UNIVERSITY OF TASMANIA

SKY'S THE LIMIT

INNER LIFE EXPOSED

TUNA TRIUMPH

STAYING HEALTHY

AMC AT THE CUTTING EDGE

UTAS

Research to Reality

2011 EDITION 8

Researchers at the University of Tasmania have reason to celebrate with the release of the 2010 QS world university rankings. We were accorded a VH (Very High) rating for research output relative to our size and focus.

This recognition is largely due to the talent and dedication of our staff and the partnerships that we have forged – with other tertiary institutions and the private sector in this State, around Australia and overseas. If we are to hold our own in an increasingly globally competitive field, then we need to build on the existing collaborations and cement new ones.

This issue of *Research to Reality* features a number of groundbreaking collaborative projects: the Australian Maritime College is working with local shipbuilder Incat and two other partners based in the Netherlands; the ACROSS team is immersed in two explosives-related projects that involve, respectively, five and eight state and national partners; while the southern bluefin tuna project involves IMAS, Clean Seas Tuna from South Australia, and seven national and nine international partners.

Professor Paddy Nixon
Pro Vice-Chancellor (Research)

Bright star just needs a good reference or two

On Earth we use signposts, landmarks and maps to figure out exactly where we are. But how do we find out the position of our planet in space?

Geodetic Very Long Baseline Interferometry (VLBI) is a technique that utilises observations from many widely spaced telescopes around the world to figure out exactly where each telescope is and how fast they are moving. Geodesy is the branch of science that deals with this type of measurement and positioning across the Earth.

VLBI is the only technique capable of measuring the Earth's position in space accurately, and is crucial for underpinning studies of geophysical phenomena – particularly those observed using orbiting satellites.

Signals detected by the different telescopes can also be combined to create a virtual, huge high-resolution telescope the size of Earth itself. This provides a key way of investigating the evolution of galaxies from the Big Bang until present day.

While promising, VLBI suffers from a number of limitations that compromise geodetic measurements. One of the biggest problems is related to a lack of good reference sources, both in terms of quantity and quality. These reference sources are space landmarks that telescopes use to position themselves on Earth.

Understanding these reference source limitations is crucial to improving the geodetic accuracy of VLBI.

So how can this be achieved?

Dr Stanislav Shabala is a Super Science Fellow in the UTAS School of Mathematics and Physics (and the Premier's Young Achiever of the Year). His project aims to improve the sample of southern sky reference sources by re-analysing existing sources, as well as searching for new ones.

An ideal VLBI reference source is a bright point on the sky. Distant quasars (very bright objects in space) are perfect for this purpose.

Dr Shabala said we see these objects as bright point sources because they are far away and have powerful jets that are aimed almost directly at us.

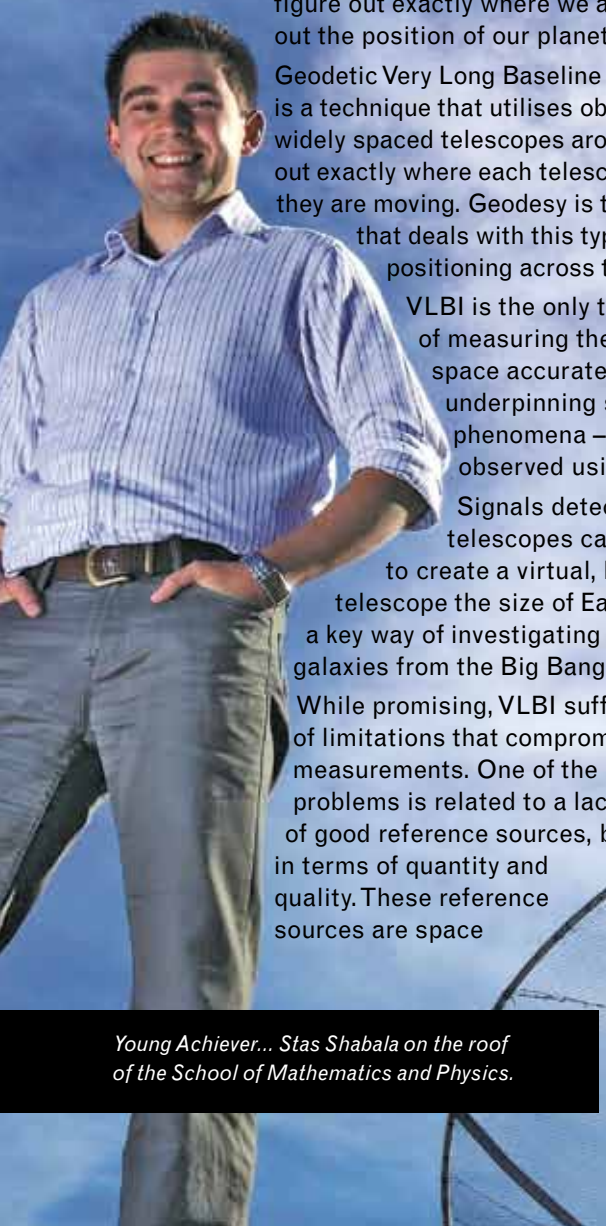
"At the start of 2010, only six geodetic VLBI telescopes routinely operated in the Southern Hemisphere and the bulk of southern quasars were not well studied. This, in turn, limits the accuracy of global VLBI measurements. As part of the AuScope program, UTAS has begun to rectify this," he said.

A new 12-metre dish has been installed at the Mt Pleasant observatory in Cambridge, Tasmania, and similar new dishes are located at Yarragadee (Western Australia) and Katherine (Northern Territory).

"This will greatly improve astrometric measurements currently possible with VLBI, allowing increased accuracy globally, and importantly, across the Australian continent.

"When combined with other techniques, this work will have profound implications for studies of various geophysical phenomena and their expression across the Earth's surface."

Dr Shabala is undertaking this project with Dr Jim Lovell, Assoc Prof Simon Ellingsen and Prof John Dickey from the School of Mathematics and Physics, and Dr Christopher Watson from the School of Geography and Environmental Studies.



Young Achiever... Stas Shabala on the roof of the School of Mathematics and Physics.

This project is funded by a $420,000 ARC Super Science Fellowship.

Assoc Prof Battaglene, Dr Cobcroft and Prof Colin Buxton, Director of Fisheries, Aquaculture and Coasts at IMAS, with the CRC Association 2010 Excellence in Innovation Award; top, wild-caught southern bluefin tuna.

This project is supported by $2m in funding to UTAS and six national partners from the Australian Seafood CRC, the Fisheries Research and Development Corporation and Clean Seas Tuna. Nine international partners are also contributing expertise.

From little things big things grow

Our aim is to create a sustainable industry to give the wild population a chance to recover.

A new research project, led by the University of Tasmania and driven by Clean Seas Tuna Ltd and the Australian Seafood Cooperative Research Centre, could be the solution to meet consumer demand for southern bluefin tuna.

A decline in wild fish stocks and cuts to fishing quotas in the past 18 months have had a significant impact on the Australian tuna industry.

However, in a world first, land-based hatcheries in South Australia, Northern Territory and NSW are being used by researchers and industry to breed and rear larvae for commercial production of the highly sought-after species.

Dr Jenny Cobcroft, Research Fellow with the Institute for Marine and Antarctic Studies, is managing the research and development aspect of the study.

"Our aim is to create a sustainable aquaculture industry and to give the wild populations a chance to recover," Dr Cobcroft said. The project involves eggs of less than 1mm in diameter being collected from wild-caught broodstock held in a land-based tank in SA. The eggs are placed in smaller tanks, with the fragile 2.5-3mm-long larvae hatching within 30 hours.

"With a relatively short window of spawning each year, it is important that we first look at the most obvious factors that will make the most difference, such as nutrition and environment, to determine what the larvae need to grow and survive in tanks," Dr Cobcroft said.

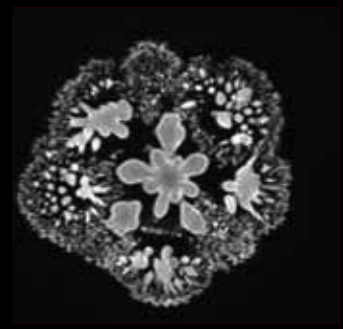
"Southern bluefin tuna larvae have a much higher survival rate in tanks than they do in the wild. Most in the wild will die through either being eaten by predators or starvation because they cannot get enough food."

The highly collaborative tuna project involves researchers and industry working closely together to translate research findings into the hatchery operation during the very limited spawning season. The research culminated in the world-first transfer of 150 juveniles to cages in the ocean in March.

IMAS' Aquaculture Program, led by Assoc Prof Stephen Battaglene, has built on experience with striped trumpeter larval-rearing to engage with national finfish hatcheries through an ARC Linkage project examining quality in cultured fish. This led to the recent projects investigating improved conditions for commercial production of yellowtail kingfish and southern bluefin tuna. A UTAS PhD candidate, Polly Hilder, is supported by a Seafood CRC scholarship to conduct complementary research on vision and feeding behaviour in larval tuna and kingfish.

MRI scans reveal the inner life of 'little green trees'

This project is a partnership with Regional Imaging Tasmania and is supported by a $5,000 grant from the Cradle Coast Campus Cross-Boundary Research Fund.



The anatomy of a 'little green tree' as revealed by an MRI scan. The brightest areas are those with the highest density of water and highlight the location of vascular tissue.

Far right: A broccoli about to be laid bare by an MRI scan.

Ever wondered about the secret inner life of broccoli? A north-west Tasmania-based researcher has discovered that MRI scans provide an important insight into some economically important structures inside broccoli heads.

MRI scans are regularly used to reveal hidden structures, injuries or illness in the human body. Now they have been used as a tool to take a close look at the size and structure of broccoli flowers and stems.

TIAR researcher Dr Mark Boersma is known as Dr Brocc to many of his colleagues, for his work in developing strategies for improving commercial broccoli production in Tasmania. "Due to the complexity of the broccoli inflorescence, establishing its true physiological stage of floral development has never been realised. So right around the world the timing of broccoli harvests is based on someone taking a look at the crop and making a decision on what they see, which may or may not relate to the crop's maximum yield potential," Dr Boersma explained.

"I thought that if the MRI allowed us to get a clear look inside the broccoli heads, we could develop an objective scale that could provide the basis for a global industry standard, and a fundamental reference for all future research that requires the assessment of broccoli maturity."

Dr Boersma applied for a grant through the UTAS Cradle Coast Campus Cross-Boundary Research Fund, an annual seeding fund that aims to encourage the development of new research projects that build collaboration across north-west Tasmania, the Cradle Coast campus and the broader university. The project partnered with Regional Imaging Tasmania, and chief radiographer Harry Hanson provided free access to MRI equipment and tracer chemicals.

Dr Boersma says the project has proven that it is possible to get a good look inside a broccoli head using MRI but that the current technology available in Tasmania is not capable of producing images with sufficient resolution to differentiate the anatomy of florets (beads) within the broccoli inflorescence.

"The project has been really useful in showing that MRI can be used to accurately measure things like the dimensions of hollow-stem cavities within broccoli stems, a feature that has only previously been estimated using relatively inefficient, destructive techniques," Dr Boersma said.

"The imagery also revealed the potential use of MRI in modelling the three-dimensional architecture of the broccoli inflorescence without using destructive sampling."

As a result of the project Dr Boersma has made a recommendation to one of Tasmania's vegetable processing companies that a high-end stereo microscope with capacity for real-time digital image analysis could be used to pursue the development of a maturity scale for broccoli.

Main image: Seeding fund bears fruit, er, vegetable: Dr Mark Boersma, aka 'Dr Brocc', left, with Regional Imaging Tasmania's Harry Hanson.

Driven to succeed at medium speed

The AMC is to play a key role in developing the next generation of Incat vessels.

Main image: Revolution Design's principal structural design engineer, Gary Davidson (left), and Prof Neil Bose pictured with two waterjets in the transom of the starboard hull of an Incat fast ferry. Inset images: left, the 112m Norman Arrow, currently operating between Portsmouth (UK) and Le Havre (France); right, Prof Bose with a multihull model inside the AMC's testing tank.

Hobart-based shipbuilder Incat is renowned internationally as a pioneer of wave-piercing technology, with its high-speed, multihull vessels operating in more than 20 countries.

Playing no small part in that success has been a long association between the company founded by Bob Clifford and researchers at the School of Engineering, notably Prof Michael Davis, and the Australian Maritime College's Assoc Prof Giles Thomas, who as a PhD student was based for a time at Incat's Derwent Park site. Much of the research to date has revolved around issues of motion and sea keeping.

The AMC, which boasts a 100m-long testing tank, is to play a key role in developing the next generation of Incat vessels, a fleet in which the need for speed will be of secondary importance to improved fuel-efficiency. This project involves the School of Engineering and Incat's Revolution Design team, plus a Dutch propeller and water-jet designer and manufacturer, Wartsila Netherlands BV, and a hydrodynamic research facility, Maritime Research Institute Netherlands.

What the team partners and Prof Neil Bose have to resolve – with the help of ARC Linkage project funding – is the question of how to propel these medium-speed catamarans. Incat's high-speed vessels feature water-jet propulsion – usually four water jets, two per hull, which allow each vessel to cruise at 40 knots.

"Incat's ships are not designed for propellers," explained Prof Bose. "The four propellers would have to sit two metres or so below the keel and a metre out the sides of the ship. So they are very exposed, and there's a drag element as the propellers have to be supported by struts. But then water jets are also problematic, because this new fleet of 130-160m-long vessels is meant to be medium speed, in the 22-27, maybe 29, knots range. Water jets are particularly good at high speed but not so good at medium speed because of the drag-hump factor.

"With high-speed vessels, resistance increases to a certain speed, then flattens off – or even drops – before increasing again. A medium-speed vessel puts the operational speed at the drag hump, which is exactly where you don't want it."

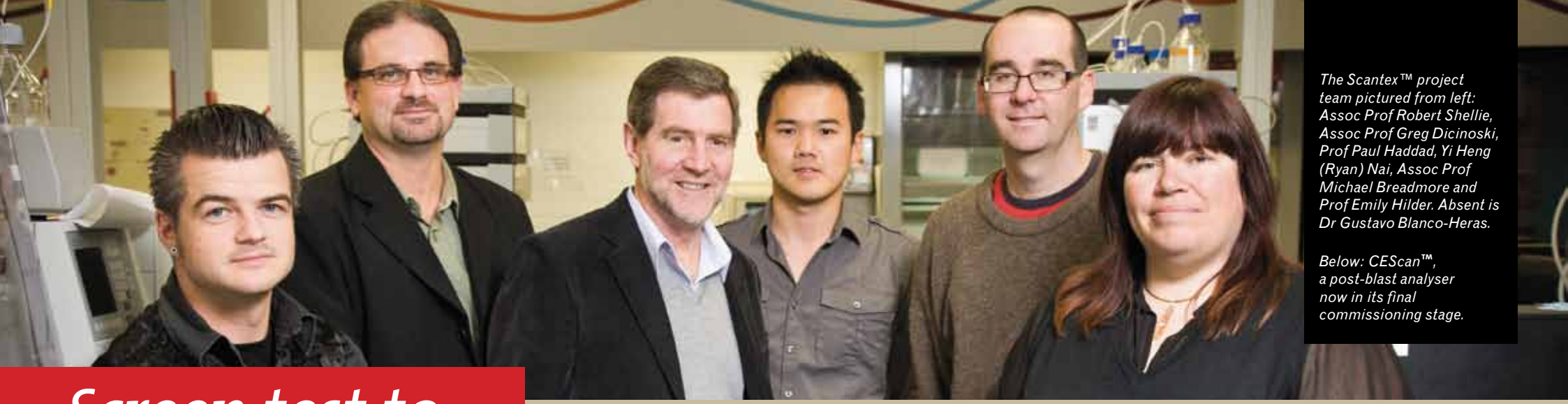
The project is still in the start-up phase and Prof Bose will have to take on three PhD students as research begins in earnest.

"There are three aspects to this," he said. "One is on the propulsion testing side, another on resistance and form of the vessel, and the third is computational – i.e., computer simulation of the other two aspects.

"On the propulsion side, to get good results we need to work on a large scale so in addition to testing in our tank we may have to build a bigger test facility, off site on a lake.

"With resistance, we will look at different shapes, to determine what form would be best for medium-speed vessels. The spacing between the hulls is also very important in consideration of drag hump."

This study is an ARC Linkage project, with funding of $260,200 over a three-year period. Incat and Wartsila Netherlands BV have contributed $150,000.



The Scantex™ project team pictured from left: Assoc Prof Robert Shellie, Assoc Prof Greg Dicinoski, Prof Paul Haddad, Yi Heng (Ryan) Nai, Assoc Prof Michael Breadmore and Prof Emily Hilder. Absent is Dr Gustavo Blanco-Heras.

Below: CEScan™, a post-blast analyser now in its final commissioning stage.

Screen test to be a matter of life and death

The latest advance can detect a homemade bomb in less than 60 seconds.

Early detection can be a life-saver, not just in combating disease but also in the fight against terrorism.

A team drawn from researchers at the Australian Centre for Research on Separation Science (ACROSS) based in the University's School of Chemistry and coordinated by Assoc Prof Greg Dicinoski and Assoc Prof Michael Breadmore, has over the past seven years developed a range of technologies to detect and identify explosives.

The latest advance – with the potential to save many lives – is new screening technology that can detect a homemade bomb in less than 60 seconds.

The screening technology, Scantex™, can detect inorganic compounds such as ammonium nitrate, potassium chlorate and potassium perchlorate – common ingredients in homemade improvised explosive devices (HMEs). It is being developed to complement existing technology used in mass-transit applications.

"We have a fast screen that is able to give a positive or negative result in less than 60 seconds," Assoc Prof Dicinoski said. "If desired, we also have a fast confirmatory system that provides reassurance that we've accurately identified the explosive device."

It is based on a platform technology called capillary electrophoresis.

"Essentially how this works is that we have a very fine glass tube about the diameter of a couple of human hairs and we place a high voltage – about 30,000 volts – across the capillary," Assoc Prof Breadmore explained. "A sample goes in one end and as it moves through under the influence of the electric field we are able to separate and identify various chemical species. It's the presence or absence of particular chemical species that leads us to deduce the chemical nature of an explosive device."

Scantex™ is not just intended for screening points at airports and mail-handling centres. You could use it to screen people going into concerts, or into sporting events.

The team's other explosives-related technology is already in its final commission stage. CEScan™ is a portable device for the comprehensive analysis of a broad range of explosives post-blast, from commercial high explosives such as TNT and Semtex to the homemade, improvised kind described earlier.

The CEScan™ researchers are Assoc Profs Dicinoski and Breadmore, Prof Paul Haddad, Dr Cameron Johns, Dr Joseph Hutchinson, Prof Emily Hilder, Dr Rosanne Guijt, Prof Pavel Nesterenko, Prof Mirek Macka, Dr Eadaoin Tyrrell and Mr Adam Gaudry.

The University's research commercialisation partner, UniQuest Pty Ltd, is working with ACROSS researchers to find a commercial partner and to help prepare the Scantex™ technology for a global launch.

The CEScan™ project has received two grants totalling $2.5 million from the Department of the Prime Minister and Cabinet via its National Security and Science Technology Branch, with support from four state and national partner organisations. The Scantex system has resulted from a $1m (including in-kind support) ARC Linkage project involving ACROSS and seven partner organisations.

You may think my research lacks resolution

...and you're right

Dr Simon Bourke ... projected his footage through refractory glass elements, lenses, prisms, shields and grates.

On November 28, 1979, Air New Zealand Flight 901 slammed into Mt Erebus in the frozen wastelands of Antarctica. All 257 passengers and crew were killed in what remains New Zealand's worst aviation disaster. A Royal Commission into the accident found that the plane had crashed due to a combination of factors, including navigational error and environmental phenomena.

The crash served as inspiration for postgraduate fine arts student Simon Bourke, a former pilot, who holds a fascination with light and the effects it can have on the landscape.

"Something may be real, but to you or me it might appear to be an illusion, or vice versa," Dr Bourke said.

"Due to different phenomena in the air, you can lose yourself in the visual environment while flying, and then you have to rely on the instrument panel and what you can hear through your headset.

"With the Mt Erebus disaster, the landscape had definitely become an illusion to those pilots. The pilots and crew had been drawn into a malevolent trick of the polar light – a phenomenon known as clear air whiteout – a loss of contrast and texture in a landscape caused by diffuse illumination and high reflection from white surfaces.

"What happened then was that they lost all reference to objects, and the mountain wound up being right in front of them."

Taking this incident as his starting point, Dr Bourke set out to film parts of northern Tasmania from the air in different light and weather conditions to create a video installation artwork.

He used a Cessna 337 twin-engined aircraft with multiple video cameras to film tracts of northern Tasmania from various altitudes at different times of the day and year. Then using an 'optical laboratory' – built on an old hospital bed – Dr Bourke projected his footage through refractory glass elements, lenses, prisms, shields and grates. This allowed him to introduce illusory elements to his video installation.

"With my process, the imagery is contained within the light source and is changed as it passes the refractory glass elements – similar to the same process of clear air whiteout," Dr Bourke said.

"Some of the images produced on the optical laboratory screen present a clear depiction of the world, while other images appear attenuated and distorted."

Dr Bourke said his research had implications for the psychology of perception, as well as real-world applications such as in environmental science, synthetic vision in aviation navigation, and even architecture. "Some people who do PhDs get a complete resolution to their research, but my research has definitely not done that. It has opened up many other areas for further investigation," Dr Bourke laughed.

Sabrina Sequeira frequently finds herself working in cramped, humid conditions.

Two schools find common ground

Research conducted at UTAS into energy efficiency standards in residential buildings may go a long way to improving the way thermal performance is measured in new homes.

AccuRate, designed by CSIRO, is Australia's accredited building thermal performance software tool. It is used by state governments to determine the energy usage of residential buildings to ensure they meet minimum efficiency standards prior to building approval.

Sabrina Sequeira, PhD candidate with the schools of Architecture and Engineering, has determined how subfloor ventilation, currently thought to be modelled incorrectly by AccuRate, affects thermal performance in residential buildings.

"We have discovered, using measured data, that in the subfloor cavity, humidity and ground evaporation may have a significant effect on the subfloor climate, which in turn affects the interior's thermal performance," Ms Sequeira said.

"For a house with an uninsulated floor the software tool assumes a certain radiant energy exchange between the bare floor and the ground. However, the software doesn't account for moisture evaporation from the ground, which in turn cools the ground surface. This directly affects the subfloor air temperature and hence the thermal performance of the area via conduction and convection, and also results in a greater radiant energy loss from the floor."

Data were collected from three purpose-built test buildings on the Launceston campus. Subfloor temperature, humidity and air speed were recorded every 10 minutes.

Data were then matched to the physics-based model in AccuRate to determine subfloor ventilation, as the amount of ground evaporation is dependent on the amount of ventilation.

"The effect of moisture transfer in the subfloor cavity may warrant inclusion in the AccuRate program. We will continue to conduct research to understand the extent of this as well as uncover other omissions from the software," Ms Sequeira said.

"I think what is most important about this research is that we have identified a problem, come up with a potential solution and demonstrated a way to improve the software."

Dr Jane Sargison, a contributor to the research from the School of Engineering, added, "This outcome demonstrates the importance of engineering and architecture researchers working together to solve important practical problems."

This research is supported by almost $19,000 in funding from the CSIRO and the Department of Justice, Workplace Standards Tasmania.

How to avoid a breakdown on the farm

Almost all individuals that we talked to knew someone in their industry who'd committed suicide.

Most of us are familiar with the poem *Clancy of the Overflow* and A. B. Patterson's idyllic "vision splendid" of life in the bush. The truth for many rural families, however, falls far short of this myth.

In Australia today, rural people have poorer outcomes from chronic disease and are more likely to engage in high-risk alcohol consumption. Rural males also have higher levels of suicide and depression than urban males. Add to this the impact of the recent difficult times (the global financial crisis, increasing industry deregulation, and extended periods of drought and other climatic extremes), and staying healthy for rural Australians has become even more important and challenging.

University of Tasmania researchers – Professor Sue Kilpatrick (who has since been appointed Pro VC Rural and Regional at Deakin University), Dr Karen Willis (School of Sociology and Social Work), Karla Peek and Dr Susan Johns (both from the UTAS Department of Rural Health) – interviewed more than 100 farmers from across Australia about what they do to stay healthy in difficult times.

"What was overwhelming was the number of times they talked about mental health," Dr Willis said. "While they thought they could control their physical health, through diet and exercise, they saw their mental health as much more outside their control.

"Almost all individuals that we talked to knew someone in their industry who'd committed suicide."

The researchers interviewed more than 100 male and female farmers from five industries (cotton, cane, grains, fishing and mixed farming) in Victoria, Western Australia and New South Wales. They also asked farmers to keep a health diary for three months on how they rated their health, their level of physical health/nutrition/mental health, and whether they were using any health services.

"What we've found is that industry organisations have an important role to play in being proactive about health," Dr Willis said. "It's important that mental health gets incorporated into industry activities, for example, field days. This helps to reduce the stigma of mental health problems, because it becomes seen as one of the many issues associated with farm life, rather than a separate issue for individuals.

"Health in rural areas is largely about being proactive in the community. There was a wonderful example in one town where the locals had set up a 'men's garage'. It was just a place where men knew they could drop in and get a cup of coffee, and connect with other farmers.

"Those community initiatives are the way to go in making sure that we're proactive with farm health."

Dr Karen Willis interviewed more than 100 farmers about what they do to stay healthy in difficult times.

This two-year project was supported by a $179,000 Rural Industries Research and Development Corporation Grant.

OUR GRADUATES HAVE WHAT IT TAKES.

DO YOU HAVE WHAT THEY NEED?

The University of Tasmania needs to attract researchers with the talent, passion and desire to excel in graduate research. We are now offering Elite Research Scholarships to outstanding applicants, and any business or individual interested in supporting our growing international reputation for research excellence is invited to contribute to the program by providing $7,500 per annum as a silent or identified sponsor. Valued at $30,000 tax-free per annum, Elite Research Scholarships are offered in specific project areas to help keep the research passion alight. **If you're keen to tick the final two boxes, contact the Dean of Graduate Research on (03) 6226 7127.**

Graduate research at UTAS

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