## Workshop Website

### www.materialsaustralia.com.au/SHM2012

The website will be updated regularly to provide the latest information about the workshop. **Organising Committee** 

Workshop Chairmen S.C. Galea (DSTO, Australia) W.K. Chiu (Monash University, Australia) A. Mita (Keio University, Japan)

## Local Organising Committee

C. Davies (DSTO, Australia) J. Kodikara (Monash University, Australia) S. Moss (DSTO, Australia) N. Rajic (DSTO, Australia) C. Rosalie (DSTO, Australia) M. Veidt (University of Queensland, Australia) L. Ye (University of Sydney, Australia)

Phone: +61 3 9326 7266

Email: imea@materialsaustralia.com.au

## International Organising Committee

D. Adams (Purdue University, USA) P. Banerji (Indian Institute of Technology, Bombay, India) C. Boller (Fraunhofer Institut für zerstörungsfreie Prüfverfahren (IZFP), Germany) F.K. Chang (Stanford University, USA) M. Derriso (USAF, AFRL, USA) C. Farrar (Los Alamos Dynamics, USA) M. Friswell (Swansea University, UK) C.P. Fritzen (University of Siegen, Germany) V. Giurgiutiu (University of South Carolina, USA) A. Guemes (Universidad Politecnica de Madrid, Spain) J. Huang (Boeing Research & Technology, USA) K.H. Leong (Petronas Research & Scientific Services, Malaysia) H. Li (Harbin Institute of Technology, People's Republic of China) C.G. Koh (National University of Singapore, Singapore) A. Mal (University of California, Los Angeles, USA) N. Takeda (University of Tokyo, Japan) W. Ostachowicz (Polish Academy of Sciences, Poland) B. Prosser (NASA Langley Research Center, USA) L. Richards (NASA Dryden Flight Research Center, USA) H. Sohn (KAIST, Korea) H. Speckmann (Airbus Operations GmbH, Germany) D. Stargel (USAF, AFOSR, USA) Z. Su (Hong Kong Polytechnic University, Hong Kong) M. Todd (University of California, San Diego, USA) Secretariat Mail: Materials Australia, P.O. Box 19, Parkville, Victoria 3052, Australia Fax: +61 3 9326 7272

# 4<sup>th</sup> Asia-Pacific Workshop on **Structural Health Monitoring**

**Call for Papers** 



5 – 7 December 2012 Melbourne, Australia



# Invitation

This is the fourth in a series of biennial Asia-Pacific workshop that focus on the field of Structural Health Monitoring (SHM). This is a particularly promising area that has attracted significant attention in recent years for its wide potential applications, particularly for civil infrastructures, and maritime and aircraft structures. The purpose of the workshop is to allow a forum where key and emerging technical issues that are critical and unique in structural health monitoring can be discussed and identified, as well as allow current state-of-the-art technologies and R&D activities in the field to be presented. The workshop is also intended to promote exchanges and cross-fertilisation among many disciplines.

# **Technical Focus**

The workshop shall focus on, but not limited to, the following topics:

- Sensor and actuator development
- Reliability of structural health monitoring methodologies
- Bio-inspired sensors
- Damage identification and properties/integrity characterisation and assessment
- Intelligent processing of materials and structures
- System integration
- Applications (particularly in the field of aircraft, automotive, rail and maritime structures, civil and petroleum infrastructures etc)

# **Who Should Attend**

This workshop is recommended to researchers and academics with interests in structural health monitoring and associated research. From past workshops, industrial practitioners have gained from attending these workshops

# **Abstract Submission**

An abstract of 300-400 word is requested, outlining the content and conclusions should be emailed to the workshop secretariat:

imea@materialsaustralia.com.au

or register your interest and abstract on-line at:

www.materialsaustralia.com.au/SHM2012

# **Sponsorship and Exhibition**

There will be an exhibition held in conjunction with the workshop. Enquiries about booking/securing booths and sponsorship should be addressed to Materials Australia

# **Key Dates**

Abstract submission	2 March 2012
Abstract acceptance	9 April 2012
Papers due	10 August 2012
Draft program	3 September 2012

## **About Melbourne**

Melbourne is an exciting place for visitors. Modern architecture and design is juxatoposed with heritage buildings reflecting Australia's unique cultural history. Melbourne is a lively, sophisticated city packed with shops, restaurants, bars and cafes in wide, leafy boulevards and tiny, atmospheric laneways that beck to be explored. Within an hour's drive of the city, visitors can enjoy some of Australia's most spectacular coastlines, wildlife reserves, wineries, temperature rainforests, surf beaches and historic townshops

# **Call for Papers**

On behalf of the Organising Committee of the 4th Asia-Pacific Workshop on Structural Health Monitoring, we wish to invite you to submit a paper and present your work in this Workshop. This workshop will be held in Melbourne from 5-7 December 2012.

Papers submitted to this workshop will be subjected to peer review. We are planning to publish the acceptance papers in a journal indexed by Elsevier: SCOPUS www.scopus.com, EiCompendex (CPX) www.ei.org/, Cambridge Scientific Abstracts (CSA) www.csa.com , Chemical Abstracts (CA) www.cas.org, Google and Google Scholar www.google.com, ISI (ISTP,ISI (ISTP,CPCI, Web of Science) www.isinet.comand the institution of Electrical Engineers (IEE) www.iee.org

# 4th Asia-Pacfic Workshop on Structural Health Monitoring, 5<sup>th</sup> to 7<sup>th</sup> December 2012, Melbourne, Australia.

	Day 1: Wednesday 5th December						Day 2: Thursday 6th December						Day 3: Friday 7th December						
8:00 8:30	8:30         Registration           8:45         Conference Opening			7:30	7:30 8:00 Paper ID Registration						8:00	Paper ID	Registration						
	Chair		W.k. Chiu	ı (Monash	University)	Chair Nobuo Takeda (University of Tokyo)			Chair		Richard Chester (DSTO)								
8:45	9:45	Keynote (SHM47)	SHM) applications into Comm Luis Gustavo dos So	nercial Av antos (EN	viation Maintenance Programs IBRAER, S.A., Brazil)	8:00	9:00	Keynote (SHM83)	Fiber-Optic-Based Structural Health Monitoring for Aerospace Vel Lance Richards (NASA Dryden, USA)		ng for Aerospace Vehicle Applications Dryden, USA)	8:00	9:00	Keynote (SHM84)	<ul> <li>Drivers, enablers and barriers for implementing SHM in aerospace applications</li> <li>Peter Foote (Cranfield University, UK)</li> </ul>				
Session	Theme		1.1 SHM Demonstrators         Paper ID         2.1 Acoustic Emission           Martin Viedt         Ivan Cole		S	Session Theme		3.1 Wireless Approaches Paper ID		4.1 Acousto-Ultrasonics	S	ssion Theme		5.1 Energy Harvesting for SHM	Paper ID	6.1 Infrastructure			
9:45	10:15	SHM45	Flight Tests Performed by EMBRAER with SHM Systems, Ricardo Pinheiro Rulli,	SHM10	Modal Acoustic Emission Investigation for Progressive Failure Monitoring in Thin Composite Plates under Tensile Test,	9:00	9:30	SHM14	In-situ Blade Deflection Monitoring of a Wind Turbine using a Wireless Laser Displacement Sensor Device within the Tower, Jung-Ryul	SHM76	Development and Validation Roadmap for In Situ Structural Health Monitoring of ADF Aircraft,	9:00	9:30	SHM69	Optimal Coil Transducer Geometry for an Electromagnetic Nonlinear Vibration Energy Harvester, Luke Vandewater, Scott Moss, and	SHM1	A One Stage Damage Detection Technique using Spectral Density Analysis and Parallel Genetic Algorithms, Maryam M. Varmazyar,		
10:15	10:45	SHM40	Structural Health Monitoring of Space Vehicle Thermal Protection Systems, N. Hoschke, D. C. Price, D. A. Scott and W. L. Richards	SHM31	MohdHofizi Hafizi, J.Epaarachchi, K.T.Lau Experimental Investigation into the Damage Characterisation in Carbon Fibre Reinforced Composite Plates Using Acoustic Emission, Bizuayehu Y Mohammed, Chee K. Tan, Steven J. Wilcox, Alex Z. S. Chong	9:30	10:00	SHM35	Lee, Paritosh Giri and Hyeong-Cheol Kim Displacement Estimation from Acceleration Measurements using a Wireless Smart Sensor, Jong-Woong Park, Sung-Han Sim, Hyung-Jo Jungand, Bill F. Spencer, Jr.	SHM17	Steve Galea and Nik Rajic Guided Waves for Aircraft Panel Monitoring, Pawel Malinowski, Tomasz Wandowski, Wieslaw Ostachowicz	9:30	10:00	SHM67	Steve Galea Multiphysics Modelling and Experimental Validation of a Bi-Axial Magnetoelectric Vibration Energy Harvester, Josh McLeod and Scott Moss	SHM16	N. Harito, M. Kirle and T. Peterson Strain as Damage Indicator for Truss and Frame Structures, S. Opoka, L. Murawski, T. Wandowski, P. Malinowski, W. Ostachowicz		
10:45 Se	11:15 ssion The	eme	BR 1.2 Thermographic Techniques	REAK	2.2 Infrastructure	10:00 S	10:00 10:30 Session Theme		BREAK 3.2 Corrosion SHM		4.2 Acousto-Ultrasonics	10:00 10:30 Session Theme		eme	BR 5.2 Acousto-Ultrasonics	EAK	6.2 Infrastructure and Medical		
	Chair		Ignacio Perez		Alfredo Guemes		Chair		Lance Richards		Victor Giurgiutiu		Chair	1	Don Price		Alan Wilson		
11:15	11:45	SHM72	Thermoelastic Stress Analysis - Emerging Opportunities in Structural Health Monitoring, Nik Rajic, Steve Galea and David Rowlands	SHM7	Modeling of Environmental Effects for Vibration-based SHM using Recursive Stochastic Subspace Identification Analysis, Chin-Hsiung Loh and Ming-Che Chen	10:30	11:00	SHM65	Acoustic Emission for Tank Bottom Monitoring Gary Martin	SHM15	Guided wavefield images filtering for damage localization, Wieslaw Ostachowicz, Pawel Kudela, Maciej Radzienski	10:30	11:00	SHM33	Lamb wave Time Reversal For Damage Detection In Composite Laminates Using Single Transducer Pair, Benjamin Normandin and Martin Veidt	SHM5	A Framework for Reliability Assessment of an In-Service Bridge using Structural Health Monitoring Data, Xinghua Chen and Piotr Omenzetter		
11:45	12:15	SHM54	Investigation of the Effectiveness of Different Thermographic Testing Modalities in Damage Detection, Tadeusz Uhl, Lukasz Pieczonka, Mariusz Szwedo	SHM20	Structural Damage Estimation using Dynamic Data and Multi-Objective Optimization, Faisal Shabbir & Piotr Omenzetter	11:00	11:30	SHM74	Optical Fibre Distributed Corrosion Sensing – Architecture and Characterization, Roman Kostecki, Heike Ebendorff-Heidepriem, Stephen Warren-Smith, Claire Davis, Grant McAdam and Tanya Monro	SHM78	In situ Modal Filtering for SHM Using a Fibre Bragg Grating Array, Cédric Rosalie , Nik Rajic , Patrick Norman and Claire Davis	11:00	11:30	SHM37	Imaging Damage using Mixed Passive and Active Sensors, Chun H. Wang and L. R. Francis Rose	SHM25	Structural Design and Verification of Composite Pressure Vessels for Submarine External Stowage, Daniel Miller		
12.15	12:45	SHM13	Laser Lock-in Thermography for Fatigue Crack	SHM63	Distributed Optical Fibre Sensors and Their	11:30	12:00	SHM58	An Amount of Wetness Sensor for Environmental Monitoring, Richard Muscat and Alan Wilson	SHM3	Application of Wavelet Parameters for Impact Damage Detection in Plates, Triston J. Shelley and C.K. Liew	11:30	12:00	SHM49	Locating Point of Impact on an Anisotropic Cylindrical Surface using Acoustic Beamforming Technique, Hayato Nakatani, Talieh Hajzargarbashi, Kaita Ito, Tribikram Kundu and Nobuo Takeda	SHM82	Applications of Compressive Sensing Technique in Structural Health Monitoring, Yuequan Bao, Hui Li, Jinping Ou		
12.10	12.15	0.111120	Yun-Kyu An, Ji Min Kim and Hoon Sohn	NCU	P. Rajeev, J. Kodikara, W.K.Chiu, T. Kuen	12:00	12:30	SHM56	Recent Progress in Intelligent Vehicle Health Monitoring , Ivan. S. Cole, Penny Corrigan, Peter T. Birt, Steve Galea	SHM39	Lamb Wave Based Monitoring of Fatigue Crack Growth Using Principal Component Analysis, Ye Lu, Mingyu Lu, Lin Ye, Dong Wang, Limin Zhou and Zhongqing Su	12:00	12:30	SHM62	Designing for Lamb Wave Based In-Situ Structural Health Monitoring, W.H. Ong, W.K. Chiu	SHM12	Evaluation of a Timber-Concrete Floor Performance under Occupant-Induced Vibrations, Piotr Omenzetter, Varun Kohli & Yohann Desgeorges		
12:45 Se	13:45 ssion The	eme	1.3 Optical Fibre based SHM		2.3 SHM Techniques and Robotics	12:30 S	13:30 ession The	eme	3.3 Infrastructure	VCH	4.3 Acousto-Ultrasonics	<u> </u>  '	+						
	Chair		Peter Foote		Chin-Hsiung Loh Analysis of Vibro-Acoustic Modulations in		Chair		Michael Todd		Wieslaw Ostachowicz				Damage Identification and Assessment in		Experimental Testing of Vibration Analysis Methods to Monitor Fracture Healing of a		
13:45	14:15	SHM34	Method for CRRP Structures Using Distributed BOCDA Optical Fiber Sensor, Nozomi Saito, Takashi Yari, Kanehiro Nagai and Kiyoshi Enomoto	SHM53	Nonlinear Acoustics Used for Impact Damage Detection – numerical and experimental study, Lukasz Pieczonka, Andrzej Klepka, Wieslaw J. Staszewski, Tadeusz Uhl and Erancesco Avmerich	13:30	14:00	SHM29	Dynamic Tests and Symptom – Based Reliability of a Set of Dismounted Bridge Beams, Antonino Quattrone, E. Matta, L. Zanotti Fragonara, R. Ceravolo, A. De Stefano	SHM19	Time-Domain Hybrid Global-Local Prediction of Guided Waves Interaction with Damage, Matthieu Gresil, Yanfeng Shen, Banibrata Poddar and Victor Giurgiutiu	12:30	13:00	SHM4	14 Tapered Sandwich Structures Using Guided Waves, Samir Mustapha and Lin Ye	SHM60	Fixated Pelvis using Synthetic Pelvises: A Preliminary Study, Lydia Chwang Yuh Wong, Wing Kong Chiu, Matthias Russ, Susan Liew		
14:15	14:45	SHM73	Strain Measurements using Fibre Bragg Gratings during Full-Scale Structural Testing of an F/A-18 Centre Barrel, Tyler Schembri, Silvia Tejedor and Claire Davis	SHM44	Damage Assessment Methodology for Nonstructural Components With Inspection Robot, Yoshihiro Nitta, Akira Nishitani, Atusmi Iwasaki, Morimasa Watakabe, Shinsuke Inai and Iwao Ohdomari	14:00	14:30	SHM28	Verification of Structural Health Assessment Methods using Full-Scale Collapse Test Data of Four-Story Steel Building, Yushi Shinagawa and Akira Mita	SHM32	Nonlinear Properties of Lamb Waves under Modulation of Fatigue Damage: Finite Element Simulation with Experimental Validation, Ming Hong, Chao Zhou, Zhongqing Su and Li Cheng	13:00	14:00		LUNCH				
14:45	15:15	SHM21	A Robust Procedure for Damage Detection from Strain Measurements Based on Principal Component Analysis, Alfredo Guemes, J. Sierra-Pérez, J. Rodellar and L. Muiica	SHM41	Active Evacuation Guidance and Structural Health Monitoring System for Buildings using Sensor Agent Robots, Akira Mita and Daiki Ise	14:30	15:00	SHM36	Optimal Structural Health Monitoring Feature Selection via Minimized Performance Uncertainty, Zhu Mao, Michael D. Todd	SHM61	Understanding of the Scattering of Incident Stress Waves by Defects on the Blind Side of a Fuel Vent Hole, Caine Doherty and W.K. Chiu	14:30			4th APWSHM Networking Event: Tour to Phillip Island				
15:15	15:45	SHM80	Prediction of obsolete FBG sensor using ANN for efficient and robust operation of SHM systems, Gayan C. Kahandawaa, Jayantha A. Epaarachchib, Hao Wangc and K.T. Lau	SHM42	Sensor Agent Robot with Servo- Accelerometer for Structural Health Monitoring , Tatsuya Akiba, Nobukazu Lee and Akira Mita	15:00	15:30	SHM57	Structural Health Monitoring of Research- Scale Wind Turbine Blades, Stuart G. Taylor, Kevin M. Farinholt, Gyuhae Park,Charles R. Farrar, Michael D. Todd, Jung-Ryul Lee	SHM22	Prediction and Measurement of Lamb Wave from Debondings at Structural Features in Composite Laminates, Ching-Tai Ng and Martin Veidt			N	<b>IONASH</b> University				
15:45 Se	16:15 ssion The	eme	BR 1.4 Optical Fibre based SHM	RÉAK	2.4 Robust Networking	15:30 S	16:00 ession The	eme	BR 3.4 Vibration -based SHM	EAK	4.4 Transducer Development		ALC: BY	E	ngineering				
	Chair	r	Claire Davis		Chun Wang		Chair	r	Yuequan Bao and Dongyu Zhang		Hoon Sohn					_			
16:15	16:45	SHM38	Distributed Strain Wontoring for Damage Detection in CFRP Bolted Structures with Embedded Optical Fibres, Nobuo Takeda, Shu Minakuchi and Takeyuki Nadabe	SHM2	High Temporal Accuracy for Data in Distributed Networks of Sensors, Alan Wilson, Tim Wilson and Peter Vincent	16:00	16:30	SHM81	Structural Seismic Damage Detection Using Fractal Dimension of Time-Frequency Feature, Dongwang Tao, Dongyu Zhang and Hui Li	SHM71	Interaction of High Frequency Lamb Waves with Surface-Mount Sensor Adhesives , Patrick Norman, Claire Davis,Cedric Rosaliecand Nik Rajic				CRC:ACS				
16:45	17:15	SHM46	Scattering Matrix Approach to Informing Damage Monitoring and Prognosis in Composite Bolted Connections, Colin Haynes, Nobuo Takeda, Michael Todd	SHM66	Dynamically Reconfigurable Multivariable MEMS Sensor Array for Unattended Systems, Stephen van der Velden, Ian Powlesland, Steve Galea, Jugdutt Singh	16:30	17:00	SHM24	Substructure Damage Detection Method for Shear Structure Using Sub-time Series and ARMAX, Liu Mei and Akira Mita	SHM64	Novel Transducer for Characterization of Low- Impedance Materials, Roberto Dugnani								
17:15	18:15	Panel	Chair: Steve Opportunities and Issues a Panel: Peter Foote (Cranfield Univer	e Galea (DS I <b>ssociateo</b> risty, UK),	TO, Australia) <b>1 with SHM Implementation</b> . Luis Gustavo dos Santos (EMBRAER,	17:00	17:30	SHM18	Damage Detection for the Los Alamos Nonlinear Bookshelf Structure, Mohammad Jamal-Ahmad and Jonathan Carter	SHM59	An Enhanced Experimental Facility for Durability and Performance Characterisation of Piezoelectric Transducers for Structural Health Monitoring, George Jung, Steve Van der Velden, Kelly Tsoi and Nik Rajic	G	Off	ice of N	aval Research	E OF AER			
Brazil), Ignacio Perez (ONR, USN), Nobuo Takeda (University of Tokyo Hsiung Loh (National Taiwan University, Taiwan) and Nik Rajic (DS				eda (University of Tokyo, Japan), Chin- wan) and Nik Rajic (DSTO, Australia)	17:30	18:00	SHM23	Effectiveness of ANN and Optimization Techniques Coupled with Surrogates in Delamination Prediction, Obinna K. Ihesiulor, Krishna Shankar, Zhifang Zhang, and Tapabrata Ray	SHM79	Behaviour of Piezoelectricity of PVDF used in Structural Health Monitoring Arup Saha Chaudhuri	U	So	ELC	Technology		Australian Governme Department of Defer Defence Science and			
18:30	20:30 Welcome Reception						19:00 22:00 Conference Dinner					Technology Organisati							









## **Structural Health Monitoring: Research and Applications**



## ISBN-13: 978-3-03785-715-1

## Authors / Editors:

W.K. Chiu and S.C. Galea

## Category:

Selected, peer reviewed papers from the 4th Asia-Pacific Workshop on Structural Health Monitoring, December 5-7, 2012, Melbourne, Australia

## Year:

2013

## **Description:**

This volume of Key Engineering Materials comprises peer reviewed papers presented at the 4<sup>th</sup> Asia-Pacific Workshop on Structural Health Monitoring held on 5<sup>th</sup> – 7<sup>th</sup> December 2012 at the RACV Club, Melbourne, Victoria, Australia. These papers were assessed on the basis of technical originality and significance in relation to both research into and applications of structural health monitoring has international relevance across maritime, aerospace and infrastructure domains for both civilian and military end-users. The aim of this book is to collate the most recent developments on this topic, with focusing in particular on the Asia-Pacific region.

## Table of contents

**Periodical:** Key Engineering Materials

Volume: Structural Health Monitoring: Research and Applications Papers published in this volume:

Preface, Committees and Sponsors

A One Stage Damage Detection Technique Using Spectral Density Analysis and Parallel Genetic Algorithms

Maryam Varmazyar, Nicholas Haritos, Michael Kirley, Tim Peterson

p.1

**Application of Wavelet Parameters for Impact Damage Detection in Plates** *T.J. Shelley, Chin Kian Liew* 

p.12

Damage Identification and Assessment in Tapered Sandwich Structures Using Guided Waves

Mustapha Samir, Ye Lin

p.25

A Framework for Reliability Assessment of an In-Service Bridge Using Structural Health Monitoring Data

Xing Hua Chen, Piotr Omenzetter

p.39

Modeling of Environmental Effects for Vibration-Based SHM Using Recursive Stochastic Subspace Identification Analysis

Chin Hsiung Loh, Ming Che Chen

p.52

Modal Acoustic Emission Investigation for Progressive Failure Monitoring in Thin Composite Plates under Tensile Test

Mohd Hafizi Zohari, Jayantha Ananda Epaarachchi, K.T. Lau

p.65

Laser Lock-In Thermography for Fatigue Crack Detection

Yun Kyu An, Ji Min Kim, Hoon Sohn

p.76

*In Situ* Blade Deflection Monitoring of a Wind Turbine Using a Wireless Laser Displacement Sensor Device within the Tower

Paritosh Giri, Jung Ryul Lee

p.84

Guided Wavefield Images Filtering for Damage Localization Wieslaw Ostachowicz, Pawel Kudela, Maciej Radzienski

p.92

**Thermoelastic Stress Analysis - Emerging Opportunities in Structural Health Monitoring** *Nik Rajic, Steve C. Galea, David Rowlands* 

p.501

Strain Measurements Using Fibre Bragg Gratings during Full-Scale Structural Testing of an F/A-18 Centre Barrel

Tyler Schembri, Silvia Tejedor, Claire Davis

p.510

**Optical Fibres for Distributed Corrosion Sensing - Architecture and Characterisation** *Roman Kostecki, Heike Ebendorff-Heidepriem, Stephen C. Warren-Smith, Grant McAdam, Claire Davis, Tanya M. Monro* 

p.522

Development and Validation Roadmap for *In Situ* Structural Health Monitoring of ADF Aircraft

Steve C. Galea, Nik Rajic

p.534

Prediction of Obsolete FBG Sensor Using ANN for Efficient and Robust Operation of SHM Systems

Gayan C. Kahandawa, Jayantha A. Epaarachchi, Hao Wang, Kin Tak Lau

p.546

Structural Seismic Damage Detection Using Fractal Dimension of Time-Frequency Feature Dong Wang Tao, Dong Yu Zhang, Hui Li

p.554

Applications of Compressive Sensing Technique in Structural Health Monitoring Yue Quan Bao, Hui Li, Jin Ping Ou

p.561