12th International Workshop on Structural Health Monitoring

IWSHM 2019

"Enabling Intelligent Life-cycle Health Management for Industry Internet of Things (IIOT)"

September 10 – 12, 2019
Stanford University

www.iwshm.org

Table of Contents

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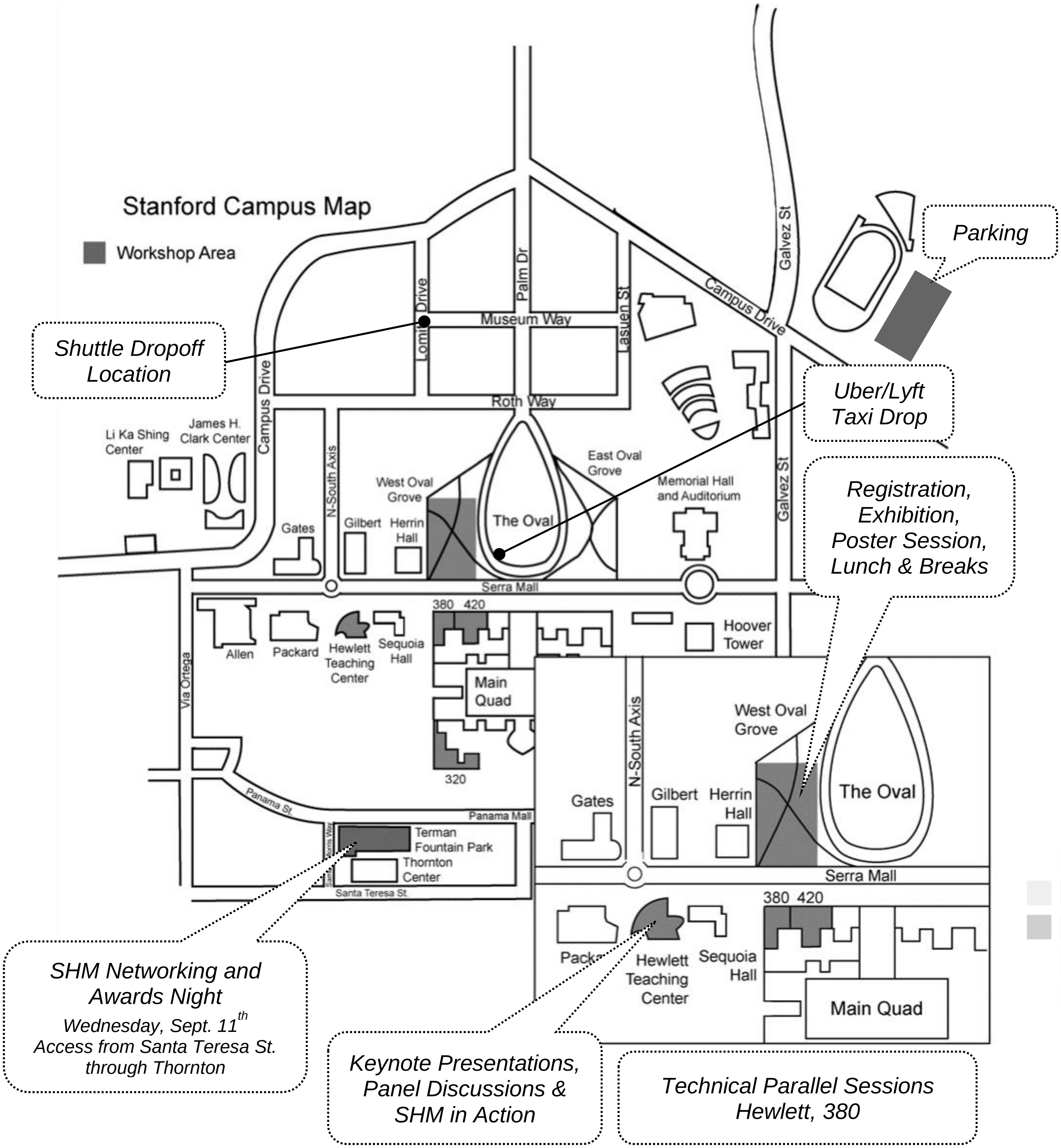
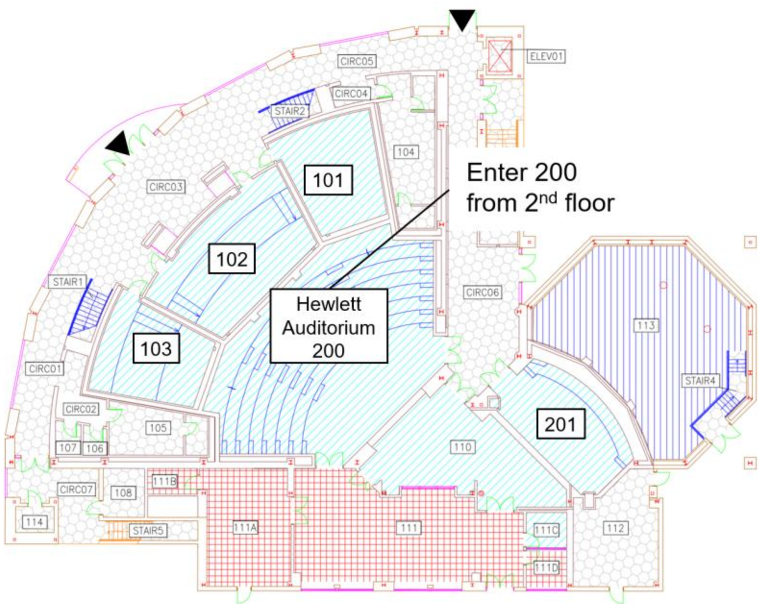
Stanford Campus Map

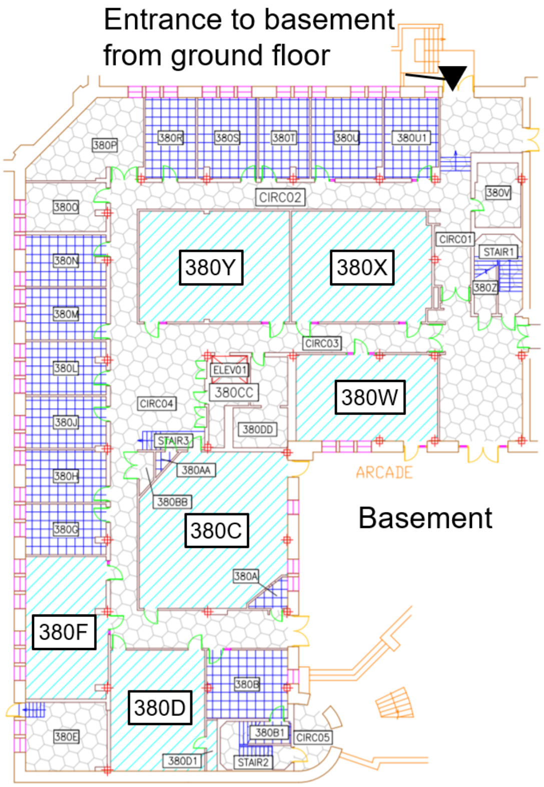


Building Floorplans

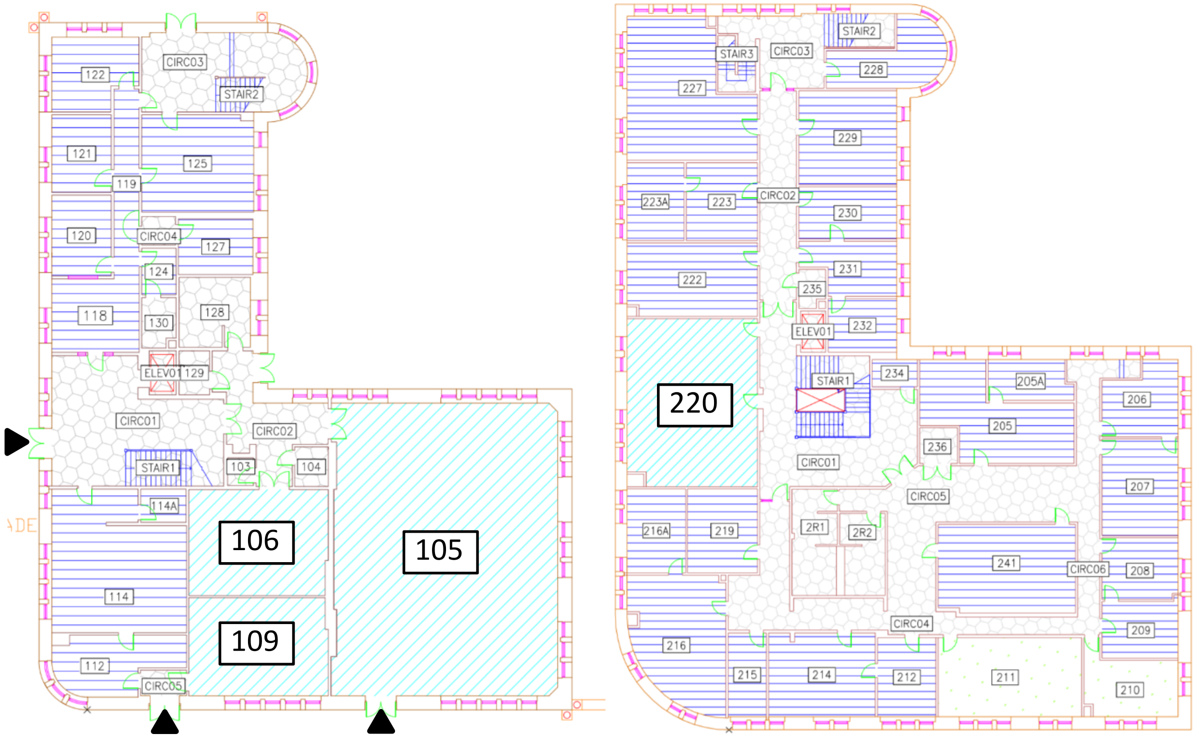
Hewlett Teaching Center 1st & 2nd Floor



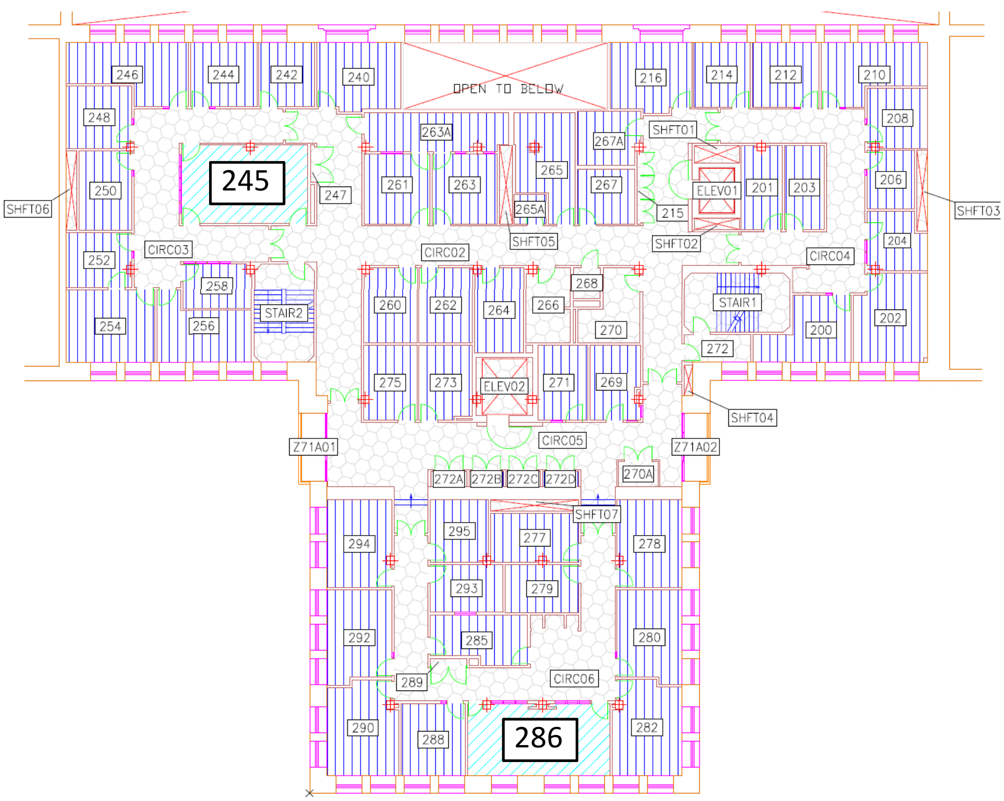
Building 380



Building 320 – 1st & 2nd Floor



Building 420 – 2nd Floor



Program At-A-Glance – Day 1

The 12th International Workshop on Structural Health Monitoring - Stanford University - 2019

TECHNICAL PROGRAM

Overview

Monday, September 9

15:00 ~ 17:00	**Early Registration**	Location: Stanford Alumni Center
17:00 ~ 19:00	**Reception**	Location: Stanford Alumni Center

Tuesday, September 10

	Hewlett 201	380-380C	Hewlett 103	Hewlett 200	380-380F	380-380W	380-380D	380--380Y	Hewlett 101	380-380X	Hewlett 102
07:00 ~ 08:20	**Registration**			Light Continental Breakfast					Location: The Oval		
08:20~ 08:30	**Opening Remarks**			Speaker: F.-K. Chang			Chair: F.-K. Chang Co-chair: A. Guemes		Location: Hewlett Auditorium (200)		
08:30 ~ 10:10	**Keynote Presentations** **Chair: Dennis Roach**	08:30 ~ 09:00	Speaker: David Piotrowski, Principal Engineer, Enabling Technologies Group, Delta Air Lines						Location: Hewlett Auditorium (200)		
		09:00 ~ 09:30	Speaker: Michael Gorelik, Chief Scientist for Fatigue and Damage Tolerance, Federal Aviation Administration								
		09:30 ~ 10:10	Speaker: William Meeker, Professor of Statistics and Distinguished Professor of Liberal Arts and Sciences, Iowa State University								
10:10 ~ 10:30	**Coffee Break / Exhibition**								Location: The Oval		
10:30 ~ 12:10	FAA Reliability workshop **Paul Swindell & Holger Speckmann**	Civil Structures I **Claus Peter Fritzen**	Diagnostics I **Antonios Kontsos & Joe Lehtola**	SPECIAL SESSION: Guided Waves in Structures for SHM I **Wieslaw Ostachowicz & Patrice Masson**	SPECIAL SESSION: Vision-based Studies for SHM I **Mohammad Jahanshahi & Werner Lienhart**	SPECIAL SESSION: Acoustic Emission and Hybrid SHM I **Victor Giurgiutiu & Emilio Di Lorenzo**	SPECIAL SESSION: Integration of Physical Modeling Monitoring and Machine Learning for SHM I **Eloi Figueiredo & Ionut Moldovan**	SPECIAL SESSION: Recent Advances on Data Processing Techniques for Ultrasonics-based SHM I **Salvatore Salamone**	SPECIAL SESSION: Human Performance Monitoring I **Kenneth Loh & Toshihide Kashima**	SPECIAL SESSION: Use of Optical MEMS/NEMS and CNT Sensors for Structural Health Monitoring Systems **Jayantha Epaarachchi**	
12:10 ~ 13:40	**Lunch at the Oval / Exhibition**								Location: The Oval		
12:10 ~ 13:40	**Poster Sessions: Q & A**								Location: The Oval		
13:40 ~ 15:00	SPECIAL SESSION: Sensing Technologies for Evaluation and Characterization of Concrete Materials I **Ying Zhang & Jinying Zhu**	Sensors and Actuators I **Pete Carini & Wen Shen**	SPECIAL SESSION: Distributed and Quasi-distributed Fiber-optic and Electrical Sensors and Associated Data Analysis and Management I **Branko Glisic & Daniele Zonta**	SPECIAL SESSION: Guided Waves in Structures for SHM II **Wieslaw Ostachowicz & Marcus Perry**	SPECIAL SESSION: Vision-based Studies for SHM II **Mohammad Jahanshahi & Slim Soua**	SPECIAL SESSION: Acoustic Emission and Hybrid SHM II **Victor Giurgiutiu & Debbie Senesky**	SPECIAL SESSION: Integration of Physical Modeling Monitoring and Machine Learning for SHM II **Eloi Figueiredo & Ionut Moldovan**	SPECIAL SESSION: Recent Advances on Data Processing Techniques for Ultrasonics-based SHM II **Salvatore Salamone & Gail Hickman**	SPECIAL SESSION: Human Performance Monitoring II **Kenneth Loh & Paul Thorley**	SPECIAL SESSION: The Impact of Engineering Informatics: The Law Legacy in the Field of Structural Health Monitoring I **Hoon Sohn & Anne Kiremidjian**	Environmental and Operational Effects **Dryver Huston & Zhu Mao**
15:00 ~ 15:20	**Coffee Break / Exhibition**								Location: The Oval		
15:20 ~ 16:40	SPECIAL SESSION: Sensing Technologies for Evaluation and Characterization of Concrete Materials II **Ying Zhang & Jinying Zhu**	Sensors and Actuators II **Prakash Patnaik & Gian Paolo Cimellaro**	SPECIAL SESSION: Distributed and Quasi-distributed Fiber-optic and Electrical Sensors and Associated Data Analysis and Management II **Branko Glisic & Daniele Zonta**	SPECIAL SESSION: Guided Waves in Structures for SHM III **Wieslaw Ostachowicz & Ying Wang**	System Identification and Structural Dynamics **William Meeker & Nathan Wells**	SPECIAL SESSION: Human-Machine Interfaces for Structural Inspection **Fernando Moreu & Marc Rebillat**	SPECIAL SESSION: Higher Level Inspection by Instrumenting Bridges Implementing SHM into the Codes **Douglas Thomson & Nazih Mechbal**	SPECIAL SESSION: Diagnostics and Prognostics of Composite Structures towards a Condition-based Maintenance Framework I **Dimitrios Zarouchas & Theodoros Loutas**	SPECIAL SESSION: Multifunctional Materials and Structures I **Ken Loh & Donghyeon Ryu & Nathan Salowitz**	SPECIAL SESSION: The Impact of Engineering Informatics: The Law Legacy in the Field of Structural Health Monitoring II **Jerome Lynch & Kay Smarsly**	SPECIAL SESSION: Digital Twin of Civil Infrastructure **Kamyab Zandi & Fernando Dotta**
20:00 ~ 23:00	**SF Bay Banquet Cruise**								Location: San Francisco		

Program At-A-Glance – Day 2

Wednesday, September 11											
	Hewlett 201	380-380C	Hewlett 103	Hewlett 200	380-380F	380-380W	380-380D	380--380Y	Hewlett 101	380-380X	Hewlett 102
07:00 ~ 08:20		**Registration**		Light Continental Breakfast					Location: The Oval		
08:20~ 08:30		**Remarks**		Speaker: A. Guemes			Chair: F.-K. Chang Co-chair: A. Guemes		Location: Hewlett Auditorium (200)		
08:30 ~ 10:00	**Keynote Presentations Chair: Matthias Buderath**	08:30 ~ 09:00	Speaker: Moshe Tur, Professor, School of Electrical Engineering, Tel-Aviv University						Location: Hewlett Auditorium (200)		
		09:00 ~ 09:30	Speaker: Michael Steep, Executive Director, Center on Disruptive Technologies and Digital Cities, Stanford University								
		09:30 ~ 10:00	Speaker: Les Lee, Program Manager, Mechanics of Multifunctional Materials and Microsystems, Air Force Office of Scientific Research								
10:00 ~ 10:20				**Coffee Break / Exhibition**					Location: The Oval		
10:20 ~ 12:00	Aerospace Structures I **J.B. Ihn & Mulugeta Haile**	Civil Structures II **Hoon Sohn**	Diagnostics II **Moshe Tur & Tadeusz Uhl**	SPECIAL SESSION: Guided Waves in Structures for SHM IV **Wieslaw Ostachowicz & Peter Kraemer**	SPECIAL SESSION: Vision-based Studies for SHM III **Mohammad Jahanshahi**	SPECIAL SESSION: Structural Health Monitoring and Condition-based Maintenance of High-speed and Intercity Railways I **Yiqing Ni & Hua-Peng Chen & Qingsong Feng**	Statistical Methods and Machine Learning I **Spilios Fassois & Rafik Hadjria**	SPECIAL SESSION: Diagnostics and Prognostics of Composite Structures towards a Condition-based Maintenance Framework Dimitrios II **Dimitrios Zarouchas & Theodoros Loutas**	SPECIAL SESSION: Nonlinear Acoustic and Ultrasonic Techniques for Structural Health Monitoring I **Tribikram Kundu & Chun Wang**	SPECIAL SESSION: Probabilistic SHM I **Daniele Zonta & Nobuyoshi Yobuki**	Prognostics and Health Management **Herbert Friedmann & Emily O'Connor**
12:00 ~ 13:30				**Lunch at the Oval / Exhibition**					Location: The Oval		
12:00 ~ 13:30				**IJSHM Board Meeting**					Location: 320-220		
13:30 ~ 15:30	Aerospace Structures II **Peter Cawley & Kishan Goel**	Civil Structures III **Erdal Safak & Elizabeth Cross**	Diagnostics III **Surajit Roy & David McCallen**	SPECIAL SESSION: Guided Waves in Structures for SHM V **Wieslaw Ostachowicz & Michael Grygier**	SPECIAL SESSION: SHM for Heavy and Critical Equipment **Keqin Ding & Grant Chang**	SPECIAL SESSION: Flexible Electronics/Sensor Network for SHM **Sameh Dardona & Nathan Salowitz**	Statistical Methods and Machine Learning II **Christian Boller & Daniel Hesser**	SPECIAL SESSION: Assessment of the Value of SHM Information I **Sebastian Thöns & Michael Todd & Maria Pina Limongelli**	Signal Processing **Fuh-Gwo Yuan & William Schneck**	Sensor Networks **Nanshu Lu**	SPECIAL SESSION: A state-wide focus on SHM **Tal Yehoshua**
15:30 ~ 15:50				**Coffee Break / Exhibition**					Location: The Oval		
15:50 ~ 18:20				**SHM in Action**			Chair: Christian Boller Co-chair: Branko Glisic		Location: Hewlett Auditorium (200)		
19:00 ~ 22:00				**SHM Networking and Award Night (BBQ)**					Location: Terman Site, Stanford		

Program At-A-Glance – Day 3

Thursday, September 12

	Hewlett 201	380-380C	Hewlett 103	Hewlett 200	380-380F	380-380W	380-380D	380--380Y	Hewlett 101	380-380X	Hewlett 102
07:00 ~ 08:20	**Registration**		Light Continental Breakfast						Location: The Oval		
08:20~ 08:30	**Remarks**			Speaker: A. Guemes			Chair: F.-K. Chang Co-chair: A. Guemes		Location: Hewlett Auditorium (200)		
08:30 ~ 10:00	**Keynote Presentations Chair: Holger Speckmann**	08:30 ~ 09:00	Speaker: Baidar Bakht, Adjunct Professor, University of Manitoba, Canada						Location: Hewlett Auditorium (200)		
		09:00 ~ 09:30	Speaker: Sebastian Thöns, Associate Professor, Technical University of Denmark								
		09:30 ~ 10:00	Speaker: Leonard Bond, Director, Iowa NDE Center								
10:00 ~ 10:20	**Coffee Break / Exhibition**								Location: The Oval		
10:30 ~ 12:00	**Panel Discussion - AI for PHM & SHM** Abhinav Saxena (GE, United States), Kai Goebel (PARC, United States), Neil Eklund (Analatom Inc., Austria), Mohak Shah (LG, South Korean), Andy Hess (PHM Society and The Hess PHM Group, United States)						Moderator: Andy Hess		Location: Hewlett 201		
10:30 ~ 12:00	**DOT SHM Panel Discussion - Barriers in Implementation of Sensor Technologies in Highway Industry** Franklin Moon (Rutgers, The State University of New Jersey), Marybeth Miceli (Miceli Infrastructure Consulting), Helmut Wenzel (Wenzel Consulting Engineers GmbH), Duncan Paterson (HDR Inc.), Hoda Azari (Federal Highway Administration)						Moderator: Hoda Azari		Location: Hewlett Auditorium (200)		
12:00 ~ 13:30	**Faculty / Student Panel**						Moderator: Charles Farrar		Location: Hewlett 201		
12:00 ~ 13:30	**Lunch at the Oval / Exhibition**								Location: The Oval		
13:30 ~ 15:30	Aerospace Structures III **Joshua Cummins & Amrita Kumar**	Civil Structures IV **Piervincenzo Rizzo & Zheng Fan**	SPECIAL SESSION: Dynamic Data Driven Applications Systems **Erik Blasch & Fotis Kopsaftopoulos**	SPECIAL SESSION: Guided Waves in Structures for SHM VI **Wieslaw Ostachowicz & Michele Meo**	SPECIAL SESSION: Vision-based Studies for SHM IV **Mohammad Jahanshahi & Emmanuel Ramasso**	SPECIAL SESSION: Structural Health Monitoring and Condition-based Maintenance of High-speed and Intercity Railways II **Yiqing Ni & Hua-Peng Chen & Qingsong Feng**	Statistical Methods and Machine Learning III **Ya Wang**	SPECIAL SESSION: Assessment of the Value of SHM Information II **Sebastian Thöns & Michael Todd & Maria Pina Limongelli**	SPECIAL SESSION: SHM Technology in Wind Turbines **Wieslaw Ostachowicz & Nikolaos Dervilis**	Reliability, Verification and Validation **Fabio Casciato & Tyler Tallman**	SPECIAL SESSION: Seismic Structural Health Monitoring for Civil Structures I **Maria Limongelli & Mehmet Celebi**
15:30 ~ 15:50	**Coffee Break / Exhibition**								Location: The Oval		
15:50 ~ 17:30		Civil Structures V **Monica Kohler**	Diagnostics IV **Kay Smarsly**	SPECIAL SESSION: Guided Waves in Structures for SHM VII **Wieslaw Ostachowicz & Wingkong Chiu**	SPECIAL SESSION: Vision-based Studies for SHM V **Mohammad Jahanshahi & Tom Druet**	SPECIAL SESSION: Structural Health Monitoring and Condition-based Maintenance of High-speed and Intercity Railways III **Yiqing Ni & Hua-Peng Chen & Qingsong Feng**	SPECIAL SESSION: Nonlinear Acoustic and Ultrasonic Techniques for Structural Health Monitoring II **Tribikram Kundu & Jingyu Huang**	Modelling, Simulation, and Digital Twins **Li Cheng & Elizabeth Gregory**	SPECIAL SESSION: Multifunctional Materials and Structures II **Ken Loh & Donghyeon Ryu & Nathan Salowitz**	SPECIAL SESSION: Probabilistic SHM II **Daniele Zonta & Dimitri Goutaudier**	SPECIAL SESSION: Seismic Structural Health Monitoring for Civil Structures II **Maria Limongelli & Mehmet Celebi**
17:30 ~ 18:00	**Farewell Gathering/EWSHM/APWSHM Preview/Workshop Adjourn**								Location: Hewlett Auditorium (200)		

Keynote Presentations

Hewlett Auditorium 200, Tuesday – Thursday, September 10th – 12th

“SHM in Civil Aviation: Moving the Industry Forward”

Tuesday, Sept. 10th, (8:30 – 9:00 AM)

David Piotrowski
Principal Engineer
Enabling Technologies Group, Delta Air Lines

There is significant interest in implementing Structural Health Monitoring on civil aircraft. However, in order to reach the full potential of SHM, lots of issues remain as challenges. These include regulatory, technical, procedural and financial. While SHM can be used as ‘alternate inspections’ to conventional NDT, a philosophical change is needed to use SHM as part of a Condition Based Maintenance program. Therefore, SHM will involve progressive step-changes in the future. This presentation will provide a vision of these changes and discuss several industry initiatives, including implementation of applications at Delta Air Lines. Additionally, this presentation will highlight the various aerospace industry standardization activities going on via SAE Committees, IATA and A4A Working Groups.

“Regulatory Considerations for Structural Health Monitoring Applications in Aviation”

Tuesday, Sept. 10th, (9:00 – 9:30 AM)

Michael Gorelik
Chief Scientist for Fatigue and Damage Tolerance
Federal Aviation Administration

SHM technology has been under development for many years; however, its current use in the certified civilian and military aviation applications is still fairly limited. Lack of regulatory guidance is often cited as one of the challenges. While this presentation is not aimed at providing such guidance, it will discuss the relevant elements of the FAA certification framework, with the main focus on high-criticality structural aircraft components. Due to this focus, SHM will be discussed in the context of fatigue and damage tolerance (F&DT) regulatory requirements and guidance, including its comparison with conventional NDI methods, risk mitigation options, etc. Other relevant considerations that will be briefly covered in this presentation include enabling research, role of public standards organizations, gap analysis and technology maturation path, and the role of SHM in the broader IVHM context. Examples of early successes in civil aviation applications and lessons learned will be provided as well.

“Statistical Methods for Probability of Detection in Structural Health Monitoring”

Tuesday, Sept. 10th, (9:30 – 10:00 AM)

William Meeker
Professor of Statistics and Distinguished
Professor of Liberal Arts and Sciences Iowa State University

There is much interest in the potential to use Structural Health Monitoring (SHM) technology to augment traditional Nondestructive Evaluation (NDE) methods to improve safety, increase asset availability, and reduce maintenance and inspection costs. SHM has the potential to be used in many areas of application including critical components in aircraft and pipelines. Probability of detection (POD) plays a critical role in aircraft structural integrity programs. As such, there has been a high interest in developing methods that can be used to assess POD in SHM applications. In contrast to traditional NDE laboratory experiments to assess POD that involve a set of specimens with cracks, SHM sensors are fixed and SHM data are acquired over time as cracks grow or otherwise evolve. Traditional statistical methods for assessing POD (e.g., as described in MIL-HDBK 1823A 2009) no longer apply to such repeated-measures data. This purpose of this paper is to review the basic statistical concepts of probability of detection (POD) and to show how these concepts can and should be applied to SHM POD studies by modifying and extending existing methods for estimating POD. The methods presented here are applicable when there is a scalar damage index or other response that will be used to make a detect decision. The paper compares a simple model based on length at detection and a random effects model to describe repeated measures data.

“Dynamic and distributed fiber-optic sensing has come of age”

Wednesday, Sept. 11th, (8:30 – 9:00 AM)

Moshe Tur

Professor of School of Electrical Engineering, Tel-Aviv University

While the importance of static fiber-optic distributed sensing has been already recognized, appreciated and applied, adding full dynamic, real-time characteristics is of crucial importance, as it enables the use of distributed sensing in time-varying scenarios in multiple applications, such as: aerospace, civil engineering, transportation and more. For example, distributed load monitoring and damage detection in a flying platform must have dynamic capabilities due to the constant motion of the subsystems under investigation. Even 'static' applications, such as the distributed mapping of strain over a loaded long wing, require some dynamic performance. Otherwise, the accuracy of the supposedly 'static' measurements may be compromised by parasitic accompanying vibrations of the structure, or, worse, testing personnel, losing their patience to wait until all vibrations die, will be reluctant to move to fiber-optic sensing. The talk will cover currently available technologies, including a few commercial implementations. It will review some proven SHM applications, discuss relevant specifications, with emphasis on the required sampling rate for the temporal bandwidth of a given application and mention a wish-list for a more widespread use of the technology.

“Re-Inventing Disruptive Innovation”

Wednesday, Sept. 11th, (9:00 – 9:30 AM)

Michael Steep

Executive Director of Center on Disruptive Technologies and Digital Cities, Stanford University

The world of disruptive technology has changed radically in the last five years. While corporations have slashed R&D funding for general research, innovation across all industries has entered a crisis stage unable to comprehend how to address the problems of innovation inside the corporation. Meanwhile, total investment spending on disruptive innovation has shifted to outside the corporation. Over $300B is invested in venture, family office, and university funding for disruptive technology crossing every area of application. Corporations have funded $200B of their total $2 trillion spend. This shift has enormous implications for how we approach innovation both from a lab research perspective and from inside the traditional corporation.

“Bio-inspired Design of Multifunctional Structures with Sensory, Actuation & Self-learning Capabilities: Air Force Perspective”

Wednesday, Sept. 11th, (9:30 – 10:00 AM)

Les Lee

Program Manager of Mechanics of Multifunctional Materials and Microsystems, Air Force Office of Scientific Research (AFOSR)

In quest for revolutionary improvement in reliability, survivability and maintainability of aerospace structures, our scientific community increasingly relies on: (i) new design paradigm for “multifunctionality” which aims to achieve judicious combinations of structural properties and specific functional capabilities dictated by the system requirements and (ii) “multiscale” integration of newly emerging materials, nanoscale devices and microsystems into the multifunctional structures. Multifunctional design is often inspired by optimum combinations of structural and/or functional properties found in biological systems where the survival of species through many evolutionary cycles has led to highly efficient designs and production of complex material systems. Among various visionary contexts for developing such bio-inspired multifunctional structures, the concepts of particular interest are: (a) “autonomic” structures which can sense, diagnose and respond for adjustment with minimum external intervention, (b) “adaptive” structures allowing reconfiguration or readjustment of shape, functionality and mechanical properties on demand, and (c) “self-sustaining” systems with structurally integrated power sources and self-regulating thermal management capabilities. Significant progress has been made by Air Force sponsored research programs for the proof of concepts concerning a number of specific cases of autonomic, adaptive and self-sustaining systems. Well-known examples from earlier work include (i) neurological system-inspired sensory network, (ii) self-healing, regeneration and in-situ repair capabilities for air vehicles as well as space platforms, and (iii) self-regulating thermal management of aerospace structures. The more recent examples of key emerging technologies are: (1) avian-inspired fly-by-feel morphing wing for the next generation of air vehicles, (2) artificial synaptic devices with “integrated” analog signal processing, memory, and learning functions in a single system, and (3) neuromorphic circuits with high-speed parallel signal processing and self-learning capabilities. Along with other exciting developments in manufacturing technologies as well as simulation methods, these advances place the state of affairs at a tipping point where entirely new classes of multifunctional structures can be designed in multiscale by high-fidelity computational modeling methods and are fabricated by multi-material additive manufacturing techniques. This overview presentation will address key scientific issues underpinning further advancement of multifunctional materials and structures.

“The use of long-term observations in enhancing bridge evaluation”

Thursday, Sept. 12th, (8:30 – 9:00 AM)

Baidar Bakht

Adjunct Professor of University of Manitoba, Canada

It is usual that for determining the load carrying capacities of existing bridges – called evaluation – the same principles are employed that are used for designing new bridges. The Canadian bridges design codes, namely the Ontario Highway Bridge Design Code and the Canadian Highway Bridge Design Code, took the lead in changing this mode of evaluation. According to these codes, the strength side of the evaluation inequality is considered through the influence of the analytical assessment of the failure of individual components on the failure of the entire bridge. On the load side of the design equality, account is taken of the density of the traffic on the multiple presence of more than one truck on the bridge.

During the past forty or so years, the authors have evaluated more than one hundred bridges with the help of short-term SHM and found that nearly 75% of the tested bridges had more load carrying capacity than could be assessed by only analytical evaluations. While short-term SHM is very useful in identifying the hidden reserves of strength in existing bridges, it provides little information on the load side of the evaluation inequality, especially on the multi-presence of trucks. The authors have also been involved in recent long-term SHM of several bridges in the Province of Manitoba in Canada. They have found that long-term observations from the SHM of bridges are useful not only in identifying the hidden reserves of strengths in existing bridges, but also provide highly useful data about the load side of the design inequality. With the help of specific examples, a case is made in this paper on the usefulness of long-term SHM in enhancing the evaluation of existing bridges.

"On the Value of Structural Health Information"

Thursday, Sept. 12th, (9:00 – 9:30 AM)

Sebastian Thöns

Associate Professor and Scientific Advisor of Danish Hydrocarbon Research and Technology Centre (DHRTC), Denmark

Associate Professor and Guest Researcher of BAM Federal Institute for Materials Research and Testing, Berlin, Germany

Associate Professor and Head of Research Group Technical University of Denmark, DECPA: Decision Processes and Analytics, Lyngby, Denmark

Structural Health Information (SHI) may hold a high potential for industrial, life safety and sustainability value and may facilitate in this way an optimal and intelligent life cycle management of infrastructure and machinery systems. SHI may be provided by various sources such as e.g. structural health monitoring, testing and digital technologies and networks such as the Industry Internet of Things (IIOT). In order to fully exploit the potential of SHI, an integration of SHI in the life cycle knowledge, performance and utility management of infrastructure and machinery systems is required.

This paper provides insights into a framework, methods and tools for the quantification of the industrial and societal value of SHI as an approach for an efficient and intelligent life cycle management of infrastructure and machinery systems. The framework, methods and tools have been developed within scientific networking project COST Action TU1402 (www.tu-1402.eu). The paper starts out with elaborating and exemplarily illustrating the fundamentals of detection theory and the Bayesian reliability, utility and decision theory. Insights to the modeling of the basic types, the precision and the costs of SHI are provided and the adaptation of structural knowledge, performance and utility management models is derived. With a set of generic studies and case studies, the value assessment of different SHI types is demonstrated and the boundaries for achieving a high industrial and societal value of SHI are explicated. The paper concludes with recommendations for infrastructure and machinery system owners and operators for achieving an efficient life cycle management by employing value of SHI analyses.

"NDE and SHM in the age of Industry 4.0"

Thursday, Sept. 12th, (9:30 – 10:00 AM)

Leonard Bond

Director of Iowa NDE Center, Iowa, United States

Conventional NDT is a mature technology, in large part controlled by codes and standards, which is resistant to rapid change. SHM has been talked about for more than 30 years and in many areas adding as a retrofit is hard and even in new equipment for many potential application areas it has yet to be implemented. That said, NDE and SHM as tools for integrated approaches to life cycle management, do appear to be on the cusp of major changes. To support advanced manufacturing and use of composites there is a need to move beyond focusing on detection of discrete defects to assessment of material state, damage and its evolution throughout a component's life cycle. Condition based maintenance is now routinely applied to rotating machinery, with data transmitted wirelessly and reviewed automatically, to give a prognostic or remaining life estimate. Advances in computer and communications technology, the internet of things and management of Big Data offer the infrastructure needed for prognostics to be applied to structural materials. This talk will highlight some challenges and opportunities provided by additive manufacturing, new design and assessment tools that bring stress analysis and NDE together, and early steps which demonstrate how NDE and SHM can potentially be revolutionized to meet the opportunities and challenges of Industry 4.0.

Special Events & Panel Discussions

Company & Institution Exhibition

West Oval Grove (Tuesday – Thursday, Sept. 10th – 12th, 7:30 AM – 4:00 PM)

The Company & Institution Exhibition highlights the state-of-the art Structural Health Monitoring technologies provided by leading companies and institutions working in the field. For more details, please go to page 52.

Poster Session – Q & A

West Oval Grove (Tuesday, Sept. 10th, 12:10 PM – 1:40 PM)

The Special Poster Session provides the opportunity to selected IWSHM authors to present their cutting-edge state-of-the-art work. During the Special Poster Session, no other technical parallel sessions take place so that all Workshop participants can attend and interact with the authors.

Special Session: FAA Reliability Workshop

Hewlett 201(Tuesday, Sept. 10th, 10:30 AM – 12:10 PM)

Session Chairs: Paul Swindell (FAA, United States)
Holger Speckmann (Testia, Germany)

The SAE Aerospace Industry Steering Committee for Structural Health Monitoring (AISC-SHM) has been focusing on the development of a reliability methodology for use of SHM on aircraft. They held the 2nd Probability of Detection Workshop for SHM in Washington DC in April 2019. The 1st was 4 years earlier at MIT in Boston MA. Mr. Paul Swindell from the FAA's William J Hughes Technical Center coordinated the event. There were approximately 50 participants during the day and a half workshop. The first day consisted of speakers reporting on work/results towards the development of a POD reliability methodology and the second half day was a round table discussion on the path forward. This session will be a continuation of the workshop with papers describing recent work and a discussion during lunch.

Special Session: The Impact of Engineering Informatics: The Law Legacy in the Field of SHM

Building 380-380X (Tuesday, Sept. 10th, 1:40 PM – 3:00 PM)

Session Chairs: Jerome Lynch (University of Michigan, United States)
Anne S. Kiremidjian (Stanford University, United States)
Wen Shen (University of Texas at Arlington, United States)

The field of engineering informatics advances information technologies including database systems, information models, web services, and cloud services, to enhance engineering applications. In the field of structural health monitoring, Prof. Kincho Law (Stanford University) has been a visionary leader pioneering new information technologies that improve the collection, management and processing of SHM data and information. Amongst his most impactful contributions to the SHM field have been his pioneering research in wireless sensor networks with in-network computing for monitoring civil infrastructure, information models for SHM applications, distributed database systems supporting cloud-based data processing architectures, and most recently machine learning frameworks for scalable interrogation of SHM data for system health diagnoses. To celebrate the seminal achievements of Prof. Law's research in SHM, his post-docs, and close collaborators have organized this special session to highlight the current and future research directions in SHM-based engineering informatics.

Special Session: A State-wide Focus on SHM

Hewlett 102 (Wednesday, Sept. 11th, 1:30 PM – 3:30 PM)

Session Chairs: Tal Yehoshua (Ministry of Defense, Israel)

Envisioning the bright future of unmanned airborne vehicles and predicting the ubiquitous use of composite materials in their structures, funding agencies in Israel have decided more than 15 years ago to invest in SHM technology in order to monitor loads, locate damages and, in general, improve the availability of these airplanes at lower maintenance costs. With their small footprint, low weight, embeddability, immunity to electrical interference and multiplexing properties, optical fibers have been chosen as the potentially promising SHM technology. This session, comprising talks from leading Israeli aerospace industries, as well from a major operator, presents the current state of the art, which has been heavily guided and supported by the Israeli Academy.

Most aspects of the Israeli involvement in fiber-optic-based SHM will be covered. From basic research on the technology, through small-scale demonstrators of innovative sensing concepts and finally to full-scale (operational) load monitoring, including production-line activities. A civil engineering application will be also presented.

Panel Discussion – Barriers in Implementation of Sensor Technologies in Highway Industry

Hewlett Auditorium 200 (Thursday, Sept. 12th, 10:30 – 12:30 PM)

Moderator: Hoda Azari (Federal Highway Administration Office of Infrastructure R&D, United States)
Panelists: Duncan Paterson (HDR Inc., United States)
Franklin Moon (Rutgers, The State University of New Jersey, United States)
Helmut Wenzel (Wenzel Consulting Engineers GmbH, Austria)
Marybeth Miceli (Miceli Infrastructure Consulting (MIC), United States)

The current practice for monitoring and maintenance of bridges is periodic visual inspection with the collected data only providing a snapshot of the bridge condition at the time of inspection. Further, hidden defects and damages may not be captured during visual inspection, which can lead to accelerated bridge deterioration and result in more expensive repair operations as compared to cases where degradation is identified and mitigated at an earlier stage. Structural health monitoring (SHM) technologies are considered as additional/complementary tools for performance monitoring to assist in bridge evaluation.

Despite several (20+) years of basic and applied research, SHM technologies are not widely used. Some potential reasons could be that there is no clear threshold state (the state corresponding to some specific action) established in bridge management for decision-making. The concept of technology leveraging (or how to use SHM in practice) has not yet been sufficiently developed. This situation is primarily attributed to the profession not yet clearly defining the role of sensing technologies in realm of bridge engineering, lack of training opportunities, lack of introduction to SHM technologies in engineering college curriculum, and finally not yet developing a compelling roadmap for how emerging technologies in the SHM field may be integrated within the management process.

Panel Discussion – AI for PHM and SHM – AI and ML Systems: Technologies, Applications, and Lessons Learned

Hewlett 201 (Thursday, Sept. 12th, 10:30 – 12:30 PM)

Moderator: Andy Hess (PHM Society and The Hess PHM Group, United States)
Panelists: Abhinav Saxena (GE, United States)
Kai Goebel (PARC, United States)
Neil Eklund (Analatom Inc., Austria)
Matthias Buderath (Airbus, Germany)

Amrita Kumar (Acellent, United States)
Mohak Shah (LG, South Korea)

Machine learning (ML) systems built in the lab regularly break down when they are deployed. The same can often be said for Deep Learning (DL) and other Artificial Intelligent (AI) approaches. This Special invited panel session involves panelists associated with the Prognostics and Health Management (PHM) Society discussing the numerous pitfalls related to deploying ML and DL approaches and systems; and lessons learned associated with the implementation of ML and DL based PHM systems. The ML and DL applications and lessons learned would be from across multiple industry sectors.

Faculty/Student Panel – Student/Early Career Discussion Session

Hewlett 201 (Thursday, Sept. 12th, 12:00 – 1:30 PM)

Moderator: Chuck Farrar (Los Alamos National Laboratory, United States)

Panelists: Mike Todd (University of California San Diego (UCSD), United States)
Elizabeth "Lizzy" Cross (University of Sheffield, United Kingdoms)

This special session is designed to be an open forum where students and early-career professionals from academia, government laboratories and industry can ask questions and get advice from more senior researchers, practitioners and managers in the field of SHM. There are no formal presentations planned for this session. The discussions are intended to be driven by questions that the early career attendees ask. The participants are encouraged to ask questions on topics related to their research, education, applications of SHM and career planning. Additionally, the participants should feel free to bring up issues regarding other challenges faced by students and early-career professional. A box lunch will be provided and the participants are encouraged to eat their lunch during the session.

SHM in Action

Hewlett Auditorium 200 (Wednesday, Sept. 11th, 3:50 – 6:20 PM)

Session Chairs: Christian Boller (Saarland University, Germany)
Branko Glisic (Princeton University, United States)

One of our highlighted events showcasing how Structural Health Monitoring works in practical applications. The session features demonstrations on a variety of SHM applications from many leading SHM companies and educational institutions. Participating organizations are listed in alphabetical order; a finalized schedule will be announced at the workshop. For more details, please go to page 47.

SHM Networking and Awards Night

Terman Fountain Park (Wednesday, Sept. 11th, 7:00 – 10:00 PM)

The SHM Networking and Awards Night takes place in the evening of the second day of the Workshop. The participants can enjoy a memorable dinner prepared by Chef Chu. The peak of this night is the Award Ceremony organized by the IWSHM Organizing Committee.

SF Bay Banquet Cruise

San Francisco – Pier3 (Tuesday, Sept. 10th, 8:00 – 11:00 PM)

The San Francisco Bay Banquet Cruise takes place in the evening of the first day of the Workshop. The participants can enjoy a unique dinner cruise prepared by California Hornblower. The boarding time is 7:45PM at San Francisco - Pier 3, On the Embarcadero at Washington Street. We provide shuttles that will depart from Stanford at 5 pm and return from San Francisco at 11 pm. For more details about the shuttle schedule, please go to page 56.

Technical Program (Tuesday, September 10th)

Welcome Session

Chair: F.-K. Chang & **Co-Chair:** A. Guemes
Location: Hewlett 200

TIME	TUESDAY, SEPTEMBER 10	
08:20 ~ 08:30	**Opening Remarks** F.-K. Chang	

Keynote Presentations

Chair: Dennis Roach
Location: Hewlett 200

TIME	TUESDAY, SEPTEMBER 10	
08:30 ~ 09:00	**SHM in Civil Aviation: Moving the Industry Forward** David Piotrowski[1] [[1]Principal Engineer, Enabling Technologies Group, Delta Air Lines]	
09:00 ~ 09:30	**Regulatory Considerations for Structural Health Monitoring Applications in Aviation** Michael Gorelik[1] [[1]Chief Scientist for Fatigue and Damage Tolerance, Federal Aviation Administration]	
09:30 ~ 10:10	**Statistical Methods for Probability of Detection in Structural Health Monitoring** William Meeker[1] [[1]Professor of Statistics and Distinguished Professor of Liberal Arts and Sciences, Iowa State University]	

FAA Reliability Workshop

Chair: Paul Swindell & Holger Speckmann
Location: Hewlett 201

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**FAA SHM Reliablity Program Overview** Paul Swindell[1] [[1]FAA]	
10:50 ~ 11:10	**Generating Viable Data to Accurately Quantify the Performance of SHM Systems** Dennis Roach[1], Paul Swindell[2] [[1]Sandia National Laboratories, [2]FAA]	278
11:10 ~ 11:30	**Detection Sensitivity Analysis for a Guided Wave (GW) Structural Health Monitoring System** Gregory Jarmer[1], Seth Kessler[1], Paul Swindell[2], William Meeker[3] [[1]METIS DESIGN CORPORATION, [2]FAA, [3]Iowa State University]	222
11:30 ~ 11:50	**Inspection Requirements for Continued Airworthiness Using Structural Health Monitoring** Michael Shiao[1], Tzikang Chen[1], Mulugeta Haile[1], Anindya Ghoshal[1], Marvin Nuss[2] [[1]Army Research Laboratory, [2]NuSS Sustainment Solutions]	342
11:50 ~ 12:10	**Reliability of Probability of Detection (POD) of Fatigue Cracks for Built- in Acousto-Ultrasound Technique as "in-situ" NDE** Spandan Mishra[1], Susheel Kumar Yadav[1], Fu-Kuo Chang[2] [[1]Acellent Technologies, [2]Stanford University]	564

Civil Structures I

Chair: Claus Peter Fritzen
Location: 380-380C

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Field Assessment of Ambient Vibration-Based Bridge Scour Detection** Kasun Kariyawasam[1], Paul Fidler[1], James Talbot[1], Campbell Middleton[1] [[1]University of Cambridge]	431
10:50 ~ 11:10	**On the Utilization of Synthetic and Measured Earthquake Ground Motions for Designing Building Monitoring Systems in the Near-Field of Major Faults** Floriana Petrone[1], David McCallen[2], Mehmet Celebi[3], Mamun Miah[1] [[1]Lawrence Berkeley National Laboratory, [2]University of Nevada, Reno, [3]United States Geological Survey]	109
11:10 ~ 11:30	**Predicting Fatigue Life of Miter Gate Anchorages with Stochastic Modeling and Limited Sensor Data** Nathaniel M. Levine[1], Brian A. Eick[1], Eric O. Johnson[2], Billie F. Spencer[1], Matthew D. Smith[2] [[1]University of Illinois at Urbana-Champaign, [2]US Army Corps of Engineers]	244
11:30 ~ 11:50	**An Expectation-Maximization Algorithm-Based Framework for Vehicle-Vibration-Based Indirect Structural Health Monitoring of Bridges** Jingxiao Liu[1], Susu Xu[1], Mario Bergés[1], Jacobo Bielak[1], James H. Garrett[1], Hae Young Noh[1] [[1]Carnegie Mellon University]	297
11:50 ~ 12:10	**Using Intelligent Software Agents to Monitor the Structural Health of Highway Bridges** Haroon Malik[1], Wael Zatar[1] [[1]Marshall University]	289

Diagnostics I

Chair: Antonios Kontsos & Joe Lehtola
Location: Hewlett 103

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Guided Wave Propagation based Analysis of Non-linear Debonding Effects in a Composite Structure** Shirsendu Sikdar[1], Wiesław Ostachowicz[1] [[1]Polish Academy of Sciences]	175
10:50 ~ 11:10	**Thermal Behavior of a Structure Characterized through 3-Dimensional Temperature Signatures for a Temperature Driven Method of Structural Health Monitoring** Jack Reilly[1], Branko Glisic[1] [[1]Princeton University]	471
11:10 ~ 11:30	**A Physics-Based Feature Weighting Approach For Fault Diagnosis Of Rolling Element Bearings** Hao Lu[1], Mohammadkazem Sadoughi[1], Andy Zimmerman[2], Chao Hu[3] [[1]Iowa State University, [2]Grace Engineered Products Inc. and Percēv LLC, [3]Iowa State Univ.]	240
11:30 ~ 11:50	**Composite Structures Integrity Monitoring Using Rotating Electrical Signals.** Tommaso D'Agostino[1], Michelo Meo[1] [[1]University of Bath]	517
11:50 ~ 12:10	**Automated Fault Diagnosis with Calibrated Artefact Probing** Tim Rooker[1], Jon Stammers[2], Keith Worden[1], Graeme Potts[3], Kevin Kerrigan[2], Nikolaos Dervilis[1] [[1]University of Sheffield, [2]Advanced Manufacturing Research Centre, [3]Metrology Software Products ltd.]	87

SPECIAL SESSION

Guided Waves in Structures for SHM I

Chair: W. Ostachowicz & Patrice Masson
Location: Hewlett 200

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Effects of Homogenization and Quasi-Isotropy Assumptions on Guided Wave-Based Nondestructive Testing Methods** Steffen Tai[1], Lifu Wang[1], Leonardo Araque[1], Ajit Mal[1], Christoph Schaal[12] [[1]UCLA, [2]California State University, Northridge]	461
10:50 ~ 11:10	**Structural Health Monitoring of Pipelines by Means of Helical Guided Ultrasonic Waves and an Algebraic Reconstruction Technique** Stylianos Livadiotis[1], Arvin Ebrahimkhanlou[1], Salvatore Salamone[1] [[1]University of Texas at Austin]	274
11:10 ~ 11:30	**Damage Detection and Localization via Cross-Correlation on Metallic Panels under Ambient Loading** YuSheng Chang[1], Fuh-Gwo Yuan[1] [[1]North Carolina State University]	427
11:30 ~ 11:50	**Algorithms for Guided Wave Detection of Corrosion in Ground Rods** Sadegh Mahmoudkhani[1], Junhui Zhao[1], Nicholas Durham[2], Colin McKenzie, Karim Abdel-Hadi, Aftab Mufti, Douglas Thomson[1] [[1]University of Manitoba, [2]University of British Columbia]	463
11:50 ~ 12:10	**Data-Driven Temperature Compensation on Lamb Waves** Ahmad B. Zoubi[1], V John Mathews[1] [[1]Oregon State University]	472

SPECIAL SESSION

Vision-based Studies for SHM I

Chair: Mohammad Jahanshahi & Werner Lienhart
Location: 380-380F

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Modal Imaging of Portsmouth, New Hampshire Bridge for Video-Based Structural Health Monitoring** Abe Davis[1 2], Justin G Chen[2], Travis M. Adams[3], Hao Sun[4], Erin S. Bell[3], Frédo Durand[2], Oral Buyukozturk[2] [[1]Cornell University, [2]MIT, [3]University of New Hampshire, [4]Northeastern University]	491
10:50 ~ 11:10	**Vision-based Decision Support for Flood Risk Assessment Using Google Street View Images** Fu-Chen Chen[1], Mohammad Jahanshahi[1], David Johnson[1], Edward Delp[1] [[1]Purdue University]	413
11:10 ~ 11:30	**Infrastructure Mapping and Inspection using Mobile Ground Robotics** Stephen Phillips[1], Nicholas Charron[1], Evan McLaughlin[1], Sriram Narasimhan[1] [[1]University of Waterloo]	314
11:30 ~ 11:50	**Pruning Deep Neural Networks for Efficient Edge Computing in Internet of Things: A Structural Health Monitoring Case Study** Rih-Teng Wu[1], Ankush Singla[2], Mohammad R. Jahanshahi[3], Elisa Bertino[1] [[1]Purdue University, [2]Research Assistant, [3]Civil Engineering]	474
11:50 ~ 12:10	**Dense 3D Displacement and Strain Measurement Framework of Miter Gates Using Computer Vision** Yasutaka Narazaki[1], Vedhus Hoskere[1], Billie F. Spencer[1], Stuart Foltz[2], Matthew D. Smith[3] [[1]University of Illinois, Urbana-Champaign, [2]United States Army Corps of Engineers, [3]Coastal and Hydraulics Lab]	154

SPECIAL SESSION Acoustic Emission and Hybrid SHM I Chair: Victor Giurgiutiu & Emilio Di Lorenzo Location: 380-380W		
TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Lamb Wave-Based Depth Characterization of Acoustic Emission Sources in Complex Metallic Plate-Like Structures** Brennan Dubuc[1], Arvin Ebrahimkhanlou[1], Stylianos Livadiotis[1], Salvatore Salamone[1] [[1]University of Texas at Austin]	103
10:50 ~ 11:10	**Multi Frequency Acoustic Emission Micromachined Transducers for Structural Health Monitoring** Hanie Kazari[1], Didem Ozevin[1] [[1]University of Illinois at Chicago]	315
11:10 ~ 11:30	**Structural Health Monitoring of Adhesively-Bonded Hybrid Joints by Acoustic Emission** Milad Saeedifar[1], Mohamed Nasr Saleh[1], Sofia Teixeira De Freitas[1], Dimitrios Zarouchas[1] [[1]Delft University of Technology]	377
11:30 ~ 11:50	**Integration of Distributed Optical Fibres and Piezoelectric Sensors for SHM of Composite Tubes** Neha Chandarana[1], Emmanuel Ramasso[2], Constantinos Soutis[1], Matthieu Gresil[1] [[1]The University of Manchester, [2]Univ. Bourgogne Franche-Comté]	259
11:50 ~ 12:10	**Location and Identification of Defects in the Gas Network by the Acoustic Emission Method** Grzegorz Świt[1], Aleksandra Krampikwska[1], Wiesław Trąmpczyński[1] [[1]Kielce University of Technology]	126

SPECIAL SESSION Integration of Physical Modeling Monitoring and Machine Learning for SHM I Chair: Eloi Figueiredo & Ionut Moldovan Location: 380-380D		
TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**A Kriging Surrogate Model for Structural Health Monitoring of Miter Gates in Navigation Locks** Yichao Yang[1], Ramin Madarshahian[2], Michael D. Todd[1] [[1]University of California San Diego, [2]University of California San Diego]	144
10:50 ~ 11:10	**Automated Infrastructure Inspection based on Digital Twins and Machine Learning** Ernst Forstner[1], Peter Furtner, Albrecht Karlusch [[1]Palfinger Structural Inspection GmbH]	23
11:10 ~ 11:30	**A General Representation for Assessing the Similarity of Structures** Julian Gosliga[1], Keith Worden[1] [[1]The University of Sheffield]	199
11:30 ~ 11:50	**Grey-box Modelling for Structural Health Monitoring; physical constraints on machine learning algorithms.** Elizabeth Cross[1], Timothy Rogers[1], Thomas Gibbons[1] [[1]University of Sheffield]	203
11:50 ~ 12:10	**Hierarchical Convolutional Neural Networks for Activity Source Detection in Building Floors** Ali Lenjani[1], Chul Min Yeum[2], Shirley Dyke[1], Ilias Bilionis[1], Jongseong Choi[1], Alana Lund[1], Amin Maghareh[1] [[1]Purdue University, [2]University of Waterloo]	458

SPECIAL SESSION Recent Advances on Data Processing Techniques for Ultrasonics-based SHM I Chair: Salvatore Salamone Location: 380--380Y		
TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Single Sensor Localization and Characterization of Acoustic Emission Sources in Metallic Panels: A Deep Learning Approach** Arvin Ebrahimkhanlou[1], Melanie B Schneider[1], Brennan Dubuc[1], Salvatore Salamone[1] [[1]The University of Texas at Austin]	102
10:50 ~ 11:10	**Location Specific Temperature Compensation of Guided Wave Signals Applied to Pipe Inspections** Stefano Mariani[1], Peter Cawley[1] [[1]Imperial College London]	84
11:10 ~ 11:30	**Learning Guided Wave Dispersion Curves from Multi-Path Reflections with Compressive Sensing** Joel B. Harley[1], K. Supreet Alguri[2], Harsha Vardhan Tetali[1], Soroosh Sabeti[2] [[1]University of Florida, [2]University of Utah]	486
11:30 ~ 11:50	**The Characterization of Weld Morphology using Ultrasonics** Lu Zhang[1], Gorkem Okudan[1], Ernesto Indacochea[1], Didem Ozevin[1] [[1]University of Illinois at Chicago]	549
11:50 ~ 12:10	**Identification of Active and Passive Sources using Elastic Waves and Computational Intelligence** Daniel Frank Hesser[1], Georg Kocur[1], Bernd Markert[1] [[1]RWTH Aachen University]	46

SPECIAL SESSION
Human Performance Monitoring I

Chair: Kenneth Loh & Toshihide Kashima
Location: Hewlett 101

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Wireless Electronic Tattoos** Nanshu Lu[1], Hyoyoung Jeong[1] [[1]University of Texas at Austin]	85
10:50 ~ 11:10	**Physics-Guided Model Transfer for Human Gait Monitoring using Footstep-Induced Floor Vibration** Mostafa Mirshekari[1], Jonathon Fagert[1], Shijia Pan[1], Pei Zhang[1], Hae Young Noh[1] [[1]Carnegie Mellon University]	303
11:10 ~ 11:30	**Vibration Source Separation for Multiple People Gait Monitoring Using FootstepInduced Floor Vibrations** Jonathon Fagert[1], Mostafa Mirshekari[1], Shijia Pan[1], Pei Zhang[1], Hae Young Noh[1] [[1]Carnegie Mellon University]	304
11:30 ~ 11:50	**Compressive Sensing Based Indoor Human Positioning Using A Single Thermopile Point Detector** Libo Wu[1], Ya Wang[1] [[1]Texas A&M University]	108
11:50 ~ 12:10	**Bone Fracture Sensing and Acoustic Data Communication** Jochen Moll[1], Mit B. Bhavsar[1], Christian Kexel[1], John H. Barker[1] [[1]J.W. Goethe-University Frankfurt am Main]	24

SPECIAL SESSION
Use of Optical MEMS/NEMS and CNT Sensors for Structural Health Monitoring Systems

Chair: Jayantha Epaarachchi
Location: 380-380X

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
10:30 ~ 10:50	**Detection Sensitivity Analysis for a Potential Drop (PD) Structural Health Monitoring (SHM) System** Seth Kessler[1], Christopher Dunn[1], Paul Swindell[2], William Meeker[3] [[1]METIS DESIGN CORPORATION, [2]FAA, [3]Iowa State University]	223
10:50 ~ 11:10	**Investigation of FBG sensor performance in detection of delamination damge in a half-conical shape composite component** Ayad Kakei[1], Jerry Manuela[1], Vishwas Srinivasan[1], Arvind Sharda[1], Mainul Islam[1], Jayantha Epaarachchi[1] [[1]University of Southern Queensland]	62
11:10 ~ 11:30	**Fibridge: Embedded fiber-optic sensing for low-cost, high resolution monitoring in bridges and critical structures** Ajay Raghavan[1], Kyle Arakaki[1], Hong Yu[1], Peter Kiesel[1], Tuan Nguyen[2], Tuan Ngo[2], Dusan Stojkovic[3] [[1]Palo Alto Research Center (PARC, a Xerox Company), [2]University of Melbourne, [3]VicTrack]	298
11:30 ~ 11:50	**Study on Local Scouring Monitoring of Hangzhou Bay Bridge** Jian Guo[1], Jiyi Wu[1], Jinquan Wang[2] [[1]Zhejiang Unversity of Technology, [2]Hangzhou Bay Bridge Development Co., Ltd.]	166
11:50 ~ 12:10	**Maglev Obstacle Detection System Based on Laser Radar** Lianbi Yao[1], Shaohua Zhang[1], Changcai Qin[1], Gilbert KATABARWA MURENZI[1] [[1]Tongji University, Shanghai]	86

SPECIAL SESSION
Sensing Technologies for Evaluation and Characterization of Concrete Materials I

Chair: Ying Zhang & Jinying Zhu
Location: Hewlett 201

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Prediction of Volumetric Strain in Concrete Due to ASR Reactions Using Acoustic Emission Technique and Artificial Neural Network** Taeyong Shin[1], Vafa Soltangharaei[2], Paul Ziehl[2], Ying Zhang[1] [[1]Georgia Institute of Technology, [2]University of South Carolina]	217
14:00 ~ 14:20	**A New Thermal Integrity Method for Pile Anomaly Detection** Qianchen Sun[1], Mohammed Elshafie[2] [[1]University of Cambridge, [2]Qatar University]	227
14:20 ~ 14:40	**Fabrication of Self-Sensing Carbon Fiber Cementitious Composites: Best Practices** Niloofarsadat Heirani[1], Ahmed Abouhussien[1], Karl Peterson[1], Fae Azhari[1] [[1]University of Toronto]	351
14:40 ~ 15:00	**Rapid Condition Evaluation of Concrete Pavement with Automated Acoustic Scanning System** Suyun Ham[1], Sanggoo Kang[1], Dafnik Saril Kumar David [[1]University of Texas at Arlington]	455

Sensors and Actuators I

Chair: Pete Carini
Location: 380-380C

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Evaluation of Commercially Available Sensors for Soil Stress Measurements** Fredric Fong[1], Mason Ghafghazi[1], Fae Azhari[1] [[1]University of Toronto]	387
14:00 ~ 14:20	**Soft Material Actuation and Shape-Change through Ultrasonic Atomization** Han-Joo Lee[1], Noe Melchor[1], Kenneth Loh[1] [[1]UC San Diego]	489
14:20 ~ 14:40	**Planar Array Capacitive Imaging for Characterizing Subsurface Composite Damage** Sumit Gupta[1], Hyung (Eric) Kim, Han-Joo Lee[1], Hyonny Kim[1], Kenneth J. Loh[1] [[1]UC San Diego]	509
14:40 ~ 15:00	**Design of Embedded Wireless Sensors for Real-Time and In-Situ Strain Sensing of Fiber Reinforced Composites** Relebohile G. Qhobosheane[1], Sujjatul Islam[1], Muthu Ram Prabhu Elenchezhian[1], Vamsee Vadlamudi[1], Rassel Raihan[2], Kenneth Reifsnider[2], Wen Shen[1] [[1]University of Texas at Arlington, [2]University of Texas at Arlington Research Institute]	443

SPECIAL SESSION

Distributed and Quasi-distributed Fiber-optic and Electrical Sensors and Associated Data Analysis and Management I

Chair: Branko Glisic & Daniele Zonta
Location: Hewlett 103

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Large Area Electronics Based Sensing Sheet for Strain Monitoring and Damage Detection of Bridges** Vivek Kumar[1], Levent E. Aygun[1], Naveen Verma[1], James C. Sturm[1], Branko Glišić[1] [[1]Princeton University]	283
14:00 ~ 14:20	**In-situ Assessment of Curvature and Bending Characteristics along Geotechnical Structures using Distributed Fiber Optic Sensors** Christoph Martin Monsberger[1], Werner Lienhart[1] [[1]Graz, University of Technology]	340
14:20 ~ 14:40	**One Hundred Years of Strain Sensing in Civil Structural Health Monitoring** Branko Glisic[1] [[1]Princeton University]	480
14:40 ~ 15:00	**Distributed Sensing to Assess Bond Degradation** Zachary Broth[1], Neil Hoult[1] [[1]Queen's University]	373

SPECIAL SESSION

Guided Waves in Structures for SHM II

Chair: W. Ostachowicz & Marcus Perry
Location: Hewlett 200

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Damage Detection in Integrated Circuit Packages using Ultrasonic Guided Wave and Clustering Algorithm** Hyunseong Lee[1], Guoyi Li[1], Aditi Chattopadhyay[1], Rajesh K Neerukatti[2], Kuang C Liu[2] [[1]Arizona State University, [2]Intel Corporation]	224
14:00 ~ 14:20	**Application of Ultrasonic Guided Waves for Surface Roughness Measurement** Mark Jahanbin[1], Sridhar Santhanam[2], Jeong-Beom Ihn[3], Alison McMillan[4] [[1]The Boeing Company, [2]Villanova University, [3]Boeing, [4]Wrexham Glyndwr University]	11
14:20 ~ 14:40	**Parameterization of Spatial Ultrasonic Wavefront via Laser Ultrasonic Techniques** See Yenn Chong[1], Michael D Todd[1] [[1]University of California San Diego]	242
14:40 ~ 15:00	**Nonlinear Guided Waves for Fatigue Crack Detection in a Steel Joint** Yu Fung Lee[1], Ye Lu[2], Wing Kong Chiu[1], Iman Salehi[1] [[1]Monash University, [2]Monash Univeristy]	93

SPECIAL SESSION
Vision-based Studies for SHM II

Chair: Mohammad Jahanshahi & Slim Soua
Location: 380-380F

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Optimized and Tailorable Speckle Pattern Generation Approach for Digital image Correlation Applications in SHM** Melvin Mathew[1], Brian Wisner[2], Shakerur Ridwan[1], Matthew McCarthy[1], Ivan Bartoli[1], Antonios Kontsos[1] [[1]Drexel University, [2]Ohio University]	442
14:00 ~ 14:20	**Damage Visualization of Scattered Ultrasonic Wavefield via Integrated High-speed Camera System** Huan-Yu Chang[1], Fuh-Gwo Yuan[1] [[1]North Carolina State University/ National Institute of Aerospace]	309
14:20 ~ 14:40	**Monitoring Post-tensioned Miter Gate Diagonals using Vision-based Vibration Measurements** Brian Eick[1], Yasutaka Narazaki[1], Matthew D. Smith[2], Billie F. Spencer[3] [[1]University of Illinois, Urbana-Champaign, [2]United States Army Corps of Engineers, [3]University of Illinois]	153
14:40 ~ 15:00	**UAV-based Non-contact Fatigue Crack Monitoring of Steel Structures** Sdiq Anwar Taher[1], Jian Li[1], William Collins[1], Caroline Bennett[1] [[1]The University of Kansas]	511

SPECIAL SESSION
Acoustic Emission and Hybrid SHM II

Chair: Victor Giurgiutiu & Debbie Senesky
Location: 380-380W

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Clustering Acoustic Emission Time-series using Unsupervised-shapelets** Emmanuel Ramasso[1], Pauline Butaud[1], Vincent Placet[1], Thomas Jeannin[1], Fabrizio Sarasini[2] [[1]FEMTO-ST Institute, [2]Sapienza-Universita di Roma]	134
14:00 ~ 14:20	**Acoustic Emission Sensing using MEMS for Structural Health Monitoring: Demonstration of a Newly Designed Capacitive Micro Machined Ultrasonic Transducer** Redha Boubenia[1], Gilles Bourbon[1], Patrice Le Moal[1], Eric Joseph[1], Emmanuel Ramasso[1], Vincent Placet[1] [[1]FEMTO-ST institute, Univ. Bourgogne Franche-Comté, CNRS]	318
14:20 ~ 14:40	**Acoustic Emission Signal of Composite Structure Decomposition by Empirical Wavelet Transform** Shaopeng Dong[1], Mei Yuan[1], Qiusheng Wang[1], Zongxia Jiao[1] [[1]Beihang University]	359
14:40 ~ 15:00	**Filtering Analysis of Acoustic Emission Parameters for Damage Fracture Characterization of Reinforced Concrete Beam Subjected to Four-point Bending** Yubo Jiao[1], Yao Zhang[1], Lidong Zhang[1], Yunpeng Zhao[2], Tianlai Yu[2] [[1]Beijing University of Technology, [2]Northeast Forestry University]	44

SPECIAL SESSION
Integration of Physical Modeling Monitoring and Machine Learning for SHM II

Chair: Eloi Figueiredo & Ionut Moldovan
Location: 380-380D

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**On Current Trends in Forward Model-Driven SHM** Paul Gardner[1], Robert J. Barthorpe[1] [[1]University of Sheffield]	282
14:00 ~ 14:20	**SHM of Bridges by Improved Complete Ensemble Empirical Mode Decomposition with Adaptive Noise (ICEEMDAN) and Clustering** Rick M. Delgadillo[1], Joan R. Casas[1] [[1]Technical University of Catalonia (UPC-BarcelonaTech)]	64
14:20 ~ 14:40	**Machine Learning based Tensile Force Estimation for PSC Girder using Embedded EM Sensor** Junkyeong Kim[1], Byung-Joon Yu[1], Ju-Won Kim[1], Seunghee Park[1] [[1]Sungkyunkwan University]	249
14:40 ~ 15:00	**Damage Identification of Sandwich Panel with Truss Core by Integrating Deep Learning Technique** Yabo Wang[1], Lingling Lu[1], Hongwei Song[1], Weimin Chen[1], Chenguang Huang[1] [[1]Chinese Academy of Sciences]	550

SPECIAL SESSION
Recent Advances on Data Processing Techniques for Ultrasonics-based SHM II

Chair: Salvatore Salamone & Gail Hickman
Location: 380--380Y

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**The Unidirectional Excitation of Guided Waves with an Increased Power using Multiple Transducer Arrays in Pipelines for Structural Health Monitoring** Xudong Niu[1], Kong Fah Tee[1], Hugo R. Marques[2] [[1]University of Greenwich, [2]TWI]	58
14:00 ~ 14:20	**Entropy-Based Damage Evaluation of Composite Structure and its Application to Structural Health Management** Hossain Ahmed[1], Mohammadsadegh Saadatzi[1], Subir Patra[1], Sourav Banerjee[1] [[1]University of South Carolina]	213
14:20 ~ 14:40	**Spatial Integration of Baseline-free Damage Detection Algorithms based on Dual-PZT for the Structural Health Monitoring of Anisotropic Composite Aeronautic Structures** Emmanuel LIZE[1], Marc REBILLAT[2], Nazih MECHBAL[2], Christian Bolzmacher [[1]CEA, [2]ENSAM-CNAM-CNRS]	176
14:40 ~ 15:00	**Intelligent Damage Detection of Composite Structure Based on Convolutional Neural Network and Wavelet Transform** Xuebing Xu[1], Jun Wu[1], Guoqiang Li[1], Pengfei Guo[1] [[1]Huazhong University of Science and Technology]	48

SPECIAL SESSION
Human Performance Monitoring II

Chair: Kenneth Loh & Paul Thorley
Location: Hewlett 101

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Monitoring Pressure Distributions at Human-Socket Prostheses Interfaces using Graphene-Fabric Sensors** Yun-An Lin[1], Sumit Gupta[1], Andrew Pedke[2], Kenneth J. Loh[1] [[1]UC San Diego, [2]LIM Innovations]	426
14:00 ~ 14:20	**Stretchable Ultrasonic Transducer Arrays for Three-Dimensional Imaging on Complex Surfaces** Xuan Zhu[1], Hongjie Hu[2], Simone Sternini[2], Sheng Xu[2], Francesco Lanza di Scalea[2] [[1]University of Utah, [2]University of California, San Diego]	457
14:20 ~ 14:40	**An Ultrasonic Stress Wave Approach on Quantitative Osseointegration Assessment of a Novel Implant** Ben Vien[1], Wingkong Chiu[1], Matthias Russ[2], Mark Fitzgerald[2] [[1]Monash University, [2]The Alfred Hospital]	237
14:40 ~ 15:00	**Video Monitoring of Tourist Density in Cultural Heritage Sites** Zheng Zou[1], Yajing Di[2], Anping Xie[2], Peng Zhao[2], Xuefeng Zhao[1] [[1]Dalian University of Technology, [2]The Palace Museum]	317

SPECIAL SESSION
The Impact of Engineering Informatics: The Law Legacy in the Field of Structural Health Monitoring I

Chair: Hoon Sohn & Anne S. Kiremidjian
Location: 380-380X

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Sensing Social Systems: Towards a True Objective Resilience Framework** Katherine A. Flanigan[1], Peng Sun[1], Jerome P. Lynch[1] [[1]University of Michigan]	484
14:00 ~ 14:20	**Linkage between a 3D Bridge Model and an IoT Information Model** Nobuyoshi Yabuki[1], Seiki Koyama[1], Tomohiro Fukuda[1] [[1]Osaka University]	518
14:20 ~ 14:40	**A Support Vector Regression-Based Approach Towards Decentralized Fault Diagnosis in Wireless Structural Health Monitoring Systems** Maria Steiner[1], Dmitrii Legatiuk[1], Kay Smarsly[1] [[1]Bauhaus University Weimar]	264
14:40 ~ 15:00	**Validation of an Ultra-Low-Cost Wireless Structural Health Monitoring System for Civil Infrastructure** Kay Smarsly[1], Everett M. Mthunzi[1], Oliver Hahn[2], Josephine Planer[2] [[1]Bauhaus University Weimar, [2]MKP GmbH]	273

Environmental and Operational Effects

Chair: Dryver Huston & Zhu Mao

Location: Hewlett 102

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
13:40 ~ 14:00	**Investigation of Broadband High-Frequency Stochastic Actuation for Active-Sensing SHM under Varying Temperature** Shabbir Ahmed[1], Fotis Kopsaftopoulos[1] [[1]Rensselaer Polytechnic Institute]	439
14:00 ~ 14:20	**Damage Localization with SP2E under Changing Conditions** Stefan Wernitz[1], Dorian Pache[1], Tanja Griessmann[1], Raimund Rolfes[1] [[1]Leibniz University Hannover]	96
14:20 ~ 14:40	**A Temperature-driven One-Class Support Vector Machine Method for Anomaly Detection** Yanjie Zhu[1], Irwanda Laory[2], Yi-Qing Ni[1] [[1]The Hong Kong Polytechnic University, [2]The University of Warwick]	115
14:40 ~ 15:00	**Damage Detection of Reinforced Concrete Bridge Considering Temperature Influence based on AANN and FCM-PSO** Xianqiang Wang[1], Jiandong Zhang[1] [[1]JSTI GROUP]	123

SPECIAL SESSION

Sensing Technologies for Evaluation and Characterization of Concrete Materials II

Chair: Ying Zhang & Jinying Zhu

Location: Hewlett 201

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**Ultrasonic-Acoustic Emission Hybrid System for Monitoring Concrete Structures Affected by Alkali-Silica Reaction** Hongbin Sun[1], Yalei Tang[1], Clayton Malone[1], Jiong Hu[1], Jinying Zhu[1] [[1]University of Nebraska-Lincoln]	332
15:40 ~ 16:00	**Monitoring Cracks with Nonlinear Coda Wave Interferometry (NCWI): Numerical and Experimental Results** Guangzhi Chen[1], Odile Abraham[1], Damien Pageot[1], Olivier Durand[1], Mathieu Chekroun[2], Vincent Tournat[2] [[1]IFSTTAR, [2]Le Mans University]	179
16:00 ~ 16:20	**Towards Embedded Fiber Optics for the Ultrasonic Monitoring of Concrete** Simon Nehr[1], Odile Abraham[2], Nicolas Roussel[1], Guillaume Laffont[1], Tom Druet[1], Bastien Chapuis[1] [[1]CEA, [2]IFSTTAR]	221
16:20 ~ 16:40	**Recognition of the Distress in Concrete Pavement using Deep Learning Based on GPR Image** Juncai Xu[1], Zhenzhong Shen[1] [[1]Hohai University]	14

Sensors and Actuators II

Chair: Prakash Patnaik & Gian Paolo Cimellaro

Location: 380-380C

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**Influence of Production and Environmental Parameters on the behaviour of hybrid Piezo / Temperature Sensors for Production and Structural Health Monitoring of Composite Structures** Michael Scheerer[1], Zoltan Simon[1], Michael Marschler[1], Bernhard Rittenschober[2] [[1]Aerospace & advanced Composites GmbH, [2]ALPEX Technologies GmbH]	5
15:40 ~ 16:00	**Mechanoluminescent-Perovskite Pressure Sensor for Structural Health Monitoring** Md Abu Shohag[1], G. Ryan Adams[2], Vincent Obiozo Eze[2], Tony Ichite[2], Lucas Braga Carani[2], Okenwa Okoli[2] [[1]FAMU, [2]FSU]	75
16:00 ~ 16:20	**A Thickness Monitoring Solution for Pipeline Integrity Management and Corrosion Detection** Natalia Garban[1], Rodrigo Rueda[1], Ali Khadimallah[1], Slim Soua[2] [[1]TWI, [2]Fullagar Technologies ltd]	405
16:20 ~ 16:40	**Development of a High Temperature Ultrasonic SHM System Using Glass Couplant** Robert A. Pritchard[1] [[1]Wood]	130

SPECIAL SESSION

Distributed and Quasi-distributed Fiber-optic and Electrical Sensors and Associated Data Analysis and Management II

Chair: Branko Glisic & Daniele Zonta

Location: Hewlett 103

TIME	TUESDAY, SEPTEMBER 10	SUBMISSION ID
15:20 ~ 15:40	**Measurement Accuracy of Distributed Sensing Fibers Embedded within Capillaries of Solid Structures** Yuzhe Xiao[1], Calvin Rans[1], Dimitrios Zarouchas[1], Rinze Benedictus[1] [[1]Delft University of Technology]	70
15:40 ~ 16:00	**Durability and Mechanical Properties of Optical Fiber Strain Sensing Cable for Structural Health Monitoring in Harsh Environment** Arianna Piccolo[1], Sylvie Delepine-Lesoille[1], Etienne Friedrich[2], Shasime Aziri[2] [[1]Andra, [2]Solifos AG]	105
16:00 ~ 16:20	**Full-length Tunnel Structural Monitoring** Daniele Inaudi[1], Roberto Walder[1] [[1]SMARTEC SA]	319
16:20 ~ 16:40	**Durability of Distributed Optical Fiber Sensors used for SHM of Reinforced Concrete Structures** Ismail Alj[1], Marc Quiertant[1], Aghiad Khadour[1], Quentin Grando[2], Karim Benzarti[1] [[1]IFSTTAR, [2]IRSN]	378

SPECIAL SESSION

Guided Waves in Structures for SHM III

Chair: W. Ostachowicz & Ying Wang

Location: Hewlett 200

TIME	TUESDAY, SEPTEMBER 10	SUBMISSION ID
15:20 ~ 15:40	**Passive Tomography by Elastic Guided Wave for Corrosion Detection in Pipelines** Huu Tinh Hoang[1], Tom Druet[1], Bastien Chapuis[1], Emmanuel Moulin[2] [[1]CEA List, [2]Université Polytechnique Hauts-de-France]	401
15:40 ~ 16:00	**Numerical and Experimental Investigation of Multilayer Delamination Detection in Composites** Hanfei Mei[1], Victor Giurgiutiu[1] [[1]University of South Carolina]	225
16:00 ~ 16:20	**Health Monitoring Of Composite Structures By Combining Ultrasonic Wave Data** Marcus Haywood-Alexander[1], Keith Worden[1], Robert Barthorpe[1], Ramon Fuentes[1], Tim Rogers[2], Nikolaos Dervilis[1] [[1]University Of Sheffield, [2]University of Sheffield]	52
16:20 ~ 16:40	**Hybrid Modeling of Elastic Wave Propagation: Domain Coupling and Stability** Siddhesh Raorane[1], Tadeusz Uhl[1], Pawel Packo[1] [[1]AGH – University of Science and Technology]	531

System Identification and Structural Dynamics

Chair: William Meeker & Nathan Wells

Location: 380-380F

TIME	TUESDAY, SEPTEMBER 10	SUBMISSION ID
15:20 ~ 15:40	**On the Potential of Dynamic Substructuring Methods for Model Updating** Thomas Simpson[1], Vasilis K. Dertimanis[1], Costas Papadimitriou[2], Eleni N. Chatzi[1] [[1]ETH Zurich, [2]University of Thessaly]	104
15:40 ~ 16:00	**Methodology for Real-Time State Estimation at Unobserved Locations for Structures Experiencing High-Rate Dynamics** Austin Downey[1], Jonathan Hong[2], Bryan Joyce[3], Jacob Dodson[4], Chao Hu[5], Simon Laflamme[5] [[1]University of South Carolina, [2]Applied Research Associates, [3]University of Dayton Research Institute, [4]Air Force Research Laboratory, [5]Iowa State University]	2
16:00 ~ 16:20	**Non-Destructive Testing for Damage Detection in Composite Materials** Emilio Di Lorenzo[1], Quirino Lorenzo Bernabei[2], Bart Peeters[1] [[1]Siemens Industry Software NV, [2]University of Rome "La Sapienza"]	25
16:20 ~ 16:40	**Vibration-Based Damage Identification of Sandwich Panels with Truss Core** Lingling Lu[1], Jie Le[1], Yabo Wang[1], Hongwei Song[1], Chenguang Huang[1] [[1]Chinese Academy of Science]	533

SPECIAL SESSION

Human-Machine Interfaces for Structural Inspection

Chair: Fernando Moreu & Marc Rebillat
Location: 380-380W

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**Subsurface Infrastructure Asset Monitoring with Geophysical Sensors and Augmented Reality** Dryver Huston[1], Tian Xia[1], Mauricio Pereira[1], Dylan Burns[1], Daniel Orfeo[1] [[1]University of Vermont]	515
15:40 ~ 16:00	**Unmanned Vehicles for Lightning Protection System Inspection and Maintenance** David Mascarenas[1], Ashlee Liao[1], John Morales[1], Frederick Berl[1], Shawn Hailey[1], [2]James Milligan[1], Dennis Vigil[1], Adam Smith[1], Robert Van Winkle[1] [[1]LANL]	384
16:00 ~ 16:20	**Remote Sensing Using Augmented Reality and Low-Cost Sensors** Marlon Aguero[1], Dilendra Maharjan[1], Soamiya Chavez[1], Maria del Pilar Rodriguez[1], David Mascarenas[2], Fernando Moreu[1] [[1]The University of New Mexico, [2]Los Alamos National Laboratory]	292

SPECIAL SESSION

Higher Level Inspection by Instrumenting Bridges - Implementing SHM into the Codes

Chair: Douglas Thomson & Nazih Mechbal
Location: 380-380D

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**Monitoring based Risk Assessment and Asset Management of Civil Infrastructures** Helmut Wenzel[1] [[1]WENZEL Consult]	329
15:40 ~ 16:00	**A Case for Adding an Inspection Level Related to SHM for Bridge Evaluation by CHBDC** Aftab Mufti[1],Farnaz Raeisi[1], Basheer Algohi[1], Baidar Bakht[1], Huma Khalid[1] [[1]University of Manitoba]	376
16:00 ~ 16:20	**A Simple Low-Cost Solution for Bridge Scour Monitoring Using Photoelectric Sensors** Mohammed Farooq[1], Fae Azhari[2], Nemkumar Banthia[1] [[1]University of British Columbia, [2]University of Toronto]	418
16:20 ~ 16:40	**Structural Health Monitoring (SHM) Innovation or Novelty – The Move to Fleet Level SHM** Douglas Thomson[1], Basheer Algohi[1], Brian Westcott[2], Evangeline Murison[3] [[1]University of Manitoba, [2]Intelligent Structures Inc., [3]Government of Manitoba]	453

SPECIAL SESSION

Diagnostics and Prognostics of Composite Structures towards a Condition-based Maintenance Framework I

Chair: Dimitrios Zarouchas & Theodoros Loutas
Location: 380--380Y

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**An Efficient Augmented Reality (AR) System for Enhanced Visual Inspection** Shaohan Wang[1], Sakib Ashraf Zargar[1], Cheryl Xu[1], Fuh-Gwo Yuan[1] [[1]North Carolina State University]	90
15:40 ~ 16:00	**Composite Material Remaining Useful Life Estimation using an IoT-Compatible Probabilistic Modeling Framework** Krzysztof Mazur[1], Sarah Malik[1], Rakeen Rouf[1], Mohammadreza Bahadori[1], Mira Shehu[1], Melvin Matthew[1], Emine Tekerek[1], Brian Wisner[2], Antonios Kontsos[1] [[1]Drexel University, [2]Ohio University]	440
16:00 ~ 16:20	**Damage Diagnosis and Prognosis In A Composite Structure By Surrogate Modelling and Particle Filtering** Demetrio Cristiani[1], Claudio Sbarufatti[1], Marco Giglio[1] [[1]Politecnico di Milano]	255
16:20 ~ 16:40	**Optimal Decision Making for Cost-Effective SHM Planning** Sunyong Kim[1], Dan M. Frangopol[2] [[1]Wonkwang University, [2]Lehigh University]	135

SPECIAL SESSION		
Multifunctional Materials and Structures I		
Chair: Kenneth Loh & Donghyeon Ryu		*Location:* Hewlett 101
TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**Damage Detection via Electrical Impedance Tomography in a Filament Wound Glass Fiber/Epoxy Composite Tube with Carbon Black Filler** Akshay Jacob Thomas[1], Tyler N. Tallman[1] [[1]Purdue University]	88
15:40 ~ 16:00	**Developing Intelligent Structures and Devices using Novel Smart Materials and Multi-Material Multi-Method (m^4) 3D Printing** Devin Roach[1], Janet Wong[1], Xiao Kuang[1], Craig Hamel[1], Joshua Kovitz[1], H. Jerry Qi[1] [[1]Georgia Institute of Technology]	59
16:00 ~ 16:20	**Topological Design and Characterization of Piezoresistive Nanocomposites** Long Wang[1], Gianmarco Vella[1], Wei-Hung Chiang[2], Kenneth J. Loh[1] [[1]UC San Diego, [2]National Taiwan University of Science & Technology]	78
16:20 ~ 16:40	**Understanding Constitutive Relationship between Mechanoluminescence of ZnS:Cu-PDMS and Strain** Alfred Mongare[1], Dominic Gallegos[1], Mariah Gammill[1], Willow Lindsey-Paek[1], Nikolai G. Kalugin[1], Donghyeon Ryu[1] [[1]New Mexico Tech]	473

SPECIAL SESSION		
The Impact of Engineering Informatics: The Law Legacy in the Field of Structural Health Monitoring II		
Chair: Jerome Lynch & Kay Smarsly		*Location:* 380-380X
TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**Fire and Rescue Operations in Extreme Winds** Min Young Park[1], Hoi Gab Jeong[2], Soon-Duck Kwon[2] [[1]National Fire Service Academy, [2]Chonbuk National University]	310
15:40 ~ 16:00	**Hierarchical Anomaly Detection using a Multi-output Gaussian Process** Woojin Cho[1], Jinkyoo Park[1] [[1]KAIST]	514
16:00 ~ 16:20	**A Hybrid Architecture for Building Energy Optimization** Karthik Krishnamurthy[1], Pradeep Singh, Nikhil Sriraman [[1]Candela IoT]	468
16:20 ~ 16:40	**Stress Monitoring Based on Lamb Waves Measurements and a Convolutional Neural Network** Hyung Jin Lim[1], Hoon Sohn[1], Ohjun Kwon[1] [[1]Korea Advanced Institute of Science and Technology (KAIST)]	32

SPECIAL SESSION		
Digital Twin of Civil Infrastructure		
Chair: Kamyab Zandi & Fernando Dotta		*Location:* Hewlett 102
TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
15:20 ~ 15:40	**A UAV-Based Platform for Real-Time Damage and Defect Identification in Concrete Structures** Elliot Ransom[1], Tanay Topac[1], Ruiqi Chen[1], Grayson Armour[1], Michael Charles Marsh, Jr.[1], Kamyab Zandi[2] [[1]Stanford University, [2]Chalmers University of Technology]	561
15:40 ~ 16:00	**A Digital Twin of Bridges for Structural Health Monitoring** Cong Ye[1], Liam Butler[2], Bartek Calka[1], Marat Iangurazov[4], Qiuchen Lu[1], Alastair Gregory[3], Mark Girolami[3], Campbell Middleton[1] [[1]University of Cambridge, [2]York University, [3]The Alan Turing Institute]	270
16:00 ~ 16:20	**Incorporation of Cracks in Finite Elements Modelling of Exiting Concrete Structures** Mattias Blomfors[1], Kamyab Zandi[1], Karin Lundgren[1] [[1]Chalmers University of Technology]	187
16:20 ~ 16:40	**A Framework for Digital Twin of Civil Infrastructure – Challenges & Opportunities** Kamyab Zandi[1], Elliot Harris Ransom[2], Tanay Topac[2], Ruiqi Chen[2], Surendra Beniwal[2], Mattias Blomfors[1], Jiangpeng Shu[3], Fu-Kuo Chang[2] [[1]Chalmers University of Technology, [2]Stanford University, [3]University of Southern Denmark]	424

Technical Program (Wednesday, September 11th)

Welcome Session

Chair: F.-K. Chang & **Co-chair**: A. Guemes

Location: Hewlett 200

TIME	WEDNESDAY, SEPTEMBER 11	
08:20 ~ 08:30	**Opening Remarks** A. Guemes	

Keynote Presentations

Chair: Matthias Buderath

Location: Hewlett 200

TIME	WEDNESDAY, SEPTEMBER 11	
08:30 ~ 09:00	**Quantitative Dynamic and Distributed Fiber-Optic Sensing Has Come of Age** Moshe Tur[1] [[1]School of Electrical Engineering, Tel-Aviv University]	
09:00~ 09:30	**Re-Inventing Disruptive Innovation** Michael Steep[1] [[1]Executive Director, Center on Disruptive Technologies and Digital Cities, Stanford University]	
09:30 ~ 10:00	**Bio-inspired Design of Multifunctional Structures with Sensory, Actuation & Self-learning Capabilities: Air Force Perspective** Les Lee[1] [[1]Program Manager Mechanics of Multifunctional Materials and Microsystems, Air Force Office of Scientific Research (AFOSR)]	

Aerospace Structures I

Chair: J.B. Ihn & Mulugeta Haile

Location: Hewlett 201

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Feasibility Analysis of Various Sensing Methods for Nondestructive Testing of Composites** Lifu Wang[1], Leonardo Araque[1], Steffen Tai[1], Ajit Mal[1], Christoph Schaal[2] [[1]UCLA, [2]California State University, Northridge]	465
10:40 ~ 11:00	**Detection of Cracks in Turbine Blades with Nonlinear Ultrasonic Frequency Modulation** Frank Mevissen[1], Michele Meo[1] [[1]University of Bath]	420
11:00 ~ 11:20	**Defect Sizing using Convolution Neural Network Applied to Guided Wave Imaging** Andrii Kulakovskyi[1], Olivier Mesnil[2], Bastien Chapuis[2], Oscar d'Almeida[1], Alain Lhémery[2] [[1]SAFRAN, [2]CEA LIST]	447
11:20 ~ 11:40	**Strain-based Structural Health Monitoring: Computing Regions for Critical Crack Detection** Simon Pfingstl[1], Markus Zimmermann[1] [[1]Technical University of Munich]	206
11:40 ~ 12:00	**Real-Time Impact Identification on an A350 Crown Panel by using Acceleration Measurements** Dimitri Goutaudier[1], Didier Gendre[2] [[1]Onera, [2]Airbus]	262

SPECIAL SESSION
Civil Structures II

Chair: Hoon Sohn

Location: 380-380C

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Low-Cost Electromechanical Impedance Testing Damage Detection of Submerged Civil Structures** Shuo Wang[1], Addie Lederman[2], Fernando Gomez[1], Billie F. Spencer Jr.[1], Matthew Smith[3] [[1]University of Illinois at Urbana-Champaign, [2]KPFF Consulting Engineers, [3]US Army Corps of Engineers]	293
10:40 ~ 11:00	**On the Utilization of Synthetic and Measured Earthquake Ground Motions for Designing Building Monitoring Systems in the Near-Field of Major Faults** Floriana Petrone[1], David McCallen[2], Mehmet Celebi[3], Mamun Miah[1] [[1]Lawrence Berkeley National Laboratory, [2]University of Nevada, Reno, [3]United States Geological Survey]	109
11:00 ~ 11:20	**Monitoring of Membrane Structures using Unmanned Aerial Vehicle Assisted Photogrammetry** Leslie Wong[1], Frank Courtney[2], Benjamin Steven Vien , Thomas Kuen, Peter Douglas, Yue Ma, Jayantha Kodikara, Wing Kong Chiu [[1]Monash University, [2]Melbourne Water]	238
11:20 ~ 11:40	**Knowledge Transfer between Buildings for Post-Earthquake Damage Diagnosis without Target Building's Historical Data** Susu Xu[1], Hae Young Noh[1] [[1]Carnegie Mellon University]	475
11:40 ~ 12:00	**Failure Monitoring of Bolted Joints by using Eddy Current Array Sensing Film** Hu Sun[1], Tao Wang[1], Qijian Liu[1], Yishou Wang[1], Xinlin Qing[1] [[1]Xiamen University]	268

Diagnostics II

Chair: Moshe Tur | **Location:** Hewlett 103

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**An IoT Enabled Framework to Support Structural Health Monitoring Applications** Haroon Malik[1], Wael Zatar[1] [[1]Marshall University]	288
10:40 ~ 11:00	**Big Data in Experimental Structural Dynamics by Synchronous Ensembles of Collocated Acceleration Signals (CAS):The Reciprocity Principle Failure and Advanced Diagnostics for Composite Structures** Ioannis Georgiou[1] [[1]National Techical University of Athens]	494
11:00 ~ 11:20	**Investigations on the Application of Actively and Passively Excited Guided Elastic Waves for the Monitoring of Fiber-Reinforced Plastics** Kilian Tschoeke[1], Tobias Gaul[1], Alexander Pietzsch[1], Eberhard Schulze[1], Lars Schubert[1] [[1]Fraunhofer Institute for Ceramic Technologies and Systems IKTS]	363
11:20 ~ 11:40	**On the Use of Distance Measures in the Phase Portrait for Damage Localisation and Severity Assessment** Xiwen Gu[1], Shixi Yang[1], Evangelos Papatheou[2] [[1]Zhejiang University, [2]University of Exeter]	375
11:40 ~ 12:00	**Identification of Out-of-Round Wheels on Heavy-Haul Railway Lines by Using Ballast Pressure Data** Qingjie Liu[1], Xiaoyan Lei[1], Jerry G. Rose[2], Qingsong Feng[1], Teng Wang[3] [[1]East China Jiaotong University, [2]University of Kentucky, [3]Texas A&M Transportation Institute]	246

SPECIAL SESSION

Guided Waves in Structures for SHM IV

Chair: Wieslaw Ostachowicz & Peter Kraemer | **Location:** Hewlett 200

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Model Assisted Probability of Detection for Guided Wave Imaging Structural Health Monitoring** Pierre Calmon[1], Olivier Mesnil[1], Roberto Miorelli[1], Xavier Artusi[1], Bastien Chapuis[1], Oscar D'Almeida[2] [[1]CEA LIST, [2]Safran Tech]	402
10:40 ~ 11:00	**Evaluation of Independent Component Analysis for Lamb-wave Crack Detection in Metallic Plates** Christian Kexel[1], Serena Pötzsch[1], Jochen Moll[1] [[1]Goethe University Frankfurt]	42
11:00 ~ 11:20	**Ultrasonic Guided Wave Dataset for Super-Resolution Reconstruction of Images from Compressed Wavefield Acquisition** Yasamin Keshmiri Esfandabadi[1], Maxime Bilodeau[2], Patrice Masson[2], Luca De Marchi[1] [[1]University of Bologna, [2]Université de Sherbrooke]	219
11:20 ~ 11:40	**Effect of Fiber Bragg Gratings Receivers' Directivity on Guided Wave Tomography of Pipe** Tom Druet[1], Huu Tinh Hoang[1], Simon Nehr[1], Guillaume Laffont[1], Bastien Chapuis[1] [[1]CEA List]	404
11:40 ~ 12:00	**Three-Dimensional Acoustic Wavenumber Spectroscopy for Structural Health Monitoring** Peter Fickenwirth[1], Mathew Adams[1], Eric Flynn[1] [[1]Los Alamos National Laboratory]	452

SPECIAL SESSION

Vision-based Studies for SHM III

Chair: Mohammad Jahanshahi | **Location:** 380-380F

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Spatial resolution improvement of digital and thermographic imaging using an automatic and controllable Super-Resolution technique** Weixiang Du[1], Yifan Zhao[1], Sri Addepalli[1] [[1]Cranfield University]	186
10:40 ~ 11:00	**A Deep Learning Approach for Impact Diagnosis** Sakib Ashraf Zargar[1], Fuh-Gwo Yuan[1] [[1]North Carolina State University, Raleigh, North Carolina]	65
11:00 ~ 11:20	**System Identification of Large-Scale Bridge Model using Digital Image Correlation from Monochrome and Color Cameras** Luna Ngeljaratan[1], Mohamed A. Moustafa[1] [[1]University of Nevada, Reno]	294
11:20 ~ 11:40	**Deep Learning-Based Damage Detection of Miter Gates using Synthetic Imagery from Computer Graphics** Vedhus Hoskere[1], Yasutaka Narazaki[2], Bille F. Spencer[2], Matthew D. Smith[3] [[1]University of Illinois at Urbana-Champaign, [2]University of Illinois at Urbana Champaign, [3]US Army Engineer Research and Development Center]	156
11:40 ~ 12:00	**Computer-Vision Based UAV Inspection for Steel Bridge Connections** Ji Young Lee[1], Chungwook Sim[1], Carrick Detweiler[1], Kwanghee Won[2] [[1]University of Nebraska-Lincoln, [2]South Dakota State University]	438

SPECIAL SESSION

Structural Health Monitoring and Condition-based Maintenance of High-speed and Intercity Railways I

Chair: Yiqing Ni & Hua-Peng Chen — ***Location:*** 380-380W

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Ultrasonic Identification of Rail Tracks from Natural Wheel Excitations: Potential for High-Speed and High-Redundancy Rail Inspection** Francesco Lanza di Scalea[1], Albert Liang[1], Simone Sternini[1], Margherita Capriotti[1], Diptojit Datta[1], Xuan Zhu[2], Robert Wilson[3] [[1]University of California, San Diego, [2]University of Utah, [3]Federal Railroad Administration]	343
10:40 ~ 11:00	**3D Displacement Monitoring of Railroad Bridges Using Unmanned Aerial Vehicles (UAVs)** Roya Nasimi[1], David Mascarenas[2], Fernando Moreu[1] [[1]University of New Mexico, [2]Los Alamos National Laboratory]	284
11:00 ~ 11:20	**Using Solitary Waves to Monitor / Measure Axial Stress** Amir Nasrollahi[1], Mahmoud Bayat[1], Piervincenzo Rizzo[1] [[1]University of Pittsburgh]	29
11:20 ~ 11:40	**Dynamic Characteristics of Vehicle-Track System Affected by Cement Asphalt Mortar Gap** Qingsong Feng[1], Kui Sun[1], Huapeng Chen[1], Xiaoyan Lei[1] [[1]East China Jiao Tong University]	15
11:40 ~ 12:00	**Propagation Characteristics of Ultrasonic Guided Waves in High-Speed Rails** Hua-Peng Chen[1], Kui Sun[1], Qingsong Feng[1] [[1]East China Jiao Tong University]	27

Statistical Methods and Machine Learning I

Chair: Spilios Fassois & Rafik Hadjria — ***Location:*** 380-380D

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Data-Driven Strategy for Energy-Efficient Structural Health Monitoring with Sparse/Delayed Signals** Hadi Salehi[1], Subir Biswas[1], Rigoberto Burgueño[1] [[1]Michigan State University]	522
10:40 ~ 11:00	**Learning Condition Indicators for Rolling Element Bearings via Deep Variational Autoencoding** Edward Zhu[1], Mulugeta Haile[1], Adrian Hood[1], Brian Dykas[1] [[1]Army Research Lab]	330
11:00 ~ 11:20	**Deep Convolutional Neural Networks for Comprehensive Structural Health Monitoring and Damage Detection** Bing Zha[1], Yongsheng Bai[1], Alper Yilmaz[1], Halil Sezen[1] [[1]The Ohio State University]	243
11:20 ~ 11:40	**Autoencoder Networks for Unsupervised Feature Extraction of Acoustic Monitoring Signals** Jeffrey Bynum[1], Parastoo Kamranfar[1], David Lattanzi[1] [[1]George Mason University]	146
11:40 ~ 12:00	**Concrete Micro Crack Detection and Segmentation Using Adaptive U-Net** Peng Sun[1], Ziyan Wu[1], Jiquan Ma[2], Pew-Thian Yap[2] [[1]Northwestern Polytechnical University, [2]the University of North Carolina at Chapel Hill]	160

SPECIAL SESSION

Diagnostics and Prognostics of Composite Structures towards a Condition-based Maintenance Framework II

Chair: Dimitrios Zarouchas & Theodoros Loutas — ***Location:*** 380--380Y

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Upscaling the Data-Driven Prognostic Methodologies Towards a Condition-Based Structural Health Management of Composite Structures** Theodoros Loutas[1], Dimitrios Zarouchas[2] [[1]Department of Mechanical Engineering & Aeronautics, University of Patras, [2]Aerospace Engineering Faculty, Delft University of Technology]	312
10:40 ~ 11:00	**Dimension Reduction Algorithms in the Damage Indexes Space for Damage Size Quantification in Aeronautic Composite Structures** Marc REBILLAT[1], Nazih MECHBAL[1] [[1]ENSAM-CNAM-CNRS]	177
11:00 ~ 11:20	**Automatic Scanning System for Surface / Internal Crack Detection of Fiber Reinforced Concrete Pipe** Suyun Ham[1], Sanggoo Kang[1] [[1]University of Texas at Arlington]	464
11:20 ~ 11:40	**Influence of Bending Loads on Ultrasonic Guided-Waves Based Structural Health Monitoring of Laminated Composite Structures** Surajit Roy[1], Skanda Rai[1], Manoj Sampangi Ram[1] [[1]California State University Long Beach]	448
11:40 ~ 12:00	**Structural Health Monitoring for Aerospace Composite Structures** Rafik HADJRIA[1], Oscar D'ALMEIDA[1] [[1]Safran]	210

SPECIAL SESSION **Nonlinear Acoustic and Ultrasonic Techniques for Structural Health Monitoring I** *Chair:* Tribikram Kundu & Chun Wang		*Location:* Hewlett 101
TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Monitoring of Bonding Quality in CFRP Composite Laminates by Measurements of Local Vibration Nonlinearity** Igor Solodov[1], Marc Kreutzbruck[1], Damian Segur[2] [[1]University of Stuttgart, [2]CEA TECH]	192
10:40 ~ 11:00	**Feasibility of a New Nonlinear Ultrasonic Technique for Monitoring Damage in Composite Plates** Hamad Alnuaimi[1], Umar Amjad[1], Pietro Russo[2], Valentina Lopresto[3], Tribikram Kundu[1] [[1]University of Arizona, [2]National Research Council (CNR), [3]University of Naples Federico]	18
11:00 ~ 11:20	**Dynamics-based Testing to Localize Macro Cracking due to Alkali-Ailica Reaction in Concrete** Sarah Miele[1], Pranav Karve[1], Sankaran Mahadevan[1], Vivek Agarwal[2] [[1]Vanderbilt University, [2]Idaho National Laboratory]	170
11:20 ~ 11:40	**Implementation of Ultrasonic Coda Wave Interferometry on a real bridge** Xin Wang[1], Ernst Niederleithinger[1], Marco Lange[1], Heiko Stolpe[1] [[1]BAM, Federal Institute for Materials Research and Testing]	189
11:40 ~ 12:00	**Outlier Analysis of Nonlinear Solitary Waves for Health Monitoring Applications** Hoda Jalali[1], Bowen Zheng[1], Amir Nasrollahi[1], Piervincenzo Rizzo[1] [[1]University of Pittsburgh]	36

SPECIAL SESSION **Probabilistic SHM I** *Chair:* Daniele Zonta & Nobuyoshi Yobuki		*Location:* 380-380X
TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Probabilistic Damage Quantification via the Integration of Non-parametric Time-series and Gaussian Process Regression Models** Ahmad Amer[1], Fotis Kopsaftopoulos[1] [[1]Rensselaer Polytechnic Institute]	477
10:40 ~ 11:00	**Risk Adaptive Maneuver for Maintenance-Free Operation** Mulugeta Haile[1] [[1]U.S Army Research Laboratory]	350
11:00 ~ 11:20	**Bayesian Information Fusion for Fatigue Crack Growth Diagnosis using Ultrasonic Guided Wave Pitch-Catch in a Piezoelectric Actuator-Sensor Network** Pranav Karve[1], Sankaran Mahadevan[1] [[1]Vanderbilt university]	230
11:20 ~ 11:40	**Bayesian Damage Characterization based on Perturbation Model Utilizing Responses at Vibration Nodes** Tianxiang Huang[1], Kai-Uwe Schröder[1] [[1]RWTH Aachen University]	136
11:40 ~ 12:00	**Ultrasonic Guided Wave Based System Identification for Beams** Muhammad Khalid Malik[1], Sergio Cantero Chinchilla[1], Dimitrios Chronopoulos[1], Juan Chiachio[2], Yasser Essa[3] [[1]University of Nottingham, [2]University of Strathclyde, [3]Aernnova Engineering Division S.A.]	91

Prognostics and Health Management *Chair:* Herbert Friedmann & Emily O'Connor		*Location:* Hewlett 102
TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
10:20 ~ 10:40	**Health Prognostics of Lithium-ion Batteries and Battery-Integrated Structures** Purim Ladpli[1], Chen Liu[1], Fotis Kopsaftopoulos[2], Fu-Kuo Chang[1] [[1]Stanford University, [2]Rensselaer Polytechnic Institute]	537
10:40 ~ 11:00	**A Novel Impedance-Based Method for Structural Monitoring of Automotive Lithium-Ion Battery Packs** Jonas Seifert[1], Jan-Philipp Schmidt[1] [[1]BMW Group]	216
11:00 ~ 11:20	**Demonstration of Prognostics Health Monitoring (PHM) in Adhesive Lap Joints using Simulated Studies** Karthik Reddy Lyathakula[1], Fuh-Gwo Yuan[1] [[1]North Carolina State University]	347
11:20 ~ 11:40	**Industrial IOT enabled SHM systems** Amrita Kumar[1], Howard Chung[1], Taru Singhal[1], Susheel Yadav[1], Cody Gray[1], Grant Chang[1], Irene Li[1] [[1]Acellent Technologies]	546
11:40 ~ 12:00	**The Industry Internet of Things (IIoT) as a Methodology for Autonomous Diagnostics, Prognostics in Aerospace Structural Health Monitoring** Sarah Malik[1], Krzysztof Mazur[1], Rakeen Rouf[1], Antonios Kontsos[1] [[1]College of Engineering, Drexel University]	446

Aerospace Structures II

Chair: Peter Cawley & Kishan Goel

Location: Hewlett 201

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Full Field Reconstruction in Aeronautical Structures Subjected to Aerodynamic Loads by a Matrix-Based Load Monitoring Algorithm** Luca Colombo[1], Claudio Sbarufatti[1], Marco Giglio[1] [[1]Politecnico di Milano]	544
13:50 ~ 14:10	**Experience with On-board SHM System Testing on Small Commuter Aircraft** Jindrich Finda[1], Vanessa Valentova[1], Radek Hedl[1] [[1]Honeywell]	306
14:10 ~ 14:30	**Multi-functional FBG interrogation for Integrated Structural Health Management** Rolf Evenblij[1] [[1]Technobis]	34
14:30 ~ 14:50	**Evaluation of Disbonds by Diagnostic System Using Lamb Wave Sensor Network** Yuki Tokita[1], Yoshiharu Kuze[1], Mitsuyoshi Uematsu[1], Kanata Fujii[1], Kosuke Watanabe[1] [[1]Mitsubishi Heavy Industries]	545
14:50 ~ 15:10	**Shape Sensing of Beams with Complex Cross-Sections using the Inverse Finite Element Method** Rinto Roy[1], Marco Gherlone[1], Cecilia Surace[1] [[1]Politecnico di Torino]	100
15:10 ~ 15:30	**Methods for SHM System Capability Evaluation from Engineer's Perspective** Martin Knob[1], Jindřich Finda[1], Vanessa Valentová[1], Radek Hédl[1], Petr Frolík[1] [[1]Honeywell]	324

Civil Structures III

Chair: Erdal Safak & Elizabeth Cross

Location: 380-380C

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Laser Ultrasonic Imaging of Built Facilities for Improved Lifecycle Management** Abhijit Mukherjee[1], Jay Kumar Shah[1], Yi Kuan Wang[1] [[1]Curtin University]	499
13:50 ~ 14:10	**Monitoring Concrete Strength using Strain Energy Based Structural Health Monitoring Technique: Hypothetical Case Study of a Gravity dam** Saikat Bagchi[1], Timir Baran Roy[1], Ashutosh Bagchi[1] [[1]Concordia University]	483
14:10 ~ 14:30	**Automated Generation of FE Model for Digital Twin of Concrete Structures from Segmented 3D Point Cloud** Jiangpeng Shu[1], Kamyab Zandi[2], Tanay Topac[3], Ruiqi Chen[3], Chun Fan[4] [[1]University of Southern Denmark, [2]Chalmlers University of Technology, [3]Stanford University, [4]Nordic Semiconductor]	493
14:30 ~ 14:50	**Autonomous Application of Smart Cement Sensor-Repairs** Jack McAlorum[1], Marcus Perry[1], Christos Vlachakis[1], Lorena Biondi[1] [[1]University of Strathclyde]	22
14:50 ~ 15:10	**Concrete Culvert Bridge Condition Monitoring Using Acceleration Responses: A Case Study** Solomon Lin[1], Ye Lu[1], Mehrisadat Makki Alamdari[2], Khoa Nguyen[3] [[1]Monash University, [2]University of New South Wales, [3]CSIRO]	20
15:10 ~ 15:30	**Crack Detection using Embedded Fiber-Optic Sensors in Reinforced Concrete Beams** Gian Paolo Cimellaro[1], Marco Domaneschi[1], Alessandro Cardoni[1], Daniele Inaudi[2], Ivan Cottone[2], Farhad Ansari[3] [[1]Politecnico di Torino, [2]SMARTEC, [3]University of Illinois at Chicago]	504

Diagnostics III

Chair: Surajit Roy & David McCallen

Location: Hewlett 103

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Structural Health Monitoring for Damage Localisation and Imaging using a Linear and Nonlinear Ultrasound Subharmonic and Modulation Method** Gian Piero Malfense Fierro[1], Salvatore Boccardi[1], Michele Meo[1] [[1]UNIVERSITY OF BATH]	412
13:50 ~ 14:10	**Real-Time Remote Monitoring of Power Plants in terms of IIoT and Cloud Computing** Jindrich Liska[1], Vojtech Vasicek[1], Martin Kas[1] [[1]University of West Bohemia, NTIS]	40
14:10 ~ 14:30	**An Integrated Ultrasonic Imaging Technique using Laser Scanning System** Jun Young Jeon[1], Seong Jin Im[1], Gyuhae Park[1], To Kang[2], Soonwoo Han[2] [[1]Chonnam National University, [2]Korea Atomic Energy Research Institute]	250
14:30 ~ 14:50	**Annealing Optimization** Ranting Cui[1], Francesco Lanza di Scalea[1] [[1]UC San Diego]	279
14:50 ~ 15:10	**Wavelet Analysis of Diffuse Ultrasonic Waves for Damage Detection** Sandeep Kumar[1], A.S. Wali[1], Amit Tyagi[1] [[1]IIT(BHU)]	272
15:10 ~ 15:30	**Identification of Train Wheel Flat Accounting for Measurement and Modeling Uncertainties** Wen-Jun Cao[1], Shanli Zhang[2], Numa J. Bertola[1], I.F.C Smith[3], C.G. Koh[2] [[1]Singapore-ETH Centre, [2]National university of Singapore, [3]Swiss Federal Institute of Technology]	21

SPECIAL SESSION **Guided Waves in Structures for SHM V** *Chair:* Wieslaw Ostachowicz & Michael Grygier *Location:* Hewlett 200		
TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Modelling and Simulation of Ultrasonic Guided Waves Propagation in the Fluid-Composite Structure Interaction** Bhuiyan Shameem Mahmood Ebna Hai[1], Markus Bause[1] [[1]Helmut Schmidt University - University of the Federal Armed Forces Hamburg]	503
13:50 ~ 14:10	**Selective Actuation and Sensing of Antisymmetric Waves Using Shear-mode Piezoelectric Transducers** Hussain Altammar[1], Nathan Salowitz[1] [[1]University of Wisconsin - Milwaukee]	422
14:10 ~ 14:30	**An Approach on how to Determine Key Performance Indicators for Guided Wave Based SHM Systems Based on Numerical Simulation** Aadhik Asokkumar[1], Ramanan Sridaran Venkat[2], Christian Boller[12] [[1]Dresden International University, [2]Universität des Saarlandes]	267
14:30 ~ 14:50	**Development of a Guided Wave Experiment for the International Space Station** John A. Sanchez[1], Andrei Zagrai[1] [[1]New Mexico Institute of Mining and Technology]	291
14:50 ~ 15:10	**SHM using Guided Waves – Recent Activities and Advances in Germany** Inka Mueller[1], Jochen Moll[2], Christian Kexel[2], Lars Schubert[3], Kilian Tschöke[3], Jens Prager[4], Yevgeniya Lugovtsova[4], Martin Bach[5], Thomas Vogt[6] [[1]Ruhr University Bochum, [2]Goethe University of Frankfurt am Main, [3]Fraunhofer Institute für Ceramic Technologies and Systems IKTS, [4]Federal Institute for Materials Research and Testing BAM, [5]Airbus Helicopters, [6]Guided Ultrasonics Ltd]	339
15:10 ~ 15:30	**Application of the Scattering Analysis Method for Guided Waves Measured by Laser Scanning Vibrometry** Christoph Humer[1], Christoph Kralovec[1], Martin Schagerl[1] [[1]Johannes Kepler University]	335

SPECIAL SESSION **SHM for Heavy and Critical Equipment** *Chair:* Keqin Ding & Grant Chang *Location:* 380-380F		
TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Development of a Shipboard Wireless Monitoring System to Monitor Ship Crews during Extreme Blast Load Exposure** Wentao Wang[1], Rui Hou[1], Ethan Kennedy[1], Liming W. Salvino[2], Jerome P. Lynch[1] [[1]University of Michigan, [2]Carderock Division of the Naval Surface Warfare Center]	308
13:50 ~ 14:10	**Development and Application of High Temperature Coke Drums Structure Health Monitoring System** Keqin Ding[1], Fangxiong Tang[1], Na Zhao[1], Li Chen[1] [[1]China Special Equipment Inspection and Research Institute]	158
14:10 ~ 14:30	**Recognition Method of Health Monitoring Point of Quayside Container Crane Based on Fuzzy Evaluation** Liu Guansi[1], Ding Keqin[1], Jin Hui[2], Chen Li[1] [[1]China Special Equipment Inspection and Research Institute, [2]Southeast University]	164
14:30 ~ 14:50	**Application of Acoustic Emission Technology on SHM of Overhead Travelling Cranes and Portal Bridge Cranes** Junjiao Zhang[1], Gongtian Shen[1], Zhanwen Wu[1] [[1]China Special Equipment Inspection and Research Institute, Beijing, China]	168
14:50 ~ 15:10	**Structural Health Monitoring and Safety Evaluation of Pressure Vessel by the use of Acoustic Emission Technology** Gongtian Shen[1], Yongna Shen[1], Junjiao Zhang[1] [[1]China Special Equipment Inspection and Research Institute, Beijing, China]	172
15:10 ~ 15:30	**Rolling Element Bearing Fault Diagnosis using Compressed Sensing and Convolutional Neural Network** Zhang Ji-wang[1], Ding Ke-Qin[1] [[1]China Special Equipment Inspection and Research Institute, Beijing, China]	266

SPECIAL SESSION **Flexible Electronics/Sensor Networks for SHM** *Chair:* Sameh Dardona & Nathan Salowitz *Location:* 380-380W		
TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Fabrication and Functionalization of Distributed and Stretchable Sensor Networks for Structural Health Monitoring** Xiyuan Chen[1], Loic Maxwell[2], Elliot Ransom[1], Tanay Topac[1], Callum Bailey[3], Sameh Dardona[3], Fu-Kuo Chang[1] [[1]Stanford University, [2]Acellent Technologies, [3]United Technologies Research Center]	558
13:50 ~ 14:10	**A Robust Expansion Process Technology for Deployment of Stretchable Sensor Networks** Elliot Ransom[1], Dustin Caldwell[2], Xiyuan Chen[1], Sameh Dardona[2], Fu-Kuo Chang[1] [[1]Stanford University, [2]United Technologies Research Center]	559
14:10 ~ 14:30	**Flexible Electronics and Software for Stretchable Sensor Networks in Structural Health Monitoring** Loic Maxwell[1], Spandan Mishra[1], Amrita Kumar[1], Xiyuan Chen[2], Callum Bailey[3], Sameh Dardona[3], Fu-Kuo Chang[2], [[1]Acellent Technologies, [2]Stanford University, [3]United Technologies Research Center]	556
14:30 ~ 14:50	**Laser Cut and Chemical Release Screen Printing Approaches for Creating Substrate Sparse Sensor Networks** Callum Bailey[1], Xiyuan Chen[2], Dustin Caldwell[1], Loic Maxwell[3], Fu-Kuo Chang[2], Sameh Dardona[1] [[1]United Technologies Research Center, [2]Stanford University, [3]Acellent Technologies]	557
14:50 ~ 15:10	**Design of Island-Bridge Layout Stretchable Electronics for High Spatial Accuracy Deployment** Tanay Topac[1], William Mangram[1], Xiyuan Chen[1], Fu-Kuo Chang[1] [[1]Stanford University]	562

Statistical Methods and Machine Learning II

Chair: Christian Boller & Daniel Frank Hesser

Location: 380-380D

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Hierarchical Fisher-information-matrix-based Clustering** Saeid Allahdadian[1], Michael Döhler[2], Carlos Ventura[1], Laurent Mevel[2] [[1]University of British Columbia, [2]University of Rennes]	1
13:50 ~ 14:10	**Detection of Damage-Induced Fatigue Response based on Structural Health Monitoring Data of In-Service Steel Bridges using Artificial Neural Network** Maryam Mashayekhizadeh[1], Erin Santini-Bell[1] [[1]University of New Hampshire]	204
14:10 ~ 14:30	**Applying the Concept of Complexity to Structural Health Monitoring** Keith Worden[1], Nikolaos Dervilis[1], Charles Farrar[2] [[1]University of Sheffield, [2]Los Alamos National Laboratory]	110
14:30 ~ 14:50	**On the Application of Domain Adaptation for Aiding Supervised SHM Methods** Paul Gardner[1], Keith Worden[1] [[1]University of Sheffield]	197
14:50 ~ 15:10	**Combining Edge and Cloud Computing for Monitoring a Fleet of Wind Turbine Drivetrains using Combined Machine Learning Signal Processing Approaches** Cédric Peeters[1], Pieter-Jan Daems[1], Timothy Verstraeten[1], Ann Nowé[1], Jan Helsen[1] [[1]Vrije Universiteit Brussel]	148
15:10 ~ 15:30	**Online Damage State Clustering of Cutting Tools using Dirichlet Process Mixture Models** Chandula T. Wickramarachchi[1], Timothy J. Rogers[1], Wayne Leahy[2], Thomas E. McLeay[3], Elizabeth J. Cross[1] [[1]University of Sheffield, [2]Element Six Ltd., [3]Advanced Manufacturing Research Centre]	208

SPECIAL SESSION

Assessment of the Value of SHM Information I

Chair: Sebastian Thöns & Maria Limongelli

Location: 380--380Y

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Measurement of Individual Risk Preference for Decision-Making in SHM** Antti Valkonen[1], Branko Glisic[1] [[1]Princeton University]	241
13:50 ~ 14:10	**Optimal Maintenance Decision Process for Deteriorating Components in Miter Gates using Markov Chain Prediction Model** Manuel A. Vega[1], Ramin Madarshahian[2], Travis B. Fillmore[3], Michael D. Todd[1] [[1]University of California San Diego, [2]University of California San Diego, [3]United States Army Corps of Engineers]	145
14:10 ~ 14:30	**Decision Making Based on the Value of Information of Different Inspection Methods** Leandro Iannacone[1], Paolo Gardoni[1], Pier Francesco Giordano[2], Maria Pina Limongelli[2] [[1]University of Illinois at Urbana-Champaign, [2]Politecnico di Milano]	147
14:30 ~ 14:50	**A Co-Word Analysis of the Structural Health Monitoring Field** Kaitlyn Kliewer[1], Edward Melcer[2], Branko Glisic[3] [[1]LERA Consulting Structural Engineers, [2]University of California Santa Cruz, [3]Princeton University]	385
14:50 ~ 15:10	**Practical Considerations in Utilizing Structural Health Information in Bridge Maintenance** Daniel Honfi[1] [[1]RISE Research Institutes of Sweden]	456
15:10 ~ 15:30	**Quantifying the Benefit of Structural Health Monitoring: Can the Value of Information Be Negative?** Andrea Verzobio[1], Denise Bolognani[2], Daniele Zonta[1], John Quigley[1] [[1]University of Strathclyde, [2]University of Trento]	31

Signal Processing

Chair: Fuh-Gwo Yuan & William Schneck

Location: Hewlett 101

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Towards On-Chip Measurement of S-Parameters for Ultrasonic Guided-Wave SHM: Damage Localization in Aluminum Using S-Parameter Measurements** Gift Nyikayaramba[1], Boris Murmann[1] [[1]Stanford University]	73
13:50 ~ 14:10	**Offset Tracking of Sensor Clock Using Kalman Filter for Wireless Network Synchronization** David Pallier[1], Vincent LE CAM[1], Arthur BOUCHE[1], Sébastien PILLEMENT[2], Qinghua Zhang[3], Laurent Mevel[3] [[1]IFSTTAR, [2]IETR, [3]INRIA]	516
14:10 ~ 14:30	**Health State Estimation of Hydraulic System Based on Generalized Multiclass Support Vector Machine** Yiwei Cheng[1], Haiping Zhu[1], Jun Wu[1], Pengfei Guo[1] [[1]Huazhong University of Science and Technology]	54
14:30 ~ 14:50	**Nonlinear Component Extraction Using Singular Value Decomposition and its Application to Breathing Crack Localization** Prawin J[1], Rama Mohan Rao A[2] [[1]CSIR Structural Engineering Research Centre, [2]CSIR STRUCTURAL ENGINEERING RESEARCH CENTRE]	81
14:50 ~ 15:10	**Event-Based Phased Array Signal Processing** Moisés Silva[1], Eloi Figueiredo[2], João C. W. A. Costa[1], David Mascarenas[3] [[1]Universidade Federal do Pará, Belém, Brazil, [2]Universidade Lusófona de Humanidades e Tecnologias, Lisbon, Portugal, [3]Los Alamos National Lab]	276
15:10 ~ 15:30	**MIMO Radar-based Real-Time Structural Health Monitoring** Davide D'Aria[1], Paolo Falcone[1], Luigi Maggi[1], Aldo Cero[1], Giovanni Amoroso[1] [[1]ARESYS srl]	305

Sensor Networks

Chair: Nanshu Lu

Location: 380-380X

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**Learning Collaborative Duty Cycling Strategies in Energy-harvesting Sensor Networks.** James Long[1], Oral Buyukozturk[1] [[1]Massachusetts Institute of Technology]	389
13:50 ~ 14:10	**Phased and Synchronous Sampling Between Multiple Smart Network Sensors for Modal Assessment of Large Structures** Mathieu Le Pen[1], Arthur Bouche[1], Ivan Guéguen[1], Michael Döhler[2], Laurent Mevel[2], Vincent Le Cam[1] [[1]Ifsttar, [2]Inria]	345
14:10 ~ 14:30	**Materials communicating with the BIM : aims and first results of the McBIM project** William DERIGENT[1], Michaël DAVID, Hang WAN, Daniela DRAGOMIRESCU, Alex TAKACS, Gaël LOUBET, Ana ROXIN, Rolland MELET, Laurent MONTEGUT [[1]University of Lorraine]	229
14:30 ~ 14:50	**High Resolution Bridge Mode Shape Identification via Matrix Completion Approach** Soheil Sadeghi Eshkevari[1], Martin Takáč[1], Shamim N. Pakzad[1], Soheila Sadeghi Eshkevari[1] [[1]Lehigh University]	12
14:50 ~ 15:10	**Wirelessly Powered and Battery-Free LoRaWAN Wireless Sensing Nodes Designed for Communicating Reinforced Concrete** Gaël Loubet[1], Ethan Gardner[2], Alexandru Takacs[3], Andréa De Luca[2], Florin Udrea[2], Daniela Dragomirescu[4] [[1]LAAS-CNRS, [2]University of Cambridge, [3]LAAS-CNRS, UPS, [4]LAAS-CNRS, INSA]	411
15:10 ~ 15:30	**Experimental Verification of the Local Damage Detection Method Based on Spatial-Temporal Correlation in Dense Sensor Networks** Hesheng Tang[1], Taotao Zhao[1], Songtao Xue[1] [[1]Tongji University]	193

SPECIAL SESSION

A state-wide focus on SHM

Chair: Tal Yehoshua

Location: Hewlett 102

TIME	WEDNESDAY, SEPTEMBER 11	SUMBISSION ID
13:30 ~ 13:50	**The Israeli Air Force Efforts in Implementing Fiber-Optic Nervous Systems in Composite Based Air Vehicles for Damage Estimation and Performance Analysis** CPT. Sagi[1], Lt.Col. Benny[1], Lt.Col. Chaim[1], Col. Ariel[1] [[1]IAF]	321
13:50 ~ 14:10	**Intelligent Structures using Textile Reinforced Concrete – Achievements and Challenges** Yiska Goldfeld[1], Gali Perry[1], Lidor Yosef[1] [[1]Technion Israel Institute of Technology]	121
14:10 ~ 14:30	**Highway to SHM: Elbit's Fast Implementation of an On-Board Monitoring System on Flying Platforms** Jonathan Balter[1], Bentsi Koren[2], Roy Davidi[3], Nahum Gorbatov[3], Moshe Tur[3] [[1]ELBIT SYSTEMS, [2]Elbit Systems, [3]Tel aviv university]	397
14:30 ~ 14:50	**Experimental Tracking of Helicopter Rotor Blade Hidden Crack Development Using Fiber-Optic-Based Sensing Technology** Lt.Col. Alex[1], CPT. Sagi[1], Yoav Ofir[2], Shay Shoham[2], Tal Yehoshua[3], Iddo Kressel[2], Moshe Tur[3] [[1]IAF, [2]Israel Aerospace Industries, [3]Tel-Aviv University]	444
14:50 ~ 15:10	**Choosing the Right Optical Fiber Coating to Meet Individual Fiber-Optic Strain Measurement Applications** Uri Ben-Simon[1], Shay Shoham[1], Yoav Ofir[1], Nadav Goldstein, Roy Davidi[2], Nachum Gorbatov, Iddo Kressel[1], Moshe Tur[2] [[1]Israel Aerospace Industries, [2]Tel-Aviv University]	449
15:10 ~ 15:30	**Calibration of a Discrete and Distributed Fiber-Optic-Based Strain-Measuring Network for the Shape-Sensing of a Wing Model Under Dynamic Loading of a Wind Tunnel** Shay Shoam[1], Uri Ben-Simon[1], Roy Davidi[3], Clive Florentin, Sagi Sheinkman, Miko Rattner[2], Maxim Freydin, Iddo Kressel[1], Daniella Raveh[2], Moshe tur[3] [[1]Israel Aerospace Industries, [2]Technion Israel Institute of Technology, [3]Tel-Aviv University]	454

SHM in Action

Chair: Chrisitan Boller & A. Guemes

Location: Hewlett 200

TIME	WEDNESDAY, SEPTEMBER 11	
15:50 ~ 18:20	**Presenting Parties** Optics11; Embedor Technologies; Metis Design Corporation; University of Waterloo - SDIC Lab; Acellent Technologies Inc; SHM & Heritage Structures Labs, Princeton University; Structures and Composites Laboratory (Stanford) & Digital Twins Lab; SMILab at the University of New Mexico; NTIS - New Technologies for the Information Society; Redondo Optics Inc; Carnegie Mellon University	

Technical Program (Thursday, September 12th)

Welcome Session

Chair: F.-K. Chang & Co-chair: A. Guemes
Location: Hewlett 200

TIME	THURSDAY, SEPTEMBER 12	
08:20 ~ 08:30	**Opening Remarks** A. Guemes	

Keynote Presentations

Chair: Holger Speckmann
Location: Hewlett 200

TIME	THURSDAY, SEPTEMBER 12	
08:30 ~ 09:00	**The Use of Long-Term Observations in Enhancing Bridge Evaluation** Baidar Bakht[1] [[1]Adjunct Professor , University of Manitoba, Canada]	
09:00~ 09:30	**On the Value of Structural Health Information** Sebastian Thöns[1] [[1]Associate Professor and Scientific Advisor, Danish Hydrocarbon Research and Technology Centre (DHRTC), Denmark; Associate Professor and Guest Researcher, BAM Federal Institute for Materials Research and Testing, Berlin, Germany; Associate Professor and Head of Research Group Technical University of Denmark; DECPA: Decision Processes and Analytics, Lyngby, Denmark]	
09:30 ~ 10:00	**NDE and SHM in the age of Industry 4.0** Leonard Bond[1] [[1]Director, Iowa NDE Center]	

Panel Discussion - AI for PHM & SHM

Moderator: Andy Hess
Location: Hewlett 201

TIME	THURSDAY, SEPTEMBER 12	
10:30 ~ 12:00	**Panel List:** Abhinav Saxena (GE), Kai Goebel (PARC), Neil Eklund (Analatom Inc.), Mohak Shah (LG), Holger Speckmann (Testia), Amrita Kumar (Acellent), Andy Hess (PHM Society and The Hess PHM Group)	

DOT SHM Panel Discussion - Barriers in Implementation of Sensor Technologies in Highway Industry

Moderator: Hoda Azari
Location: Hewlett 200

TIME	THURSDAY, SEPTEMBER 12	
10:30 ~ 12:00	**Panel List:** Franklin Moon (Rutgers, The State University of New Jersey), Marybeth Miceli (Miceli Infrastructure Consulting), Helmut Wenzel (Wenzel Consulting Engineers GmbH), Duncan Paterson (HDR Inc.), Hoda Azari (Federal Highway Administration)	

Faculty / Student Panel

Moderator: Charles Farrar
Location: Hewlett 201

TIME	THURSDAY, SEPTEMBER 12	
12:00 ~ 13:30		

Aerospace Structures III

Chair: Joshua Cummins & Amrita Kumar
Location: Hewlett 201

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Embedded Fiber Bragg Gratings for the Process and Structural Health Monitoring of Composite Boosters for Space Applications** Daniel Stelzl[1], Anna Pfleiderer[1], Peter Ortmann[1], Tim Wiedemann[1], Miro Duhovic[2], Manfred Resch[3] [[1]MT Aerospace AG, [2]Institut für Verbundwerkstoffe GmbH, [3]INFAP GmbH - Industrial Fibre Applications]	125
13:50 ~ 14:10	**Experimental Study on the Measurement of Dynamic Strains for Composite T-Joint Subjected to Hydrodynamic Ram using PVDF Sensors** Eun-Su Go[1], In-Gul Kim[1], Dong Geon Kim[1], Jong-Heon Kim[2] [[1]Chungnam National University, [2]Agency for Defense Development]	388
14:10 ~ 14:30	**Sensor Integration and Data Exploitation of Structural Health Monitoring Network integrated on a Unmanned Aerial Vehicle (UAV)** Antonio Fernandez-Lopez[1], Daniel del Rio-Velilla[1], Malte Frovel[2], Ignacio Gonzalez Requena[1], Alfredo Güemes[1] [[1]Universidad Politécnica de Madrid (UPM), [2]Instituto Nacional de Técnica Aeroespacial (INTA)]	307
14:30 ~ 14:50	**UAV Inspections of Metallic and Composite Aircraft Panels** V. Tzitzilonis[1], S. Deane[1], N.P. Avdelidis[12], K. Malandrakis[1], J.A. Gonzalez Domingo[1], C. Ibarra Castanedo[2], L. Zanotti Fragonara[1], X.P.V. Maldague[2], A. Tsourdos[1] [[1]Cranfield University, [2]Universite Laval]	521
14:50 ~ 15:10	**Internal Corrosion Detection in Pipes using Piezoelectric Transducers** Jayalakshmi Raju[1], Suresh Bhalla[1], Visalakshi Talakokula[2] [[1]IIT Delhi, [2]Bennett University]	348
15:10 ~ 15:30	**Reliable Damage Monitoring Under Time-Varying Conditions Based on Gaussian Mixture Model and Delay-And-Sum Imaging** Yuanqiang Ren[1], Lei Qiu[1], Shenfang Yuan[1], Fang Fang[1] [[1]Nanjing University of Aeronautics and Astronautics]	51

Civil Structures IV

Chair: Piervincenzo Rizzo & Zheng Fan
Location: 380-380C

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Health Monitoring of Chloride Attack in Concrete Bridges** Takahiro Sonoda[1], Kimitoshi Matsuyama, Kuniyoshi Nakatsui, Masaaki Nakano, Toru Kouchi, Yusuke Shimma, Masayasu Ohtsu [[1]NIPPON KOEI Co., Ltd.]	538
13:50 ~ 14:10	**Dynamic Characterization and Vulnerability Assessment of a School Building in Italy** Alessandro Cardoni[1], Ali Zamani Noori[1], Sebastiano Marasco[1], Marco Domaneschi[1], Valentina Villa[1], Farhad Ansari[2], Carlo Caldera[1], Gian Paolo Cimellaro[1] [[1]Politecnico di Torino, [2]University of Illinois at Chicago]	506
14:10 ~ 14:30	**Application of a Structural Health Monitoring System to the Minerão Stadium in Brazil** Michele Frizzarin[1], Paolo Franchetti[1], Otávio Oliveira Goes[2] [[1]Franchetti Group, [2]Minerão Stadium]	529
14:30 ~ 14:50	**Distributed Fiber Optic Sensors for Multiple Crack Monitoring in Reinforced Concrete Structures** Antoine Bassil[1], Ernst Niederleithinger[2], Xin Wang[2], Daniel Kadoke[2], Xavier Chapeleau[1], Dominique Leduc[3], Odile Abraham[1], Mathias Breithaupt[2], Samuel Pötschke[2] [[1]IFSTTAR, [2]Bundesanstalt für Materialforschung und-prüfung (BAM), [3]University of Nantes]	320
14:50 ~ 15:10	**A New Approach to System Identification of Tall Buildings** Erdal Safak[1], Eser Cakti[1] [[1]Bogazici University]	98
15:10 ~ 15:30	**Enhancing the Efficiency of Structural Condition Assessment By Integrating Building Information Modeling (BIM) Into Vibration-Based Damage Identification (VBDI)** Sam Bahmanoo[1], Mojtaba Valinejadshoubi[1], Ardalan Sabamehr[1], Ashutosh Bagchi[1], Saikat Bagchi[1] [[1]Concordia University]	481

SPECIAL SESSION

Dynamic Data Driven Applications Systems

Chair: Erik Blasch & Fotis Kopsaftopoulos
Location: Hewlett 103

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**High Accuracy Flight State Identification of a Self-Sensing Wing via Machine Learning Approaches** Zhe Huang[1], Hongyi Zhao[1], Cheng Liu[1], Xi Chen[2], Fotis Kopsaftopoulos[3], Fu-Kuo Chang[1] [[1]Stanford University, [2]Shanghai Engineering Research Center of Civil Aircraft Health Monitoring, [3]Rensselaer Polytechnic Institute]	28
13:50 ~ 14:10	**Towards Proving Runtime Properties of Data-Driven Systems using Safety Envelopes** Samuel Breese[1], Carlos Varela[1], Fotis Kopsaftopoulos[1] [[1]Rensselaer Polytechnic Institute]	371
14:10 ~ 14:30	**Data-Driven Stochastic Identification of a UAV Under Varying Flight and Structural Health States** Anegi James[1], Fotis Kopsaftopoulos[1] [[1]Rensselaer Polytechnic Institute]	554
14:30 ~ 14:50	**Rotating Machinery Prognostics via the Fusion of Particle Filter and Deep Learning** Meng Ma[1], Zhu Mao[1] [[1]Umass Lowell]	333
14:50 ~ 15:10	**Fleet Prognosis with Physics-informed Recurrent Neural Networks** Renato Nascimento[1], Felipe Viana[1] [[1]University of Central Florida]	338
15:10 ~ 15:30	**Dynamic Data Driven Applications Systems (DDDAS) For Structural Awareness** Erik Blasch[1], Jaimie Tiley[1], Martin Schmidt, Gernot Pomrenke [[1]AFOSR]	173

SPECIAL SESSION

Guided Waves in Structures for SHM VI

Chair: Wieslaw Ostachowicz & Michele Meo

Location: Hewlett 200

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Non-Collinear Shear Wave Mixing at a Contact Interface: Analytical Modelling and Parametric Investigation** Philippe Blanloeuil[1], L. R. Francis Rose[2], Martin Veidt[3], Chun H. Wang[1] [[1]University of New South Wales, [2]Defence Science and Technology Group, [3]University of Queensland]	563
13:50 ~ 14:10	**Baseline-free Method for Acousto-Ultrasonic On-Line-Monitoring of Cracks in Mechanically Loaded and Rotating Axles** Tobias Reitz[1], Claus-Peter Fritzen[1] [[1]University of Siegen]	137
14:10 ~ 14:30	**Placement Optimization on Tubular Structures – Towards Application on Tubular Structures** Zainab Ismail[1], Samir Mustapha[1], Hussein Tarhini[1] [[1]American University of Beirut]	132
14:30 ~ 14:50	**On the Quantification of Adhesive Layer Thickness Effect on PWAS Performance and Damage Detection Capability** Andrea Calvo-Echenique[1], Mónica Torres-Garcia[1], José Manuel Royo[1], Susana Calvo[1] [[1]Instituto Tecnológico de Aragón (ITA)]	50
14:50 ~ 15:10	**Model-based Ultrasonic Guided Wave Inspection to Identify and Attenuate the Effect of Environmental Temperature in Structural Health Monitoring** Saqlain Abbas[1], Fucai Li[1], Xiaotong Tu[1] [[1]Shanghai Jiao Tong University, China]	94
15:10 ~ 15:30	**Reliable Damage Monitoring Under Time-Varying Conditions Based on Gaussian Mixture Model and Delay-And-Sum Imaging** Yuanqiang Ren[1], Lei Qiu[1], Shenfang Yuan[1], Fang Fang[1] [[1]Nanjing University of Aeronautics and Astronautics]	51

SPECIAL SESSION

Vision-based Studies for SHM IV

Chair: Mohammad Jahanshahi & Emmanuel Ramasso

Location: 380-380F

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Temporal Modeling of Point-cloud Evolution for Predictive Structural Assessments** Mozghan Momtaz Dargahi[1], Sara Mohamadi[1], David Lattanzi[1] [[1]George Mason University]	142
13:50 ~ 14:10	**A Compressed Sensing Approach to Operational Modal Analysis using Phase-Based Video Motion Magnification** Tom Gibbons[1], Ramon Fuentes[1], Robin Mills[2], Elizabeth Cross[1], Keith Worden[1] [[1]The University of Sheffield, [2]University of Sheffield]	226
14:10 ~ 14:30	**Computer Vision Based In-Plane Strain Field Monitoring for Identification of Local Damages in Structural Members** T. Jothi Saravanan[1], Mayuko Nishio[1], Tatsuya Suzuki[1] [[1]Yokohama National University]	252
14:30 ~ 14:50	**VR Based Strabismus Diagnosis using Image Processing** Yinan Miao[1], Jun Young Jeon[1], Gyuhae Park[1], Hwan Heo[1] [[1]Chonnam National University]	361
14:50 ~ 15:10	**Pop-outs Segmentation for Concrete Prognosis Indices using UAV Monitoring and Dense Dilated Convolutions** Takato Yasuno[1], Junichiro Fujii[1], Masazumi Amakata[1] [[1]Yachiyo Engineering Co.,Ltd.]	410
15:10 ~ 15:30	**Operational Vision-Based Modal Identification of Structures: A Novel Framework** Soheil Sadeghi Eshkevari[1], Nasser Heydari[1], J. Nathan Kutz[2], Shamim Pakzad[1], Panayiotis Diplas[1], Soheila Sadeghi Eshkevari[1] [[1]Lehigh University, [2]University of Washington]	331

SPECIAL SESSION

Structural Health Monitoring and Condition-based Maintenance of High-speed and Intercity Railways II

Chair: Yiqing Ni & Hua-Peng Chen

Location: 380-380W

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**The Study of Running Stability of Piggyback Car Based on A FE-Rigid Coupled Model** Liu Xiaoxue[1], Guo Hanfei[1], Xie Suming[1], He Weidong[1], Li Xiaofeng[1], Zhang Youwei[1] [[1]Dalian JiaoTong University]	45
13:50 ~ 14:10	**Monitoring-Assisted Derailment Prediction of a High-Speed Train Running on a Long-Span Cable-Stayed Bridge** Sumei Wang[1], Yuanfeng Duan[2], Jongdar Yau[3], Yi-Qing Ni[4] [[1]The Hong Kong Polytechnic University, [2]Zhejiang University, [3]Tamkang University, [4]Hong Kong Polytechnic University]	74
14:10 ~ 14:30	**Variational Autoencoder-Based Approach for Rail Defect Identification** Yuan-Hao Wei[1], Yi-Qing Ni[1] [[1]The Hong Kong Polytechnic University]	118
14:30 ~ 14:50	**An Inversed Greedy Method for Information-Based Optimal Sensor Placement on Bridges** Beiyang Zhang[1], Yi-Qing Ni1 [[1]The Hong Kong Polytechnic University]	122
14:50 ~ 15:10	**Acoustic Emission Feature Extraction and Classification for Rail Crack Monitoring** Dan Li[1], Shaopeng Xu[1], Yang Wang[1], Wei-Xin Ren[1] [[1]Hefei University of Technology]	127
15:10 ~ 15:30	**Monitoring of Rail Bolted Joint Looseness with PZT Network-Based EMI Technique under a Deep Learning Framework** Lu Zhou[1], Si-Xin Chen[1], Alex Choy[1], Yi-Qing Ni[1] [[1]The Hong Kong Polytechnic University]	161

Statistical Methods and Machine Learning III

Chair: Ya Wang
Location: 380-380D

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**SHM Based Damage Detection using Cointegration and Linear Multivariate Data Analysis: Performance Comparison Based on a Real Case Study** Emanuel Tomé[1], Mário Pimentel[1], Joaquim Figueiras[1] [[1]University of Porto, Faculty of Engineering]	323
13:50 ~ 14:10	**An Automated Non–Parametric Healthy Subspace Method for Unsupervised Robust Vibration–Based Damage Detection Under Uncertainty** Kyriakos Vamvoudakis-Stefanou[1], Spilios Fassois[1], John Sakellariou[1] [[1]University of Patras]	358
14:10 ~ 14:30	**Mode Separation of Complicated Guided Wave in Plate-Like Structures Based on Sparse Bayesian Learning Approach** Meijie Zhao[1], Yong Huang[1], Wensong Zhou[1], Hui Li[1] [[1]Harbin Institute of Technology]	508
14:30 ~ 14:50	**Structural Damage Classification using Machine Learning Algorithms and Performance Measures** Jersson Xavier León[1], Wilman Alonso Pineda Muñoz[2], Maribel Anaya[3], Jaime Vitola[4], Diego Tibaduiza[5] [[1]Universidad Nacional de Colombia, [2]Universidad Pedagógica y Tecnológica de Colombia., [3]Universidad Sergio Arboleda, [4]Universidad Santo Tomás, [5]Unversidad Nacional de Colombia]	421
14:50 ~ 15:10	**Identification of Time-varying Structural Parameters by Integrated Wavelet Decomposition and Kalman Filter with Partial Response Measurements** Ying Lei[1], Siyi Chen[1], Jubin Lu[1] [[1]Xiamen University]	313
15:10 ~ 15:30	**Visual Analysis for PCA-Based Skin-Stringer Debonding of Composite Stiffened Panels** Francesca Maria Pisano[1], Monica Ciminello[1], Fulvio Romano[1], Umberto Mercurio[1] [[1]CIRA - Italian Aerospace Research Centre]	49

SPECIAL SESSION

Assessment of the Value of SHM Information II

Chair: Sebastian Thöns & Michael Todd
Location: 380--380Y

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Optimal Ultrasonic Sensor Configuration for Plate-Like Structures Using the Value of Information** Sergio Cantero-Chinchilla[1], Juan Chiachío[2], Manuel Chiachío[3], Dimitrios Chronopoulos[1], Arthur Jones[1], Yasser Essa[4], Federico Martín de la Escalera[4] [[1]The University of Nottingham, [2]University of Strathclyde, [3]University of Granada, [4]Aernnova Engineering Division S.A.]	35
13:50 ~ 14:10	**Structural Health Monitoring for Aerospace Composite Structures** Rafik HADJRIA[1], Oscar D'ALMEIDA[1] [[1]Safran]	210
14:10 ~ 14:30	**Integrated Life-cycle Decision Framework for Structural Systems** Jorge Mendoza[1], Jochen Köhler[1], Elizabeth Bismut[2], Daniel Straub[2] [[1]Norwegian University of Science and Technology, [2]Technische Universität München]	254
14:30 ~ 14:50	**Quantification of the Posterior Utilities of SHM Campaigns on an Orthotropic Steel Bridge Deck** Lijia Long[1], Isaac Farreras Alcover[2], Sebastian Thöns[3] [[1]Dept. of Civil Engineering, Aalborg University, Aalborg, Denmark, [2]COWI A/S, Lyngby, Denmark, [3]Department 7: Safety of Structures, BAM Federal Institute for Materials Research and Testing, Berlin, Germany]	265
14:50 ~ 15:10	**Method of Generating Economic Value from Navigation Lock Structural Health Information** Vasileios Geroulas[1], Dean Harrison[2], Guga Gugaratshan[2], Matthew Smith[3] [[1]HBM Prenscia, [2]HBM nCode Federal LLC, [3]U.S. Army Corps of Engineers]	441
15:10 ~ 15:30	**Value of the SHM System in the Context of Risk-Based Inspection Planning** Wei-Heng Zhang[1], Da-Gang Lyu[1], Michael Havbro Faber[2], Sebastian Thöns[3] [[1]Harbin Institute of Technology, [2]Aalborg University, [3]Technical University of Denmark]	390

SPECIAL SESSION

SHM Technology in Wind Turbines

Chair: Wieslaw Ostachowicz & Nikolaos Dervilis
Location: Hewlett 101

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Fibre Reinforced Polymer Structure Under Simultaneous Temperature and Humidity Influence – FBG Sensors, THz Spectroscopy, and Vibrothermography Methods** Katarzyna Majewska[1], Magdalena Mieloszyk[1], Wieslaw Ostachowicz[1] [[1]Polish Academy of Sciences]	182
13:50 ~ 14:10	**Structural Health Monitoring: A Review of Uncertainty Quantification Methods in Wind Turbine Systems** Paulo H Gonzaga[1], Nikolaos Dervilis[2], Keith Worden[2], Rob Barthorpe[2], Nevena Stevanovic[1], Lars Bernhammer[1] [[1]Siemens Gamesa Renewable Energy, [2]The University of Sheffield]	117
14:10 ~ 14:30	**Monitoring of Wind Turbine Blades using Radar Technology: Results from a Field Study at a 2MW Wind Turbine** Jochen Moll[1], Moritz Mälzer[1], Jonas Simon[1], Ashkan Taremi Zadeh[1], Viktor Krozer[1], Manfred Dürr[2], Christian Kramer[3], Herbert Friedmann[3], Andreas Nuber[3], Rahmi Salman[4], Dimitry Pozdniakov[4] [[1]J.W. Goethe-University Frankfurt am Main, [2]Volta Windkraft GmbH, [3]Woelfel Engineering GmbH + Co. KG, [4]HF Systems Engineering GmbH & Co. KG]	97
14:30 ~ 14:50	**Gaussian Processes for Structural Health Monitoring of Wind Turbine Blades** Kartik Chandrasekhar[1], Nevena Stevanovic[2], Elizabeth J. Cross[1], Nikolaos Dervilis[1], Keith Worden[1] [[1]University of Sheffield, [2]Siemens Gamesa Renewable Energy]	196
14:50 ~ 15:10	**Structural Strain Monitoring of a Composite Scaled Turbine Blade using Embedded QRS Sensoring** Julio Cesar De Luca[1], Jean-François Feller[2], Mickael Castro[2], Olivier Fouche[1], Bertrand Lascoup[1], Jonathan Raujol[1], Antoine Lemartinel[1] [[1]IRT Jules Verne, [2]University of South Brittany (UBS)]	220
15:10 ~ 15:30	**Structural Health Monitoring, SHM, As a Tool for Optimizing the Performance of a Wind Power Plant** Herbert Friedmann[1], Carles Colomer Segura[1], Carsten Ebert[1], Andreas Nuber[1], Christoph Schmidt[1] [[1]Wölfel Engineering GmbH + Co. KG]	360

Reliability, Verification and Validation

Chair: Fabio Casciato & Tyler Tallman

Location: 380-380X

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Sensor Reliability in Extreme Environments for Asset monitoring** Howard Chung[1], Franklin Li[1], Taru Singhal[1] [[1]Acellent Technologies]	547
13:50 ~ 14:10	**Validating Accelerometers for Rotating Machinery in Structural Health Monitoring Applications** Theresa Loss[1], Oliver Gerler[2], Alexander Bergmann[1] [[1]Graz University of Technology, [2]eologix sensor technology gmbh, Graz]	16
14:10 ~ 14:30	**Evaluation of Structural Health Monitoring Sensors During Fatigue Loading at Room Temperature** Shashank Pant[1], David Backman[1], Peter Keum[1], Marcias Martinez[2], P. Patnaik [1] [[1]National Research Council Canada, [2]Clarkson University]	99
14:30 ~ 14:50	**Estimation of Remaining Life of the Orthotropic Deck of a Bridge Exposed to Extreme Traffic and Wind Actions** Mariia Nesterova[1], Franziska Schmidt[1], Christian Soize[2] [[1]IFSTTAR, [2]Universite Paris-Est]	178
14:50 ~ 15:10	**Reliability of Lamb Wave SHM Systems: Influence of Hydrostatic Pressure, Mechanical Loading and Fatigue on the Value of a Damage Index** Lucas Dorneles[1], Henrique Oliveira[1], Thomas Clarke[1], Fernando Dotta[2], André Tamba[2], Ricardo Rulli[2] [[1]Federal University of Rio Grande do Sul (UFRGS), [2]Embraer S.A.]	370
15:10 ~ 15:30	**Strategy for In-Situ Determination of Autogenous Self Healing Capacity Through Limited Measurements** Avik Kumar DAS[1], Christopher K Y LEUNG[1] [[1]Hong Kong University of Science and Technology]	39

SPECIAL SESSION

Seismic Structural Health Monitoring for Civil Structures I

Chair: Maria Limongelli & Mehmet Celebi

Location: Hewlett 102

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
13:30 ~ 13:50	**Identification of Sparse Damage in Steel-Frame** Filippos Filippitzis[1], Monica Kohler[1], Thomas H. Heaton[1] [[1]California Institute of Technology]	326
13:50 ~ 14:10	**An Intelligent Wireless System for Real-Time Seismic Monitoring of Civil Infrastructure** Yuguang Fu[1], Tu Hoang[1], Kirill Mechitov[1], Jong R. Kim[2], Billie F. Spencer, Jr.[1] [[1]University of Illinois at Urbana-Champaign, [2]Nazarbayev University]	76
14:10 ~ 14:30	**Nonlinear Seismic Response Reconstruction in Minimally Instrumented Buildings - Validation using NEESWood Capstone Full-Scale Tests** Milad Roohi[1], Eric M. Hernandez[1], David Rosowsky[1] [[1]University of Vermont]	7
14:30 ~ 14:50	**Seismic Monitoring of Cable-Stayed Bridge using Wireless Sensor Network** Dionysius Siringoringo[1], Yozo Fujino[1], Makoto Suzuki[2], Vaibhav Mehta[1] [[1]Yokohama National University, [2]The University of Tokyo]	198
14:50 ~ 15:10	**Comparison of Indicators of Damage Location Based on Information Gain** Pier Francesco Giordano[1], Maria Pina Limongelli[1] [[1]Politecnico di Milano]	95
15:10 ~ 15:30	**Estimating Damage Level in Reinforced Concrete Structures Based on the Detection of High-Frequency Transients** Aleksandar Zhelyazkov[1], Peter Furtner[2], Helmut Wenzel[3], Daniele Zonta[4] [[1]University of Trento, [2]Vienna Consulting Engineers GmbH, [3]Wenzel Consulting Engineers GmbH, [4]University of Strathclyde]	120

Civil Structures V

Chair: Monica Kohler

Location: 380-380C

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**Geothermal Power: Monitoring the Building Response During Installation** Fabio Casciati[1], Sara Casciati[2], Alessandro Colnaghi[2], Lucia Faravelli[1] [[1]University of Pavia, [2]SIART srl]	69
16:10 ~ 16:30	**Experimental Verification of the Eddy-Current Inerter System with Cable Bracing for Seismic Mitigation** Songtao Xue[1], Xinlei Ban[1], Liyu Xie[1] [[1]Tongji University]	57
16:30 ~ 16:50	**Application of Image Recognition Technology to Sound Spectrogram of Impact-Echo Method** Hiroshi Shimbo[1], Toshiaki Mizobuchi[1], Jun-ichiro Nojima[2] [[1]HOSEI University, [2]J-Power Design]	66
16:50 ~ 17:10	**Nonparametric Structural Mass and Hysteretic Behavior Simultaneous Identification using Limited Acceleration Measurement** Bin Xu[1], Jing Li[1], Bai-Chuan Deng[2] [[1]Huaqiao University, [2]Hunan University]	353

Diagnostics IV

Chair: Tadeusz Uhl & Kay Smarsly
Location: Hewlett 103

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**Bend Detection of Pipe using Guided Waves** Xin Zhang[1], Wensong Zhou[1], Hui Li[1] [[1]Harbin Institute of Technology]	507
16:10 ~ 16:30	**Structural Health Monitoring Systems Based on SH Wave Transducers Sparse Array and Phased Array** Qiang Huan[1], Faxin Li[1] [[1]Peking University]	8
16:30 ~ 16:50	**Impact Index Method for Railway Catenary Short-wave Irregularity Evaluation** Yuming Ding[1], Xiaodi Xu[1], Jinzhao Liu[1], Wenxuan Zhang[1] [[1]China Academy of Railway Sciences]	79
16:50 ~ 17:10	**A Large-scale and Lightweight Piezoelectric Sensor Network for Aircraft Smart Composite Skin** Yu Wang[1], Lei Qiu[1], Yijie Luo[1], Rui Ding[1] [[1]Nanjing University of Aeronautics and Astronautics]	101

SPECIAL SESSION

Guided Waves in Structures for SHM VII

Chair: Wieslaw Ostachowicz & Wingkong Chiu
Location: Hewlett 200

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**Multi-Scale and Multi-Physical-Field Coupling Simulation on Detection Mechanism of Aggregates Segregation in CCFST Using PZT Based Stress Wave Measurement** Bin Xu[1], Hongbing Chen[2], Tianmin Zhou[3] [[1]Huaqiao University, [2]Tsinghua University, [3]University of Houston]	354
16:10 ~ 16:30	**Effect of Temperature on Time Reversibility of Lamb Wave in Thin Plates with Surface-Bonded Piezoelectric Wafers** Bhabagrahi Natha Sharma[1], Santosh Kapuria[2], A. Arockiarajan[1] [[1]Indian Institute of Technology, Madras, [2]Indian Institute of Technology Delhi]	322
16:30 ~ 16:50	**A Baseline-Free Fatigue Crack Detection Approach in Orthotropic Steel Deck using Ultrasonic Guided Waves** Peng Wang[1], Wensong Zhou[1], Hui Li[1] [[1]Harbin Institute of Technology]	501
16:50 ~ 17:10	**Signal Domain Transform-Based Damage Imaging For the Complicated Structures** Jian Cai[1], Zhiquan Zhou[1], Yi Wang[1], Bohang Xing[1], Yang Zhang[1] [[1]Nanjing University of Aeronautics and Astronautics]	157
16:30 ~ 16:50	**Investigation of Acoustoelastic Guided Waves Subjected to an Inhomogeneous Prestress** Peng Zuo[1], Zheng (David) Fan[1] [[1]Nanyang Technological University]	155

SPECIAL SESSION

Vision-based Studies for SHM V

Chair: Mohammad Jahanshahi & Tom Druet
Location: 380-380F

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**Applying Computer Vision Technology to Health Monitoring for Underground Structure in a Landslide Area** I-Hui Chen[1], Po-An Chen[2], Miau-Bin Su[1] [[1]National Chung Hsing University, [2]Soil and Water Conservation Bureau, COA]	4
16:10 ~ 16:30	**An Attribute-Based Few-Shot Learning Framework for Structural Damage Classification** Yang XU[1], Yuequan BAO[1], Hui LI[1] [[1]Harbin Institute of Technology]	10
16:30 ~ 16:50	**Pixel-Wise Crack Identification of Steel Box Girder by Fully Convolutional Network** Yapeng Guo[1], Yang Xu[1], Shunlong Li[1] [[1]Harbin Institute of Technology]	61
16:50 ~ 17:10	**A DNN-Based Civil Structure Semantic Segmentation and Motion Information Identification Algorithm** Jin Zhao[1], Hui Li[1] [[1]Harbin Institute of Technology]	129
17:10 ~ 17:30	**A Topology-Aware 3D Reconstruction Algorithm for Long-Span Cable-Stayed Bridges** Fangqiao Hu[1], Hui Li[1] [[1]Harbin Institute of Technology]	253

SPECIAL SESSION

Structural Health Monitoring and Condition-based Maintenance of High-speed and Intercity Railways III

Chair: Yiqing Ni & Hua-Peng Chen

Location: 380-380W

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**A Bayesian Probabilistic Approach for Damage Detection of a Population of Nominally Identical Structures: Application to Railway Wheel Condition Assessment** Qiu-Hu Zhang[1], Yi-Qing Ni[1], Lu Zhou[1] [[1]Hong Kong Polytechnic University]	190
16:10 ~ 16:30	**Application of Driving Recorder to Evaluate Rail Irregularity and Vehicle Swing** Ching-Lung Liao[1], Sumei Wang[2], Yi-Qing Ni[1] [[1]National Taiwan University, [2]Hong Kong Polytechnic University]	211
16:30 ~ 16:50	**Preliminary Study on Assessing Delaminated Cracks in Cement Asphalt Mortar Layer of High-speed Rail Track using Normalized Impact-Echo Method** Chia-Chi Cheng[1], Yi Qing Ni[2], Keng-Tsang Hsu[1], Tai-Tung Wai[2] [[1]Chaoyang University of Technology, [2]The Hong Kong Polytechnic University, Hong Kong]	336
16:50 ~ 17:10	**Real-Time Object Detection Based on R-FCN Network Under Structured Scene of High-Speed Railway** Qiang Han[1], Shengchun Wang[1], Yue Fang[1], Peng Dai[1] [[1]China Academy of Railway Sciences]	400
17:10 ~ 17:30	**Damage Assessment of High-Speed EMU Train Axles via SHM Technology Based on PZT Sensor Networks** JianYing Liang[1], Long Ma[1], Zeng-Ye Ju[1], Hui Wang[1], Zong-Zheng Wang[1] [[1]CRRC Qingdao Sifang Co., Ltd.]	540

SPECIAL SESSION

Nonlinear Acoustic and Ultrasonic Techniques for Structural Health Monitoring II

Chair: Tribikram Kundu & Jingyu Huang

Location: 380-380D

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**Third Harmonic Shear Horizontal Waves for Material Microstructural Degradation Monitoring** Fuzhen Wen[1], Shengbo Shan[1], Li Cheng[1] [[1]The Hong Kong Polytechnic University]	55
16:10 ~ 16:30	**Quantitative Characterization of Hypervelocity Debris Cloud-induced Pitting Damage in AL-Whipple Shields Using Nonlinear Ultrasonic Waves** Wuxiong Cao[1], Pengyu Zhou[1], Kai Wang[1], Yafeng Wang[1], Runqiang Chi[2], Baojun Pang[2], Zhongqing Su[1] [[1]The Hong Kong Polytechnic University, [2]Harbin Institute of Technology]	92
16:30 ~ 16:50	**Modeling and Experiments on Nonlinear Ultrasonic Guided Waves for Fatigue Crack Detection and Evaluation** Yanfeng Shen[1], Junzhen Wang[1], Yiran Tian[1], Mingjing Cen[1] [[1]Shanghai Jiao Tong University]	393
16:50 ~ 17:10	**Nonlinear Ultrasonic Wave Spectroscopy for Detecting Local Defect Resonance Frequency in Delaminated GLARE Plate** Subhankar Roy[1], Tanmoy Bose[1], Kishore Debnath[1] [[1]National Institute of Technology Meghalaya]	261
17:10 ~ 17:30	**Acoustic Emission Monitoring of Hydrogen Induced Cracking in Steel Structures** Kaamil U.R.M. Shibly[1], Ángela Angulo[2], Shaker Janabi[1], Slim Soua[3], Abderrazak Traidia[1], Ali Khadimallah[2] [[1]Saudi Aramco, [2]TWI Ltd, [3]Fullagar Technologies Ltd]	372

Modelling, Simulation, and Digital Twins

Chair: Li Cheng & Elizabeth Gregory

Location: 380--380Y

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**On the Integration of SHM and Digital Twin for the Fatigue Assessment of Naval Surface Ships** Alysson Mondoro[1], Benjamin Grisso[1] [[1]Naval Surface Warfare Center, Carderock Division]	228
16:10 ~ 16:30	**Damage Localization via Model Updating using a Damage Distribution Function** Marlene Bruns[1], Benedikt Hofmeister[1], Clemens Hübler[1], Raimund Rolfes[1] [[1]Leibniz University Hannover]	195
16:30 ~ 16:50	**Model Based Optimisation of Ultrasonic Corrosion Measurement** Alexander Ballisat[1], Paul Wilcox[2], Anthony Croxford[2] [[1]Centre For Modelling & Simulation, [2]University of Bristol]	328
16:50 ~ 17:10	**On the Reliability of Finite Element Models for the Training of Machine Learning Algorithms for Damage Detection in Bridges** Mihai Adrian Bud[1], Mihai Nedelcu[1], Lucian Radu[2], Ionut Dragos Moldovan[2], Elói João Faria Figueiredo[2] [[1]Technical University of Cluj-Napoca, [2]Lusófona University]	236
17:10 ~ 17:30	**A Novel Double Beam Element with Continuously Distributed Elastic Springs for Modelling De-bonds in Adhesively Bonded Joints** Shweta Paunikar[1], Srinivasan Gopalakrishnan[1] [[1]Indian Institute of Science]	352

SPECIAL SESSION

Multifunctional Materials and Structures II

Chair: Kenneth Loh & Donghyeon Ryu

Location: Hewlett 101

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**Sensing Capabilities of Carbon Nanotube Reinforced Adhesive Films in Joints with Dissimilar Materials: An Approach from Coupon to Sub-Element Level** Xoan Xosé Fernández Sánchez-Romate[1], Alberto Jiménez-Suárez[1], María Sánchez[1], Alfredo Güemes[2], Alejandro Ureña[1] [[1]University Rey Juan Carlos, [2]Universidad Politécnica de Madrid]	111
16:10 ~ 16:30	**Self-Sensing 3D Printed Repair for Concrete Substrates** Christos Vlachakis[1], Lorena Biondi[1], Jack McAlorum[1], Marcus Perry[1] [[1]University of Strathclyde]	33
16:30 ~ 16:50	**Tunable Hybrid Acoustic Metamaterials For Structural Health Monitoring** Xiaodong Wu[1], Hailin Cao[1], Xiyuan Chen[2], Fu-kuo Chang[2] [[1]Chongqing University, [2]Stanford University]	498
16:50 ~ 17:10	**Additively Manufactured Sensors for SHM of Composite Structures** Benjamin Raju[1], Kishore Babu Kancherla[1], Dakshayini B Shankar[1], Nitin Balajee Ravi[1], Rushal Patil[1], Debiprosad Roy Mahapatra[1] [[1]Indian Institute of Science]	492
17:10 ~ 17:30	**A Flexible and Lightweight Impact Monitoring System with Ultra-low Power Consumption for Aircraft Smart Composite Skin** Lei Qiu[1], Xiaodong Lin[1], Yu Wang[1], Shenfang Yuan[1], YongAn Huang[2] [[1]Nanjing University of Aeronautics and Astronautics, [2]Huazhong University of Science and Technology]	68

SPECIAL SESSION

Probabilistic SHM II

Chair: Daniele Zonta & Dimitri Goutaudier

Location: 380-380X

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**Assessing the Likelihood of Damage at the Start of a Structural Health Monitoring Campaign** Matthew R. Jones[1], Tim J. Rogers[1], Nikolaos Dervilis[1], Keith Worden[1], Elizabeth J. Cross[1] [[1]The University of Sheffield]	124
16:10 ~ 16:30	**Experimental Validation of the Population-Form to Represent Nominally-Identical Systems** L.A. Bull[1], N. Dervilis[1], K. Worden[1] [[1]University of Sheffield]	133
16:30 ~ 16:50	**Output-Only Identification of Loading and Modal Parameters in Dynamic Systems with Non-Gaussian Inputs** Timothy J Rogers[1], Keith Worden[1], Robin S. Mills[1], Elizabeth J. Cross[1] [[1]University of Sheffield]	202
16:50 ~ 17:10	**On an Application of Probabilistic Risk Assessment to Structural Health Monitoring** Aidan Hughes[1], Keith Worden[1], Robert Barthorpe[1] [[1]The University of Sheffield]	215
17:10 ~ 17:30	**A Decision Support System for Scour Management of Road and Railway Bridges Based on Bayesian Networks** Andrea Maroni[1], Enrico Tubaldi[1], Dimitry Val[2], Hazel McDonald[3], Stewart Lothian[4], Oliver Riches[5], Daniele Zonta[1] [[1]University of Strathclyde, [2]Heriot-Watt University, [3]Transport Scotland, [4]Network Rail Scotland Route, [5]ARUP Scotland]	543

SPECIAL SESSION

Seismic Structural Health Monitoring for Civil Structures II

Chair: Maria Limongelli & Mehmet Celebi

Location: Hewlett 102

TIME	THURSDAY, SEPTEMBER 12	SUMBISSION ID
15:50 ~ 16:10	**A Non-Parametric Approach Toward Structural Health Monitoring for Processing Big Data Collected from the Sensor Network** Ramin Ghiasi[1], Mohammad Reza Ghasemi[1], Mohammad Noori[2], Wael Altabey[3] [[1]University of Sistan and Baluchestan, [2]California Polytechnic State University and Southeast University, [3]Alexandria University]	234
16:10 ~ 16:30	**Seismic and Structural Health Monitoring Systems for Large Concrete Dams** Sérgio Oliveira[1], André Alegre[1] [[1]LNEC/DBB]	280
16:30 ~ 16:50	**Seismic Structural Health Monitoring of a Six-story Wooden Building** Toshihide Kashsima[1], Hiroto Nakagawa[1] [[1]Building Research Institute]	290
16:50 ~ 17:10	**Seismic Damage Identification for Bridges based on Transmissibility Function and Support Vector Machine** Jianan Mi[1], Yixiao Zhang[1], Weifeng Liu[1], Lijun Liu[1] [[1]Xiamen University]	382
17:10 ~ 17:30	**In situ Distributed Strain Monitoring of a Small-Scale Reinforced Concrete Structure using Combined FBG/OFDR Fiber Optics Sensing for Assessment of its Seismic Degradation Mechanisms** Sylvain MAGNE[1], Stéphane ROUGEAULT[1], Rudy DESMARCHELIER[1], Thierry CHAUDAT[2], Sandra VASIC[2], Fan WANG[2], Estelle Hervé-Secourgeon[3], François VOLDOIRE[4] [[1]CEA LIST, [2]CEA, [3]ENS Paris-Saclay, [4]EDF R&D]	409

Poster Session (Thursday, September 10th)

Poster Session
(Q & A Session: Tuesday, Sept. 10th, 12:10 PM – 1:40 PM)
Location: West Oval Grove

TIME	TUESDAY, SEPTEMBER 10	SUMBISSION ID
12:10~ 13:40	**Research on Welded Joints Stress Condition Assessment of Railway Freight Car Welded Frame with Considering Stress Concentration Effect** Chunliang Niu[1], Suming Xie[1], Xiangwei Li[2], Wen Wang[2] [[1]Dalian Jiaotong University, [2]CRRC Qiqihar Rolling Stock Co., LTD.]	37
12:10~ 13:40	**Reinforcement-Learning-Based Identification of the System for the Purpose of Structural Change Detection** Ziemowit Dworakowski[1] [[1]AGH University of Science and Technology]	38
12:10~ 13:40	**Research on Wheel Fatigue Test of Railway Vehicles Based on Non-contact Full-field Strain Measurement Technology** Fuxing Tan[1], Lan Zhang[1], Zhiwei Zheng[1], Yanji Zhang[1] [[1]CRRC Changchun Railway Vehicles Co.,Ltd.]	60
12:10~ 13:40	**A Kind of EPDM Graphene Based Large Strain Flexible Sensor** Donghui Jin[1], Wenzhong Qu[1], Li Xiao[1] [[1]Wuhan University]	67
12:10~ 13:40	**SETRIC - Sparsity Enforcing Time Reversal Imaging Concept for Ultrasonic Guided Waves** Christian Vogl[1], Christian Kexel[1], Jochen Moll[1] [[1]J. W. Goethe University Frankfurt am Main]	82
12:10~ 13:40	**Performance Comparison of Improved Particle Filters for On-Line Fatigue Crack Prognosis** Jian Chen[1], Shenfang Yuan[1], Hui Wang[1] [[1]Nanjing University of Aeronautics and Astronautics]	83
12:10~ 13:40	**Deep Learning-Based Data Anomaly Detection in Rail Track Inspection** Si-xin Chen[1], Yi-Qing Ni[1], Jin-zhao Liu[2], Nan Yao[2] [[1]The Hong Kong Polytechnic University, [2]China Academy of Railway Sciences]	113
12:10~ 13:40	**Fatigue Crack Identification in Weld Zone of Bogie Using Guided Wave** Jiajia Yan[1], Guipeng Chen[1], Hu Sun[1], Xinlin Qing[1] [[1]Xiamen University]	119
12:10~ 13:40	**Damage Classification Using Labelled and Unlabelled Measurements** L.A. Bull[1], K. Worden[1], N. Dervilis[1] [[1]University of Sheffield]	131
12:10~ 13:40	**Damage Identification on the Leaf Spring of a Railway Freight Wagon – Findings from Snap-Back Experiments with Transient Excitation** Peter Kraemer[1], Herbert Friedmann[2], Markus Richter[2] [[1]University of Siegen, [2]Wölfel Engineering GmbH + Co.KG]	141
12:10~ 13:40	**Damage Localization using Pattern Recognition Techniques and Statistical Dissimilarity Analysis** Harold S. Rodriguez[1], Diego Alexander Tibaduiza Burgos[1], Francesc Pozo[2], Jersson X. León[1] [[1]Universidad Nacional de Colombia, [2]Universitat Politecnica de Catalunya]	143
12:10~ 13:40	**UAS-Based 3D Reconstruction Imagery Error Analysis** Shanyue Guan[1], Zhen Zhu[1] [[1]East Carolina University]	152
12:10~ 13:40	**Study on Structural Performance Test of Railway Prestressed Hollow Thin-walled Pier** Chun Fen Wang[1], Qi Wang[1], Guo Zheng Xi 2 [[1]Northwest University for Nationalities, [2]Shandong Transportation Research Institute]	159
12:10~ 13:40	**Fabry-Perot Fiber Optic Sensors for Civil and Geotechnical Monitoring of Large Structures** Daniele Inaudi[1], Roberto Walder[1], Ryan Bulatao[2] [[1]SMARTEC SA, [2]ROCTEST]	162
12:10~ 13:40	**Advanced Non Destructive Technique for Debonding Inspection of Aircraft Composite Structures** Assunta Sorrentino[1], Fulvio Romano[1], Angelo De Fenza[2], Umberto Mercurio[1] [[1]CIRA SCPA, [2]Universidad Carlos III de Madrid]	174
12:10~ 13:40	**Elliptical Triangulation Method for Damage Identification on a Complex Aeronautical Structure** Angelo De Fenza[1], Assunta Sorrentino[2], Donato Perfetto[3], Alessandro De Luca[3], Giuseppe Petrone[4], Francesco Caputo[3] [[1]Universidad Carlos III de Madrid, [2]CIRA SCPA, [3]University of Campania L. Vanvitelli, [4]Università degli Studi di Napoli Federico II]	180
12:10~ 13:40	**Alternative Excitation and Data Analysis Techniques for Damage Detection in Metallic Plates** Jonas Brettschneider[1], Peter Kraemer[1], Jochen Moll[2] [[1]University of Siegen, [2]Goethe University of Frankfurt am Main]	212
12:10~ 13:40	**Incorporating Non-destructive Field Measurements in Stochastic Finite Element Analysis of Reinforced Concrete Structures** Ruilin Raymond Ma[1], Frank J. Vecchio[1], Fae Azhari[1] [[1]University of Toronto]	231

12:10~ 13:40	**Ringing Suppression for Ultrasonic Nondestructive Testing using Iterative Learning Control and H-Infinity Synthesis** Divyadeep Upadhyay[1], Christoph Schaal[12] [[1]California State University, Northridge, [2]University of California, Los Angeles]	248
12:10~ 13:40	**Mobile Robotic Platform for Inspecting Aircraft Surfaces Using Lamb Waves** Alvin Miranda[1], Cesar Gonzales[1], Artur Balyan[1], Christoph Schaal[1] [[1]California State University, Northridge]	256
12:10~ 13:40	**A new online Structural Health Monitoring Technique to detect subtle damage considering environmental variability** K. Lakshmi[1], A. Rama Mohan Rao[1] [[1]CSIR- Structural Engineering Research Centre]	258
12:10~ 13:40	**Background of the Algorithms Creation and Actual Algorithm to Online Estimate of Reliability of Skyscrapers** V Vengrinovich[1] [[1]Institute of Applied Physics of the Belarus National Academy of Sciences]	281
12:10~ 13:40	**Real Time Extraction of TOA from Overlapped AE Waves** Avik Kumar DAS[1], Christopher K Y LEUNG[1] [[1]The Hong Kong University of Science and Technology]	301
12:10~ 13:40	**Observation and Detection of Machining Phases in EDM Microdrilling by Acoustic Emission** Quentin Lefebvre[1], Martial Personeni[1], Emmanuel Ramasso[1], Martin Ducas[2], Sébastien Thibaud[1] [[1]FEMTO-ST, [2]SAFRAN]	311
12:10~ 13:40	**Research on New Type Disc Lock Scaffold Safety Monitoring System** Zhao Ming[1], Chen Junrong[1], Yang Guowei[2], Chen Rui[1] [[1]Tongji University, [2]Shanghai Metro Line 13 Development Co., Ltd.]	334
12:10~ 13:40	**Investigating the Structural Response of Composite Repairs at Low Temperatures** Isabel McBrayer[1], Fady Barsoum[1] [[1]Embry-Riddle Aeronautical University]	355
12:10~ 13:40	**Long Term Strain Monitoring and Management System of Retrofitted Bridges** Huang Huang[1], Zhishen Wu[1] [[1]Ibaraki University]	356
12:10~ 13:40	**Study of the Damage Detection Apporaches for Addtitively Manufactured Parts** Paweł Malinowski[1], Artur Andrearczyk[1], Tomasz Wandowski[1] [[1]Institute of Fluid Flow Machinery, Polish Academy of Sciences]	365
12:10~ 13:40	**Thermal Wave Imaging for Defect Determination during Automated Fibre Placement** Gian Piero Malfense Fierro[1], Francesco Flora[1], Michele Meo[1] [[1]University of Bath]	366
12:10~ 13:40	**Validation of Eddy Current Finite Element Scheme for Non-Destructive Evaluation Problems Without Removing Coatings** Bruna Iost Camacho[1], Thomas Clarke[1], Fernando Dotta[2] [[1]Federal University of Rio Grande do Sul, [2]Embraer S.A.]	367
12:10~ 13:40	**Analysis of Pathological Tremor Behavior: Application to Design a Passive Tremor Attenuator** Sarah Gebai[1], Gwendal Cumunel[1], Mohammad Hammoud[2], Gilles Foret[1], Emmanuelle Apartis[3], Emmanuel Flamand-Roze[3], Elodie Hainque[3] [[1]Université Paris-Est, [2]SDM Research Group, [3]Faculté de Médecine de Sorbonne Université]	368
12:10~ 13:40	**Deep Convolutional Neural Network for Condition Identification of Connections in Steel Structures** Tong Zhang[1], Suryakanta Biswal[2], Ying Wang[2] [[1]King's College London, [2]University of Surrey]	369
12:10~ 13:40	**The Effect of Truck Loads on Highway Bridges via Bridge Weigh-in-motion Algorithm** Xiangang Lai[1], Matteo Mazzoti[1], Kirk Grimmelsman[2], Ivan Bartoli[1], A. Emin Aktan[1] [[1]Drexel University, [2]Intelligent Infrastructure Systems]	380
12:10~ 13:40	**The Concept of Health Monitoring System for Mi 8 Helicopter with Integrated Sensor Network** Artur Kurnyta[1], Michal Dziendzikowski[1], Wojciech Zielinski[1] [[1]Air Force Institute of Technology]	396
12:10~ 13:40	**Magnetorheological Fluid Device for Semi-Active Control of Hydraulic Damping** Gheorghe Ghita[1], Marius Cristian Pop[2], Ana-Maria Mitu[3], Tiberiu Adrian Salaoru[2] [[1]IMSAR, [2]INCAS Bucharest, [3]Institute of Solid Mechanics of the Romanian Academy]	407
12:10~ 13:40	**Intelligent Processes and Operational Monitoring of Composite Systems** Sean Psulkowski[1], Marquese Pollard[1], Sean Jackson[1], Phong Tran[1], Tarik Dickens[1] [[1]Florida A&M University-Florida State University]	414
12:10~ 13:40	**Damage Detection and Localization in Concrete Slabs Through Linear and Nonlinear Vibration Analysis** Jesús N. Eiras[1], Cédric Payan[1], Sandrine Rakotonarivo[1], Narintsoa Ranaivomanana[1], Vincent Garnier[1] [[1]Aix Marseille Univ, CNRS, Centrale Marseille, LMA]	434
12:10~ 13:40	**Experimental Investigation of Crack Detection and Quantification using PWAS Array** Asaad Migot[1], Yeasin Bhuiyan[2], Victor Giurgiutiu[1] [[1]University of South Carolina, [2]Collins Aerospace (A United Technologies Company)]	435
12:10~ 13:40	**Towards the Application of Image Based Monitoring of USACE Large Civil Infrastructure** Quincy G. Alexander[1], Vedhus Hoskere[2], Billy F. Spencer Jr.[2], Matthew D. Smith[1] [[1]US Army Corps of Engineers, [2]University of Illinois Urbana-Champaign]	445

12:10~ 13:40	**Estimation of the Delamination Size of Carbon Fiber Panels from the Impact Sound** Patrick Uriarte[1], Kumar Y. Shah[1], Ibrahim Tansel[1], Kayla Etienne[1] [[1]Florida International University]	460
12:10~ 13:40	**Control of the Building Parameters of Additively Manufactured Polymer Parts for More Effective Implementation of Structural Health Monitoring (SHM) Methods** Ahmed Mohamed[1], Alireza Modir[1], Kumar Y. Shah[1], Ibrahim Tansel[1] [[1]Florida International University]	466
12:10~ 13:40	**Unsupervised Damage Detection in Time-Varying Environmental Conditions Using an Autoencoder and Support Vector Data Description** Ahmad B. Zoubi[1], V John Mathews[1] [[1]Oregon State University]	470
12:10~ 13:40	**An Improved Subspace Identification of a Nonlinear Soil-Structure System** Hoda Soltani[1], Joseph P. Havlicek[2] [[1]Shannon and Wilson Inc., [2]University of Oklahoma]	490
12:10~ 13:40	**Remarks on the Collapse of the Polcevera Viaduct** Marco Domaneschi[1], Gian Paolo Cimellaro[1], Maurizio Morgese[1], Farhad Ansari[2], Alessandro Zona[1] [[1]Politecnico di Torino, [2]University of Illinois at Chicago]	505
12:10~ 13:40	**Electrical Resistivity used for Liquid Imbibition Monitoring in Cement-Based Materials: Comparison Between Experience and Simulation** Mohamed Abdou Ibro[1], Jérôme Verdier[1], Sandrine Geoffroy[1], Hugo Cagnon[1] [[1]Université de Toulouse]	520
12:10~ 13:40	**Real-time State Estimation and Control of a Self Sensing UAV Wing via Physics Informed Deep Learning Model** Tanay Topac[1], Sera Lee[1], Xiyuan Chen[1], Purim Ladpli[1], Chen Liu[1], Alexander Strange[1], Fu-Kuo Chang[1] [[1]Stanford University]	527
12:10~ 13:40	**The use of Adapted Measurement Techniques for the Structural Monitoring for Arianegroup Needs: Focus on Two Specific Needs and Solutions Evaluated** David Barnoncel[1], Patrick Peres[1] [[1]ArianeGroup]	534
12:10~ 13:40	**Real Time Monitoring for Condition Assessment and Long Term Behavior of Metro Lines** Elisabetta Pistone[1], Hanno Töll[1], Günther Achs[1] [[1]VCE Vienna Consultin Engineers ZT GmbH]	535
12:10~ 13:40	**Structural Health Monitoring for the Assessment of the Dynamic Response of Existing Masonry Structures in Seismic Areas** Filippo Lorenzoni[1], Nicola De Conto[1], Francesca da Porto[1] [[1]University of Padova]	536
12:10~ 13:40	**Railway Safety Inspection Intervals Based on Damage Tolerance and Fracture Control Theory** Zongzheng Wang[1], Long Ma[1], Zhongwen Li[1], Hui Wang[1], Zihao Zhao[1], Zengye Ju[1] [[1]CRRC Qingdao Sifang Co., Ltd.]	541
12:10~ 13:40	**Frequency Mixing Response of Ultrasonic Guided Waves in Plate** Weibin Li[1], Yaru Xu[1], Yonghee Lee[3], Mingxi Deng[2], Younho Cho[3], Xinlin Qing[1] [[1]Xiamen University, [2]Chongqing University, [3]Pusan National University]	548
12:10~ 13:40	**Static Tactile Sensing for a Robotic Electronic Skin via an Electro-Mechanical Impedance Based Approach** Cheng Liu[1], Yitao Zhuang[2], Fu-Kuo Chang[1] [[1]Stanford University, [2]Zenith Aerospace]	555
12:10~ 13:40	**Component Data Assisted Finite Element Model Updating of Composite Flying-wing Aircraft using Multi-level Optimization** Wei Zhao[1], Abhineet Gupta[2], Chris D. Regan[2], Rakesh K. Kapania[1], Peter J. Seiler[2] [[1]Virginia Polytechnic Institute and State University, [2]The University of Minnesota]	888
12:10~ 13:40	**Electroencephalographic Observation of Augmented Cognition via Non-invasive Transcranial Infrared Laser Stimulation** Yingjun Zhao[1], Xinlong Wang[1], Hanli Liu[1], F. Gonzalez-Lima[1] [[1]University of Texas]	999

SHM in Action

Hewlett Auditorium 200 (Wednesday, Sept. 11th, 3:50 – 6:20 PM)

One of our highlighted events showcasing how Structural Health Monitoring works in practical applications. The session features demonstrations on a variety of SHM applications from many leading SHM companies and educational institutions. Participating organizations are listed in alphabetical order; a finalized schedule will be announced at the workshop.

Session Chairs: Christian Boller (Saarland University, Germany)
Branko Glisic (Princeton University, United States)

Order	Organization Name
1	Optics11
2	Embedor Technologies
3	Metis Design Corporation
4	University of Waterloo - SDIC Lab
5	Acellent Technologies Inc.
6	SHM & Heritage Structures Labs, Princeton University
7	Structures and Composites Laboratory & Digital Twins Lab
8	SMILab at the University of New Mexico
9	NTIS - New Technologies for the Information Society
10	Redondo Optics Inc
11	Carnegie Mellon University

Optics11

Optics11 will demonstrate world's only fiber optic Acoustic Emission system OptimAE. As fiber optic systems have some specific advantages over electric systems, like the immunity to liquids and/or strong EMI fields, the system will show the measurements capabilities of our fully passive sensors as they are facing such conditions.

Embedor Technologies

Seismic structural health monitoring of structures is critical to not only provide early warning of seismic motions but also enable rapid structural condition assessment for informed decisions. Wireless smart sensors are an attractive alternative to expensive and difficult-to-deploy wired monitoring systems, as they significantly reduce deployment and operating costs. However, seismic structural monitoring using smart sensors faces obstacles that include stringent energy constraints and limited transmission bandwidth. We will showcase an intelligent wireless system for real-time seismic monitoring of civil infrastructure. The event-driven system consists of three main components: ultralow-power on-demand sensing prototypes, a high-throughput live streaming framework, and a graphical user interface for real-time damage assessment. We will demonstrate that the system can detect seismic motions, provide high-quality synchronized data, and present damage assessment in real-time. Specifically, the demo will include: (1) real-time interstory drift estimation of a 6-story building model under a seismic event, and (2) sudden damage detection of the building model under a seismic event.

Metis Design Corporation

Metis Design Corporation will demonstrate their novel carbon nanotube (CNT) based potential drop (PD) fatigue crack gauge. This sensor does not employ any cables, connectors or batteries, and is able to reliably track cracks in any material starting from ~1mm. An active RFID architecture is used to momentarily power the system to remotely acquire data and indicate the current crack length in real-time. A fiberglass test article will be loaded in tension to grow a natural crack in this live demonstration, while crack length is displayed on a laptop a meter away.

University of Waterloo - SDIC Lab

We will showcase a video of the inspection robotics that we have developed (related to our manuscript, "Infrastructure Mapping and Inspection using Mobile Ground Robotics"). Our video/presentation will show footage of real-world data collection using our robots, automated processing, and inspection results. Our video/presentation will combine existing footage (e.g., https://www.youtube.com/watch?v=YCihWIBIGZ8) with new footage which focuses on results obtained using our platform.

Acellent Technologies Inc.

Acellent will demonstrate how its SHM system enables mine owners to detect damage on their mining equipment and receive damage alerts any time, anywhere in the world.

SHM & Heritage Structures Labs, Princeton University

SHM & Heritage Structures Labs will present a method and associated software for integrating, accessing, and visualizing heterogeneous SHM data and metadata of structures using virtual environments. Demo will be made using heritage Morris Island Lighthouse (Charleston, South Carolina, USA) as a case study.

Structures and Composites Laboratory (Stanford) & Digital Twins Lab (Chalmers)

Digital Twins Lab, a joint research team from Stanford (USA) and Chalmers (Sweden), will demonstrate the creation of a Digital Twin for a concrete beam in a live demo. Digital Twin of an infrastructure is a living digital simulation that brings all the data & models together and updates itself from multiple sources to represent its physical counterpart. We will demonstrate an innovative solution in which next-generation Autonomous Data Collection, Data-Driven models and Physics-Based models are integrated to a Digital Twin framework to create a comprehensive SHM system for condition assessment of infrastructures. The will demo includes: (1) Data Collection: real-time 3D scanning of a cracked concrete beam using a 3D structured-light scanner, (2) Crack Detection: real-time crack detection using an AI-based algorithm, and (3) Simulation: real-time incorporation of the detected crack into FE model, and real-time FE simulation.

Smart Management of Infrastructure Laboratory (SMILab) at the University of New Mexico

In this demonstration, the most updated human-structure interface enabled using Augmented Reality will be shared through a series of examples including, but not limited to: crack measurement, human-robotic interaction, time machine, downsizing, and more. The Smart Management of Infrastructure Laboratory (SMILab) has been collaborating with the Engineering Institute of Los Alamos National Laboratory developing Augmented Reality for Structural Inspection since Fall 2016

NTIS – New Technologies for the Information Society

The IIoT is a powerful tool in SHM. The beggining of my presentation is the brief description of IIoT in terms of developed real-time remote monitoring system. The key part of the presentation is to show the remote monitoring web client in action. The emphasis is placed on trend view tool, operator screen display and analysis tile, which contains the time-frequency and polar graph display. The analysis is made using the rotational blade vibration data, however there is no limitation to use for SHM. The demonstration is largely in video format. To sum up the demonstration will show how the user can easily monitor simultaneously a number of structures geographically located in different locations from the main station only using the internet connection.

Redondo Optics, Inc.

Redondo Optics will demonstrate the wireless battery power fiber optic sensor systems.

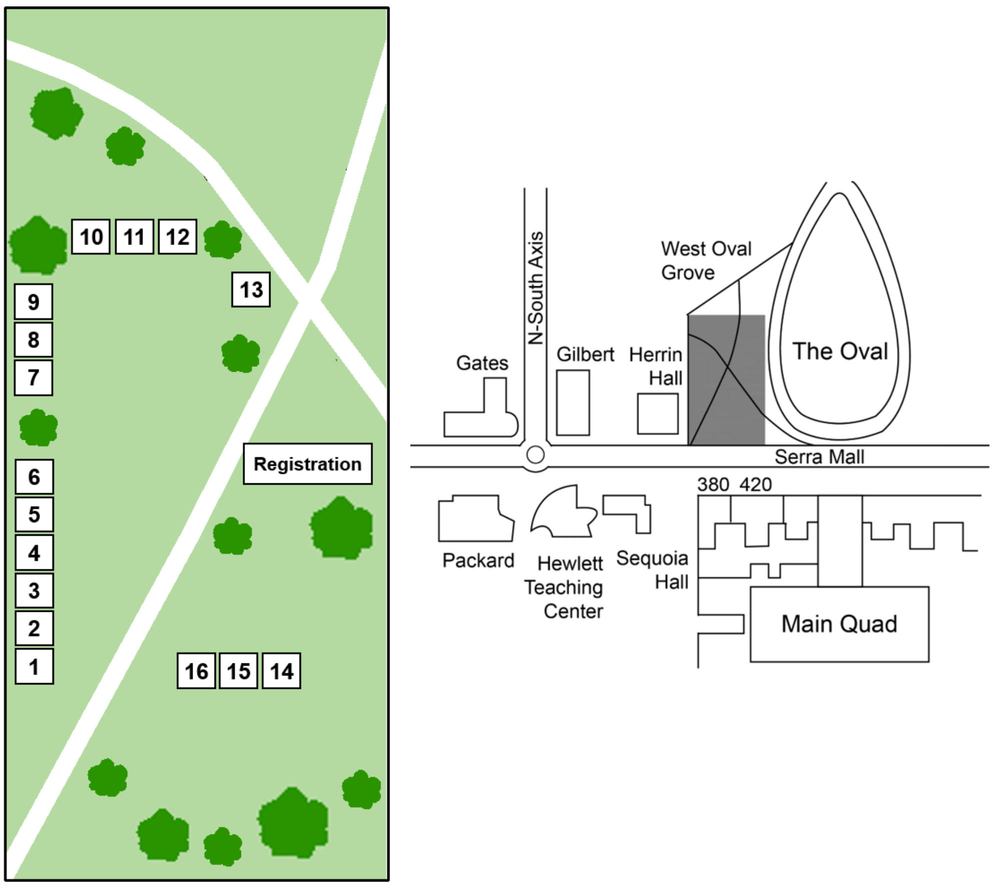
Carnegie Mellon University

Occupant monitoring is an important aspect of many smart building applications such as smart healthcare and efficient energy management. Current sensing approaches for occupant monitoring (e.g., pressure-based, vision-based, and mobile platforms) either require dense deployment, have privacy concerns, or need the occupants to carry or wear a device. To overcome these limitations, we introduce a new sensing approach using footstep-induced floor vibrations. The main intuition is that occupants' activities (e.g., walking) cause the structure to vibrate. These vibrations travel through the structure and we receive them in our vibration sensors. In this demo, we will introduce and describe our sensing system and the data acquisition system. Then, we describe and show some of the applications in occupant monitoring such as occupant localization and detection.

Company & Institution Exhibition

West Oval Grove (Tuesday – Thursday, Sept. 10th – 12th, 7:30 AM – 4:00 PM)

The Company & Institution Exhibition highlights the state-of-the art Structural Health Monitoring technologies provided by leading companies and institutions working in the field.



Exhibition Map – West Oval Grove, the Stanford Oval

Booth	Organization Name
1&2	Acellent Technologies Inc.
3	Technobis
4	The Laboratory for Verification & Validation (LVV)
5	Optics11
6	Mistras
7	Roctest/Smartec
8	PARC
9	Intelligent Fiber Optic Systems Corporation (IFOS)

Booth	Organization Name
10	Embedor Technologies
11	Optilab
12	Redondo Optics, Inc.
13	Luna Innovations
14	WCNDT 2020 Seoul
15	Sensors/ Aerospace Journal
16	Structures and Composites Laboratory (SACL)

Acellent Technologies Inc.

Acellent is the global leader in Structural Health Monitoring. Through sensor-based technology and intelligent diagnostic algorithms, Acellent's end-to-end solution ensures structural integrity and safety by detecting damage, analyzing severity, and enabling condition-based maintenance. Acellent can even predict the remaining lifecycle of structures. Using artificial intelligence and IOT, Acellent can connect physical structures to the cloud so asset owners and maintenance crews can assess damage 24/7 from anywhere in the world. Acellent: smarter structures for a safer world.

Technobis

Technobis IPS offers leading edge Fiber Optic Sensing products in Aerospace, Healthcare, Mobility, Energy, leveraging the size, weight and precision advantages of Photonic Integrated Circuits (PIC) based components to implement the readout function for Fibres Optic sensors. Through sustained innovation on PIC design, PIC packaging and module assembly (automated back-end foundry), the module size has been reduced by orders of magnitude to enable prototypes to be applied in demanding markets. PIC technology will play a major role in Industry 4.0 with its ability to provide reliable, miniature, COTS sensing components and systems for all markets.

The Laboratory for Verification & Validation (LVV)

The Laboratory for Verification & Validation (LVV), part funded by the EPSRC and by the European Regional Development Fund (ERDF), is a unique dynamics testing facility open to both academia and industry that enables research into V&V of models across test scales and in all environments. Led by the Dynamics Research Group (DRG) at The University of Sheffield, the laboratory offers significant benefits across a range of industrial sectors including energy, aerospace, automotive and renewables.

The centrepiece of the facility is a series of three large environmental chambers designed for dynamic testing under realistic environmental conditions. They offer the ability to control temperature and humidity and to simulate both wind and rainfall. An integrated shake table and reconfigurable electro-dynamic shakers enables dynamic testing across a broad frequency range within the chambers. A separate wave tank facility enables generation of deep water wave conditions. A strong wall and floor are also available for the testing of large size components and structures.

Optics11

Optics11 is a fast-growing high-tech company that develops revolutionary new industrial optical fiber measurement systems for applications in acoustic monitoring, acceleration & strain sensing and more. The underlying shared technology enables our systems to be more sensitive, affordable and have a higher bandwidth compared to existing industry standards. At IWSHM 2019 we will release (and show) world's first 16 channel fully fiber optic AE measurement system.

With our unique sensing technologies, we focus on the following four products: acoustic emission (AE) sensors, accelerometers, acoustic arrays and hydrophone arrays. Applications we serve are AE and acceleration sensing in structural health monitoring (e.g. high voltage applications (PD), aviation, railway), condition and process monitoring (rotating equipment, oil & gas), underwater acoustic sensing (seismology) and perimeter sensing.

Mistras

MISTRAS is a leading, OneSource, global provider of technology-enabled asset protection solutions used to maximize the uptime and safety of critical energy, industrial, and public infrastructure. MISTRAS combines our industry-leading services, products, technologies, and software to provide a unique, custom-tailored solution for each customer's individual asset protection need. Please check their website for more information.

Roctest/Smartec

Roctest/Smartec offers a complete line of sensor-based solutions ranging from traditional vibrating wire technology to state-of-the-art next generation fiber-optic technology used for the measurement and monitoring of geotechnical projects and structural health monitoring (SHM) of critical assets such as: dams, tunnels, mines, buildings, bridges, nuclear power plants and many other structures too numerous to list. For less than 1% of the construction cost, Roctest/Smartec's technological solutions can extend the life of an asset, reduce the need for costly repairs and deter catastrophic failure

PARC

PARC brings together science, creativity and expertise to accelerate your innovation journey. Practicing Open Innovation, we help startups, Fortune 500 companies, and government agencies turn possibilities into breakthroughs. We create new business opportunities, accelerate time to market, augment internal capabilities, and reduce risk for our clients.Please check their website for more information.

Intelligent Fiber Optic Systems Corporation (IFOS)

IFOS is in the business of Fiber Optics Interrogator systems offering advanced Fiber-Optic Sensing Solutions for Monitoring & Control of High-Value Assets from KHz to MHz. Different sensing elements can be deployed on a single optical fiber enabling a mix of strain, temperature and derivative measurements (e.g. displacement, tilt, pressure, chemical and biochemical measurements) to best meet varying customer needs at a series of discrete locations. Customized sensors are available upon request. Please check their website for more information.

Embedor Technologies

Embedor Technologies provides wireless monitoring systems for structural condition assessment of civil infrastructure. Based on smart sensor technology that delivers meaningful information and not just data, our products offer a cost-effective alternative to wired sensors and visual inspections. Embedor's sensors give near real-time insight into the evolution of a structure's condition and early warning of potential damage from extreme events (earthquakes, hurricanes) or long-term deterioration (corrosion, stress fractures), thus enabling asset owners and engineering firms to make informed decisions regarding the operation and maintenance of structures.

Optilab

Optilab is a developer of innovative, high performance fiber optic products and photonic equipment. Optilab offers customized solutions for RFoF, testing and measurement, and fiber sensing applications. The newest Sedona platform is battery operated and completely portable with a 7" LCD touch screen and Wi-Fi capabilities. Optilab is headquartered in Phoenix, Arizona with its facilities occupy 15,000 sq. ft., a multimillion-dollar building. Research and development, assembly, qualifications, sales, marketing, and technical support are conducted at this location to support worldwide customers. Optilab also owns and manages OEQuest.com, an e-Commerce website.

Redondo Optics, Inc.

Redondo Optics Inc.'s product lines include passive and dynamic fiber Bragg grating sensor(s) and interrogation systems for multi-point distributed measurement of strain, temperature, pressure, vibration, acceleration, acoustics, acoustic emissions, and ultrasound; distributed fiber optic sensors for hydrocarbon fuels (liquid and gas), RH and moisture, and cryogenic gas leak detection, multi-parameter fiber optic fluorescence sensors (O2, CO2, H2, T, P, pH, RH), fluorescence lifetime detection systems, and micro- and nanofluidic biochips for biological analysis. Please check their website for more information.

Luna Innovations

Luna Innovations is a leader in fiber optic sensing solutions for structural monitoring and testing. Luna's innovative measurement systems include the ODiSI system featuring continuous, distributed strain sensors with sub-mm spatial resolution, and the (formerly Micron Optics) HYPERION for dynamic interrogation of fiber Bragg grating (FBG) and Fabry-Perot sensors. The new os7500 accelerometer features unprecedented sensitivity and can be easily multiplexed on a single optical fiber for distributed vibration and acoustic monitoring applications. Please check their website for more information.

WCNDT 2020 Seoul

The 20th World Conference on Non-Destructive Testing (20th WCNDT 2020) will be hold on June 8 (Mon)-12 (Fri), 2020, Coex (Convention and Exhibition Center), Seoul, Korea. Please check their website for more information.

Aerospace Journal

Please visit the website for the special issue announcement "Selected Papers from IWSHM 2019" in the Aerospace Journal. Please check their website for more information.

Sensors

Please visit the website for the special issue announcement in the Sensors Journal. Please check their website for more information.

Structures and Composites Laboratory (SACL)

Structures and Composites Laboratory (SACL) is located in the Department of Aeronautics & Astronautics at Stanford University. The main focus of the group is related to the development of novel intelligent multifunctional structures, structural health monitoring diagnostics and prognostics, and micro-fabricated sensors and sensor networks. Please check their website for more information.

Awards

SHM Lifetime Achievement Award

An individual in the SHM community who has championed SHM over their career by advancing the state-of-the-art through their meritorious accomplishments in research, applications, education or sponsorship of the discipline will be selected to receive the prestigious SHM Lifetime Achievement Award by a committee of researchers, educators and practicing scientists and engineers. **This award is sponsored by 'Boeing'.**

SHM Person of the Year Award

A structural health monitoring person of the year (SHM-POY) will be selected by the editors and associate editors of Structural Health Monitoring: An International Journal. The Person of the Year should have made an outstanding contribution to the field of SHM that will benefit society. This contribution can be in the form of theory, analysis, applications, education, or other ways that support the discipline of SHM and benefit society. The award is meant to recognize accomplishments within the past year or few years. **This award is sponsored by 'SAGE'.**

SHM Hans-Juergen Schmidt Award

Individuals in the SHM community, recognized for their outstanding leadership in advancing technologies in industry and government, will be selected by an Award Committee representative of the world-wide SHM community to receive during every SHM workshop (International Workshop on Structural Health Monitoring [IWSHM], European Workshop on Structural Health Monitoring [EWSHM] and Asia-Pacific Workshop on Structural Health Monitoring [APWSHM]) the SHM Hans-Juergen Schmidt Award. **This award is sponsored by 'Aerospace Journal' and 'IWSHM committee'.**

The Achenbach Medal

The Achenbach Medal has been created to recognize an individual (within 10 years of PhD) who has made an outstanding contribution to the advancement of the field of Structural Health Monitoring. It is an international award and nominations from all over the world are encouraged.

Best Paper Award

The SHM Best Paper Award is presented to one or more individuals whose paper(s) are selected to have the highest quality and innovation from the Proceedings of the 2019 IWSHM. The Award Committee is formed by all the Session Chairmen for this Workshop. They may propose among the articles from the sessions of their specialty, one or two papers which may be candidates for the Award, justifying their proposal. **This award is sponsored by 'Boeing'.**

Best Poster Paper Award

The SHM Best Poster Paper Award is presented to one or more individuals whose poster paper(s) are selected to have the highest quality and innovation from 2019 IWSHM. The Award Committee is formed by all the Session Chairmen for this Workshop. They may propose among the articles from the sessions of their specialty, one or two poster papers which may be candidates for the Award, justifying their proposal. **This award is sponsored by 'Sensor Journal'.**

Student Best Paper Award

The IWSHM organizing committee is pleased to invite students to submit abstracts for the 2019 IWSHM Student Best Paper Award Competition. Papers will then be evaluated by a committee of experts from academia, industry, and the research community. **This award is sponsored by 'DEStech Publications'.**

The Most Practical SHM Solutions for Aerospace Award

Airbus is proud to sponsor a prize for the "Most Practical SHM Solutions for Aerospace" to be demonstrated in SHM in Action. The session will be judged by a panel of representatives from industry and government. The prize will be awarded at the end of the session. **This award is sponsored by 'Airbus'.**

The Most Practical SHM Solutions for Civil/Mechanical Systems Award

The Most Practical SHM Solution for Civil & Mechanical Systems will be demonstrated in the SHM in Action. The session will be judged by a panel of representatives from industry and government. The prize will be awarded at the end of the session.

Transportation

Workshop Venue

Registration location: **West Oval Lawn**, the Stanford Oval, Stanford University (east end of the Herrin Hall (393 Serra Mall, Stanford, CA 94305)). GPS coordinates: (37.4295393, -122.1709593). You can also access these and other map resources at: iwshm-location.iwshm.org/

Parking

The **Varsity Parking Lot** (Lot-97) is the parking space for the event. Address: Varsity (L-97), 624 Nelson Rd, Stanford, CA 94305, on September 10th – 12th, 2019. The parking in this lot is **complimentary for conference attendees**. There are by-the-hour parking spots around campus and closer to the Workshop location, but at a higher rate and on a first-come-first-serve basis. Please consult the instructions on Stanford Parking and Transportation Services (PT&S) website for more details. Metered parking is enforced Monday through Friday from 8 a.m. to 4 p.m. Parking is free throughout the University after 4p.m. and all day on weekends.

Uber and Lyft

The **Stanford Oval** is the closest drop-off point. Address: 20 Palm Dr., Stanford, CA 94305. Guests to IWSHM 2019 are encouraged to use Uber or Lyft for easy transportation.

Marguerite Shuttle Service

For guests staying in the Stanford Guest House at SLAC, a complimentary shuttle service will connect you from the guesthouse parking lot to The Stanford Oval. More information about this service can be found online at https://transportation.stanford.edu/marguerite/slac . A condensed conference schedule is presented below.

Morning All Days: Marguerite Schedule (09/10 09/11 09/12)	
Stanford Guesthouse	The Oval
7:35	8:05
8:05	8:35
8:35	9:05

Evening All Days: Marguerite Schedule (09/10 09/11 09/12)				
The Oval	Terman Grove | Roble Stop	Stanford Guesthouse	Terman Grove | Roble Stop	Cantor Museum
17:05	17:09	17:35	17:56	18:05
17:35	17:39	18:05	18:26	18:35
18:05	18:09	18:35	18:56	19:05
18:35	18:39	19:05	19:26	19:35
19:05	19:09	19:35	19:56	20:05
19:35	19:39	20:05	20:26	20:35
20:05	20:09	20:35	20:56	21:05

Free Shuttle Service

A complimentary shuttle service that connects the Workshop location and several hotels is provided for all participants from September 10th – 12th. The complimentary shuttle service will be provided between Crowne Plaza, Dinah's Garden Hotel, Hilton Garden Inn, Creekside Inn, Hotel Parmani and the Sheraton Hotel, and the Stanford campus. Conference guests will be dropped off at the Cantor Art Museum, from which the conference can be reached on foot. Guests staying at nearby hotels may use any stop on this line for transportation to or from the conference. A special shuttle will also be offered for all guests attending the Tuesday evening cruise.

Shuttle Schedule

Morning All days: To Workshop (09/10 09/11 09/12)

BUS	Dinah's Garden | Crowne Plaza	Hilton Garden Inn (Across Street)	Creekside | Hotel Parmani (Across Street)	Sheraton Palo Alto	Cantor Museum
BUS 1	6:35	6:40	6:45	7:00	7:05
BUS 2	6:55	7:00	7:05	7:20	7:25
BUS 1	7:15	7:20	7:25	7:40	7:45
BUS 2	7:35	7:40	7:45	8:00	8:05
BUS 1	7:55	8:00	8:05	8:20	8:25
BUS 2	8:15	8:20	8:25	8:40	8:45

Evening Tuesday : From Workshop to Cruise (09/10)

BUS	Cantor Museum	Sheraton Palo Alto	Creekside | Hotel Parmani	Hilton Garden Inn	Dinah's Garden Hotel	Hilton Garden Inn	Creekside Inn	Sheraton Palo Alto	Hornblower Landing
BUS 1	16:50	16:55	17:10	17:15	17:20				
BUS 2	16:55	17:00	17:15	17:20	17:25				
BUS 3	17:00	17:05	17:20	17:25	17:30				
BUS 2					18:00	18:05	18:10	18:25	19:40
BUS 3					18:05	18:10	18:10	18:30	19:45
BUS 4	17:50								19:30
BUS 5	17:50								19:30
BUS 6	17:55								19:35
BUS 7	18:05								19:40
BUS 1	18:05								19:45

Evening Tuesday : From Cruise (09/10)

BUS	Hornblower Landing	Stanford Guesthouse	Parking Lot L-97	Sheraton Palo Alto	Creekside | Hotel Parmani	Hilton Garden Inn	Dinah's Garden Hotel
BUS 1	23:00	23:50	0:00	0:15	0:20	0:35	0:40
BUS 2	23:00	23:50	0:00	0:15	0:20	0:35	0:40
BUS 3	23:00	23:50	0:00	0:15	0:20	0:35	0:40
BUS 4	23:00	23:50	0:00	0:15	0:20	0:35	0:40
BUS 5	23:00	23:50	0:00	0:15	0:20	0:35	0:40
BUS 6	23:00	23:50	0:00	0:15	0:20	0:35	0:40

Evening Wednesday: From Workshop (09/11)

BUS	Cantor Museum	Sheraton Palo Alto	Creekside Inn	Hilton Garden Inn	Dinah's Garden Hotel
BUS 1	18:30	18:35	18:50	18:55	19:00
BUS 2	18:30	18:35	18:50	18:55	19:00

Evening Wednesday: From BBQ (09/11)

BUS	Terman Grove	Sheraton Palo Alto	Creekside Inn	Hilton Garden Inn	Dinah's Garden Hotel
BUS 1	21:40	21:45	22:00	22:05	22:10
BUS 2	21:40	21:45	22:00	22:05	22:10
BUS 1	22:20	22:25	22:40	22:45	22:50
BUS 2	22:20	22:25	22:40	22:45	22:50

Evening Thursday: From Workshop (09/12)

BUS	Cantor Museum	Sheraton Palo Alto	Creekside Inn	Hilton Garden Inn	Dinah's Garden Hotel
BUS 1	18:00	18:05	18:20	18:25	18:30
BUS 2	18:00	18:05	18:20	18:25	18:30
BUS 3	18:40	18:45	19:00	19:05	19:10
BUS 2	18:40	18:45	19:00	19:05	19:10

Marubeni

President and CEO • Masumi Kakinoki

Daring to Explore the Future

I think of Marubeni as an "eternal partner" that "fills the gaps" of the world.
First, we filled the world's geographical gaps through trade.
Next, we used investment to fill the gap between the
current value and future value of businesses.
Now, we are called upon to fill a new type of gap:
"Understanding and interpreting the future."

But where can these gaps be found, and how deep do they go?
Moving forward, it is essential that we identify risks, treat them as opportunities,
and have the courage to take on the challenge of uncertainty.
This will not be a simple task—
But making sense of the complex is our very reason for being.

This is the era in which we confront the unknown world,
help people realize their dreams.
We must continue to take a leading position in guiding the world.
Marubeni is no place for complacency.
Each and every one of us must think, act and create together –
forming a team that moves as one.
This is my vision for Marubeni, as new President & CEO.

Looking towards the future,
we have plotted a course to our growth over the next decade with
"GC2021", our Medium-Term Management Strategy.
At the core of this Strategy is our "Global crossvalue platform".
Overcoming departmental boundaries,
the line between internal and external, and even international borders,
Marubeni will become a platform for the creation of new solutions.
While pursuing sustained growth in existing domains,
and explosive growth through new business models,
we will accelerate the speed of our action plans.

Through dedicated debate and discussion,
we have honed our strategies and solidified our preparations.
We are ready to overcome any obstacle.
So come on, Marubeni – let's dare to explore the future,
and explore it with a smile!

Think outside the circle, Marubeni.

Think
outside
the circle.

Global crossvalue platform
Marubeni

Kaneka Americas Holding, Inc.

In September 2016, Kaneka Americas Holding, Inc. established the Kaneka US Innovation Center, in Newark, Silicon Valley, as a development site for research and business activities. This is our second R&D base, following one in Texas. This center promotes open innovation and surveys the advanced technological trends.

SAFRAN

SAFRAN is an international high-technology group operating in the aviation (propulsion, equipment and interiors), defense and space markets. SAFRAN has a global presence, with more than 92,000 employees and sales of 21 billion euros in 2018. Working alone or in partnership, SAFRAN holds world or European leadership positions in its core markets. SAFRAN undertakes Research & Development programs to meet fast-changing market requirements, with total R&D expenditures of around 1.5 billion euros in 2018.

“Enabling Intelligent Life-cycle Health Management for Industry Internet of Things (IIOT)”

IWSHM
2019

12th International Workshop on Structural Health Monitoring

http://www.iwshm.org
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