'Talking' to structures to boost public safety

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University of Adelaide researchers are developing low-cost technology which can 'talk' to structures like bridges and aeroplanes to monitor their structural health and assess them for damage.

The technology should help improve public safety, and significantly reduce the cost of maintenance and repair.

"It will allow us to talk to the structure to see whether there are any defects, where they are and, ultimately, provide detail about the shape of any damage and how extensive it is – just like someone going to the doctor for a health check," says researcher Dr Alex Ng, lecturer in the School of Civil, Environmental and Mining Engineering.

The system being developed is for structures made from high-tech materials called fibre-composite laminates, now widely used in the aerospace, construction, energy, transport and sporting goods industries, but is also applicable to other structural materials such as steel.

"These composite materials are incredibly attractive for structural purposes because they are lightweight but extremely strong, with potentially significant energy efficiencies and better fuel consumption," says Dr Ng. "For example, the new Boeing 787 Dreamliner is 80% composite materials by volume.

"However, being a laminated material, it is difficult to accurately determine whether the internal layers are damaged without undertaking destructive testing. Developing cost-effective, non-destructive

techniques will be of great value to these industries and for public safety."

One area for potential use is in monitoring the structural integrity of steel bridges. "The collapse in 2007 of the Minneapolis bridge in the US raised questions about inspection as well as design. Visual inspection is not enough to be absolutely certain you have no cracks. Eventually Australia will face the same problem," says Dr Ng. He is a member of the executive committee of Australian Network of Structural Health Monitoring which is working to avoid that situation.

With this new project, the University of Adelaide researchers are using a system of electrical devices (transducers) which send out and receive signals in the form of waves which pass through the structure like ripples on water. Defects or damage are revealed in the data received back.

The transducers can either be embedded into the structure when it's built or bonded to the surface afterwards. The data is collected and transferred to a control centre where it can be monitored online, around the clock, to ensure structural integrity at all times.

Dr Ng received an Australian Research Council (ARC) Discovery Early Career Researcher Award for this three-year project, which started this year.

"To date we've developed a laboratory system to generate the structural waves and receive back signals with some good preliminary results," he says. "Right now we can only detect where the damage is. By the end of three years we aim to also know the size and shape of any defects, ultimately producing a detailed picture of the inside of the structure."

Provided by University of Adelaide