

St Pancras Station, London

## Rust Detection Technology

Using innovative technology originally developed for cultural conservation Opus aims to detect rust on steel structures from up to 100m away.

The idea for developing the technology originally came from Opus structural materials and corrosion engineer Raed El Sarraf, who has undertaken numerous assessments of steel structures to determine levels of corrosion, including the Auckland Harbour Bridge, and is very familiar with the challenges involved in making these

assessments. For example, it is easy to mistake red lichen for rust from a distance, and very difficult to determine the degree of corrosion occurring beneath paint and other surface coatings.

Working in collaboration with scientists at Nottingham Trent University, Opus believes the new technology could save tens of millions of dollars per year in surveying costs while removing the need for potentially hazardous inspections. The project has been recognised and supported by UK Innovate, a

### • *In this issue*

- 1** Rust Detection Technology
- 3** Paving the Way – Wellington's Smart Motorway
- 4** Raingardens Provide Clean Green Solution
- 4** Sharing Ideas for Our Industrial Legacy
- 5** Slippery When Wet
- 6** Getting Involved in Our Community
- 8** New Staff

government agency that aims to drive business growth by supporting science and technology developments, with a \$750,000 research grant.

The three-year research programme aims to develop a remote imaging system using a hand-held tripod or UAV-mounted instrument that simultaneously performs both 3D and spectral imaging. This combination of imaging has not been available before for use in a single system for the inspection of structures. The resulting 3D models will provide detailed information regarding surface blistering and corrosion that could inform decisions about when to repair or decommission structures such as bridges.



Auckland Harbour Bridge

This leading-edge spectral imaging technology, using a broadband laser-like light source with a wide-frequency range, will enable more precise data collection than previously possible, Professor Haida Liang, Head of the Imaging & Sensing for Archaeology, Art History & Conservation (ISAAC) research group at Nottingham Trent University explains:

"Normally a colour image has three channels but with spectral imaging you chop it down to more, finer channels, so instead of just three you can have ten or whatever you like," Liang says.

**"We are collecting not just a 2D image but an image cube."**

Originally developed with a grant from the UK's Engineering and Physical Sciences Research Council, the spectral scanning system allows automatic, in situ, remote imaging at distances up to 35m of paintings at

high resolution. This technology has already proven itself in the field of conservation to closely examine wall and ceiling paintings that would have otherwise been inaccessible, such as the Sanskrit writings and drawings that were revealed in 2012 in the UNESCO world heritage site of the Mogao caves in China's Gobi Desert.

The potential applications of 3D spectral imaging in civil engineering came to light in late 2015 when Opus' James Hulme approached Nottingham Trent University for assistance with a number of remote imaging issues related to rust. Liang's work with remote imaging for conservation, and her work with red ochre - a paint made up of the same chemical ingredient as rust - meant she had highly relevant expertise.

**"When I heard James' problem with rust I thought – it is the same as red ochre. And at that point we clicked."**

The support of the UK Innovate research grant has enabled Opus and Nottingham Trent University to be more ambitious in their work and the team has set its sights on extending the surveying distance from 30m to 100m.

**"We are creating a next-generation system that won't be like the original. We can go back to the drawing board and do something totally different and smarter," says Liang.**

**Contact:** Richard Curtis

**e.** [richard.curtis@opus.co.nz](mailto:richard.curtis@opus.co.nz)





Photographer, Lindsay Keats

## Paving the Way – Wellington's Smart Motorway

Surfacing of Wellington's new smart motorway was recently completed using a novel long-life asphalt developed at Opus Research in partnership with Fulton Hogan for the NZ Transport Agency. This is the first time the epoxy modified open-graded porous asphalt (OGPA) has been used in Wellington and will provide a quieter ride into and out of the city.

The development of the epoxy modified asphalt was driven by the user benefits it provides for the public and the cost savings resulting from the very long life expected. As well as being a low-noise asphalt, this type of surface allows free drainage of rainwater which will improve traffic safety through enhanced skid resistance and provide better visibility from reduced tyre spray. Conventional OGPA suffers from a short useful life. For road users, the long life expected from epoxy OGPA also means reduced delays, lower costs and fewer road works.

Before the application of the new surfacing the Transport Agency required extensive site investigations be undertaken to ensure that the

underlying pavement was in good condition and suitable for this type of asphalt. Opus Research extracted cores of the old pavement and reviewed the quality of the existing materials in the laboratory as a specialist service for the Transport Agency.

During the two weeks of production and laying for the Wellington Motorway, Opus Research undertook quality control testing of the mix on behalf of Fulton Hogan and the Transport Agency.

The success of this type of asphalt depends on precise control of the manufacturing process. Because the material is expensive, maintaining good quality control is essential to ensure the value of the final product is preserved. A key factor is the amount of epoxy in the asphalt mix. To monitor the epoxy concentration we developed a new analysis method using an infrared spectroscopy technique. This innovative and rapid method allows the amount and relative proportions of the two epoxy components to be measured to within  $\pm 1\%$ .

Epoxy OGPA will be used in the next few months on the Cambridge section of the Waikato expressway and on the Western Corridor project (SH1 John's Road upgrade), in Christchurch.

**Contact:** Phil Herrington

**e.** [phil.herrington@opus.co.nz](mailto:phil.herrington@opus.co.nz)

## Raingardens Provide Clean Green Solution



Visualisation of urban raingarden

Opus landscape architects and stormwater engineers have been studying an innovative solution for urban stormwater management to benefit smart cities striving for green infrastructure. Due to increasing population and huge infrastructure developments in many cities, including Auckland, the quality of surface water is a growing concern. Led by Suman Khareedi, this project aims to design a suspended raingarden to counter stormwater management challenges faced by cities.

Low impact designs like raingardens are efficient stormwater treatment solutions but, because they are not practical in congested urban areas, suspended raingardens are a smarter and more compact answer. Incorporating treatment aspects and organic content into the gardens removes pollutants from stormwater runoff and supports plant growth.

During the study, our stormwater experts collaborated with University of Auckland post-graduate students to test three different lightweight materials that could be used in raingardens to treat runoff water. Results showed that all three tested lightweight materials demonstrated effective treatment of artificial stormwater runoff. During the next stage of the project each material was optimised for plant growth to ultimately identify which was the best to be used in the field. Results from this study could benefit not only the local Council but also cities worldwide striving for water sensitive designs.

The findings of this study were presented at the World Water Congress & Exhibition, organised by the International Water Association, in Brisbane in October. Our stormwater engineers are also in discussions to implement this novel approach to stormwater treatment.

**Contact:** Suman Khareedi

**e.** [suman.khareedi@opus.co.nz](mailto:suman.khareedi@opus.co.nz)

## Sharing Ideas for Our Industrial Legacy

"Removing barriers to the use of crumb rubber in roads" was the topic of Opus Materials Scientist Jeremy Wu's presentation at the Road Engineering Association of Asia and Australasia (REAAA) NZ Roadshow this year. The aim of the Roadshow was to promote research and development, to share knowledge and experiences, and to network. The theme for this year's roadshow was "Our Industrial legacy – What are we leaving our children?"

Jeremy, who was the key researcher of this recently published NZ Transport Agency report (578) on the use of recycled crumb rubber, used this opportunity to speak to several hundred participants across five venues (Auckland, Taupo, Wellington, Christchurch, and Dunedin) about the research findings as well as to promote the collaborative effort of the roading industry in putting the technology into practice. His key points touched on the benefits of tyre rubber in roads.

"The benefit of tyre rubber in bitumen is two-fold, it not only enhances the performance of the bitumen and its applications but also diverts a waste stream away from landfills," Jeremy said.

"Devulcanised tyre rubber has a potential to be introduced into the roading industry with fewer barriers."

**Contact:** Jeremy Wu

**e.** [jeremy.wu@opus.co.nz](mailto:jeremy.wu@opus.co.nz)



# Slippery When Wet

## Have you ever wondered what a road sign is really trying to tell you?

Joining forces with the NZ Transport Agency, the Behavioural Sciences team took on a project to develop understandable, cost-effective signage to warn drivers of potential slippery conditions in certain areas. Because previous research has shown that current signs haven't been well understood, our team were determined to find an innovative solution.

The approach involved three key phases. Firstly, a literature review identified key principles for a clear, understandable design from which a series of model signs were created. The models were considered by a group of the public in an interactive workshop. Participants identified issues and preferences for the current and alternative signage and chose which sign they felt would be best understood by drivers and why. Participants also indicated their preference for the sign to include text on accompanying plates.

After a discussion with the Steering Group, it was decided that the main sign would remain unchanged but two new additional plates with the text "SLOW WHEN WET" and "SLIPPERY WHEN WET" would be tested, along with the current sign.

Lastly, on-road trials were conducted at three curves on State Highway 58 that connects the Hutt Valley to Porirua in the Wellington region. The key performance measure was vehicle speed. Changes in speed were measured before any signs were added, and after the addition of each different sign to determine which sign was the most effective. The signs were left in position for five weeks at each curve with data collected from the final two weeks of each period in order to account for variation caused by congestion, accidents, road works, or any initial novelty effects.

The results showed that in dry conditions the signs made no practical difference to how fast people were driving; however, in wet conditions the presence of any sign resulted in both a significant and practical reduction in speed on all three curves. The "SLOW WHEN WET" sign had the most impact with a 7km/h reduction in speed. Therefore, this text plate was recommended for use in conjunction with the current sign for future use.

**Contact:** Margaret Trotter

**e.** [margaret.trotter@opus.co.nz](mailto:margaret.trotter@opus.co.nz)



SRS signage options tested in on-road trial



# Getting Involved in Our Community

## STEMM Festival proves a hit

Hutt City Council's Science, Technology, Engineering, Mathematics and Manufacturing (STEMM) festival continues to reinforce Lower Hutt as a New Zealand centre for technology-rich industries.

During this year's festival in June, Opus Research, along with other local businesses and organisations, opened their doors to the public to showcase their science, innovation and technology expertise.

Despite the torrential rain, many visitors came to visit the Opus Research facilities. The open day was particularly popular among young children who were keen to learn more about science and technology. One young boy took a video recording of his entire

tour, which was part of his birthday present from his parents. The available tours included the wind tunnel, infrastructure laboratories, our instrumented bike, an overview of water treatment technology, along with some insights into some of our exciting R&D projects.

Lower Hutt Mayor Ray Wallace said that the success of the Festival helps prove that Lower Hutt is a centre of science and technology.

"I'm impressed once again by the level of support for the Hutt STEMM Festival, from the businesses and organisations hosting events, and from the people who attend and are engaged by what they find.

"It's especially heartening to see so many young people's enthusiasm for science and technology, as they are the ones who will continue to make Lower Hutt a great place to live, work and play into the future."

More information can be found at [www.huttstemm.nz](http://www.huttstemm.nz)



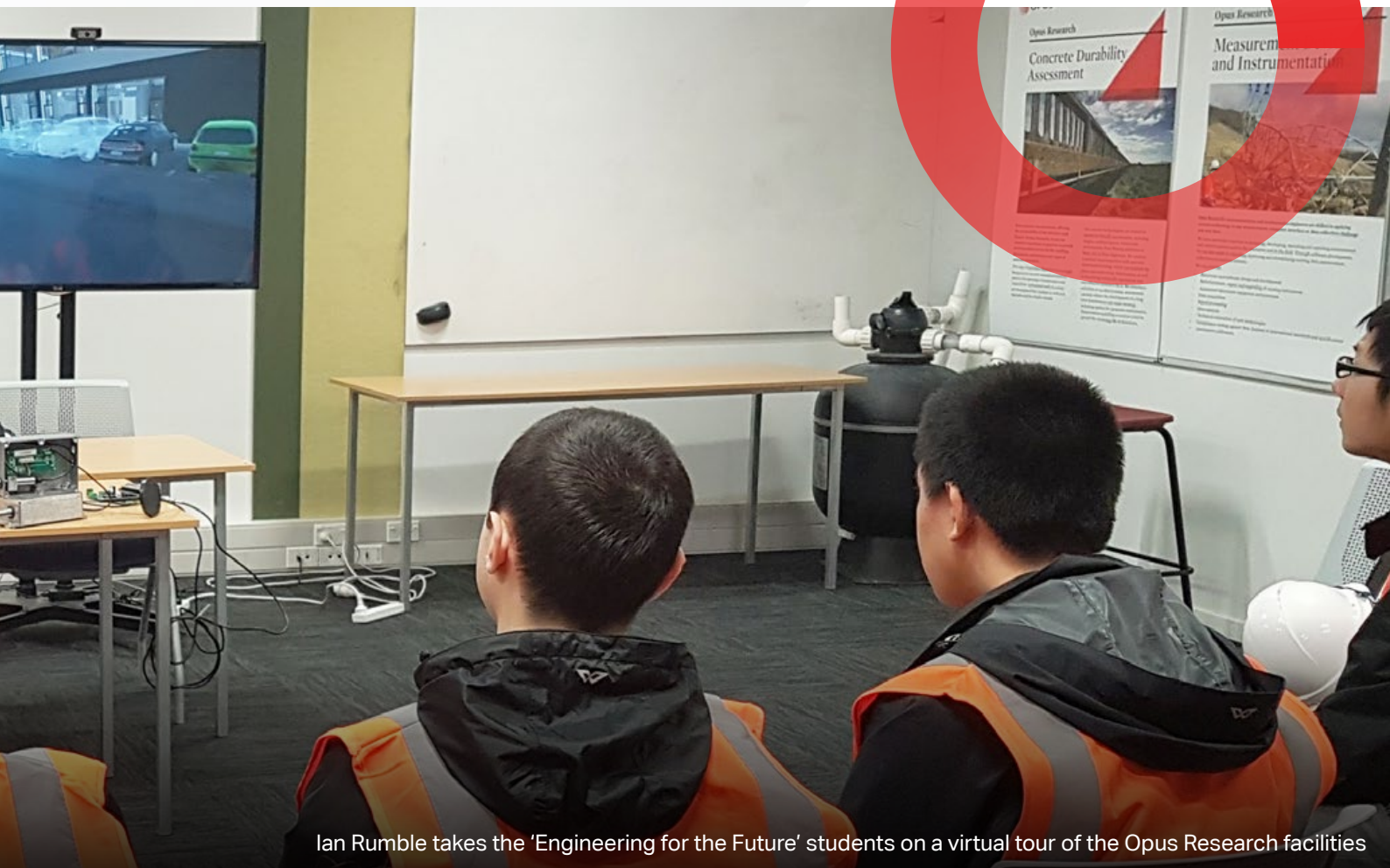
## Engineering for the future

In partnership with IPENZ, Beca, MWH and AECOM, Opus helped bring a new programme to life, the first of its kind in Wellington, to celebrate the field of engineering. The Week of Engineering was developed to promote engineering in our community as an exciting and rewarding career for young graduates entering the workforce. We aimed to show that the work of engineers is all around us, from our public transport to bridges, dams and tall buildings and as an engineer, you can help make a real difference to the future of our cities.

Various initiatives took place during the week, including one-day workshops targeted at senior high school children with a mix of fun activities, design-and-build tasks and site visits. Minister Steven Joyce joined the students for one of the design tasks, and Opus Research hosted two group site visits. The outstanding interest and engagement from the students was rewarding for all involved.

The week culminated with a public Open day 'Engineering a Stronger City' which provided the opportunity to meet top engineers from the private, public and education sectors, enabling the public to explore and discover how engineering has shaped Wellington - and the world - through to exciting and interactive stalls and activities. The Week of Engineering was a huge hit, with enthusiastic visitors getting involved and taking away valuable information. We are now exploring the potential to expand the Week of Engineering within the region, and roll out to other centres across New Zealand next year.

More information can be found at  
[www.weekofengineering.co.nz](http://www.weekofengineering.co.nz)



Ian Rumble takes the 'Engineering for the Future' students on a virtual tour of the Opus Research facilities

## New Staff

---



### Iain McIver

Engineering Scientist, Iain McIver returned to Opus Research after five years pursuing other interests. For the last three years Iain has been working in an agritech product development company where he continued to develop his strong analytical skills. Iain's primary role within the Engineering Sciences team relates to road-traffic noise, structural monitoring and data analysis, particularly modelling of noise and assessment of effects.

Outside of work Iain enjoys running, biking, kayaking and fishing.

#### **Iain McIver**

**e.** [iain.mciver@opus.co.nz](mailto:iain.mciver@opus.co.nz)



### Jo Westwood

Jo Westwood recently joined Opus Research as Client Care Coordinator and is the third member of our Business Services team. Jo has extensive secretarial experience and has most recently worked for law firm Buddle Findlay. Jo also enjoys coordinating events and marketing.

Outside of work Jo is kept busy with her two children, juggling ballet and tae kwon do lessons. She loves interior design and runs a styling blog, working with a few companies styling and photographing their products.

#### **Jo Westwood**

**e.** [jo.westwood@opus.co.nz](mailto:jo.westwood@opus.co.nz)



### Laurence Harrow

Laurence Harrow joined Opus Research after transferring from the Opus Napier office. Laurence is part of the pavements team specialising in road surfacings and asset management. Laurence is also part of the NZ Transport Agency national surfacing steering group providing direction and education on surfacings within the roading industry and works with Opus' global asset management team in Australia and Malaysia.

Laurence enjoys being outdoors with hunting, tramping, fishing, diving and kayaking the main activities pursued.

#### **Laurence Harrow**

**e.** [laurence.harrow@opus.co.nz](mailto:laurence.harrow@opus.co.nz)



## Opus Research

33 The Esplanade, Petone  
PO Box 30 845, Lower Hutt, Wellington, New Zealand

**t.** +64 4 587 0600 | **e.** [opusresearch@opus.co.nz](mailto:opusresearch@opus.co.nz)

[www.opus.co.nz/opus-research](http://www.opus.co.nz/opus-research)