Paul Teal

Associate Professor
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Dr Teal's research focuses on signal processing of acoustic and electromagnetic waves, including developing new processing techniques and applying them to solve specific problems. More and more sensors are being deployed to collect signals from the environment that require interpretation - or processing - to extract information. While scientists usually perform offline data analysis, engineers are called on to construct devices that perform signal processing unassisted and in real time, e.g. a smart phone. Signal processing tools offer solutions to a wide variety of scientific and industrial problems.

Dr Teal is an associate professor at Victoria University of Wellington. He has a B.E. from the University of Sydney and a PhD from the Australian National University.

Dr Teal's specific research topics include:

- *Detection and Interpretation of the Cochlear Microphonic Signal*
  This project has the potential to fundamentally change the way that some hearing impairments are diagnosed, and perhaps even more significantly, the way that hearing aids are prescribed (see story on reverse).
- *Signal Processing for Nuclear Magnetic Resonance (NMR)*
  Dr Teal's research is contributing directly to the challenge of interpreting experimental results using NMR for the petroleum industry.

  "The usual method of interpreting NMR decay data based on converting it into a spectrum is computationally expensive, and numerically unstable," explains Dr Teal. "By using a parametric approach and Baysian methods, we can estimate the relevant decay parameters directly from the recorded NMR data."

- *Bayesian Signal Processing for Advanced Sonar*
  Dr Teal has proposed and validated several original approaches to multi-target tracking. "By combining Bayesian methods with a technique known as MUSIC, we have outperformed previously methods applicable to SONAR," Dr Teal says.

He has also developed some original resampling methods that may become the methods of choice for many research and commercial applications, including RADAR and SONAR.

- *Multi-sensor acoustic signal processing*
  Dr Teal has contributed innovations in several application areas using arrays of microphones and/or loudspeakers:

1. New approaches to enhance emergency communication for law enforcement and fire-fighters working in noisy environments.
2. A new and promising approach for surround-sound systems based on "shaping" the acoustic behaviour of the room.
3. New methods using microphones grouped in pairs to locate where sounds such as bird calls originate.

To find out more about Dr Teal's research, please contact him directly by calling +**64-4-463 5966** or emailing him at **paul.teal@ecs.vuw.ac.nz**

Improving the treatment of hearing defects

Dr Teal has made a number of innovations using arrays of microphones and loudspeakers

"My vision is that we will one day be able to hook people up to a device that plays them tones and sounds and gives an automatic read-out on the tuning of the hearing aid they need," says Dr Teal. "Developing the first, full model of a working cochlea will bring us closer to realising that vision."

Dr Paul Teal, an associate professor in the School of Engineering and Computer Science, is part an international research team funded by the European Commission 7th Framework Programme for Research.

The team will provide a realistic, three dimensional, finite element model of the motion in the cochlea, a spiral chamber located inside the ear that turns sound vibrations into electrical signals which travel along nerves to the brain and allow us to hear.

Victoria is the only university outside Europe to have a researcher as part of the successful bid.

- *Measuring the cochlear microphonic*

Dr Teal was asked to join the team because of his world-leading research into better ways of measuring the cochlear microphonic, which is the electrical signal generated inside the cochlea. His work could lead to the development of new techniques to more accurately assess hearing loss.

Dr Teal's input allows electrical components to be added to the model which would otherwise be only mechanical and acoustic.

- *Modelling the Cochlea*

Sections of the cochlea have been modelled before but no one has yet developed a complete picture. If the team succeeds, Dr Teal says it will answer a lot of questions.

"There is still a lot of dispute about the details of how the cochlea even works," explains Dr Teal. "It's hard to study because of where it is in the body and the complex processes at work."

- *Measuring the individual*

Dr Teal's research takes advantage of recent advances in electronics to find ways of collecting an electrical signal directly from the cochlea.

"The test most commonly used to measure hearing loss at the moment is the audiogram," he observes. "The audiogram only records the amplification required for the quietest sounds, and the prescriptions for other sound levels are based on population averages rather than an individual's condition."