



PIONEERING VISION SAVES LIVES

Across the globe, more than eight billion scans have been completed to date using world-leading magnetic resonance imaging technology developed at UQ.

For over two decades, UQ has been at the forefront of advances in magnetic resonance imaging (MRI) technology, with its first innovation now used in 67 per cent of MRI scanners manufactured worldwide – all thanks to a holiday work experience program undertaken by one junior engineer.

“As an undergraduate electrical engineer in the late 1980s, I took up a vacation placement in the biomedical engineering department at Brisbane’s Princess Alexandra Hospital,” says MRI technology pioneer Professor Stuart Crozier.

“Working in the spinal unit, I saw how some biomedical engineers had developed small devices to activate patient muscles, enabling them to do ordinary things like lifting a cup to their mouth. I was amazed – and inspired.”

Inspired so much so that he pledged to use his skills and understanding of technology to benefit patients. Following that vacation program, Professor Crozier went on to receive a placement in an MRI research group at the Mater Hospital in 1988 – a placement that was set to transform his life and that of so many others.

“MRI is a relatively young diagnostic imaging technology compared to the others commonly used,” he says, “and when I first joined the research program there were lots of breakthroughs happening.

“Exciting developments are still happening and we are closely involved.”

Collaborating with Professor David Doddrell at UQ’s Centre for Magnetic Resonance (now the Centre for Advanced Imaging (CAI)), Professor Crozier co-invented a signal correction technology that corrected magnetic field distortions to produce faster, clearer and more accurate images, without adding to the cost of the MRI machines.

An MRI is a non-invasive, painless diagnostic technique that gives detailed pictures of organs and structures in the body. Using a powerful magnetic field to measure the magnetism within a body, it creates thin-section images that are used to map and analyse the body in great detail, which aids in the diagnosis of many medical conditions.

The UQ-developed MRI technology helps to identify subtle image features, improving the quality of diagnosis at an earlier stage of disease and increasing the success rate of early medical intervention.

With the help of UniQuest, UQ’s main commercialisation company, this technology was licensed to Siemens and GE Healthcare in 1998 – the two largest companies in the MRI industry. Both companies have since incorporated UQ’s image-correction technology into all their MRI machines, representing around two-thirds of all machines on the market, with an estimated eight billion scans having been taken since then.

“Professor Crozier’s ground-breaking research has had a profound effect on the international biomedical imaging market and the diagnosis and treatment of patients worldwide,” says Dr Dean Moss, UniQuest’s CEO.

“The success of his work is an excellent example of UQ’s research excellence translating into products that create change on a global scale.

“We foresee that the momentum and royalties generated from the first MRI innovation will lead to even more research and so generate further breakthroughs.”

Professor Crozier, Associate Dean (Research) for UQ’s Faculty of Engineering, Architecture and Information Technology, is a prolific inventor with 27 patent families to his name.

In 2005, UniQuest established Magnetica Limited, with Professor Crozier as the founding scientist. The company was created to commercialise high-performance superconducting MRI magnets for compact, portable MRI machines able to scan human limbs without having to immerse the whole body in the magnetic field. To date, the company has attracted over \$12 million in investment and grant funding.

Magnetica’s research and innovation in magnet design also led to the development of small 1.5T extremity magnets used in systems sold by GE Healthcare. These were developed in collaboration with Japan Superconductor Technology, Inc (Jastec), a subsidiary of multinational Kobe Steel, and supported by grant funding from the Queensland Government. About 220 of these units have been sold for approximately US\$110 million.

In 2012, Professor Crozier received the prestigious Australian Academy of Technological Sciences (ATSE) Clunies Ross Award for his 20-year contribution to the field

of MRI technology, and was also acclaimed as a UQ Innovation Champion.

In the same year, the \$11 million Siemens MAGNETOM 7 Tesla (7T) scanner, the most powerful whole-body MRI scanner in the Southern Hemisphere, was installed at UQ's CAI, providing unprecedented opportunities for imaging research in Australia.

According to CAI Director Professor David Reutens, its installation has been of benefit to important research programs into neurodegenerative diseases such as Alzheimer's and Parkinson's disease, and disabling diseases such as arthritis.

Today, Professor Crozier and his team continue to research and develop innovative imaging technologies, playing a key role in the development of modern MRI and Nuclear Magnetic Resonance systems produced and sold by leading global companies.

They have been working to enhance magnet design, radio frequency coil design and gradient coil design to develop compact, portable machines and improve patient comfort.

An exciting new project is the development of image-guided therapy for cancer patients. In this work, which is in collaboration with researchers in Sydney and Stanford, a unique MRI system developed by Professor Crozier and his team detects tumours which may be moving inside the body (for example, lung tumours move as patients breathe) and directs a radiation beam to the position of the moving tumour. In this way, healthy tissue is not damaged (unlike conventional treatment) and the tumour receives a more optimal dose. The prototype of this system is expected to be tested in 2017.

Thanks to more than two decades of world-leading MRI research and development at UQ and the resultant commercialisation outcomes, the University is well placed to continue its research and generate new breakthroughs in imaging technologies.

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Mr Aiman Al Najjar, MRI Facility Manager for the Centre for Advanced Imaging, scans a patient on the Centre's \$11 million Siemens MAGNETOM 7 Tesla (7T) scanner.

The journey so far:

1995: Professors Stuart Crozier and David Doddrell from UQ's Centre for Magnetic Resonance develop an MRI technology that corrects magnetic field distortions and produces faster, clearer and more accurate images, without adding to the cost of MRI machines.

1998: The technology is licensed to Siemens and GE Healthcare, benefiting people globally with more than eight billion scans completed to date.

2005: UniQuest establishes Magnetica Limited to commercialise high-performance superconducting MRI magnets for compact, portable MRI machines.

2010: Magnetica's research and innovation in magnet design leads to the development of small 1.5T extremity magnets, developed in collaboration with Jastec and used in systems sold by GE Healthcare.

2012: Professor Crozier receives the prestigious ATSE Clunies Ross Award.

2014: Professor Crozier is named a UQ Innovation Champion.

2014: Siemens MAGNETOM 7 Tesla (7T) scanner, the most powerful MRI body scanner in the Southern Hemisphere, is installed at UQ's Centre for Advanced Imaging.

2016: A prototype of a unique image-guided therapy system is under construction.

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