



INTERNATIONAL SOCIETY FOR STRUCTURAL HEALTH MONITORING OF INTELLIGENT INFRASTRUCTURE

# ISHMII Membership Notes July-August 2013

Vol. 3 Issue 5

## President's Letter

Dear Society Members and Colleagues,

The summer finds us busy with research, writing and field work. For our members who manage civil infrastructure, it is time for inspections and evaluations, construction and maintenance, and to consider data collected from applications, the hardware and software that measures change to or movement by structures. All of us are immersed in applications. Information we collect becomes the basis for concise business decisions and for research and change – for innovation.



Lately, I have been considering how innovation occurs. As president of ISHMII, I have given thought to our instruments as sharing information is a force for creative development of products and pushes research to the next level. Our Web site at [www.ishmii.org](http://www.ishmii.org), the [\*Journal of Civil Structural Health Monitoring\*](#) and our workshops and conferences are vital tools for ISHMII members. I urge you to submit your research for publication in the *JCSHM* and technical reports for inclusion on the Web site as [Case Studies](#).

As we participate in conferences and workshops, we collaborate and share our insights from practical experience and research efforts. We challenge others to innovate - to take knowledge a step further. We motivate our colleagues, students and the managers or owners of massive infrastructure to consider how innovations in sensing, data collection and analysis and new SHM tools can make infrastructure safer, stronger, longer lasting, and more profitable. And, that is just the start.

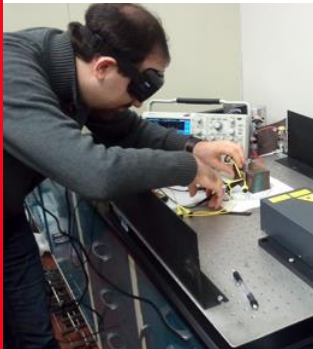
For a professional Society like ISHMII, selecting leaders who are front-and-center in the SHM field is important. This year brings transition to the [ISHMII Council](#), the Society's authoritative body. As the Council bids goodbye to Dr. Fritz K. Brunner, one of its earliest members, it also welcomes five new members. These councilors come from Canada, USA, China, Austria, and include the first member from Saudi Arabia. Not only do we seek a

broad geographic representation, we seek Council members with differing experiences. That includes Council members who are early in their career as well as those who bring the breadth of knowledge associated with a long and productive career in SHM. I invite you to read the article below that reminds us of the contributions of Dr. Brunner to our field and introduce each of the new ISHMII Council members: Dr. Dagmar Svecova, Dr. Genda Chen, Dr. Zhang Yufeng, Dr. Werner Lienhart, and Dr. Mohammed H. Baluch.

The future of innovation also rests in the hands of those who will follow us.

### Up and Coming Researchers

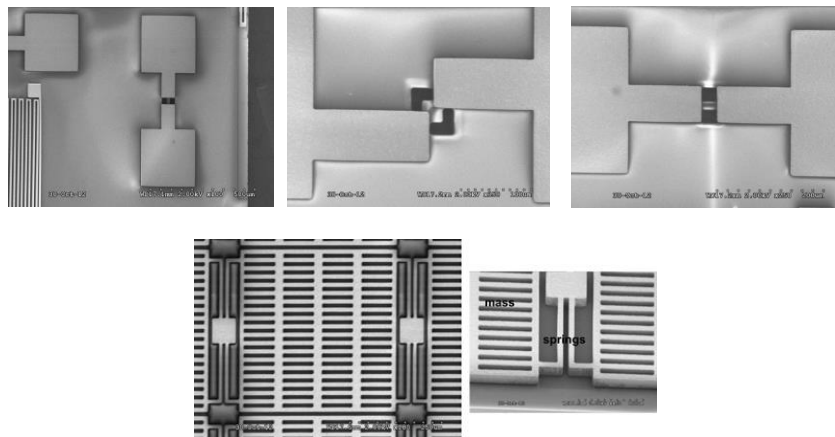
With the remarkable level and quantity of research conducted at the graduate level, it is exciting to continue to introduce up-and-coming researchers. Meet three young researchers, one now a faculty member, who were brought to our attention for their inventive research by several Council members.



[Hossain Saboonchi](#) joined the Department of Civil and Materials Engineering at the University of Illinois at Chicago, USA, in 2011 as a Ph.D. student where he conducts interdisciplinary research titled *Multi-functional MEMS Device for Real Time Intelligent Damage Detection and Location* with Dr. Didem Ozevin. Hossain's mechanical engineering background, enhanced by recent coursework in electrical engineering, has helped him excel quickly. Hossain's research seeks to integrate multiple MEMS-based sensing elements on the same device to improve the damage-detection capability of SHM on fatigue-loaded structures.

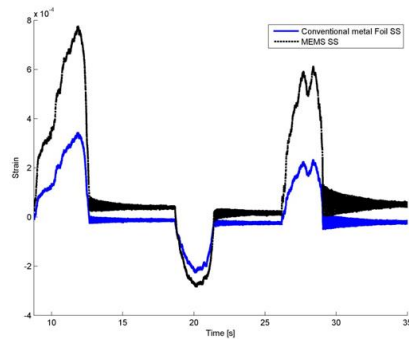
He is pictured (left) while testing the MEMS sensors using a Q-switched laser source.

The MEMS device includes out-of-plane and in-plane acoustic emission (AE) sensors operating at 60 kHz and 150 kHz and piezoresistive strain sensors. The out-of-plane sensors have the sensitivities comparable to piezoelectric sensors reported as the first time in the literature. An article related to this result is currently in press in the *Journal of Smart Materials and Structures*.

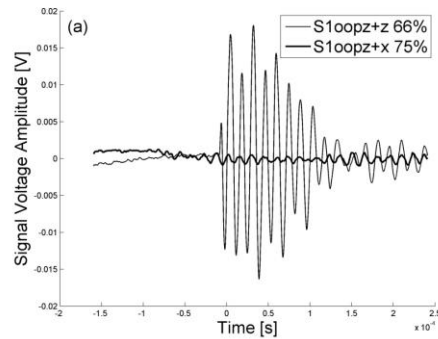


Strain sensors for vertical, diagonal and horizontal strain measurements (top) and the AE sensor for out-of-plane sensing (bottom)

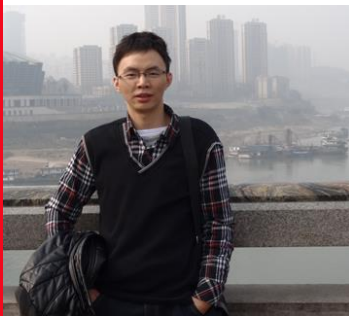
Piezoresistive sensors have the ability to detect static and dynamic strains at three directions. All the sensors are positioned on a 1 cm x 1 cm area device. The concurrent utilization of AE and piezoresistive strain sensors will bring significant benefits to the structural monitoring due to redundant data collection.



*MEMS strain (black) vs Foil gauge (blue)*



*MEMS AE response for laser at -z direction (out-of-plane) vs -x direction (in-plane)*



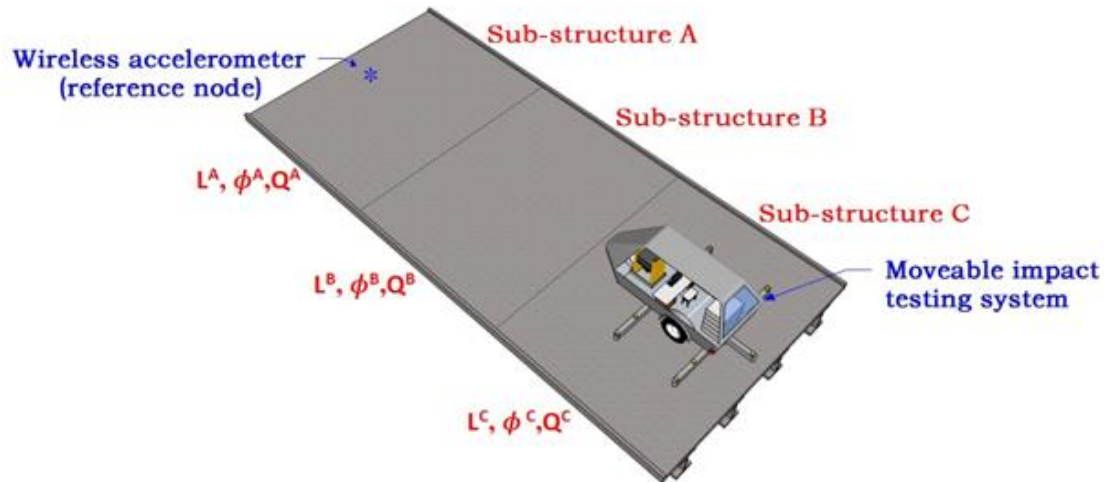
[Shuanglin Guo](#) is an MS student under the supervision of Professor Jian Zhang in the International Institute of Urban System Engineering, Southeast University, China. Recipient of many competitive prizes in mathematics and mechanics, Shuanglin's background provides a good basis for his current research – the development of the theory of structural flexibility identification from the monitoring data. More specifically, he is researching displacement flexibility identification from the acceleration sensing and strain flexibility identification by using the long-gage FBG sensing.



*Macro-strain- and acceleration-based flexibility identification theory testing showing the accelerometer mounted below the long-gauge fiber optic sensor*

Unlike general structural identification, which only identifies normal structural modal parameters including natural frequency, damping ratio and model shapes, his project will accurately identify the exact acceleration/strain frequency response functions (FRFs) from the impact test data. Thus, the displacement/strain flexibility matrices can be accurately

estimated from which the deflection/strain response of the structure under any static load can be predicted. Finite element simulation and experiment examples have successfully verified the effectiveness of the flexibility identification method he developed.

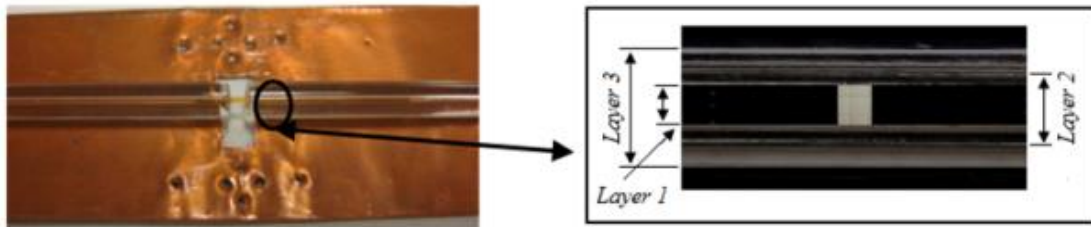


*Rapid evaluation of a short/middle span bridge*

Based on their displacement/strain flexibility identification theory, the research group with which Shuanglin is affiliated is developing an automatic impact testing system for rapid safety evaluation of short/middle span bridges. The integrated system consists of the mobile impacting device, novel sensors, data acquisition, and automatic data processing software. Its aim is to complete the field test of a normal short/middle bridge within half an hour, and automatically produce the flexibility identification results once the impact test is done. The displacement/strain flexibility characteristics of the structure will be used for static displacement/strain prediction and subsequent capacity evaluation. This system has the potential to be widely applied for safety evaluation of a population of short to mid-size bridges.

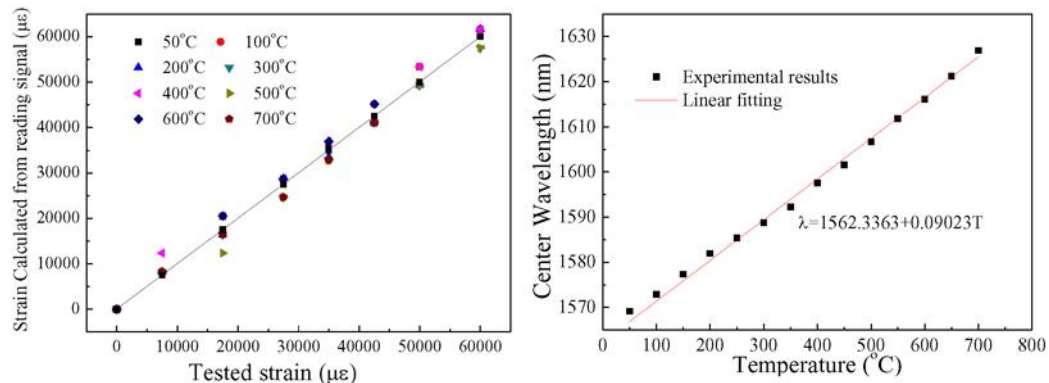


**Dr. Ying Huang** received her Ph. D. in civil engineering with an emphasis on structural health monitoring in 2012 under the supervision of Dr. Genda Chen at Missouri University of Science and Technology, USA. Ying's major research developed an innovative sensing system to monitor the health condition of steel structures in post-earthquake fire environments. Post-earthquake fires introduce simultaneous large deformation and high temperature, a condition that has been increasingly encountered in recent years and can easily destroy most commercial sensors.



*Left: Top view of a sensor prototype - Optical sensor head and metal sub-sheet.  
Right: Micro-view of the sensor head (side view)*

To meet the ever increasing need to solve this problem in civil engineering structures, Ying developed a unique hybrid fiber optic sensing system consisting of a CO<sub>2</sub>-laser induced long period fiber grating (LPFG) sensor and a movable extrinsic Fabry-Perot interferometer (EFPI) sensor. The LPFG and EFPI sensors are connected in series. On one hand, the LPFG is at least two orders more sensitive to temperature than strain and, thus, is regarded as a temperature sensing component of the hybrid sensing system. On the other hand, packaged with a glass tube only, the EFPI has a weak cross effect of temperature on strain measurements of the order of  $0.5 \mu\epsilon/^\circ\text{C}$ , depending upon the thermal coefficients of the optical fiber and the glass tube. Therefore, the EFPI mainly works as a strain sensing component of the hybrid sensing system. Prototype hybrid sensors can simultaneously measure strain and temperature up to 12% and 800  $^\circ\text{C}$ , respectively. The effectiveness of the hybrid sensing system has been validated through laboratory tests with a scaled steel frame structure.



*A prototype of the hybrid sensing system showing the cross temperature-strain effect and strain measurement accuracy (left) and temperature sensitivity (right)*

In addition, Ying also researched bridge scour and corrosion monitoring. An innovative “smart rock” based on electromagnetic field detection for bridge scour monitoring and a nano-particle coated LPFG sensor for corrosion monitoring was developed. Ying has published 11 articles in peer-reviewed journals. Five articles and one book chapter resulted from her test data and the numerically simulated results from her major research. She has also published a number of conference papers and has two patents pending. With an excellent research track record, Ying is now an assistant professor in the Department of Civil Engineering at North Dakota State University.



## Sharing Knowledge Through Conferences and Workshops

Sharing knowledge is a significant role for ISHMII.

ISHMII has two important meetings this year. I invite those of you whose efforts touch the life-span of bridges to attend [CSHM-5 \(2013\)](#), a workshop on the structural health monitoring and maintenance of short and medium-span bridges to be held in Japan from October 24th to 26th. CSHM-5 will focus on the use of rational health monitoring systems, like those that use a moving vehicle to collect data, and development of an IT-based bridge health monitoring system that incorporates the latest information technologies for lifetime management of existing bridges, including strategies for managing data collection systems that are designed for successful bridge health. *Pictured (right) is the historic Kintai Bridge in Iwakuni, Yamaguchi, Japan.*



I encourage you to join us in Hong Kong in December at the 6th International Conference on Structural Health Monitoring of Intelligent Infrastructure, [SHMII-6 \(2013\)](#), our official conference and a vital platform for international scientists, engineers, researchers and project managers to discuss recent advances in the SHM of intelligent infrastructure and to explore the potential for international cooperation. There, we will share innovative ideas on the state-of-the-art, state-of-the-practice and future trends of smart sensors, advanced sensor networks, signal processing and real-time data management, structural health diagnosis and prognosis, and life-cycle performance assessment for SHM.

We can see all of the fields in which ISHMII now casts so much influence. The SHMII-6 topics include presentations and posters on smart sensing materials, wireless sensors, fiber optical sensors, GPS and other advanced sensors as well as sensor networks. An exciting topic is self-powered sensors, harvesting energy to run the sensor networks. Presentations will include use of remote systems and the transmission of data, its acquisition and processing, data mining and management. Researchers conducting modeling will present on multi-scale and other advanced modeling methods, system identification and model updating.

Practitioners will add to our knowledge on field applications such as loading identification and extreme loading assessment, conditional and multi-scale monitoring, SHM-aided life-cycle performance assessment and damage control, repair and strengthening. As we discuss integrated systems and implementations of SHM, we will explore asset health management and non-destructive testing and evaluation. The conversation on monitoring will include bridges, buildings, dams, tunnels, space structures, heritage and other structures as the applications for our work is ever-expanding.

I hope this motivates you to become an active member of ISHMII.

In closing, I remind all our colleagues to renew their individual, student or corporate membership or become a member. Your financial contributions make it possible for ISHMII to thrive and fulfill its mission.

With warm wishes,

**Farhad Ansari**, President

[FAnsari@uic.edu](mailto:FAnsari@uic.edu)

Articles published in *Membership Notes* may be cited as follows: Name(s) of the authors, (Year), "title of the article," ISHMII Membership Notes, Vol. No., Issue No., pp.

## ISHMII Council Recognizes Retirement, Welcomes New Members

The ISHMII Council, President, Executive Committee and staff thank **Dr. Fritz Brunner** for his dedication to ISHMII and his contributions to SHM as a pre-eminent researcher. An early member of ISHMII, Dr. Brunner steps down from the Council that he substantially influenced following a decade of participation. The Council guides and takes decisive action for ISHMII, and through this role, Dr. Brunner played an important role in the development and growth of the Society.

Now Professor Emeritus at the Technical University of Graz, Austria, [Fritz Brunner](#) served as the esteemed head of the Institute of Engineering Geodesy and Measurement Systems from 1994 to 2011, having arrived at TU Graz from the University of New South Wales. Educated at the Technical University of Vienna, he was also an A. v. Humboldt fellow at the Geodetic Institute, University of Stuttgart and, on the commercial side of engineering, head of the Advanced Products Group at Wild Heerbrugg Ltd., Switzerland. In addition to receiving the A. v. Humboldt Award in 1990, Dr. Brunner was awarded the 1994 Friedrich Hopfner Medal from the Austrian Geodetic



Commission. The past-President of that Society, he is an Executive Board member of the Austrian Society of Surveying and Geoinformation, Fellow of the International Association of Geodesy and serves on the editorial boards of the ISHMII JCSHM and the Journal of Geodesy. Pictured above, Professor Emeritus Brunner is in the Measurement Lab working with an automatic calibration facility for electro-optical distance motors which was developed and built by the Department. The rotating target is shown with various reflecting surfaces. We invite you to read more of Dr. Brunner's accomplishments on his [Graz TU Web site](#).

Welcome to the newly-inducted members of the [ISHMII Council](#). The five councilors come from Canada, USA, China, Austria, and include the first member from Saudi Arabia.

[Dagmar Svecova](#), director of the [ISIS Canada Resource Centre](#) at the University of Manitoba (Canada), is an associate professor of Civil Engineering. ISIS Canada hosts the headquarters of ISHMII. Educated at Slovak Technical University and Carleton University (Ph.D.), Dr. Svecova conducts research in reinforced and pre-stressed concrete structures as well as timber structures reinforced or strengthened with FRP. She is a member of the American Concrete Institute and Canadian Society of Civil Engineers, where she chairs the sub-committee on Timber Bridges. Among her current research projects are the investigation of the serviceability of FRP-reinforced and pre-stressed concrete and half-scale and full-scale testing of FRP-strengthened timber stringers. The latter includes the

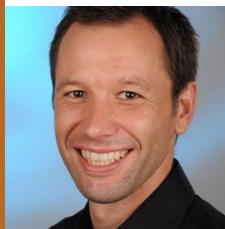


effects of temperature on bond between creosote treated timber and epoxy used to secure FRP bars in the stringers, which is called near surface mounted reinforcement.



A professor of civil engineering, [Genda Chen](#) is the associate director of the [Mid-America Transportation Center](#) at the Missouri University of Science and Technology (USA). Educated at Dalian Institute of Technology and the State University of New York at Buffalo (Ph.D.), Dr. Chen is a registered professional engineer, ASCE Fellow and Executive Committee member of the U.S. Panel for Structural Control and Monitoring. Among his memberships and appointments are the Earthquake Engineering Research Institute, Transportation Research Board Seismic Design and Performance of Bridges Committee, American Concrete Institute 408 Committee on Development and Splicing of Deformed, ASCE Subcommittees on Performance of Bridges and Seismic Isolation Systems Testing. Dr. Chen's research fields include SHM, structural materials and mechanics including interface behavior and deterioration of composite systems fatigue, fractures and forensic investigation, structural control and earthquake engineering, and multi-hazard assessment and mitigation. Visit [Dr. Chen's Web site](#) for [Smart Rocks and Wireless Communication System for Real-Time Scour Monitoring and Mitigation of Bridges](#), a newly-posted video.

[Zhang Yufeng, Ph.D.](#), a structural engineer educated at South-east University (China), holds the title of Professor and Senior Engineer for the [Jiangsu Transportation Institute \(JSTI\)](#), Nanjing. He is the vice director of the engineering monitoring center and deputy director of Bridge Structural Engineering Research Division. Dr. Zhang is engaged in bridge design, inspecting, SHM, testing and sensing, and evaluation technology research. A member of Jiangsu Institute of Architecture and Civil Engineering Prestressed Committee and the Jiangsu Provincial Institute of Metrology and Measurement On-line Monitoring Committee, he is also a National first-class registered structural engineer, State registered consultant engineer and project management professional. His accomplishments include the design and implementation of SHM systems for many highway bridges including those over the Yangtze River at Sutong, Jiangyin, Chongqi, Ma'an Shan, and Anqing, and the Inner Mongolia Erdos Ulan Mulun River No. 4 Bridge. Dr. Zhang has monitored the construction of about 40 bridges and the inspection, evaluation, reinforcement and repair work of a similar number of bridges. In addition to his publications, he holds 5 patents. He has been awarded over 10 distinguished provincial prizes and awards, and in 2010, Dr. Zhang received the title of Outstanding Scientific and Technological Personnel from the Ministry of Transport of the People's Republic of China.



[Professor Werner Lienhart](#) heads the [Institute of Engineering Geodesy and Measurement Systems](#) at the Technical University of Graz (Austria). In this position since 2011, he was the Product Manager for Innovation, Business Area Geomatics, at Leica Geosystems AG after receiving his Ph.D. at Graz TU. He holds undergraduate degrees from Nottingham Trent University GB and Graz. Recipient of the Josef-Krainer-Förderungspreis, BMW Scientific and Austrian Construction Awards for this doctoral research, his current interests lie in SHM, sensor selection and sensor placement, fiber optic sensors, and the analysis and calibration of geodetic measurement systems. Dr. Lienhart is the Associate Editor for Europe on the Editorial Board of ISHMII's electronic magazine, *The Monitor*. He is a member of the Austrian Geodetic Commission, Society for Calibration of Geodetic Devices, Austrian Society for Surveying and Geoinformation, German Geotechnical Society, Austrian National Committee on Large Dams, and a substitute management committee member of COST ICT Action TD1001 (Novel and Reliable Optical Fibre Sensor Systems).



for Future Security and Safety Applications).

Professor of civil engineering at [King Fahd University of Petroleum & Minerals](#) (Saudi Arabia), [Mohammed H. Baluch](#) graduated from Nadirshaw Edulji Dinshaw College and Purdue University (Ph.D.). A founder of the ACI Eastern Province Chapter of Saudi Arabia and leader of the ASCE, Dr. Baluch is a referee for the *ASCE Journal of Composite Materials*, *ACI Journal of Materials*, *Cement & Concrete Composites*, *International Journal of Damage Mechanics*, *Transactions of the Canadian Society of Mechanical Engineering*, and the civil engineering editor for the *Arabian Journal for Science and Engineering*. Dr. Baluch specializes in structural engineering, concrete mechanics, reinforced concrete design, computational mechanics, concrete repair, and forensic engineering, and he established the KFUPM earthquake engineering laboratory. He provides expert diagnostic advice and repair strategies related to structural distress and failure. These have included finite element modeling, forensic engineering studies and full scale load tests. His research projects have also included modeling the failure of high temperature gas lines, review of RC anchor blocks for pipes transporting oil, and development of superior mortar linings for pipes transporting water. He is involved in the development of standards for the pre-cast industry in the Kingdom.



**Welcome to all of the new ISHMII Council members!**

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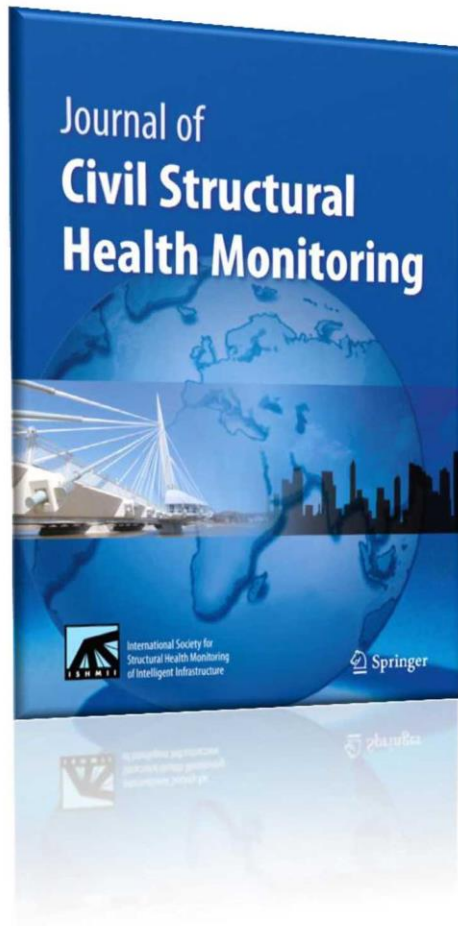
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Investigate the [Abstracts](#)

Non-members are invited to peruse the JCSHM Index and read abstracts.

*Volume 3, Issue 2, May 2013 is available to ISHMII members who have logged in to their account at [www.ISHMII.org](http://www.ISHMII.org).*

**JCSHM welcomes your research  
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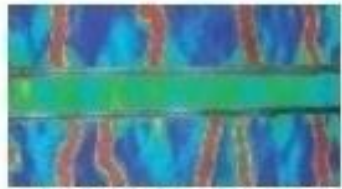


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