Hearing protection technology has been the successful focus of a team within the Western Australian Telecommunications Research Institute (WATRI), a collaboration between Curtin and The University of Western Australia for research in wireless systems, signal processing and electronic systems.

Six years ago, Professors Sven Nordholm and Kevin Fynn from Curtin’s School of Electrical Engineering and Computing, began focusing WATRI’s expertise on developing a technology to assist workers in industries where noise-induced hearing loss can be a risk.

‘A major problem for workers in noisy environments was that they had no choice but to use conventional earmuffs or earplugs that inhibit face-to-face communication,’ Nordholm said.

“We developed new “speech-enhancement” algorithms that filtered extraneous noise from entering an array of microphones but admitted useful soundwaves such as human voices.”

Proof-of-concept for the new technology was completed in 2004, and its success led to the company Sensear Pty Ltd being formed. The team has now produced a range of hearing-protection devices that enhance voice communications where acoustic signal-to-noise ratios are problematic.

‘The Sensear technology allows binaural processing, which means that directions of external sounds are maintained – an important capability in environments where alarms or sirens occur,’ Nordholm said.

‘Wearers can also communicate more clearly while using electronic devices such as mobile phones and two-way radios.’

The headphones are now used in a range of environments where noise-induced hearing loss could be an issue, such as in the military, and across commercial and hospitality industries. Notably, Sensear is providing its world-leading technology to companies such as Alcoa, BHP Billiton and Qantas.

The success has now led to the Australian Research Council awarding Sensear and Curtin a three-year grant to further develop the technology into products that are suitable for people who must also use hearing aids.

The new project aims to solve the issue of acoustic feedback, or ‘howling’, which limits the amplification that can be achieved for selective frequencies, for the hearing-impaired, this can prevent their use of electronic hearing protection devices.

‘First we want to advance the body of knowledge about speech intelligibility,’ said Nordholm, who is chief scientist at Sensear.

‘Specifically, we need to better understand how the human auditory system performs complex binaural signal analysis and synthesis under adverse listening conditions.’

The Sensear team will then apply the knowledge to develop algorithms that exploit both the human auditory model and sonic cues.

‘This project has the potential to innovate speech and hearing products – and to lead to the next generation of audio communication devices in general,’ Nordholm said.

sensear.com

Western Australia’s roads comprise an 18,000-kilometre network worth $36 billion per annum in construction and maintenance. The design of road surfaces – or pavement – is therefore an important branch of civil engineering in WA, and to Main Roads Western Australia (MRWA), the authority that manages the State’s road network.

The Pavement and Geotechnical Research Group within Curtin’s Department of Civil Engineering now has the best pavement engineering laboratory in WA. As a result, the group is able to develop and undertake innovative projects in pavement design and construction.

The goal of one project is to facilitate use of recycled concrete for pavement construction. Funded by the State Government’s “Towards zero waste” program, the project aims to demonstrate that recycled concrete performs well as sub-base and base-course material in roads.

Professor Hamid Nikraz, Head of the Department of Civil Engineering, explains the project’s contribution to environmental sustainability.

‘Utilising recycled concrete in road construction will reduce the significant amount of waste concrete that goes into landfill,’ he said. ‘It will therefore reduce the need for virgin quarry materials – which means less land clearing and natural habitat destruction, and a reduction in air pollution caused by dust.

‘Importantly, there’ll be a larger market for recycled concrete and more construction and demolition waste delivered to recyclers.’

Government and industry groups who no longer need to have projects undertaken at facilities in the eastern states increasingly seek the group’s expertise.

civil.eng.curtin.edu.au/research/pavement_group

Another project is addressing the issue of early surface damage on new roads in WA, which is resulting from the continual increase in vehicles. The Australian Research Council is supporting the Curtin team and their research partners MRWA and the Planning and Transport Research Centre with a three-year Linkage Project.

The group will assess the construction material known as hydrated cement-treated crushed rock base (HCTCRB) to examine whether factors involved in its manufacture, road design or construction are partly responsible for the problem.

At the Pavement Engineering Laboratory, Nikraz’s team can combine numerical methods, sophisticated laboratory testing and computational models to accurately simulate HCTCRB behaviour under traffic loads.

‘Australian engineers have been relying on empirical design, experience and basic experimentation – methods that make it difficult to accurately assess why the damage is occurring,’ he said. ‘Overseas, engineers have begun using mechanistic design to explain pavement characteristics under real operational conditions. Having a state-of-the-art laboratory is enabling us to bring pavement analysis and design in WA up to international standards.’

The team will assess samples made with different amounts of cement and water, and evaluate performance variables such as strength, deformation, shrinkage, fatigue and durability.

The results will enable the project to identify an optimum mix of HCTCRB for WA roads, and should resolve the problems with early degradation of road surfaces.

Pavement research smoothes the way

The increased use of recycled concrete, and the reasons why roads are degrading prematurely, are two areas of focus for Curtin’s Pavement and Geotechnical Research Group.