Research News

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Team designs unique wireless sensor

BY FRANK NOLAN
Research Promotion

Throughout North America, bridges and overpasses are getting old. As these structures near the end of their expected service lives, safety and timely maintenance are becoming increasingly important, and accurate monitoring of their structural health is critical.

In the Faculty of Engineering, a team of researchers is developing innovative wireless sensors to measure strain and displacement in structures. The new devices can provide accurate, quantitative data about changes in the condition of a bridge or overpass over time.

"Right now, the kind of information that is typically gathered about a bridge might include photographs, as well as a range of physical measurements that are written up on a chart to provide an evaluation," said electrical and computer engineering professor Doug Thomson. "Our sensors would give very specific numbers, and you would get a very clear indication when the structure starts to change."

In addition to Thomson, the team includes electrical and computer engineering researchers Greg Bridges, Lot Shafai, and Dan Card; grad students Mehran Fallah Rad and Rajat Jayas; and civil engineer Aftab Mufti, president of ISIS Canada (Intelligent Sensing for Innovative Structure), a National Network of Centres of Excellence based in the Faculty of Engineering. One of the biggest advantages of the group's new design is that it is passive, or un-powered.

"This is a very important point, because about two thirds of the cost of traditional wired sensors is associated with the cabling required for power and communications," Thomson said. "Also, if you have to replace a battery every six months, it can be very expensive, especially if the sensor is installed on a part of the structure that doesn't have easy access."

The wireless sensor consists of a hollow chamber, a central metal rod, and a connector that allows an electric signal to be fed inside via an antenna. The signal creates an electric resonance inside the cavity, which can then be measured. The concept, Thomson said, is very similar to the way a guitar string works.

"When the chamber is compressed, it resonates at a different frequency because the length has changed. It's just like what happens when you change the length of a guitar string. By comparing the new frequency with previous ones, we can tell exactly how much the chamber has physically changed, which then tells us what's happening with the structure it's installed on."

Thomson said there are only half-a-dozen groups in the world working on passive, wireless sensors, and he believes his is the only one working specifically with a radio frequency (RF) cavity design. The team is now preparing for the first field installation of the new design on a bridge in Nova Scotia.

"This will give us a chance to refine the design of both the sensor and the portable interrogation system used to read it," Thomson said. "I'm very excited about this project, and I think it has a lot of possibilities. Of course, we still have a long way to go before you see these sensors attached to a lot of bridges, but that's the goal."

Photo by Frank Nolan

Doug Thomson, electrical and computer engineering, is part of a team designing a passive, wireless sensor for monitoring the health of bridges and overpasses.

Network examines prairie droughts

BY FRANK NOLAN
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Researchers from across Canada gathered in Winnipeg from January 11 to 13 for a workshop focused on understanding and predicting prairie droughts. The meeting was organized by the Drought Research Initiative (DRI), a network established in 2005 by researchers from universities in Manitoba, Saskatchewan, Alberta and Quebec to examine data from the drought of 1999-2004.

With funding support from the Canadian Foundation for Climate and Atmospheric Sciences, DRI researchers are examining the physical characteristics of droughts, as well as how they form, how they evolve, and how they end.

"We have very good, comprehensive information about the 1999-2004 drought, including satellite data and a range of other measures," said John Hanesiak, assistant professor in the department of environment and geography, and a member of the Centre for Earth Observation Science (CEOS). "Now we're focused on how we can apply this knowledge and put it into context, with the ultimate goal of developing more accurate seasonal drought prediction models."

Hanesiak leads the DRI research theme focused on analyzing and characterizing the drought of 1999-2004. University of Manitoba soil scientist Paul Bullock is also working on this theme, assessing the consequences of drought for the productivity of different types of crops. Even though the group has only completed one year of the five-year project, Hanesiak said they have already established that this drought had some unique characteristics.

"The large-scale atmospheric circulation was quite different, even within different years of this drought period," Hanesiak said. "Each year had its own unique look. It was likely a combination of different things that kept the drought going, and it's starting to look like there might have been almost a feedback among these various factors."

The second theme involves studying the physical processes involved in droughts, and includes University of Manitoba civil engineering professor Allan Woodbury, who is studying groundwater models. DRI's third theme is focused on combining the characterization from theme one and the physics from theme two to develop more accurate drought forecasting.

"Drought is a critical phenomenon on the Canadian prairies that affects everything from crop production to hydro-electric power generation, forest fires and waterfowl habitat," said DRI network manager Rick Lawford, based at CEOS. "Many of our current climate change models suggest that the climate of the prairies may be drier in the future, so it's no surprise that this has become a very hot topic. By looking at the large-scale dynamics of these systems and other smaller-scale processes, our studies will have broad application, and they will provide a benchmark for what a possible future large, multi-year drought could look like."

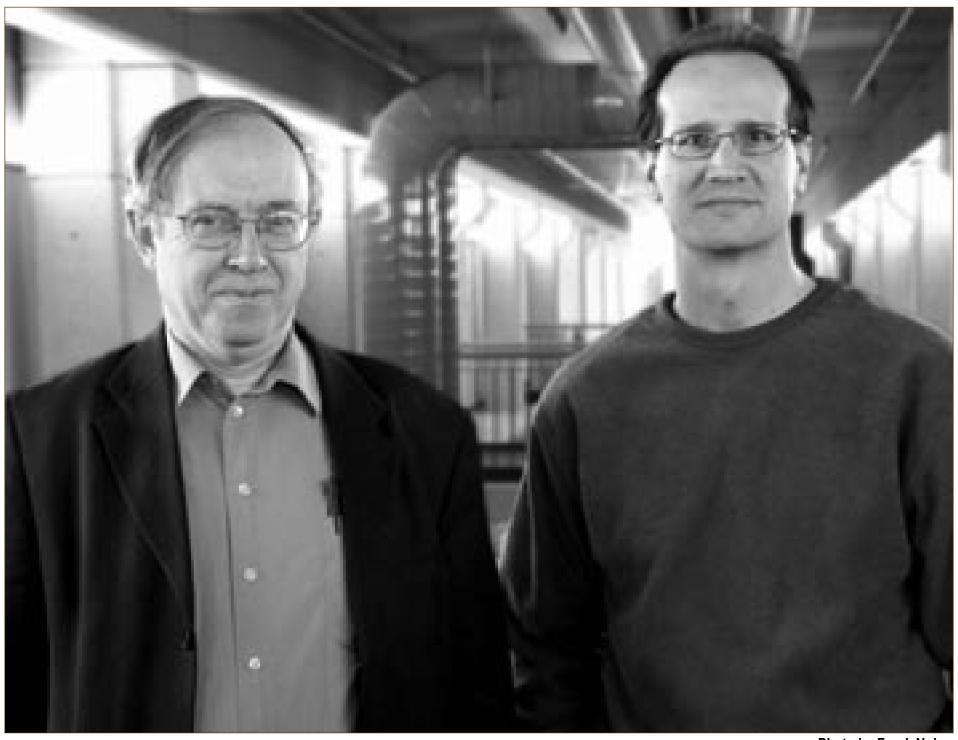

Photo by Frank Nolan

John Hanesiak (right), environment and geography, with Rick Lawford, network manager for the Drought Research Initiative.

Bringing Research To Life

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