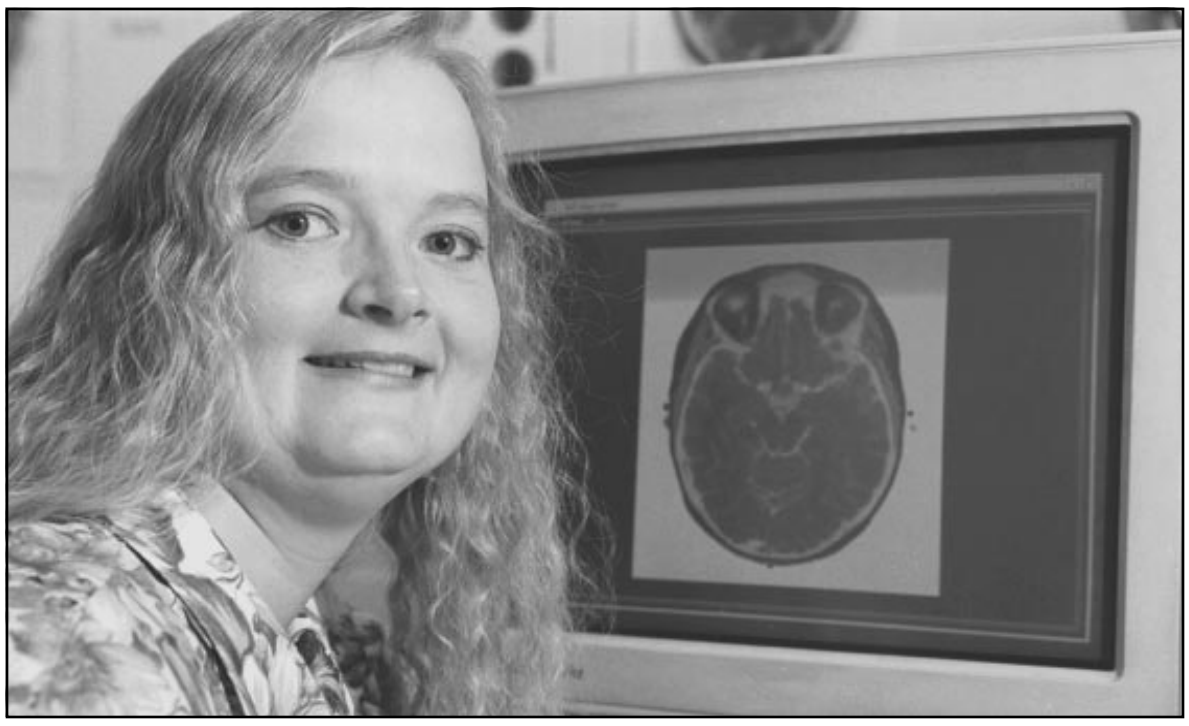
# Student uses her brain to get answers

## Electrical activity charted in three-dimensional image



*Monica Hurdal…'brain function still a mystery'*

**By NOEL GENTNER**

A PhD student at QUT's School of Mathematics is literally using her brain to delve deeper into the human brain to seek more specific answers to as yet unanswered questions.

Ms Monica Hurdal is endeavouring to reconstruct a 3D computer image from scans of her own brain to assist in pin-pointing sources of electrical activity in the brain that are due to observing visual stimuli.

She said it was not an unusual procedure for researchers in this area of work to use scans of their own brain to carry out their projects.

"Brain functions are definitely still a mystery and there is a tremendous amount that is unknown," Ms Hurdal said.

"There is only a basic understanding of anything to do with the human brain and any advancement in knowledge into specific brain functions is welcomed."

Ms Hurdal has completed her first year of her PhD work and believes she will not complete her research and findings until the end of next year.

She obtained an Honours degree in her Bachelor of Mathematics degree, majoring in Computer Science and Statistics at the University of Waterloo in Canada before coming to Australia.

Ms Hurdal said she saw her PhD as an extension of her Master of Science degree by research in mathematics and psychology obtained at the University of Newcastle in New South Wales.

"There are a lot of general conclusions you can make about vision and the visual cortex and how the brain processes information," Ms Hurdal said.

"An example of this is that things you see on the left are initially processed by the right side of the brain in the visual cortex and things you see on the right are processed by the left side of the brain.

"I want to be more specific and obtain a more localised and accurate precise spot of where visual information is processed in the visual cortex.

"It is generally accepted that visual information is initially processed along a deep groove, called the calcarine fissure, which runs through the visual cortex located at the back of the brain."

Ms Hurdal said she was trying to identify, within a few millimetres, particular areas that were doing the visual processing.

She said she hoped to do this by using magnetic resonance imaging scans of her own brain to reconstruct a 3D computer image from them.

This would provide a 3D surface that could be used to pinpoint the location of the processing source in the brain.

"There is a lot of discrepancy as to the exact location and how much tissue is devoted to processing particular parts of what you see," Ms Hurdal said.

"I am trying to create a 'cortical magnification map' to determine the amount of neural tissue which processes information from the visual field.

"For example, central vision processes finer details than peripheral vision, and so more area of the brain is devoted to processing central vision.

"I am endeavouring to map and describe the relationship between specific areas of the visual field and how much of the visual cortex processes those areas.

"In this particular aspect of my work, the methodology I am taking is novel and will give medicine and psychology a new quantitative tool for investigating the visual cortex.

"This methodology could also be applied to other areas of brain research, such as determining the relationship between specific tones or sounds and how much of the auditory cortex processes those tones.

"My work and research will hopefully provide a set of computer programs and algorithms to interpret data and provide more specific answers."

Ms Hurdal is carrying out her PhD work under the supervision of Professor Sean McElwain.

Professor McElwain said Ms Hurdal's work was a prime example of how mathematics could be used in other disciplines to solve new problems.

"What we do is take ideas from another discipline and work within a mathematical framework, developing mathematical models to aid in the interpretation of experiments and data for that discipline," he said.

# PIRIS to monitor research info

**QUT is leading Australian universities in the development of an information management system for research performance indicators.**

When completed, the Performance Indicators Research Information System (PIRIS) will streamline reporting on research activities and will put valuable information at the fingertips of decision-makers.

The project has been funded by a grant of $121,474 from the National Priority (Reserve) Fund.

It is a collaborative project between the Division of Research and Advancement and the Division of Information Services.

The project team consists of Judy Waugh, Diana Norkaitis and Marek Bienko from Management Information Systems and Norma Gilbert and Moira Wood from the Office of Research.

Ms Wood said QUT, as with all Australian universities, collected information to report to DEET agencies on research performance and general research outcomes.

"PIRIS will take these raw research data and greatly enhance performance management and evaluation," she said.

"It will have predictive and modelling capacities able to translate operational level information into a form that meets the needs of managers and executives."

She said the Office of Research aimed to develop a product not only for use within the research office, but something that would be used for research management purposes throughout the university.

"PIRIS will provide information on evaluative and comparative research indicators to aid in the development of appropriate strategies and research management objectives," she said.

"The information may be used by centre directors, heads of schools, deans, pro-vice-chancellors right up to the vice-chancellor."

Ms Wood said the PIRIS team had aimed for an end product that was as flexible and accessible as possible to best meet the needs of a diverse range of users.

"The idea is for a very user-friendly 'click and point' type interface operating in a Windows environment, for presenting the information in spreadsheet or graph format," she said.

Ms Wood said PIRIS could become a software application for use within Australian universities.

"It is designed to use performance indicators set down by both DEET and higher education institutions, but is flexible enough to allow universities with different research focuses and performance indicators to customise PIRIS to their needs," she said.

"By the end of this year programming should be written and we should have a test system.

"The test will come when the system goes on-line at QUT early in 1996, where it will be implemented on our research information system."

Ms Wood said the final report was expected to go to the National Priority (Reserve) Fund in April 1996.

# Researcher seeks order in chaos

CHAOS is in the everyday thoughts of one newly appointed senior lecturer's mind at QUT's School of Mathematics.

Dr Rodney Wolff is applying some aspects of chaos theory and statistics to two research projects.

One project concerns patterns in speech and using computers to recognise spoken words.

The other project involves statistical analysis of financial systems using measures of stability in such processes as international monetary exchange rates.

The exchange rate project is a joint effort by Dr Wolff and a colleague at the National School of Statistics and Economic Administration in Paris.

Dr Wolff said it had only been in the past decade that mathematicians had had sufficient theoretical knowledge to look seriously at chaos theory.

He said the theory could be characterised by "making observations on a system at successive time points such that two runs of observations which begin a small distance apart will follow very different patterns as time goes on."

Dr Wolff said this meant that if a small error was made in the detailed recording of observations over a period of time one's prediction would be nothing like the actual outcome.

"Data which are chaotic exhibit strange behaviour but really follow a few very simple deterministic rules that don't change," Dr Wolff said.

"Because of these deterministic rules you can find patterns in chaos."

Dr Wolff said he was interested in monetary exchange rates because they had certain regimes of stability where they could fluctuate without plummeting or skyrocketing.

"Observers have not yet decided whether exchange rates have strong random components or whether there is evidence of chaos there, some deterministic rule which is responsible for the complicated behaviour," he said.

Dr Wolff said his research aimed to estimate a statistical measure of stability in exchange rates rather than creating an explicit deterministic mathematical formula.

In his other project, Dr Wolff is endeavouring to apply the same deterministic approach to human speech traces for computer speech recognition.

"My approach is to build up graphical patterns in speech traces and identify word patterns with figures for the computer to recognise the spoken word," Dr Wolff said.

"It is slightly more intuitive than existing methods which try to tune parametric models.

"What I am trying to do is to say that this shape or picture obtained from speech data corresponds to an actual word."

Dr Wolff said he hoped to have one of the projects completed by the end of the year.

# Scientists develop disease-resistant pawpaws for south-east Asian market

**QUT'S Centre for Molecular Biotechnology has received a grant of $429,000 to genetically engineer disease-resistant pawpaws for Thailand and Malaysia.**

**Centre Director Professor James Dale said an epidemic of the papaya ringpsot virus had devastated crops in south-east Asia.**

**"In Thailand in the mid-1980s they were exporting around $US70 million in pawpaws. Because of this virus they now can't even supply their domestic market," Professor Dale said.**

**"The virus is spreading throughout south-east Asia. Typically it remains at a low level for three to five years before erupting into an epidemic. Once that epidemic hits, it's impossible to stop."**

**Professor Dale said there was virtually no naturally occurring resistance to the virus in Thai pawpaw varieties, leaving genetic engineering as the most practical solution.**

**"We have developed a method of transforming pawpaw in Australia which is really very good," he said.**

**"To make the resistance genes we actually take genes from the virus and put that into the plant.**

**"We have already done this successfully in Australian plants with Australian isolates of the virus.**

**"So what we have to do is work with Thai scientists to develop a similar process specific to Thai cultivars."**

**Professor Dale said the project was funded by the Australian Centre for International Agriculture Research (ACIAR) and was being conducted in collaboration with scientists from the Thai Department of Agriculture, two Thai universities and the Malaysian Agriculture Research and Development Institute.**

**He said ACIAR had the mandate to sponsor collaborative agricultural research between Australia and other countries.**

**"ACIAR projects have to be collaborative — there has to be something of benefit to Australia. In this case it is the chance to build on existing Australian research into pawpaw disease resistance," he said.**

**Professor Dale said he believed developed nations like Australia had a responsibility to share technology and expertise with developing countries.**

**"I believe biotechnology and information technology are very real examples of where the division between rich and poor countries can become greater," he said.**

**"Rather than being of use to the world, it (technology) will actually create a much wealthier group and a much poorer group because developing countries don't have a history of being involved in biotechnology and don't have access to that expertise.**

**"From an ethical point of view, I think it is essential they (developing countries) have access to that technology," Professor Dale said.**