ISIS INNOVATOR
NEWSLETTER OF ISIS CANADA RESEARCH NETWORK July 2004
The Canadian Network of Centres of Excellence on Intelligent Sensing for Innovative Structures

Second International Workshop on Structural Health **Monitoring** of **Innovative** Civil Engineering **Structures**

Keynote Speakers


Dr. Baidar Bakht
JMBT Structures Research Inc., Canada


Dr. Konrad Bergmeister
University of Applied Science, Austria


Dr. J.J. Roger Cheng
University of Alberta, Canada


Mr. Dan Frangopol
University of Colorado at Boulder, USA


Dr. Gordon Sparks
University of Saskatchewan, Canada


Dr. Toshiyuki Oshima
Kitami Institute of Technology, Japan


Dr. Zhishen Wu
Ibaraki University, Japan

Workshop Chair

Dr. Aftab Mufti
ISIS Canada Research Network
University of Manitoba
Canada

SHM ISIS 2004

September 22-23, 2004
Winnipeg, Manitoba, Canada

Registration and Conference Information
www.isiscanada.com

Solution-Oriented Research for the Global Infrastructure Crisis

Formation of International Society for Structural Health Monitoring of Intelligent Infrastructures (ISHMII)

As the design and construction of civil structures continue to evolve, it has become imperative these structures be monitored for their health. In order to meet this need, the discipline of structural health monitoring (SHM) has emerged. It involves the application of electronics to civil structures and aims to assist engineers in realizing the full benefits of structural health monitoring.

Against this background, a new international organization for the advancement of SHM, the Internationl Society for Structural Health Monitoring of Intelligent Infrastructures (ISHMII) has recently been established. The aim of the Society is to advance the understanding and application of structural health monitoring in civil infrastructure, in the service of the engineering profession and society.

The council for the ISHMII was formed by invitation and has a membership from several countries. The first council meeting was held in conjunction with the SPIE 2004 Conference in San Diego, California, in March 2004 and the council approved the ISHMII constitution and Executive Committee.

Executive Committee

President - Professor Aftab A. Mufti
Vice Presidents - Professor Emin Aktan
Professor Dan Frangopol
Professor Urs Meier
Professor Konrad Bergmeister
Professor Jan-Ming Ko
Professor Yozo Fujino
Conference Chair - Professor Jinping Ou
Secretary - Professor Zhishen Wu
Treasurer - Dr. Daniele Inaudi
Newsletter Editor - Dr. John Newhook

Members-at-Large and Advisory Committee to Council

Professor Toshi Oshima
Professor Farhad Ansari
Dr. Masoud Motavalli
Dr. Helmut Wenzel
Professor Pradipta Banerji
Professor H.M. Koh
Mr. David Fletcher

The next ISHMII meeting will take place in Kyoto, Japan in October 2004.

Creation of Structural Health Monitoring Support Centre at the University of Manitoba

The Structural Health Monitoring Support Centre was established in April 2002 by the Research Management Committee of ISIS Canada to provide staff, equipment, supplies, operations, training and demonstration facilities to serve the ISIS Network. It is housed in the W.R. McQuade Laboratory at the University of Manitoba and functions under the direction of Dr. Aftab Mufti.

The centre's primary goal is to evolve as a national centre of expertise for providing technical support for SHM and Civionics technologies for field projects across Canada. The equipment pool and technical support not only serves the needs of the ISIS network, but also is available to industry and the public sector on a commercial basis.

W.R. McQuade Structures Laboratory

The Support Centre is staffed by the following personnel:
- **Evangeline Rivera**, Research Technician and Civioncs Engineer
- **Liting Han**, Research Technician and Civioncs Engineer
- **Loren Card**, Research Technician and Civioncs Engineer, and
- **Chad Klowak**, Research Technician and Civioncs Engineer.

IDERS / SHM Systems
Fibre Bragg Interrogation System

A convergence of sorts took place back in 2001 which brought ISIS Canada and IDERS Inc. together. ISIS had done excellent research defining requirements for fiber optic strain measurement systems for structural health monitoring (SHM) applications. The problem was a lack of available appropriate commercial systems which could offer the performance, accuracy, quality and price required.

Based on IDERS systems development and production experience dating back nearly 15 years, as well as their desire to invest and partner with ISIS to develop a wholly new and innovative system, a joint venture partnership was born. Significant research assistance contributions from the National Research Council's Industrial Research Assistance Program were a key component as well.

The specification and requirements were demanding - more ports (up to 32), +/- 0.25 microstrain resolution and long-term +/- 5 microstrain accuracy, remote internet access, industrial quality plus much more at a per unit price less than 50% of other existing systems was an ambitious goal. The development required a team which included over 20 of IDERS engineering and technical staff, not withstanding the significant involvement by ISIS and other University researcher to advance the project.

The development process was not without hurdles. Commercial laser sources, the heart of any fibre optics system, were difficult to obtain and poorly supported as this project was undertaken in parallel with the implosion of the telecoms market - the primary consumer of sources. The source initially selected did not meet published specifications - this determined only after a significant investment in time and resources. The next selection, while technically adequate, had supply temporarily suspend while the company who supplied the source attempted to get their financial affairs in order during the market recovery. Through it all, development continued, with continuous validation testing being conducted by ISIS.

In March of this year, armed with final development and a newstrong laser source supplier, both IDERS and ISIS were able to demonstrate a system in final trim. Testing conducted by Dr. Douglas Thomson and Evangeline Rivera confirmed the system has met specification - the most significant milestone in the project. In the time to date since, ISIS has expanded the validation efforts to include upcoming tests in Sherbrooké and Calgary as well as independent tests conducted by Dr. Emin Aktan at Drexel University. In parallel, IDERS is working to complete its obligation to ISIS by producing and delivering five additional systems, with deliveries expected in June.

Not wanting to rest on its laurels, IDERS is committed to an aggressive ongoing course of research and development for the system which will have benefits to researchers and structures owners alike. Enhancements to the instrument will include:

- Support for additional fibre optic sensors: multi-element bragg arrays, long gauge, chemical sensing
- Support for electrical-type sensors: accelerometers, geophones
- Advanced software capabilities for autonomous alarms generation and data decimation
- A compact and portable 2-port FBG instrument as a tool for rapidly validating sensor installations.

These new innovations built upon the benchmark SHM5100 will provide valuable and enabling tools to advance the civil structures research and practice - a remarkable demonstration of the value of partnership.

ANNOUNCEMENTS

Student Elections

President:
Rania Al Hammoud
University of Waterloo

Award Winning Presentations

Best:
Britton Cole
Queen's University
"*Flexural Load Tests on Concrete-Filled Circular FRP Tubes with Internal FRP and Steel Reinforcement*"

Distingushed:
Yimin Li
University of Toronto
"Design of Retrofitting FRP for Concrete Columns"

Honourable:
Cara Denkhaus
University of Alberta
"Structural Health Monitoring of Syncrude's Aurora Double Roll Crusher"

Essay Competition

Ved Prakesh Sharma
University of Alberta

BEST OF CONFERENCE

Best of Group D

Poster D4
Chad Klowak & Amjad Memon
University of Manitoba

Best of Group A
Poster A5
Kyle Schonknecht
University of Alberta

Best of Group B
Poster B10
Hongpo Xu
Carleton University

Best of Group C
Poster C4
Derek Tardif
Université de Sherbrooke

KEYNOTE SPEAKER - Professor Jin-Guang Teng

Department of Civil & Structural Engineering
The Hong Kong Polytechnic University

As the founding President of the International Institute for FRP in Construction (IIFC), which is striving to advance the understanding and the application of fibre-reinforced polymer (FRP) composites in civil infrastructure, Prof. Teng outlined the research being conducted throughout Asia regarding the application of FRP composites in civil engineering, steel and steel-concrete composite structures, shell and spatial structures, and nonlinear and buckling behaviour of structures. This was very useful for ISIS participants because the Asian research complements that of ISIS Canada. Prof. Teng is the inventor of the ComShell roof, a thin steel base concrete shell formed from modular units. This is a new structural system for economically enclosing large spaces.

Confederation Bridge Tour

Many thanks to Dr. Gamil Tadros, Structural Consultant for SPECO Engineering Ltd. and Technical Applications Consultant for ISIS Canada, for leading an 96-person delegation to the Confederation Bridge and conducting an amazing interior tour of this Canadian landmark. Dr. Tadros is credited with the conceptualization of the design of the Confederation Bridge.

Through Private Sector Use of ISIS Technology

[*The following article is republished from Wardrop Engineering in-house newsletter. Dr. Shehata joined Wardrop upon graduation from the ISI S Canada research program at the University of Manitoba.*]

Structural Health Monitoring Identifies State-of-Health Status for Civil Infrastructure

Dr. Emile Shehata, P.Eng, PE - Transportation Division

Civil infrastructure systems, generally the most expensive assets in any country (an estimated $2 trillion in Canada), are deteriorating at an alarming rate due to inadequate maintenance, excessive loading and adverse environmental conditions. By and large, today's bridges and roads are "deaf, dumb and blind". Feedback on their "state of health" is practically non-existent. The introduction of innovative design approaches to new systems is painfully slow due to heavy reliance on traditional construction and maintenance practices and the conservative nature of design codes.

Introducing…Structural Health Monitoring (SHM), an evolving technology that can define the ongoing health of emerging innovative civil infrastructure and bring a long-service life in comparison to most other commercial products. The technology has been introduced into engineering practice over the past five years and has been incorporated into several projects including the collaborative work of Wardrop and ISIS Canada on Taylor Bridge in Headingley, MB - the first structure worldwide to be remotely monitored.

One of our more recent projects, The Esplanade Riel Pedestrian Bridge in Winnipeg, MB, gave us the opportunity to take SHM technology to the next level. Wardrop designed the SHM system with a nerve network consisting of sensors and a "brain" represented by the Data Acquisition system, which is interactive and remotely monitored and evaluated. The system incorporates conventional electric strain gauges, thermocouples, unidirectional and tri-axial accelerometers, a wind monitor, inclinometers and a web camera. In constantly gauges the "heartbeat" of the bridge as it responds to changes in temperature, wind velocity and people-induced loads.

The goal for this state-of-the-art technology is to identify problem areas more quickly than traditional methods. Any problems can, therefore, be cost effectively resolved in a timely manner, resulting in long-term savings to the maintenance budget.

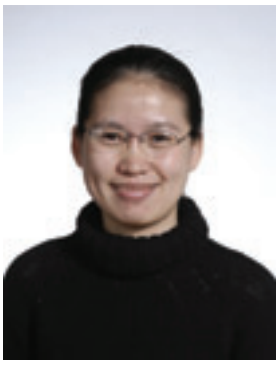
Conference Highlights Continued....

Scholarship Winners

Each of the following students were awarded $5,000 scholarships:

Urs Meier Scholarship for Engineering Excellence
Derek Tardif
Université de Sherbrooke

Open to All ISIS Post-Graduate Students
Ved Prakash Sharma
University of Alberta



Women In Engineering
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University of Toronto

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Website www.isiscanada.com

Dr. Aftab Mufti was elected as the founding ***President of the International Society for Structural Health Monitoring of Intelligent Infrastructures (ISHMII).*** He was also recognized by ***NSERC*** for 25 years of excellence for important research achievements. Dr. Mufti also gave a presentation to parliamentarians at the ***Parthership Group for Science and Engineering (PAGSE)*** breakfast. Dr. Mufti received an excellent response from the crowd, that was pleased with his presentation and progress of ISIS Canada.

ISIS Canada is pleased to welcome **Dr. Clair Callaghan** to the ***Board of Directors.*** Dr. Callaghan is currently the President of Cabletec Limited. He was the Dean, Faculty of Engineering at Sir George Williams University from 1969-77 and was President of the Technical University of Nova Scotia from 1977-89. He is an NRC & NSERC council member and holds the Patent on Cable Tension Control. Dr. Callaghan is also a member of numerous professional engineering associations and is a Fellow of the Engineering Institute of Canada.

Mr. Ralston MacDonnell's exceptional contributions to engineering in Canada was recognized by his election to a ***Fellow of the Engineering Institute of Canada.***

Dr. Xiaoyi Bao was awarded the inaugural version of the ***University of Ottawa Inventor of the Year Award***. She was honoured in a ceremony in Ottawa and was given a sculpture and cash award to help achieve the maximum commercialization result for her technology.

The International Concrete Repair Institute (ICRI) awarded **Vector Construction Group** and Manitoba Hydro with its ***2003 International Concrete Repair Institute Award of Excellence for Longevity*** for their joint efforts in the rehabilitation of Manitoba Hydro's Seven Sisters Generating Station.

Mr. Don Whitmore, Vector Construction Group

A special congratulations to **Dr. Vidyadhar Limaye,** who was selected as the winner of the ***Dalhousie University Doctural Thesis Award in the Natural and Medical Sciences and Engineering for 2004***. His thesis "*Steel-free Bridge Decks Under Cyclic Loading: a Study of Crack Propagation and Strength Degradation*" was selected from those nominated by departments and faculties from across the science and engineering disciplines represented by the Faculty of Graduate Studies. Dr. Limaye is a graduate student, under the advisory of Dr. Aftab Mufti, Dr. Baidar Bakht and Dr. John Newhook.