noise notes volume 8 number 2

in this issue…

noise notes

ISSN 1475–4738

noise notes is published quarterly by

Multi-Science Publishing Co. Ltd.

5 Wates Way, Brentwood, Essex, UK

Tel: +44 (0)1277 224632 · Fax: +44 (0)1277 223453

email: mscience@globalnet.co.uk · ©Multi-Science Publishing Co. Ltd.

Smart bridges under development with new federal grant

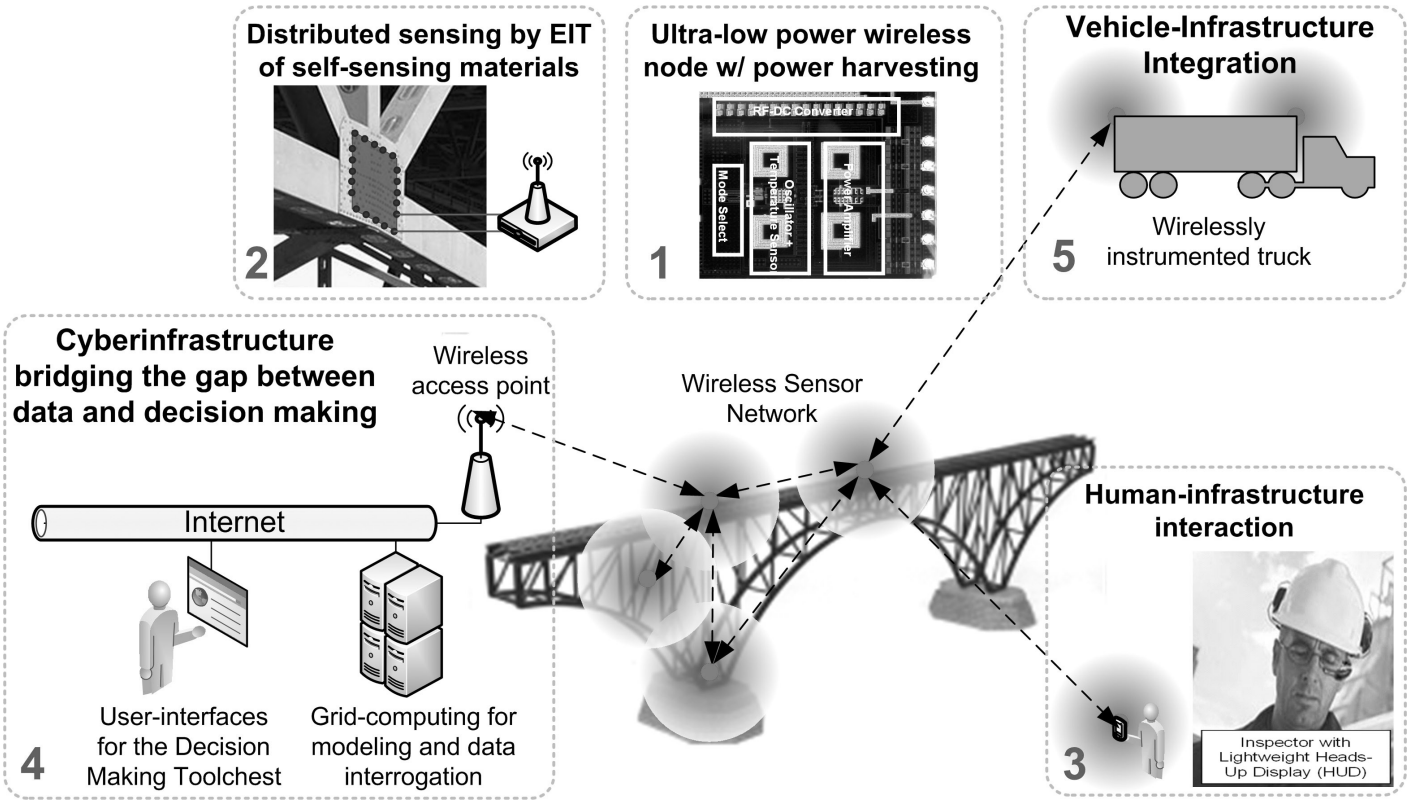
Engineering smart bridges that can thoroughly discuss their health with inspectors is the goal of a new $19-million project led by the University of Michigan.

A year and a half after the I-35 bridge collapse in Minneapolis, the five-year project aims to create the ultimate infrastructure monitoring system and install it on several test bridges whose precise locations are not yet determined.

The monitoring system is envisioned to include several different types of surface and penetrating sensors to detect cracks, corrosion and other signs of weakness. The system would also measure the effects of heavy trucks on bridges, which is currently impossible. And through enhanced antennas and the Internet, the system would wirelessly relay the information it gathers to an inspector on site or in an office miles away.

Funded in large part by nearly $9 million from the National Institute of Standards and Technology's (NIST) Technology Innovation Program (TIP), the project involves 14 researchers from the University of Michigan's College of Engineering and its Transportation Research Institute (UMTRI). In addition, engineers at five private firms in New York, California and Michigan are key team members. The remaining funding comes from cost-sharing among the entities involved and the Michigan Department of Transportation. MDOT has offered unfettered access to state bridges to serve as high-visibility test-beds showcasing the project technology.

"This project will accelerate the field of structural health monitoring and ultimately improve the safety of the nation's aging bridges and other infrastructures," said Jerome Lynch, principal investigator on the project and assistant professor in the Department of Civil and Environmental Engineering. "We want to develop new technologies to create a two-way conduit of information between the bridge official and the bridge. We are excited to collaborate on these transformative technologies with partners like MDOT who could use them immediately to



improve bridge inspection processes."

Four types of sensors will contribute to gathering data. Victor Li, professor of civil and environmental engineering, has developed a high-performance, fiber-reinforced, bendable concrete that's more durable than traditional concrete and also conducts electricity.

Researchers would measure changes in conductivity, which would signal weaknesses in the bridge. On test bridges, the deck would be replaced with this concrete.

A carbon nanotube-based "sensing skin" that Lynch and a colleague in chemical engineering are developing would be glued or painted on to "hot spots" to detect cracks and corrosion invisible to the human eye. The skin's perimeter is lined with electrodes that run a current over the skin to read what's happening underneath based on changes in the electrical resistance.

Low-power, low-cost wireless nodes could look for classical damage responses like strain and changes in vibration. These nodes would harvest energy from vibrations on the bridge or even radio waves in the air. They are being developed by Dennis Sylvester, an associate professor in the Department of Electrical Engineering and Computer Science; and Khalil Najafi, chair of the Electrical and Computer Engineering division.

The fourth type of sensor would be housed in the vehicles that travel on the bridge. UMTRI researchers will outfit a test vehicle to measure the bridge's reaction to the strain the vehicle imposes. This information is not available today. But how vehicles, especially trucks, affect bridges is a critical piece of information that could help predict the structure's lifetime. Leading this effort is Research Professor Tim Gordon, head of UMTRI's Engineering Research Division.

Today, bridge inspectors rely mostly on their eyes to determine if a structure is sound.

"Our work will add to what is currently done, not replace it, Gordon said. "The infrastructure problem and

the feasibility of new monitoring strategies are emerging at the same time. We believe we have ways of testing the performance of bridges as integrated structures, not just inspecting their components."

Other parts of the system will organize data into meaningful displays and communicate it from the sensors to the inspector. Vineet Kamat, assistant professor in civil and environmental engineering, will lead the human-infrastructure interaction effort.

"The technologies from this project could prove very beneficial to the citizens of Michigan in the longer lasting, smarter, safer and ultimately more sustainable roadways." said State Transportation Director Kirk Steudle. "Recognizing that our nation's infrastructure is the backbone of our economy, this type of innovative research is critical to the future of Michigan and the United States. MDOT is pleased to partner with the University of Michigan on this important engineering project."

Lynch says if this set-up were installed on all bridges, researchers could then make statistical comparisons among bridges. This would help them determine if, for example, all suspension bridges developed certain dangerous signs of wear after a certain age.

"The NIST TIP initiative is timely given the deteriorated state of our infrastructure today. The success of the University of Michigan team, lead by Professor Lynch, exemplifies both the excellence of our faculty and how they are engaged in high impact research that solves the world's most challenging problems," said Nancy Love, chair of the Department of Civil and Environmental Engineering.

NEWTOWN'S TOO NOISY

The industrial noise in Gainesville's (GA) Newtown community can be so loud that the Occupational Safety and Health Administration would require ear protection. But many of the people subjected to that level of noise are the community's residents, according to an engineer who tested the noise levels in a neighborhood adjacent to the Blaze Recycling yard. Jamie Henderson says that when he tested the noise levels on Norwood Street—a residential street that dead-ends at the Blaze Recycling property line—the noise registered as high as 93 decibels. Even in industrial areas, OSHA requires workers to wear hearing protection when noise levels register at 85 decibels. Henderson and his partner, toxicologist Kathryn Wurzel, say the noise and the dust caused by industries surrounding the Newtown community create an unhealthy environment for the nearby residents. Henderson and Wurzel have been working with attorneys from the University of Georgia's Land Use Clinic and Greenlaw to help the Newtown Florist Club address the issues for nearly a year now. Recently, they presented their research to ministers and community members in the Newtown area as well as city department heads and City Council member Ruth Bruner. The group asked Gainesville officials to consider amending the city's code to put a damper on noise and air pollution that they say Newtown residents have to endure because of their industrial neighbors. "Where (the ordinances stand) is not doing the job, and evidence is what's going on in the Newtown community," Henderson said. Ela Orenstein, an attorney for Greenlaw, said the city's rules on noise, which prohibit noise that can be heard 100 feet from its point of origin and "unreasonably disturbs" residents, are vague and difficult to enforce. The group has proposed that the city amend its code with measurable, decibel-based noise restrictions that control noise and vibration as well as requiring industries to create a management plan for dust emissions.

NOISE ORDINANCE NEEDS TO KEEP UP

Residents in Huntsville (AL) are complaining to the city council about noise from leaf blowers. The city's National Resources Division tested a number of blowers and found that they exceeded the 80dB limit on noise. Except leaf blower noise was not included in the ordinance when it was drawn up in the 1980s, for the simple reason that blowers were not in common use on any scale in those days. The Council is now looking into the practicalities of updating the ordinance, to include 'new' sources of noise like leaf blowers.

MARKET RESPONDS: QUIETER LEAF BLOWERS

For years, noisy leaf blowers have served as a source of morning aggravation and have spawned endless quarrels among neighbors. But now, in response to a flurry of new ordinances restricting their use, leaf-blower makers are bringing out quieter and more fuel-efficient models. Manufacturers are introducing blowers that operate at noise levels between 65 and 70 decibels as opposed to older models that operate at 70 decibels or higher. They are also rolling out products with lower emissions to comply with new federal standards. Last autumn the US Environmental Protection Agency adopted new emissions limits for small non-road engines – which include leaf blowers – that it says will reduce emissions of volatile organic compounds that contribute to air pollution by 34% by 2030. Shindaiwa Inc. will shortly release its EB8520RT blower, which has a 65-decibel-level "hush mode" and which the company says is more fuel efficient than older models. Last summer, Echo Inc. released its PB-255 leaf blower, which operates at 65 decibels. Husqvarna Professional Products Inc. came out with a new version of its 356BT backpack blower in 2007, which operates at 64 decibels and has lower emissions than previous models.

NO MATCH DAY NOISE FROM NEW STADIUM

Match-day noise at Everton FC's proposed new stadium will be as loud as a vacuum cleaner for neighbouring families in Kirkby, according to an acoustics expert. Jim Powlson, a consultant for Manchester based WSP Acoustics, said people living on the Grange estate would have to cope with up to 73 decibels at worst and that fell within approved guidance. But Andrew Pykett, sitting on the bench alongside planning inspector Wendy Burden, accused Mr Powlson of picking and choosing which bits of guidance he accepted. He said: "It's almost as if you're extracting the bits that suit your argument." He asked why Mr Powlson had chosen to rely on the environmental nuisance regulations which govern acceptable levels of noise at pop concerts when the stadium proposals rule them out. He said: "To prove environmental nuisance on noise is quite difficult whereas the planning system as in the UDP (Unitary Development Plan) all that is needed is impact on residential amenity. "In short you don't need as much noise to affect amenity as you do to get on to the level of an environmental problem. "Using the Pop Code (the environmental nuisance regulations governing rock concerts) is inappropriate." Instead, he suggested the noise assessment used criteria the stadium development would easily meet. But Mr Powlson said that, in fact, he had used pop concert codes as well as planning guidance to check whether the stadium would affect its neighbours. The impact was considered "moderate adverse" at worst thanks to the stadium's enclosed design, he concluded. He declined to answer why no roof had been used as in Cardiff's Millennium Stadium to contain noise despite referencing it in his evidence.