THE COLLAPSE OF THE BRIDGE ON THE MAGRA RIVER AT ALBIANO, ITALY
Paolo Clemente

Bad luck of the Italian bridges seems to have no end. After the failure of the Polcevera Viaduct in Genoa on August 14th, 2018, one of the most famous bridges in Italy, another bridge collapsed on April 8th, 2020. It was the bridge along the SP70 road, on the Magra river at Albiano, between Toscana and Liguria Region (Fig. 1).

The structure consisted of two lanes and two pedestrian paths, whose total length was about 270 m. The bridge was under the management of ANAS (the Italian National Agency for Roads) since November 2018, because considered of national interest. The main structure was composed of five reinforced concrete arches, each with a span of about 50 m, with four masonry piers and two abutments at the ends. The arches, each with three hinges, had variable section and were in (non-prestressed) reinforced concrete, as well as the vertical pillars that transferred the loads from the deck to the arches.

Continued on next page
The bridge was designed by Arrigo Carè and Giorgio Giannelli and built by the “Nino Ferrari Company” in 1949 (Fig. 2), on the place of the previous bridge, built between 1906 and 1908 (one of the first concrete bridges in Italy) and destroyed by the Germans in 1944 by means of bombs and mines. As usual in the post-war reconstruction of infrastructures, due to the absolute scarcity of material resources, efforts were made to preserve the remaining parts of the structure. Therefore, the original static scheme was kept and the same piers with their foundations were used. The foundations of the piers had been built thanks to the use of pneumatic (compressed-air) caissons with sub-foundations, an innovative technique for that period. The masonry piers were just placed on the concrete foundation, and any unbalanced horizontal force should be absorbed by friction. The top of each pier was replaced by a new reinforced concrete top to properly anchor the new hinges.

The infrastructure had already showed damage signs. In November 2019 a crack was noticed by many motorists. After the inspection performed by the ANAS technicians the crack was repaired and the traffic was allowed without limits as written in a letter from ANAS to the Municipality of Albiano: “The Albiano viaduct, monitored and supervised by ANAS personnel, does not present at the moment critical issues, such as to compromise its statics. On the basis of this, any emergency measure for the viaduct would not be justified”. Afterword the history has demonstrated a different situation.

What are the possible causes of the collapse?
Traffic, very limited due to the Covid-19 pandemic, was not a problem. The bridge probably came to the end of its life time. The causes of the collapse should be searched in the old parts of the bridge, such as the piers, but a degradation of a structural element should also be considered. Actually, the bridge was hardly overloaded in the last two years due to the closure of an alternative road for maintenance works (Fig. 3).

It is worth noting that the structural type did not satisfy the “robustness” requirement, that is, the ability to limit the propagation of the effects of localized damage, to avoid a chain collapse, which seems to have happened in this case. It should be reminded that, at the time of construction, the technical regulations did not contemplate the requirement of “robustness”.

At the time of writing this note, different committees are working to analyse the collapse and individuate the causes. The failure was certainly localized. Actually, the first three piers from west side were rotated to the east side after the collapse (Fig. 4). Instead, the 4th pier, i.e., the last one at the east side, did not rotate apparently (Fig. 5). This seems to confirm the hypothesis that the collapse started from the first span to the east and then spread to the others with a chain effect. The collapse is likely to have occurred in a few tens of seconds, as confirmed by local witnesses.

The local failure could be related to the deterioration of one of the hinges. These were realized, as usual in concrete arches, by means of an appropriate arrangements of the steel reinforcements (Mesnager hinge), between the springing of the arch and the new reinforced concrete top of the piers.

It is apparent than a suitable structural health monitoring system of the bridge would have provided an alarm in time and avoid the failure. Now the authorities are controlling bridges similar to the Albiano Magra bridge. As usual in Italy, prevention is something we do after the disaster and not before.

The author thanks Dr. Fabrizio Ferrari (Nino Ferrari Company) for the historic and structural information and INGENIO (https://www.ingenio-web.it/) for the photos of the bridge.
DISTRIBUTED AND QUASI-DISTRIBUTED MONITORING OF CIVIL INFRASTRUCTURE

We are pleased to announce the launch of a Special Issue in Journal of Civil Structural Health Monitoring (JCSHM) which is a SCI-indexed journal. This Special Issue focuses on “Distributed and Quasi-Distributed Monitoring of Civil Infrastructure”. With the rapid development in the infrastructure systems, the long-term performance of civil structures for the life-cycle service becomes a major concern. Structural health monitoring (SHM) is able to facilitate understanding of real structural behavior and provide important information for assessment of structural safety. In the past two decades, a series of distributed sensing and monitoring technologies, such as Brillouin, Rayleigh or Raman backscatter-based fiber optic sensors, as well as Fiber Bragg Grating (FBG) sensors, have been implemented in the SHM for bridges, tunnels, dams, dykes, port structures, pipelines, etc. The aim of this Special Issue is to collect the latest advances and trends in the field of distributed monitoring of civil infrastructure.

The topics of interest include but are not limited to:
- Recent development in distributed and quasi-distributed monitoring techniques;
- Integration of distributed and quasi-distributed SHM systems;
- Advanced signal processing and big data analysis related to distributed and quasi-distributed monitoring;
- Structural condition assessment and damage detection based on distributed and quasi distributed monitoring;
- Case study of distributed and quasi-distributed monitoring techniques in civil infrastructure systems.

The deadline for full paper submission is October 1st, 2020.

Authors will be required to explain the novelty contained in the paper in their cover letter during submission. Purely theoretical or numerical investigations without verification using field or experimental data are not accepted for publication in JCSHM.

Guest Editors:
Dr. Xin Feng
E-mail: fengxin@dlut.edu.cn

Dr. Branko Glisic
E-mail: bglisic@princeton.edu

Dr. Daniele Inaudi
E-mail: daniele.inaudi@smartec.ch

MONITORING INFRASTRUCTURE SYSTEMS IN SMART CITIES VIA MOBILE SENSING

The path to smart and sustainable cities is inherently complex and multi-dimensional and it requires fundamental shifts in the management of our infrastructure systems. Bridges are among the most critical links of our infrastructure network and ensuring that our bridges are performing to their best with cost-effective solutions is of the utmost importance for developing smart and sustainable infrastructure systems. In this context, the big data collected from non-contact and mobile sensing/monitoring technologies offer a significant promise.

The aim of this special issue is to showcase the most recent studies on mobile sensing/monitoring technologies for paving the way to developing the smart infrastructure systems in future’s smart cities. Potential topics of interest in the context of civil structural health monitoring include, but are not limited to: crowdsourcing-based monitoring (such as using smartphones or other user devices), citizen sensing, drive-by monitoring, robotic monitoring, drone-based monitoring, computer vision-based applications, signal/image processing for mobile sensing applications, big data analytics, artificial intelligence (AI), internet of things (IoT), case studies and applications.

Submitted papers should not be under consideration for publication elsewhere.

Please inform the guest editor, Prof. Mustafa Gül about your intention to submit a paper.

Guest editor:
Mustafa Gül
E-mail: mustafa.gul@ualberta.ca

STRUCTURAL HEALTH MONITORING WITH PIEZOELECTRIC TRANSDUCERS

An ongoing global challenge is the maintaining of structural integrity for aging infrastructure. In countries like the United States, large swaths of vital infrastructure in transportation, energy, waste management, etc. are in dire need of remediation. As the health of such vital infrastructure is key to economic growth, there is an urgent need to search for ways to not only preserve the integrity of existing structures, but also ensure the health of future structures. While remediation can come temporarily through large investments on conventional maintenance and construction, a more reliable and long-term solution is the use of newly developed monitoring technologies. A class of technologies that show promise for tackling such a grand task are piezoelectric transducers.

Piezoelectric materials, a type of smart materials, can convert between mechanical energy (e.g. vibrations, strain) and electrical energy (e.g. voltage). This fundamental operating principle has given rise to nearly limitless possibilities in technological development. The core of countless modern devices, ranging from smart phones to ultrasonic cleaners, are based on transducers made from piezoelectric materials. While piezoelectric materials continue to revolutionize our way of life in unexpected ways, their potential for radically transforming structural robustness has not yet been fully realized.

Therefore, to push forward innovation and raise awareness in the development of piezoelectric transducers for structural health monitoring, this issue will showcase cutting edge examples of high impact research in this area. Examples include embedded sensing networks, interfacial monitoring systems, innovative sensors and actuators, damage localization and characterization, modeling and simulation, case studies, sensing networks supported by artificial intelligence, among many other fascinating topics. Readers will see that manifestations of futuristic smart structures that can sense damage, report damage, and even automatically effect temporary repairs have come within practical reach as piezoelectric transducers become more advanced.

Guest editors:
Dr. Gangbing Song
E-mail: gsong@uh.edu

Dr. Hong-Nan Li

Dr. Siu Chun Michael Ho

CITIES VIA MOBILE SENSING
This Special Issue focuses on “Structural Health Monitoring (SHM) of High-rise Buildings and Spatial Structures”. The past two decades have witnessed that SHM can provide authentic data of loading, environmental effects, structural performance and conditions without scaling and modelling errors. These data are greatly beneficial to: (1) the validation of design methodologies and theoretical/numerical models, as well as the understanding of the complex structural behaviors; (2) the evaluation of condition/performance of structures in terms of both post-event assessment and life-cycle analysis; and (3) the operation and management of structures, where the monitoring data can be used for structural control, informed decision making and guiding the emergency response. High-rise buildings and spatial structures especially benefit from SHM because they typically have more complex or unique structural systems and their behaviors cannot be fully predicted in the design stage. The demands for SHM of these structures are continuously growing. Recently, rapid advances in sensing technologies, machine learning/artificial intelligence and new tools for big data analytics have offered a variety of opportunities for further enhancing the capacity of SHM.

The main objective of this Special Issue is to provide a forum for international researchers working on SHM to exchange information on the emerging frontiers of research activities and discuss the potentials of new technologies and future directions, to better inform the wider community of researchers and practitioners. This Special Issue aims at synthesizing the state-of-the-art SHM techniques for high-rise buildings and spatial structures and will cover a broad range of topics, including full-scale monitoring, experimental studies, development of novel diagnostic and prognostic methods, etc. Emerging technologies in these areas are especially welcome.

Papers are invited on topics including but not limited to:
- New sensing technologies, including robotics, computer vision, etc.;
- Artificial intelligence and machine learning-based SHM methodologies;
- SHM-oriented big data analytics;
- Digital twin technology;
- Validation of design methodologies or theoretical models;
- Performance/condition assessment and forecasting;
- Uncertainty quantification in SHM;
- Application of SHM in resilience planning.

The deadline for full paper submission is July 22, 2020.

Authors will be required to explain the novelty contained in the paper in their cover letter during submission. Purely theoretical or numerical investigations without verification using field or experimental data are not accepted for publication in JCSHM.

Guest editors:
Dr. Yi-Qing Ni
E-mail: ceyqni@polyu.edu.hk

Dr. Yanlin Guo
Email: yanlin.guo@colostate.edu

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10th International Conference on Structural Health Monitoring of Intelligent Infrastructure

FEUP · 2021
30 June › 2 July
Porto · Portugal

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Deadline for paper submission
10 January 2021

Paper acceptance notification
1 March 2021

Deadline for registration and payment authors
1 April 2021

Deadline for early bird registration
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SHMII-10 Conference
30 June - 2 July 2021

www.fe.up.pt/shmii10
Dear Colleague,
We would like to invite you to contribute and participate to SHMII-10, the Tenth International Conference on Structural Health Monitoring of Intelligent Infrastructure, Porto, Portugal, from 30 June to 2 July 2021. The conference website (www.fe.up.pt/shmii10) is open for abstract submission until 30 June 2020.

The Conference Program will include (https://web.fe.up.pt/~shmii10/conference/keynote-lectures/):

6 Plenary Keynote Lectures, by
- Dr. Sreenivas Alampalli (New York State Department of Transportation, USA)
- Prof. Aftab Mufti (University of Manitoba, Canada)
- Prof. Daniele Zonta (University of Trento, Italy)
- Prof. Jinping Ou (Harbin Institute of Technology, China)
- Prof. Didem Ozevin (University of Illinois at Chicago, USA)
- Prof. Ruben Boroschek (University of Chile, Chile)

9 Semi-Plenary Keynote Lectures, by
- Prof. Elsa Caetano (University of Porto, Portugal)
- Prof. Hong-Nan Li (Dalian University of Technology, China)
- Prof. Nurdan Apaydin (Bogazici University, Turkey)
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- Prof. Michael Todd (University of California, San Diego, USA)
- Prof. Maria Pina Limongeli (Politecnico di Milano, Italy)

and 29 Thematic Mini-Symposia (https://web.fe.up.pt/~shmii10/conference/mini-symposia/).

A few Special Issues of Journal of Civil Structural Health Monitoring (https://ishmii.org/jcshm/) will be organized based on selected papers of SHMII-10.

Up-to-date information about the conference objectives, mini-symposia, venue and submission procedure can be found on the conference website. Opportunities for Sponsors and Exhibitors are also described at the conference website.

We would appreciate if you could forward this information to colleagues who may be interested in this conference, using also the attached flyer.

Yours sincerely,
Álvaro Cunha (Conference Chair)
Elsa Caetano (Conference Co-Chair)
Wolfgang Habel (Advisory Committee Chair)
INTRODUCTION
The International Society for Structural Health Monitoring of Intelligent Infrastructure and the Faculty of Engineering of the University of Porto (FEUP) are pleased to announce that the Tenth International Conference on Structural Health Monitoring of Intelligent Infrastructure (SHMII-10) will be held in Porto, Portugal, from 30 June to 2 July 2021.
The nine previous conferences in the series were held in Tokyo (Japan, 2003), Shenzen (China, 2005), Vancouver (Canada, 2007), Zurich (Switzerland, 2009), Cancun (Mexico, 2011), Hong-Kong (China, 2013), Turin (Italy, 2015), Brisbane (Australia, 2017) and St. Louis (USA, 2019). This conference is devoted to recent research advances on technologies related with the health monitoring for the condition assessment and management of civil infrastructure systems, including real-world applications (e.g. on highways, railways, bridges, buildings, airports, seaports, water resources systems, oil and gas pipelines, wind turbines, dams, high voltage transmission lines, etc.).

CALL FOR ABSTRACTS
Authors wishing to contribute to the scientific program of SHMII-10 are requested to create an account on the conference website www.fe.up.pt/shmii10 and to submit a one-page abstract before 30 June 2020 through that website. 29 mini-symposia will be organized at SHMII-10 and are listed here. If the abstract is accepted, authors will be asked to submit a paper for publication in the conference proceedings. In principle, the proceedings will be listed in SCOPUS and/or Thomson Reuters ISI Web of Knowledge.

VENUE
The Conference will take place at the Faculty of Engineering of the University of Porto, FEUP (Faculdade de Engenharia da Universidade do Porto).
Porto is the largest city of Northern Portugal. The Historic Centre of Porto, classified as World Heritage by UNESCO, is one of the most attractive entertainment venues for visitors, providing a rich variety of monuments and ordinary dwelling, from different periods stretching back as far as the 14th century. The city of Porto and its river, Douro, cannot be dissociated. The Douro valley, with its lovely terraces of vineyards clinging to the hillsides, is the kingdom of the famous Port Wine (www.ivdp.pt) and offers visitors spectacular views. Porto is the centre of a culturally and naturally rich region that gathers together history, arts and nature (sea and mountains); it is a perfect starting point for tourist excursions (of various durations and flavours). The city of Porto is easily accessible from abroad. Several airlines offer direct service to Francisco Sá Carneiro International Airport, located about 12 Km from the City Centre.

EXHIBITION
Companies are invited to participate in the exhibition during the conference. For further information, please contact the conference secretariat.

CONFERENCE THEMES
› sensors/ actuators
› sensor networks/ system integration
› remote sensing/ robotic and UAV platforms for SHM and maintenance intervention
› multifunctional materials and structures
› diagnostics/signal processing/state awareness
› prognostics/ health management/ safety assurance
› SHM system design and cyber physical systems
› SHM for the industry internet of things
› full-scale demonstration and real-world SHM applications (aerospace, marine, civil engineering, railway, energy generation)

MINI-SYMPOSIA
MS01. Advanced sensor technologies and application for SHM of Civil Infrastructure
MS02. Smart materials and sensing solutions for Intelligent Infrastructures
MS03. Nondestructive evaluation of structure materials
MS04. Acoustic emission monitoring of Civil infrastructures
MS05. Innovative data-driven techniques for Structural Health Monitoring
MS06. Data driven structural identification and performance evaluations
MS07. System identification, model updating and damage detection
MS08. Bayesian methods for vibration-based SHM
MS09. SHM enhanced by machine learning and artificial intelligence
MS10. Real world applications of fibre optic sensing for infrastructure monitoring
MS11. Advances in SHM strategies and its application to Civil Infrastructures
MS12. Cost-benefit of SHM systems
MS13. The use of SHM in bridge evaluation
MS14. SHM of energy infrastructures (wind turbines, dams, power lines, pipelines, …)
MS15. SHM of offshore, marine and subsea structures
MS16. Assessment and SHM of Cultural Heritage structures
MS17. Seismic SHM: current and future research, innovation and practice
MS18. SHM for disaster prevention and resilience of infrastructure systems
MS19. SHM of extended geotechnical structures
MS20. SHM-aided life-cycle performance assessment
MS21. From structure observation to Physics-based SHM models and digital twins
MS22. Blind source separation for SHM: A benchmark study
MS23. Structural performance evolution and analysis based on monitoring data
MS24. Value of Information and Integrity Management of Infrastructures
MS25. Preservation of Historic Structures by SHM in the African and Middle East Region
MS26. Latest advances on SHM and smart structures in Australia/Oceania
MS27. Latest SHM advances in the Asian region
MS28. Progress in international standardization of SHM methodologies
MS29. SHM (other topics)

www.fe.up.pt/shmii10
Use of conservative models for design and management of civil infrastructure

Sai G.S. Pai a, Ian F.C. Smith a, b
a Cyber Civil Infrastructure, Future Cities Laboratory, Singapore-ETH Centre, ETH Zurich, Singapore; email: sai.pai@sec.ethz.ch
b Applied Computing and Mechanics Laboratory, Swiss Federal Institute of Technology (EPFL), Station 18, GC-G1-537, Lausanne, Switzerland

Design of civil infrastructure involves many conservative (safe) choices. These choices lead to existing structures that are safer than design requirements. However, conservative models used for design may not be safe for management of existing structures. This is demonstrated in this article with the help of a simply-supported concrete beam set up as shown in Figure 1.

The simply-supported beam, shown in Figure 1, is used for demonstrating the effect of safe modelling assumptions on structural design and subsequent management actions. Let the beam, shown in Figure 1, be subjected to a load of 100 kN. This beam is assumed to have a depth of 410 mm during structural design (as-designed). However, the real depth of the beam is unknown to the manager and to the asset manager.

The beam, in reality, is stiffer than predicted by design calculations (model). For the first case, structural design, the beam is assumed to be subjected to a load of 100 kN. The deflection at mid-span is predicted for this load. For the second case, management of an existing beam, the deflection of the beam is observed to be 3.1 mm. In this case, the load on the beam has to be estimated. The real depth of the beam (440 mm) is unknown to the designer and to the asset manager.

Management of civil infrastructure involves estimating structural behaviour based on observations. In Figure 3(b), estimation of load on the beam is compared with the actual load on the beam (100kN) for an observed beam deflection of 3.1mm. In this example, the manager cannot access this beam to measure accurately its depth. The estimated load on the beam, estimated using the conservative design model, is 80kN, which is lower than reality. A lower estimation of load on infrastructure may lead to unconservative predictions and bad asset-management decisions.

Acknowledging model uncertainty may help ensure accurate predictions and conservative management (Pai et al. 2019; Smith 2016). Typically, in civil engineering, uncertainties are estimated to be distributed normally. For the test case shown in Figure 1, the beam depth is assumed to have the following possible distributions:

- Normal with a mean equal to the design value (410 mm, no bias) and a standard deviation of 10 mm.
- Normal with a mean of 430 mm (as-designed value+20 mm) and standard deviation of 10 mm.

The bias in uncertainty distributions is justified based on the understanding that built infrastructure are typically stiffer than as-designed. Typically, on-site inspectors would not allow a beam that was less than 410 mm. The biased and unbiased normal distributions of beam depth are shown in Figure 3(a).

For the two estimations of normal uncertainty in beam depth shown in Figure 3(a), two distributions of load on the beam for an observed deflection of 3.1 mm are estimated, as shown in Figure 3(b). The real load on the beam is 100 kN. Distribution of the load estimated on the beam is accurate (95th percentile bounds include the real value) only when model bias is included in the uncertainty estimation.

The information in Figure 3(b) is troubling. Firstly, although a biased normal distribution includes the real value (100 KN), probability values around this real value are not high. This does not make sense. Secondly, while uncertainties are typically assumed to be normal, civil infrastructure are built to at least meet design specifications. The uncertainty following construction may therefore be estimated to have a lower bound equal to...
Continued from previous page

the design value and an engineering estimate equivalent to, say 95% of the normal curve for the upper bound. With only bounds as relevant information, the most appropriate choice for an uncertainty quantification is a uniform distribution (Jaynes 1957). Therefore, for the test case shown in Figure 1, the beam depth may be assumed to have the following uniform distributions, see also Figure 3c:

- Uniform with bounds 390mm and 430mm (centred on design value of 410mm, no bias)
- Uniform with bounds 410mm and 450mm (lower bound is the design value of 410mm)

With beam depth as a uniformly distributed random variable, estimations of load on the beam for an observed deflection of 3.1mm are shown in Figure 3(d). Distribution of these estimations have been simplified to a uniform distribution in Figure 3(d). Assuming beam depth to be uniformly distributed with no bias leads to a distribution of estimated load that does not include the real load on the beam (inaccurate estimate). Such inaccurate estimations, as mentioned previously, may lead to unconservative predictions and bad management actions.

The load on the beam is estimated accurately (distribution bounds includes real value) when the bias in model and uncertainty related to beam depth are estimated accurately. Distribution of beam depth based on engineering knowledge provides accurate estimation of load and enables safe management. Assuming uniform distributions for interpreting observations (measurements) using models has other advantages such as robustness to changes in correlations between several measurement locations (Pai 2019; Pasquier 2015).

Based on the evaluation of the simply-supported concrete beam, following conclusions are relevant:

- Models and assumptions that are conservative for structural design verification are not necessarily conservative for predictions required to support management of existing structures.
- Accounting for uncertainties using biased distributions can ensure conservative structural behaviour assessments to support good asset management decision-making.
- In civil engineering contexts, estimations of model uncertainties using biased uniform distributions are more appropriate than biased normal estimations.

References


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**2020 MEMBERSHIP RENEWAL**

2020 Renewal invoices were issued earlier this year through our new online membership system (Wild Apricot/Prosonify). Memberships not paid by July 15, 2020 will lose access to the members only area of the ISHMII website and access to the JCSHM.

Benefits to Members:

- Exclusive on-line access to the peer-reviewed Journal of Civil Structural Health Monitoring
- Discounted rate at ISHMII Conferences
- First-hand information on upcoming meetings
- Career Opportunities
- Case Studies
- and much more

For questions regarding membership, please contact Charleen Choboter at the ISHMII Administrative Centre by email at: charleen.choboter@umanitoba.ca

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Please watch your email this summer for a membership survey. Your input is appreciated. We want to hear your thoughts. The short survey has a big impact
A Novel Strategy To Design Measurement Systems For Bridge Load Testing

Numa J. Bertola1,2, Ian F.C. Smith1,2

1Future Cities Laboratory, Singapore-ETH Centre, ETH Zurich, Singapore, Singapore.
2Applied Computing and Mechanics Laboratory (IMAC), School of Architecture, Civil and Environmental Engineering (ENAC), Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland.

Sensor data, collected using a measurement system, help increase the accuracy of behaviour predictions of the finite-element model by reducing the uncertainties on model parameters. Although strategies for data interpretation have been extensively studied, the monitoring system (sensor type and location) is often chosen by engineers using only qualitative rules of thumb. Rational methodologies for measurement-system design have the potential to improve the performance of structural identification.

The design of measurement systems can be defined as an optimization task, where possible sensor locations are treated as discrete variables and an objective function is selected to assess the information gain. Recently, the hierarchical algorithm for sensor placement has been introduced in the context of bridge load testing (Bertola et al. 2017). This methodology used a novel objective function called joint entropy to evaluate possible sensor configurations. To estimate the information gain, this metric accounts for the variability of model predictions at possible sensor locations as well as mutual information between locations. Furthermore, the hierarchical algorithm can include information from dynamic load tests (Bertola and Smith 2019) and account for multiple objectives such as the costs of monitoring and the ability to detect faulty sensors (Bertola et al. 2019).

Figure 1A presents the Singapore Flyover during the static load tests in 2016, while the finite-element model is shown in Figure 5B. The goal of monitoring in this case is to determine reserve capacity through reducing uncertainties related to values for Young’s modulus and the vertical and rotational stiffnesses of bearing devices. Initial ranges and identification after monitoring are shown in Table 1. Structural identification has been performed using error-domain model falsification (EDMF). EDMF is an easy-to-understand model updating methodology that has been shown to provide more accurate parameter-value identification when compared to residual minimization and traditional Bayesian model updating (Goulet and Smith 2013).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial range</th>
<th>Identification using EDMF</th>
<th>Range reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete-deck Young’s modulus $\mu_1$ (GPa)</td>
<td>20 – 35</td>
<td>20.1 – 34.9</td>
<td>1.3 %</td>
</tr>
<tr>
<td>Concrete-barrier Young’s modulus $\mu_2$ (GPa)</td>
<td>3 – 40</td>
<td>8.5 – 39.9</td>
<td>14.8 %</td>
</tr>
<tr>
<td>Precast-beam Young’s modulus $\mu_3$ (GPa)</td>
<td>25 – 50</td>
<td>38.3 – 49.9</td>
<td>53.4 %</td>
</tr>
<tr>
<td>Vertical stiffness of bearing devices $\xi_1$ [N/m/mot]</td>
<td>8 – 11</td>
<td>8.3 – 8.7</td>
<td>89 %</td>
</tr>
<tr>
<td>Rotational stiffness of bearing devices $\xi_2$ [rad/(N/m/mm)]</td>
<td>9 – 13</td>
<td>9.1 – 12.9</td>
<td>3.5 %</td>
</tr>
</tbody>
</table>

Figure 2 shows the sensor configuration that is chosen by engineers and the one that is determined by the hierarchical algorithm. The engineers have selected locations mostly based on high signal-to-noise ratios. They have also decided to install sensors on all girders (Figure 2A). The hierarchical algorithm has determined sensor locations based on their joint-entropy values, leading to a non-intuitive configuration (Figure 2B). For instance, locations with small signal-to-noise ratios (close to the support) have been selected. In terms of information gain (joint entropy), the hierarchical-algorithm configurations outperform the engineering-judgement configurations for any number of sensors (Figure 2C). Smaller parameter ranges could thus have been identified (Table 1) if sensors were placed according to the hierarchical algorithm.

This study illustrates that rational methodologies for measurement-system design can improve the performance of structural identification. The hierarchical algorithm supports the selection of the sensor configuration that maximizes the information gain.

Figure 2 A) Sensor configuration chosen by engineers. B) Optimal sensor configuration. C) Comparison of the information gain.

References


Pipeline Design with GRIN Lens to Improve the Propagation Distance of Ultrasonic Waves

Gorkem Okudan1, Hrishikesh Danawe2, Serife Tol2 and Didem Ozevin1
1University of Illinois at Chicago / 2University of Michigan

Timely and efficient assessment of the integrity of civil infrastructure is of utmost importance. Guided wave ultrasonic testing (GWUT) and acoustic emission (AE) are well-acknowledged nondestructive evaluation methods that are used in the assessment of the structural integrity of pipelines by taking advantage of elastic wave propagation. Unlike in many other inspection technologies, they have the capability of pinpointing the location of defects accurately. The common drawback of both methods is the inevitable attenuation of the wave energy over long distances. Our aim is to overcome this challenge by augmenting the conventional pipe design using phononic crystals (PCs). The PCs are artificially engineered periodic structures with so-called scatterers (or inclusions) arranged over or embedded into the base material. With PCs, unusual effective mechanical properties can be obtained such that existing materials do not exhibit.

Motivated by the promising achievements of the PCs, we implement a curved gradient-index phononic crystal lens (GRIN lens) on a laboratory-built pipe made of structural steel. GRIN lens is made of artificially engineered and graded stub attachments with a variation of their refractive index to modify the effective wave velocity. Because of the graded design, the energy of propagating elastic waves can be focused at a particular point for a particular frequency, which can be tuned by changing the spatial distribution and grading of extrusions. Figure 1 shows the GRIN lens design for pipe geometry consisting of steel stubs of various heights, changing from 1 to 5 mm, with a unit cell length a of 20 mm. The stubs can be attached artificially to existing pipes or built during the design process. Due to the variation of the stub heights, the refractive index and the wave velocity vary around the pipe circumference. The elastic waves propagating along the sides of the lens layer are gradually bent towards the centerline, focusing at a specific location. For an operating frequency of 50 kHz, the focal points are approximately located at 30a and 25a for L(0,1) and L(0,2), respectively. Figure 1 shows the behavior of wave propagation in pipe with and without GRIN lens using COMSOL Multiphysics software. Wave front bends toward focal point with concentrated energy.

The performance of GRIN lens is validated with experiments. Figure 2 shows the experimental configuration. An array of 24 equally spaced piezoelectric discs manufactured by Steminc, each having a 5-mm diameter and 0.4-mm thickness is attached around the pipe circumference to generate plane waves. The receiving piezoelectric discs attached at focal points are connected to the PCI-8 data acquisition system manufactured by MISTRAS Group. The experiments are conducted for the pipe states with the GRIN lens and without the GRIN lens. The details of GRIN lens design can be found in the article by Danawe et al. under review. Although the GRIN lens has been designed for 50-kHz operating frequency, the adhesive between pipe and stubs causes the shift of dispersion curves to lower frequencies. The GRIN lens works as desired for the frequency range between 20 to 40 kHz, with the highest amplification observed at 30 kHz.

Whereas for the AE mode, the piezo array is used as a receiver connected to the data acquisition system. Pencil-lead breaks (PLBs) are used to generate crack-like activities which cause burst-type emissions within the pipe. The PLBs are performed along the centerline of lens layer with 5a increments. The results show that both L(0,1) and L(0,2) wave modes are amplified significantly at 30 kHz, similar to the UT mode. Figure 2 indicates the pipe configuration with GRIN lens, and the attenuation curves for both pipe states. It can be observed that the wave energy can be amplified at certain distances along a pipe, namely within the focal region. In conclusion, the results show that the GRIN lens can change the effective properties of conventional pipes such that the amplitude of propagating elastic waves is increased at focal points as compared to conventional behavior of spreading. The reciprocal property of GRIN lens improves detecting both the propagation of planar waves and point sources in pipelines. This research was supported by the National Science Foundation under Award No. CMMI 1914663/1914583. The support from the sponsoring organization is gratefully acknowledged.

Figure 1. The proposed pipe design with GRIN lens to enhance the guided wave ultrasonics and acoustic emission; the simulation of wave propagation in plain pipe and the pipe with GRIN lens using COMSOL Multiphysics software.

Figure 2. Attenuation curves along the centerline of the GRIN lens for both plain pipe and pipe with GRIN lens cases at 30 kHz.
NSF Funding yields wireless game changer for long term bridge monitoring

Mehdi Kalantari Khandani1 and Maria-Francesca Steyn1
1Resensys LLC

With support from the National Science Foundation (NSF), Resensys LLC has changed the game in long term wireless monitoring by coupling 10yr battery life with high rate precision measurement. For customers, this means that precise fatigue analysis (such as rainflow counting), and accurate accounting of all loading cycles for that purpose can now be achieved ... while enjoying the economic benefits of wireless technology.

As stated by Dr. Colin Caprani of Monash University during a recent project that uses the technology in Australia, “(SenSpot) monitoring instruments were required to be able to take strain at high enough sampling rate, so they could precisely and accurately measure strain on various structural members of the bridges as the loads were transported. At the same time, after the transportation of the super-load had completed, we needed to leave the monitoring systems on the bridges for long term monitoring, to continue to watch for emergent damage. Resensys sensors successfully met both requirements. They are capable of monitoring structures and characterizing the responses of the bridge live load, yet they are low-maintenance and operate for several years without the need for battery replacement. This is a key commercial advantage”

The novelty of the SenSpot technology advances is the combination of ultra-low power sensing and wireless communication with long term monitoring of strain at high sampling rates of up to 50-100 samples per second. By using only a ½-AA battery, the device has 10 years of battery life.

To customers, a long battery life is highly desirable, particularly in the context of bridge monitoring application, where battery replacement requires safe access to the location of a sensor. By reducing the need to access the sensors for battery replacement, calibration and other maintenance, expensive lane closure and access equipment is also reduced. A sensor with a long battery life enables very low maintenance while providing long term monitoring on bridge’s structural members

With NSF funding, Resensys broke new ground in the world of high-quality, low-power wireless sampling, enabling a complete new category of bridge monitoring applications which used to be cost prohibitive using conventional bridge monitoring technologies as they relied on wired sensors or wireless technologies with short battery life.

This change in commercialization occurs because the sensors are completely wireless, so they are easy and quick to install. Given the massive size and access limitations, installation of wiring systems on highway bridges is often expensive and labor intensive. Once the economic equation is altered, new possibilities occur as the capability to monitor strain at high measurement rates for several years enables complete understanding of the structures, the number of loading cycles, overstrain instances and rate of accumulation of fatigue. Such information is useful for two purposes. First, knowing the statistics and magnitude of loading cycles per month or per year provides a good insight to calculate the rate of fatigue and find the remaining useful life of a structural member. Secondly, when a structural member gets closer to the end of its fatigue life, the strain monitoring could provide important early alerts of fatigue damage, helping timely repair and asset management decisions before the issue becomes major or costly, or even compromises the safety the public.

Figure 1 shows a sample graph from a wireless SenSpots sensor. The reported data had been installed on a load bearing steel element of a major interstate highway bridge. As can be seen in the graph in the bottom row of the table, the one-hour data shows the high rate of strain samples. As an important breakthrough of SenSpot sensor technology, the average energy expenditure per measured sample is so low, so the device takes high quality samples by spending very little energy. Figure 2 shows further granularity into this same data provided in Figure 1.

Inspecting the graph in Figure 2 shows a number of spike-like patterns in the strain graph. Each of the spikes represents one loading cycle caused by a passing truck. To illustrate this observation, a one-minute zoomed-in sample of data at around time 15:34 is further shown. As can be seen in the lower graph, passing of a truck at 15:34:42 caused more than 60 microstrain on strain increase. In addition, a few seconds later, two other trucks passed at 15:34:53, and 15:34:58, producing 35 and 54 microstrain, respectively. Long term fatigue analysis on a bridge structural member is done by accurately detecting and counting such loading cycles. While the graph in Figure 1 is only a 1-hour sample, SenSpot sensors are capable of sustaining this level of information over long periods of time.

Continued on next page
While the NSF funded advances were primarily developed to make long-term strain monitoring for fatigue analysis more affordable; the data provided can be used for bridge load rating, and may allow changes in that application as well. In load rating applications, the peak strain values reported by the maximum legal loads on the bridge provide the needed information. Due to high sampling rate, wireless SenSpot can accurately detect and characterize peak strain caused by such loads. Using statistical distribution of peak strain values caused by such loads over a few days, an accurate indication of strain caused by the heaviest legal loads in critical load bearing members is obtained. Bridge engineers can use such information to conduct precise analysis, model calibration, and load rating. The advantage of load rating using this scheme is that with continuous and ongoing data from the bridge, the actual safe load bearing capacity can be revised immediately if a structural change in the bridge happens and the load rating process will be much more adaptive and responsive to the condition of the structure.

While SenSpot is primarily developed for strain monitoring, variations of the technology have also been applied to monitoring other quantities of interest. Modified variations of the sensor are capable of monitoring tilt/inclination, displacement, acceleration (vibration), temperature, and humidity. The sensors can be used to monitor movement of bearings and expansion joint, cracks, tilting and inclination of piers, as well as monitoring of vibration, and general environmental conditions of a bridge.

The applications and benefits of bridge monitoring are well-known, but the development of wireless, ultra low-power, high-rate quality sampling offers exciting opportunities for owners to understand and manage their assets in ways that were not previously commercially feasible.

Communication from CSHM-8 Organizers

Dear Colleague,

We hope that you, your family, and research team are healthy and safe, and that you are gaining back your previous lives after these challenging time dominated by the pandemic.

In consideration of the current trend of the COVID-19 outbreak and of the forced stop of travels and research activities due to the lockdown in many Countries, the 8th Workshop on Civil Structural Health Monitoring (CSHM-8) has been postponed to March 31st – April 2nd, 2021.

If you have abstract accepted, it will be automatically transferred to the 2021 event. If you have already submitted a paper, the review process will start soon and you will be notified about the results of peer review in the next weeks.

If you have already applied for early registration or sponsorship, you have to confirm your application by sending an email to cshm8@unimol.it in order to start the payment process.

If you are interested in submitting additional abstracts or in applying for sponsorship, there is still time to do it.

All key dates are published on the Workshop website at the following address: http://cshm8.unimol.it/key-dates/

For abstract and paper submission, please visit: http://cshm8.unimol.it/submission/

For sponsorship opportunities, please visit: http://cshm8.unimol.it/sponsors/

For any inquiry, please do not hesitate at contacting us at cshm8@unimol.it Best wishes for you all. We look forward to seeing you in Naples next year.

The CSHM-8 Organizing Committee
**Workshop fees**

**Full registration**: 550,00 € (early registration) – 600,00 € (late registration) VAT included  
**Student registration**: 400,00 € (early registration) – 450,00 € (late registration) VAT included  
**Accompanying person**: 100,00 € VAT included

Fees include attendance to the Workshop sessions, lunches, coffee breaks, workshop dinner, social events, proceedings, one-year ISHMII membership.

**Social program**

Naples is a vibrant city, renowned throughout the world for its art, architecture, culture and food. A rich social program is going to be announced soon.

**Local Organizing Committee**:
- Dr. Carlo Rainieri (Chair, University of Molise)  
- Prof. Giovanni Fabbrocino (Co-chair, University of Molise)  
- Prof. Filippo Santucci de Magistris (University of Molise)  
- Prof. Francesca Ceroni (Parthenope University)  
- Prof. Nicola Caterino (Parthenope University)  
- Dr. Matilde Antonella Notarangelo (S2X s.r.l.)  
- Dr. Danilo Gargaro (S2X s.r.l.)

For any inquiry about the Workshop, including sponsorship and exhibition, please send an email to:  
[cshm8@unimol.it](mailto:cshm8@unimol.it)
The CSHM-8 Workshop

“Aging structures and infrastructures in hazardous environment” is the main theme of the workshop. Theoretical as well as applicative contributions focused on SHM of existing and/or historical structures and infrastructures exposed to natural or man-made hazards are welcome. Within the main theme of the Workshop, papers referring to the following relevant topics are strongly encouraged:

1. Innovative sensing solutions for SHM
2. Data-driven damage detection techniques
3. Nonlinear systems and analysis techniques
4. Influence of environmental and operational conditions
5. SHM in earthquake prone regions
6. Real world applications

Technical program

The technical program includes five structured sessions, three keynote lectures from outstanding experts in the field, and special sessions on expert knowledge in SHM from around the world.

Key dates

Abstract submission: October 31st, 2020 (extended)
Notification of abstract acceptance: November 15th, 2020
Paper submission: December 8th, 2020
Paper acceptance: December 30th, 2020
Early registration: December 18th, 2020
One registration per paper is required.
The Proceedings will be published on Lecture Notes in Civil Engineering (Springer) and indexed in Scopus and WoS.

Venue

The Workshop will take place in the city center of Naples, at Pacanowski Palace, overlooking the entire Gulf of Naples with Castel dell’Ovo and the new “freed” waterfront.
FEATURE ARTICLE

INDUSTRY PARTNERSHIP COMMITTEE

**Mission**
Create a strong partnership among industry researchers, industry managers, universities and the public and leverage their respective advantages in structural monitoring field, to quickly advance the industrial development of SHM technologies as a whole.

**Vision**
To advance the development of SHM for infrastructure protection in the most effective way and by educating the public and the governments about the importance of this field.

**Preamble**
At present, structural health monitoring is at a key development stage. On one hand, theoretical research is fast moving forward; on the other hand, there is a huge urgent demand in the industry. However, we cannot fill the gap between theoretical research and practical application. University researchers are focused heavily on theoretical work and do not pay enough attention to the importance of engaging the asset managers and the public.

With the rapid technological development in cloud, big data, IoT and mobile applications, we are at a very critical turning point. Multiple disciplines are deeply and closely integrated and will make greater contributions if these new areas and tools are well integrated.

The researchers should aim to pinpoint and solve the problems facing the infrastructure safety and what the asset managers and owners are faced with. This approach will even have a positive impact on the theoretical research and will open new doors for exploring more effective ways for infrastructure protection in partnership with industry. Our committee will endeavor to explore and identify more needs or demands from the industry, and apply relevant technologies in industrial projects.

**Deliverables**
1. Explore and identify the latest research results in structural monitoring;
2. Explore the needs of SHM for industry management and asset managers;
3. Develop a deep insight about how to transform latest technology into applications;
4. Identify key connections and synergy among industry, universities and research institutes to effectively apply technologies in industrial practice.

**Executive Committee Members:**
Chair: Wilson Hong (Weixing) - wilson7199@qq.com
Vice-Chair: Mohammed Noori - mnoori@outlook.com
Vice-Chair: Wensong Zhou – zhouwensong@hit.edu.cn

For more information on any of the ISHMII Committees or to become involved, please contact the committee Chairs:

ISHMII Committee on Early Career Researchers
Ting-Hua Yu - yth@dlut.edu.cn

ISHMII Committee on Data-Enhanced Infrastructure Engineering
Aftab Mufti – Aftab.mufti@umanitoba.ca

ISHMII Committee on Standardization
Zhishen Wu - zhishen.wu.prof@vc.ibaraki.ac.jp

ISHMII Committee on Resilient Structures and Infrastructure (CORSI)
Gian Paolo Cimellaro - gianpaolo.cimellaro@polito.it

ISHMII Committee for Industry Partnership
Wilson Hong - wilson7199@qq.com

ISHMII Committee on CSHM in the Middle East, Gulf and African Regions
Mohamed Zaki - MZaki@iasonline.org

ISHMII Committee on Next Generation Technology Development in Infrastructure Monitoring
Hamid Ebrahimian – hebrahimian@unr.edu

In this issue of The Monitor, we offer our first profile of two of our new ISHMII Committees, the ISHMII Committee on Data-Enhanced Infrastructure Engineering and Early Career Researchers.

Five new committees, first profiled at SHMI-10 in St. Louis last summer, are intended to advance scholarship, promote research, and enhance ISHMII’s influence globally in the realm of structural health monitoring. The five new committees are:

- ISHMII Committee on Early Career Researchers
- ISHMII Committee on Data-Enhanced Infrastructure Engineering
- ISHMII Committee on Standardization
- ISHMII Committee on Resilient Structures and Infrastructure (CORSI)
- ISHMII Committee for Industry Partnership
- ISHMII Committee on CSHM in the Middle East, Gulf and African Regions
- ISHMII Committee on Next Generation Technology Development in Infrastructure Monitoring

The Monitor
Summer 2020
Committee on Standardization

Background and significance

- Governments and professional groups related to civil engineering write and publish standards and codes to protect the safety of critical infrastructure and surrounding populations.
- The standards and codes are developed to bridge the gap between research and practices.

Goals and Tasks

1. Develop international model codes (ISHMII code series) for SHM of infrastructure;
2. Establish the architecture of intelligent infrastructure;
3. Maintain the state-of-the-art and the state-of-practice knowledge database on SHM and intelligent infrastructure;
4. The exchange of information and harmonization on SHM documentations, specifications, and guidelines from different countries and regions.

Strategies

ISHMII SHM Code Level I

General Principles, Definitions and Approaches

Remarks:

The guide should be sufficiently broad and also accessible (i.e. intelligible) to a range of stakeholders in SHM from the structure operator to the academic expert.

Schedule

2015
Step 1: Preparation
✓ Survey and state-of-art report on SHM standardization activities

2016-2019
Step 2: Development of ISHMII SHM Code Level 1
✓ Have finished the draft and under discussion
☑ Will be submitted to council for comments by Oct 2019
☑ Will be submitted officially for council approval by Dec 2019
☑ Publication

Step 3: Development of ISHMII SHM Code Level 2
☑ Form the team (leaders and members)

Step 4: Development of ISHMII SHM Code Level 3
☑ Schedule will be confirmed later

Remarks:

- Bridge Structures
- Geotechnical Engineering
- Fiber Optic Sensors based SHM
- ...

ISHMII SHM Code Level III

Guidelines for Different Major Structures or Major Sensing Technologies

ISHMII SHM Code Level III

Recommended SHM Guidelines/Standards of Different Countries or Regions

References: call for more codes

Several existing SHM Codes:

- Structural Health Monitoring in Australia (Australia · 2011)
- Guidelines for Structural Health Monitoring (Canada · 2001)
- Design Standard for Structural Health Monitoring Systems (China · 2012)
- SMACO final report 2006 (Europe Union · 2006)
- Fundamentals of the Conservation of Structures (Switzerland · 2011)
- Structural Health Monitoring of Civil Infrastructure (UK · 2006)
- Long-term Bridge Performance (LTBP) Program Protocols (USA · 2016)

Executive Committee Members:

Chair: Z.S. Wu (Japan & China)
Co-chairs: J. Brownjohn (UK) & Y.Q. Ni (Hong Kong, China)

Key members:

- F. Ansari (USA)
- P. Furtner (Austria)
- B. Glisic (USA)
- W. Habel (Germany)
- H. Huang (Japan)
- J.T. Kim (South Korea)
- Y. Lei (China)
- H. Li (China)
- H.N. Li (China)
- M.P. Limongelli (Italy)
- Y. Lu (UK)
- A. Mufti (Canada)
- J. Newhook (Canada)
- B. Shi (China)
- D. Thomson (Canada)
- H. Wenzel (Australia)
- L. Yin (China)
- J. Zhang (China)
- Y.F. Zhang (China)

Co-operating countries and regions (expected):

- Austria, Canada, China (Mainland, Hong Kong), Germany, Japan, South Korea, USA
As a follow up to a plan proposed by Professor Wu, and approved by the Council, in order to broaden the scope of the scholarly publications by ISHMII, and to increase the global visibility and leadership of our professional society, we have made a special arrangement with CRC/Taylor and Francis, to publish a series of books on emerging and relevant topics. These books will be published as part of a series of technical books on various ISHMII related themes.

To initiate this new effort, we encourage the Council members and, especially ISHMII Committee chairs, colleagues working on various technical reports, and all ISHMII members to volunteer and take the leadership for organizing a book with a theme related to various aspects of SHM, such as Application of Data Analytics in SHM, Resilience and Reliability of Intelligent Infrastructure, etc. These colleagues, leaders, would prepare a call for contributed chapters from ISHMII members and/or others within the SHM research community.

Anyone who agrees to contribute to these special book volumes will then be expected to submit a short abstract, and an outline, for an invited/contributed chapter that would consist of approximately 20 pages which summarizes their ongoing research, a review, or other technical contents. These collected chapters (15-20) will be published in form of a Special Volume/Book by CRC.

A typical Call for Book Chapters can be as follows:

**Dear Colleagues:**

We are pleased to announce that we have organized a Special Volume to be published by CRC Press/Taylor & Francis Publisher, entitled: [Title of the proposed Book]

Following is the list of Editors: [Include 1-3 names as the Editors]

On behalf of all Editors, we would like to invite you to contribute a chapter to this Special Volume. Please note:

- Proposal Submission Deadline:
- Notification of Acceptance:
- Full Chapter Submission:
- Peer Review Results Returned:
- Final Chapter Submission Due to Editors:
- Target Book Release:

Should you accept this invitation, we appreciate it if you can submit a one (1) page chapter proposal including a brief outline that explains how the proposal fits the scope and the goal of the book described broadly in the Title. Please direct any inquiries to [Organizer of the ISHMII volume].

We encourage all Council members and ISHMII members to take this initiative seriously. As mentioned, this will enhance the visibility of ISHMII, and it is a great opportunity to share your scholarly work through a high quality technical book published by a highly respected technical publisher, CRC/Taylor & Francis, and it is a valuable scholarly endeavor that is recognized by the scholarly community.

If you have any questions in this regard and would like to find out more details on how to initiate your proposed book volume please contact Professor Mohammad Noori at [mnoori@outlook.com](mailto:mnoori@outlook.com) who will be assisting ISHMII council with this new initiative.
ASCE/EMI awards Frangopol 2020 Alfred M. Freudenthal Medal

Life-cycle engineering pioneer recognized with lifetime achievement award

Dan M. Frangopol, the inaugural Fazlur R. Khan Endowed Chair of Structural Engineering and Architecture at Lehigh University, is the recipient of the 2020 Alfred M. Freudenthal Medal awarded by the Engineering Mechanics Institute (EMI) of the American Society of Civil Engineers (ASCE).

Frangopol, who is a Distinguished Member of ASCE, a past Vice President of EMI, and an Inaugural Fellow of EMI, has been recognized for his “outstanding contributions to the advancement of probabilistic, reliability and risk methods in civil engineering, particularly in developing probabilistic models for life-cycle performance assessment, maintenance and optimum management of civil infrastructure systems in diverse loading environments.”

According to ASCE, which represents more than 150,000 members of the civil engineering profession in 177 countries, this prestigious medal is awarded every two years to “an individual in recognition of distinguished achievement in safety and reliability studies applicable to any branch of civil engineering.”

ASCE established the award in 1975 to honor Freudenthal, who is recognized as the “father” of structural reliability.

Frangopol is regarded as a worldwide authority on structural reliability, optimization, and life-cycle engineering. Throughout his distinguished career of research, education, and service, he has received a number of awards from ASCE, including the 2020 Raymond C. Reese Research Prize, the 2019 George W. Housner Structural Control and Monitoring Medal, the 2019, 2004, and 1998 State-of-the-Art of Civil Engineering Awards, the 2016 Outstanding Projects and Leaders Awards (OPAL) Lifetime Achievement Award in Education, the 2016 Alfredo Ang Award on Risk Analysis and Management of Civil Infrastructure, the 2015 Alfred Noble Prize, the 2014 and 2001 J. James R. Cross Medals, the 2012 Arthur M. Wellington Prize, the 2007 Ernest E. Howard Award, the 2005 Nathan M. Newmark Medal, and the 2003 Moisseiff Award.

ASCE honors Frangopol, Liu with 2020 Reese Research Prize

CEE professor, former postdoc recognized for achievements in structural engineering research

Dan M. Frangopol, the inaugural Fazlur R. Khan Endowed Chair of Structural Engineering and Architecture at Lehigh University, and his former postdoc Yan Liu, Associate Professor, School of Naval Architecture and Ocean Engineering, Wuhan, Hubei, China, are the recipients of the 2020 Raymond C. Reese Research Prize awarded by the American Society of Civil Engineers (ASCE).

According to ASCE, which represents more than 150,000 members of the civil engineering profession in 177 countries, this prestigious prize is:

“awarded to the author or authors of a paper in a print issue of an ASCE journal in the twelve-month period ending with June of the year preceding the year of the award that describes a notable achievement in research related to structural engineering and which indicates how the research can be used. The paper should include the results of research (experimental and/or analytical) and, in particular, should indicate and recommend how the research can be applied to design; it is this latter feature that is considered to be most important.”

ASCE established the award in 1970 to recognize outstanding contributions to the application of structural engineering research. In this context, the 2020 Raymond C. Reese Research Prize was awarded to recognize the outstanding achievement in research related to structural engineering and, in particular, the novelty of the proposed design approach using utility theory to consider the attitude and preference of the decision maker toward the inspection outcome and its application to design of an integrated decision-making framework for optimum inspection planning of fatigue sensitive structures, such as highway bridges and naval ships. The results of this outstanding research were shared with the academic and professional community through the article “Utility and Information Analysis for Optimum Inspection of Fatigue-Sensitive Structures,” that appeared in the ASCE Journal of Structural Engineering, Volume 145, Number 2 (February), 2019.

This is the 11th award-winning journal paper of Frangopol and his current and former PhD students and postdocs, including nine from ASCE (Alfred Noble Prize (2015), Cross Medal (2001 & 2014), Moisseiff Award (2003), Reese Research Prize (2020), State-of-the-Art of Civil Engineering Award (1998, 2004 & 2019), and Wellington Prize (2012), one from IABSE (Outstanding Paper Award (2007), and one from Elsevier (Munro Prize (2006)).

Frangopol elected to National Academy of Construction

Dan M. Frangopol, the inaugural Fazlur R. Khan Endowed Chair of Structural Engineering and Architecture at Lehigh University, has been elected to the National Academy of Construction (NAC).

NAC members are selected through a rigorous peer nomination and election process and come from all sectors of the built environment — owners, contractors, designers, government agencies, professional service firms, and academia.

The mission of NAC “is to select, honor, and recognize those individuals who have made extraordinary contributions to our industry,” as stated by Tom Sorley, the president of the Academy. NAC currently has 326 distinguished leaders from every segment of the engineering and construction industry. Members apply their corporate experience and talent toward enhancing the strength of our industry and well-being of our nation.

“It is an extremely high honor for me to join the 2020 class of 36 new members elected to NAC and represent Lehigh University,” says Frangopol.

This becomes Frangopol’s fifth academy membership: three foreign national academies (Royal Academy of Belgium for Science and the Arts, Romanian Academy, and Academy of Technical Sciences of Romania) and one European (Academy of Europe).

Frangopol is regarded as a worldwide authority on life-cycle engineering, structural reliability, and optimization. His main research interests are in the development and application of probabilistic concepts and methods to civil and marine engineering including life-cycle cost analysis; structural reliability; probability-based assessment, design, and multi-criteria life-cycle optimization of structures and infrastructure systems; structural health monitoring; life-cycle performance maintenance and management of structures and distributed infrastructure under extreme events (earthquakes, tsunamis, hurricanes, and floods); risk-based assessment and decision making; multi-hazard risk mitigation; infrastructure sustainability and resilience to disasters; and climate change adaptation.

Throughout his distinguished career of research, education, and service, Frangopol has received many honors including 4 honorary doctorates, 14 honorary professorships, medals, prizes and awards from the American Society of Civil Engineers (ASCE) including Distinguished Membership, International Association for Structural Safety and Reliability (IASSAR), International Association for Bridge Engineering (IABSE), International Society of Automotive Engineers (SAE International), International Association for Life-Cycle Civil Engineering (IACCE), International Association for Bridge Maintenance and Safety (IABMAS) and other professional organizations.

Frangopol is the Founder and Editor-in-Chief of Structure and Infrastructure Engineering an international peer-reviewed journal launched in 2005 and the Founding Editor of the Book Series Structures and Infrastructures. He is the author or co-author of 3 books, 50 book chapters, and over 400 articles in archival journals (including 11 award-winning papers from ASCE, IABSE, and Elsevier).

Frangopol will be formally inducted as a member at NAC’s next annual meeting to be held in Boston, Massachusetts, October 29-31, 2020.

Read more about Frangopol’s research and achievements here.
REQUEST FOR CONTRIBUTIONS TO THE MONITOR
The Official Newsletter of the International Society of Structural Health Monitoring of Intelligent Infrastructure

We invite contributions in one of the following forms:

- **SHM research and applications report**: Article containing 600-800 words, and 2-4 figures and/or tables with captions
- **SHM research or application short note**: Article containing 250-500 words, and 1-2 figures and/or tables with captions (text longer than 500 words will become report)
- **New SHM product or service**: Article describing in 150-250 and 2-3 figures a new product and/or service that appeared in SHM market
- **New SHM-related book**: Article describing a new book on SHM in 250-500 words; this article can be written either by the author or by a reader
- **Updates related to SHM** that might be of interest to ISHMII members, such as (but not limited to): short news (e.g., from newspapers), events (e.g., conferences, workshops, etc.), articles or books in SHM that attract particular attention (e.g., the best papers in journals or conferences, the most downloaded papers, etc.).
- **Information on any award won by ISHMII members**.

Articles submitted to Monitor should not mimic the JCSHM – Journal for Civil Structural Health Monitoring or other scholarly journals papers but should describe practical field applications of SHM used in bridges, buildings and other infrastructure.

**Guidelines:**

Guidelines for submission can be found on the ISHMII website at the following link: https://ishmii.org/wp-content/uploads/2019/05/Monitor-Guidelines.pdf

**Deadlines:**

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<td>Winter 2020 (Dec, Jan, Feb)</td>
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**Submission:**

When you have your content ready for submission according to the guidelines, send all files, attached in an email to central@ishmii.org. In the subject line please indicate: ISHMII Monitor Article Submission.

**Inquiries:**

Can be submitted to Charleen Choboter at Charleen.choboter@umanitoba.ca
Executive Committee

**President**
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