the international networks and institutions that shape cultural policy, especially in Australia, the USA and Britain.

'In an era of evidence-based policy, we are asking about the evidence that ideas actually work and, if so, whether they produce a 'serial monotony' in which everyone does the same thing, giving no-one a particular advantage,' David says.

The research team showed how cultural policies follow circuits of influence in which policies and people flow constantly in regular patterns.

'An important part of these circuits is the system

of advisers and experts who are going from country to country presenting their blueprints without spending much time in those places,' Deborah explains. 'They have ready-made policy ideas and are very influential.'

One such adviser is Richard Florida, known for his idea that an urban creative class can help regenerate a city. He has a range of corporate and government clients, and the research team has tracked where he and his creative class blueprint has been appearing around the world.

'His ideas are very attractive,' David notes. 'Florida's set of prescriptions appeal to policy-makers and to the traditional arts constituency. But the evidence is rather too slight and uneven to support all his claims or the faith put in them.'

Florida's work illustrates the ever-expanding range of expectations that are placed on cultural policy.

'We have gone from culture being the 'nice side of life' to being seen as integral to a contemporary economy based on creativity,' David says. 'But it has become something of a panacea. We see the so-called 'Guggenheim effect' – building a signature cultural facility – as an attempt to satisfy the impetus to be seen to be doing something, especially in declining industrial cities. Culture is also expected to carry an increasingly substantial burden in the social inclusion agenda, but there are formidable structural problems confronting any 'cultural solution'.'

The term 'circuits of influence' recognises that in some cases it is hard to be sure where a policy originated. David cites broadcast anti-siphoning laws as an example.

'Each European Union member can list events of national cultural significance that cannot be captured exclusively by pay TV,' he explains. 'Nearly all of these are sporting events. Australian policy-makers looked at EU policy as part of a review of our anti-siphoning regulations. Because Australia has the strongest anti-siphoning scheme in the world they are often cited in Europe as the way to go. So there's a constant dialogue between policies.'

National cultural policy frameworks are increasingly influenced by supra-national bodies, notably the EU and UNESCO. For example, the EU's Capital of Culture program, in which a city showcases its cultural life, encourages cities to look directly to the EU to shape their local cultural agenda and for funding to support urban renewal. UNESCO has copied this program. However, the UWS researchers note that there is no compelling evidence that it has made a major and lasting change in any city, even in the much-cited pioneering case of Glasgow in 1990.

'For anything to be sustainable it has to be connected to local frameworks and priorities,' Deborah argues.

'Western Sydney is a region that is very diverse culturally and is regarded as underdeveloped in terms of cultural facilities and a creative ethos,' David concludes. 'That makes it open and attractive – but also vulnerable – to the types of policy prescription that we have been investigating.'

Professors Deborah Stevenson and David Rowe explore the international networks and institutions that shape cultural policy



Guggenheim Museum Bilbao, Frank Gehry, architect, located in Bilbao, Basque Country, Spain
Image courtesy Guggenheim Museum Bilbao.

PLANNING FOR WESTERN SYDNEY'S GROWTH

When governments and businesses returned to long-term planning after the shocks of the global financial crisis (GFC), the Urban Research Centre's strategies for employment growth in Western Sydney attracted fresh attention.

The Centre's report on employment strategies for Sydney's North-West and West-Central sub-regions was commissioned by the Western Sydney Regional Organisation of Councils and project partners, with funding from the NSW Department of Planning.

'Our report was launched in March 2009 in the middle of the GFC. Planners and politicians in state and local government are getting back to the fine-grained task of reengineering the Sydney Basin; of ensuring that residential growth is matched by growth in employment,' Professor Phillip O'Neill, Director of the Urban

Research Centre, says.

A major economic analysis, the report sets out strategies to enable Western Sydney to deliver 280,000 net additional jobs by 2031, the target in the state government's 2005 metropolitan strategy. The region today houses 2 million people, which is expected to rise by 1.1 million in the next 25 years.

The Urban Research Centre stresses the need for a long-term approach to developing employment, land, infrastructure and a more efficient transport system.

'The supply of quality local jobs to Western Sydney households is arguably the single most important step in producing a sustainable, liveable city,' Phillip explains. 'These jobs will come with attention to developing place assets that make the area attractive to investors, quality infrastructure to build the area's links and networks, and urban

structures that build efficiencies into business and daily life.

'Governments in the past two decades failed to plan adequately for employment growth. This report provides direction for the rollout of efficient and effective infrastructure as the state and federal governments resume provision of economic resources for this region.'

At a local government level, authorities are incorporating strategies from the study into their environment and development plans.

The report is not just a set of strategies; it is a comprehensive account of economic and social change in Western Sydney over the last decade. Each council in the North-West and West-Central sub-regions has been given a detailed local economic and employment history.

'Too often councils have been forced to rely on expensive and piecemeal reports,' according to Phillip. 'This report gives decision-makers a considerable resource to which they can return for many years as they seek to integrate growth in Western Sydney's economy with new residential areas.'

The Urban Research Centre was selected to undertake this project due to its history of quality research in labour market problems and urban development in Western

Sydney. The report confirms the Centre as a source of multidisciplinary expertise for the provision of highly relevant research. The study involved three full-time researchers from the Centre as well as collaborators from Macquarie University, a consulting firm, Strategic Economics, and the Director of the UWS-based Whitlam Institute, Eric Sidoti.

The extensive consultation undertaken with key regional stakeholders has strengthened relationships between UWS and local government. 'It was a fine example of the University's capacity to combine engagement and a world-class research activity,' Phillip believes.

The Urban Research Centre is communicating its findings from this project through scholarly papers, presenting it as an exemplary international case study of an integrated development strategy. Because Western Sydney is a major urban region, there is considerable interest in how it confronts its development agenda over the next two to three decades.



CAMPBELL TOWN

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SPOTLIGHT ON STAR ARCHITECTS

A book on star international architects by a foundation member of the Urban Research Centre has attracted interest around the world for its comprehensive and critical examination of architecture practice.

The Global Architect: Firms, Fame and Urban Form by Dr Donald McNeill explores the world of global firms led by celebrated architects. He positions the mythology or cult of the individual genius within the reality of firms characterised by distinct ways of working and the need to continue to attract high-calibre young staff.

With the expansion in global architectural practice Donald was interested in how, and how often, architects physically travel. The book details how major firms such as Foster and Partners and Denton Corker Marshall have harnessed information technology to reduce the need for design leaders to visit foreign cities on a regular basis, allowing greater time in the design studio.

Recent years have seen a rise in firms from Asia. Initially

many adopted a Western mode but in the last 10 years Chinese architecture has reached critical mass and started to export its styles to Western countries.

Donald notes that architectural practice has rarely been examined from a critical perspective. That fresh angle, as well as being published by a firm of the stature of Routledge in New York and considerable North American content, has seen the book join reading lists in architecture programs at such institutions as Harvard and McGill since its publication in 2008.

Ethics in architectural practice is subject to particular critical appraisal, with a chapter contributing to the emerging debate over ethical issues. A star architect brings legitimacy not only to individual projects: a government with a questionable human rights record can benefit from engaging a major international firm to undertake a project. Water usage and water rights raise other ethical issues, as has been seen in Abu Dhabi. Donald is concerned that much 'green building' discussion

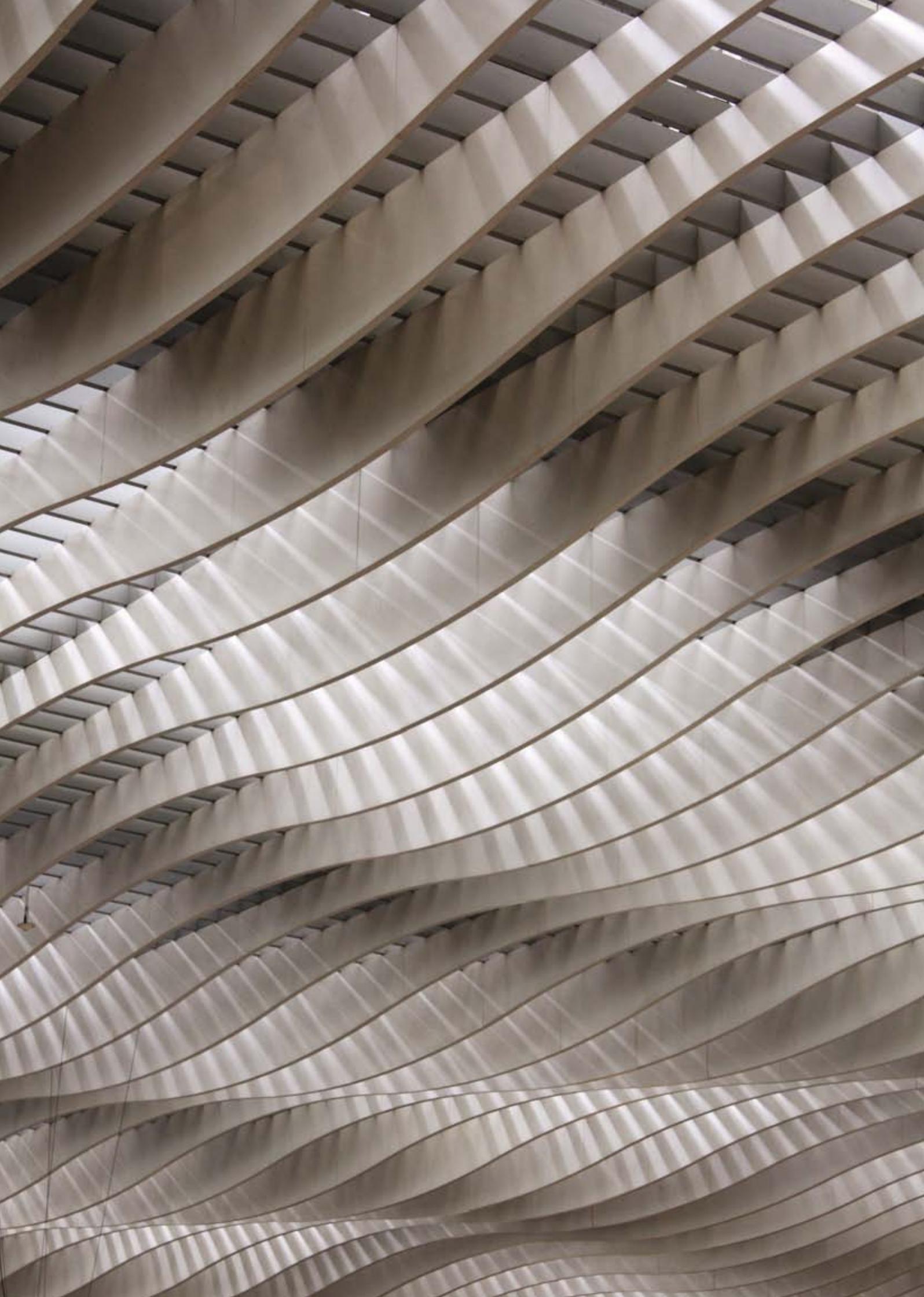
has been superficial, with firms satisfying building codes while encouraging driving.

This research had its origins in Donald's PhD thesis on Spanish cities, from King's College, London. Looking at the establishment of the Guggenheim Museum in Bilbao, designed by Frank Gehry, started his interest in how architects operate on an international scale.

Donald is one of several researchers at UWS with a background in human and economic geography: others include the Urban Research Centre's Director, Professor Phillip O'Neill, Professor Kay Anderson in the Centre for Cultural Research, as well as Professor Katherine Gibson in the Centre for Citizenship and Public Policy and Professor Kevin Dunn in the School of Social Sciences.

'Understanding urban conditions requires a holistic viewpoint,' Donald believes. 'There is also intersection with property development, taking a long-term view of investments and how they can change the urban environment.'

Donald's current major research project is on global city airports. With an ARC Discovery Project grant, he is examining how airports are politically embedded in cities, how they have changed due to such factors as private equity and the renewal of even recent airports such as Foster's design for Hong Kong's Chek Lap Kok.



FROM CELLS TO SANDSTONE: HOW MOLECULES MOVE

Professor William S. Price's standing as one of the world's top researchers in molecular diffusion studies using magnetic resonance techniques was exemplified by the publication in October 2009 of his book 'NMR Studies of Translational Motion' as part of Cambridge University Press's Molecular Science series.

This series presents advanced monographs and textbooks on the exciting developments that have taken place in molecular science in recent years. Bill's contribution to the series balances theory with experimental observations: typifying the way that his research is shared almost equally between new method development and the application of nuclear magnetic resonance (NMR) where it has not been used before.

Bill is Leader of UWS's Nanoscale Organisation and Dynamics University Research Group and the UWS node of the National Imaging Facility.

'My interest is the motion of molecules, such as how they

move through a cell, especially how we can measure that motion,' Bill explains. 'Self-diffusion, which is the random thermal motion of molecules, is the most fundamental form of transport at the molecular level: it underpins many chemical and biological processes.'

New theory and methods developed by Bill and his collaborators within UWS and around the world include using NMR to measure protein association. How proteins interact with each other is important in normal physiological processes and in such diseases as Alzheimer's and cataracts. Bill has also performed a great deal of research into measuring diffusion inside restricting geometries (such as cells) and the types of structural information that can be obtained from such measurements.

'One of these new techniques could contribute to successful approaches to a major medical challenge or new diagnostic

techniques,' Bill notes.

The medical applications for NMR, notably magnetic resonance imaging (MRI), are considerable but NMR is distinguished by the growing range of other fields in which it can be applied. Bill has been advocating its potential in such diverse areas as plant physiology, separation science and nanotechnology.

Many of the theoretical advances made by the Nanoscale Group have been in development of new NMR pulse sequences, which determine the type of information that an NMR experiment will provide. Bill has devised sequences that allow investigation of small signals (e.g. from molecules at low concentration in blood) in the presence of much larger signals (e.g. water) that would otherwise swamp the measurement.

He has also identified ways of using diffusion to probe protein crystallisation processes, to help clarify the problem of why some

proteins defy being crystallised for use in other common characterisation techniques.

Bill's work is highly cited by other researchers and he has received requests for advice from industry overseas.

'Every day is different: from images of grapes to diffusion in sandstone,' Bill says.

And from mouse hearts to room-temperature molten salts, which are attractive for use in electrochemical devices such as solar cells, fuel cells and batteries.

Further research opportunities lie in developing more advanced techniques coupled with analysis to extract ever more information on the nano- to macroscopic length scales from magnetic resonance experiments.



INTERNATIONALLY AWARDED EARLY CAREER SUSTAINABILITY RESEARCH

Associate Professor Ian Anderson from the Centre for Plants and the Environment won the ProSPER.Net-Scopus Young Scientist Award for Agriculture and Natural Resources research in 2009 for his 'outstanding contributions in sustainability and managing ecosystems for the future generations'.

Ian focuses on the biodiversity of forest soil microorganisms and the importance of symbiotic microorganisms in carbon sequestration in Australian forest soils.

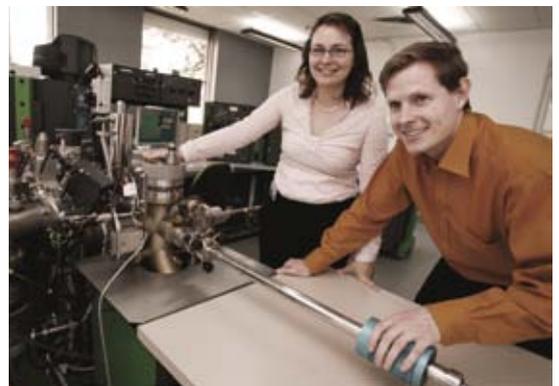
Very early in his career, he developed molecular techniques for ecological investigations of soil-born fungi. These have led to unprecedented advances in research on soil

microorganisms, particularly on how soil fungal communities respond to environmental impacts such as climate change and soil stresses.

The award he received is highly competitive and based on data from Elsevier's abstract and citation database of peer-reviewed literature as well as documented social impact. Of the 15 finalists for the 2009 awards drawn from across the Asia Pacific region, Ian was the only Australian and one of the youngest contenders.



Associate Professor Ian Anderson



SIMS Facility



Eastern Sedge Frog

DIVERSE FIELDS TO BENEFIT FROM ENHANCED FACILITY

The secondary ion mass spectrometry (SIMS) facility opened at UWS in 2009 promises to benefit fields as diverse as solar energy, forensic science, silicon chip manufacturing, geology, environmental science and biological science.

'This advanced facility will bring new opportunities for collaborations with other institutions and industry,' UWS Vice-Chancellor Janice Reid AM said at the facility's launch.

In SIMS analysis, a beam of ions – a type of particle – is fired at a test material, which dislodges other ions from the material's surface. These 'secondary ions' provide a very accurate reading of chemical composition at and near the surface of the test material. SIMS can identify elements

ranging in atomic weight from hydrogen to uranium, even when they are only present in parts per billion.

UWS's SIMS is based on an instrument previously located at the Australian Nuclear Science and Technology Organisation. An Education Investment Fund grant enabled UWS to add digital capabilities, among other enhancements, to make the SIMS a core component of the University's National Environment and Energy Research Facilities (see page 4).

The Australian Universities SIMS community will be accessing this facility through AINSE Limited.

POLLUTION CAN PROTECT FROGS

A decline in the number of frogs is a major concern around the world, and the east coast of Australia has been affected particularly severely.

The most significant cause of the decline is widely thought to be the spread of a type of fungus, chytrid, which is found in water. One chytrid species causes a disease that can devastate amphibian populations.

Pollution is another potential cause of frog deaths, although frog numbers have been declining away from human settlements as well as in inhabited areas.

Research by Professor Shelley Burgin, an ecologist and environmental scientist in UWS's School of Natural Sciences, shows a more complex picture: one in which pollution appears to be holding chytrid at bay.

Shelley and a UWS graduate student, Alan Lane, investigated frog numbers in towns and pristine areas in the Blue Mountains west of

Sydney. The frogs in areas away from the towns had become less diverse over time. The researchers proposed that the frogs associated with urban wetlands were being protected from the chytrid fungus by salts in sewage.

'It was exactly the opposite of what you would expect,' Shelley said.

'Salinity kills the chytrid fungus. It is similar to the probable reason that the Green and Gold Bellfrog is found on coastal wetlands that have at least intermittent saline contamination, and in places like the Homebush Bay brick pits that would be contaminated with heavy metals.'

Their findings were published in one of the world's top biology journals, *Freshwater Biology*.

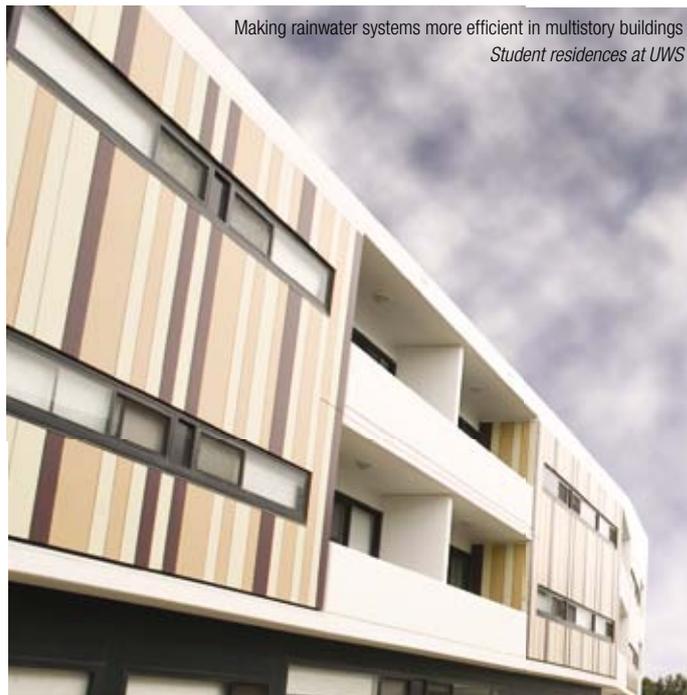
DO RAINWATER TANKS PAY FOR THEMSELVES?

Despite the growing popularity of rainwater tanks, there was a surprising lack of research on their long-term financial return when Dr Ataur Rahman and some of his students began to develop software that could calculate rainwater harvesting costs and benefits.

A Senior Lecturer in Water and Environmental Engineering at UWS, Ataur's research focuses on saving and conserving water through water-sensitive management and design. With Erhan Eroksuz and Joseph Dbias, Bachelor of Civil Engineering honours students, and a Research Assistant, Mazharul Islam, he developed a PC-based tool that can calculate the life-cycle return on rainwater tanks in multistoried buildings.

'Property owners and developers can run various scenarios to see how much different tank options would save and to design an efficient, effective system,' Ataur explains.

Costs involved in installing and running a rainwater harvesting system include



Making rainwater systems more efficient in multistory buildings
Student residences at UWS

capital expenditure on tanks and plumbing and operational expenses such as electricity for pumps, less any government subsidy.

The likely levels of rainwater to be harvested depend on such factors as land, roof and lawn sizes, and rainfall. Water savings depend on potential demand, including the number of cars that are likely to be washed based

on the number of apartments, the number of residents and patterns of rainfall.

Cost saving calculations take account of the price of mains water and interest rates as well as incorporating net present value.

The results are depicted as graphs of tank size versus water savings, a whole life-cycle cost breakdown and indications of the reliability of

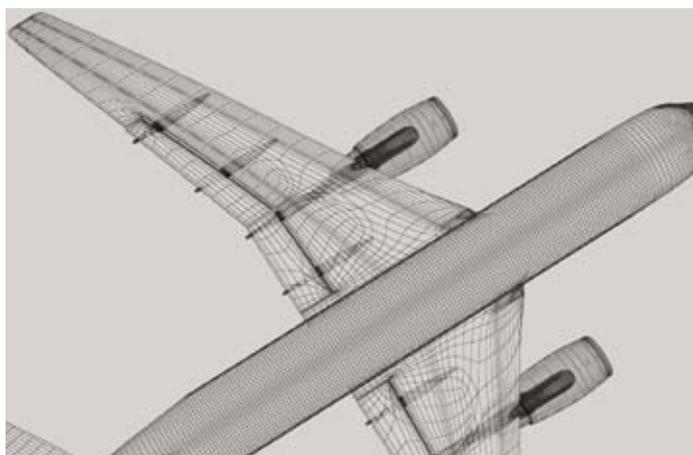
the tank in supplying water, for example through a drought.

Payback on a rainwater harvesting system very much depends on the parameters chosen, especially the cost of mains water and how water will be used. Just using harvested rainwater outdoors gives the most favourable financial outcome, as using it in toilets significantly increases the cost of plumbing. Entering a range of prices for mains water shows that a tank would offer a good financial return if mains water was priced closer to its real cost.

Other benefits of installing rainwater tanks – notably security of supply, satisfaction from living a greener lifestyle and freedom from water restrictions – are in addition to the financial factors analysed in the UWS software.

The research team has continued to upgrade the software and state government organisations have expressed interest in applying it.

Erhan's honours thesis, on the 'Economics of Rainwater Tanks' won the Senior University Bachelor of Engineering Student Award from the Young Engineers Australia Sydney Division in 2006.



OVERCOMING A COMPLEX ENGINEERING CHALLENGE

Professor Yang Xiang from UWS's Civionics Research Centre has developed an innovative computational method that can slash the time that engineers take to calculate the frequency of vibrations in thin-walled structures and give them a more precise result.

Yang was awarded a three-year ARC Discovery Project grant in 2006 to overcome problems in the existing methods of understanding and controlling high frequency vibration in thin-walled structures, such as plates, shields and plate-assembly. These are used across civil, mechanical, structural and aerospace engineering.

Yang developed an algorithm that identifies the natural frequency of a structure once conditions are given. Engineers will be able to use this method to understand how thin-walled structures of varying

shapes and sizes will respond when subjected to a range of complex loading conditions.

'For the first time, engineers can measure thousands of vibration frequencies,' Yang explains. 'Nobody had been able to resolve this before due to the number of elements involved and because many established methods become unstable at very high frequencies.'

Structures have natural frequencies with which they vibrate. Subjecting a thin-walled structure to a high frequency can lead to forced vibration or heat. Excessive vibration and unacceptable noise can create great fluctuations in mechanical loads and stresses and result in fatigue of structural, electronic and other delicate components.

'These problems need to be controlled at the design stage, which can be done

by predicting the structural response,' Yang says.

Previous computation tools such as finite element analysis are not as efficient as Yang's new algorithm, in both computing time and capacity. The new method can deliver results twice as fast as other methods, which for a large structure could require days of time on a supercomputer.

These earlier tools took a statistical approach based on a limited set of frequencies, such as 10. However, some structures have thousands of frequencies.

Also, previous approaches were less than satisfactory in fields such as aerospace where aircraft, satellites and other space vehicles vibrate very quickly.

Yang's standing as one of the international leaders in the area of computational mechanics has been enhanced by publication of

his approach in top journals. A growing number of citations indicates that many other researchers are adopting the new method as a way to solve their analytical challenges.

Professor Guowei Wei of Michigan State University, a mathematician who was a visiting fellow in UWS's School of Engineering, has applied Yang's method to image processing and magnetic processing. Their collaboration over the last decade has produced more than 15 journal papers as well as papers at a number of computational conferences.

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