

# **3rd International Operational Modal Analysis Conference**

## **(IOMAC 2009)**

**Portonovo, Italy  
4 - 6 May 2009**

**ISBN: 978-1-63266-842-4**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2009) by International Operational Modal Analysis Conference (IOMAC)  
All rights reserved.

Printed by Curran Associates, Inc. (2014)

For permission requests, please contact IOMAC  
at the address below.

IOMAC  
c/o Francesco Benedettini  
DICEAA University of L'Aquila  
Via G. Gronchi, 18  
67100 L'Aquila, Italy

Phone: 39 334 6646908  
Fax: 39 086 1242303

[francesco.benedettini@univaq.it](mailto:francesco.benedettini@univaq.it)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

## TABLE OF CONTENTS

<b>Real-Time Performance Tracking on a 183m Concrete Chimney and Tuned Mass Damper System.....</b>	1
<i>J. Brownjohn, E. Carden, R. Goddard, G. Oudin, K. Koo</i>	
<b>The Trouble with Vibration Measurements...(Lecture).....</b>	12
<i>David Ewins</i>	
<b>Challenges in Identification of the Humber Bridge Modal Parameters Based on an Ambient Vibration Test.....</b>	13
<i>Filipe Magalhães, J. Brownjohn, Elsa Caetano, Álvaro Cunha</i>	
<b>Identification of Modal Properties of the Ironworkers Memorial Second Narrows Crossing: Testing on Deck.....</b>	21
<i>Carlos Ventura, Juan Carvajal, Jose Centeno, Bishnu Pandey, Sharlie Huffman</i>	
<b>Online Automatic Identification of Modal Parameters of a Bridge Using the p-LSCF Method .....</b>	30
<i>Filipe Magalhães, Edwin Reynders, Álvaro Cunha, Guido De Roeck</i>	
<b>Long-Term Monitoring of a Highway Bridge .....</b>	38
<i>Xianfei He, Joel Conte, M. Fraser, Ahmed Elgamal</i>	
<b>Numerical Model Derivation of the Composite High-Speed Train Viaduct Based on the Experimental Data.....</b>	46
<i>M. Kahsin, B. Peeters</i>	
<b>Modal Identification of Railway Bridges from Ambient and Free Vibration Records.....</b>	56
<i>Jorge Rodrigues, Maíra Ledesma</i>	
<b>Analysis and Extraction of Temperature Effects on Natural Frequencies of a Footbridge based on Continuous Dynamic Monitoring .....</b>	64
<i>Wei-Hua Hu, Carlos Moutinho, Filipe Magalhães, Elsa Caetano, Álvaro Cunha</i>	
<b>Dynamic Investigations of the Solferino Footbridge.....</b>	72
<i>C. Cremona</i>	
<b>Modal Analysis of a River Exploitation Power House, With and Without the Turbine/Generator Units Being in Operation.....</b>	82
<i>Reto Cantieri</i>	
<b>Comparison of Two Different OMA Techniques Applied to Vibration Data Measured on a Stadium Grandstand .....</b>	90
<i>Alessandro Caprioli, Alfredo Cigada, Marcello Vanali, Carmelo Gentile</i>	
<b>Influence of the Intake Tower Dynamic Behaviour on Modal Identification of Cabril Dam.....</b>	97
<i>Paulo Mended, Sergio Oliveira</i>	
<b>Dynamic Testing of a Concrete Arch Dam .....</b>	103
<i>Pilate Moyo, Chris Oosthuizen</i>	
<b>Modal Parameter Estimation of a PVC-Product Cleaning Machine by Means of Operational Modal Analysis.....</b>	109
<i>Marco Troncosso, Alessandro Rivola</i>	
<b>Operational Modal Analysis of Large 2-Pole Rotating Machinery .....</b>	117
<i>Joel Johansson, Henrik Samuelsson, Niels-Jørgen Jacobsen, Anders Angantyr</i>	
<b>Engine Excitation for Operational Modal Analysis .....</b>	124
<i>Andreas Friedmann, Matthias Schmidt</i>	
<b>Double Modes Determination of a Gearbox Shaft Using Operational Modal Analysis .....</b>	132
<i>A. Malekjafarian, M. Ashory, M. Khatibi</i>	
<b>Ground Vibration Test and Aeroelastic Analyses of the CIRA Unmanned Space Vehicle .....</b>	139
<i>Marika Belardo, Ignazio Dimino, Vincenzo Quaranta</i>	
<b>Identification of the Dynamic Properties of Active Twist Rotor Model Blade Using Output-Only Data.....</b>	149
<i>G. Coppotelli, F. Vetrano, F. Nitzsche, D. Feszy, A. Mander, P. Wierach, J. Riemschneider</i>	
<b>Use of Correlation Techniques in Output-Only Analysis .....</b>	158
<i>A. Agneni, L. Balis Crema, G. Coppotelli</i>	
<b>Operational Modal Analysis on a Wind Turbine Gearbox .....</b>	165
<i>S. Gade, R. Schlombs, C. Hundeck, C. Fenselau</i>	
<b>Investigation of 3-D Unsteady Turbulent Flow and Noise Reduction in Expansion Chamber of Internal Combustion Engines .....</b>	173
<i>Babak Harsini</i>	
<b>Using Combined Deterministic-Stochastic Average-Based-Spectra Approach in Operational Modal Analysis.....</b>	182
<i>Luca Grieco, B. Peeters, G. Coppotelli</i>	

<b>Viscoelastic Damping Devices for Space Applications.....</b>	196
<i>R. Monti, P. Gasbarri, F. Vetrano</i>	
<b>Comparison of Input/Output and Output/Only Modal Parameter Estimation Techniques on a Simple Mechanical Structure.....</b>	205
<i>A. Culla, W. D'Ambrogio, A. Fregolent</i>	
<b>Data Acquisition Systems for Operational Modal Analysis .....</b>	213
<i>Niels-Jørgen Jacobsen, Ole Thorhauge</i>	
<b>Modal Analysis on a 500 kW Wind Turbine with Stereo Camera Technique.....</b>	221
<i>Uwe Schmidt Paulsen, Oliver Erne, Markus Klein</i>	
<b>Wireless Sensor Technology for Structural Health Monitoring of Historical Masonry Structures .....</b>	228
<i>Rafael Aguilar, Luis Ramos, Paulo Lourenco</i>	
<b>Modal Analysis of Composite Materials by Electronic Speckle Pattern Interferometry and Accelerometer .....</b>	236
<i>Sona Rusnáková, Dana Bakošová, Ivan Letko, Juraj Slabeycius, Ján Krmela</i>	
<b>Application of Radar Technology to Deflection Measurements and OMA of Bridges .....</b>	242
<i>Carmelo Gentile, Giulia Bernardini</i>	
<b>Operational Modal Analysis by Thermoelasticity.....</b>	252
<i>R. Flori, R. Marsili, G. Rossi</i>	
<b>An Approach for Response Reconstruction in Seismic Applications .....</b>	262
<i>Dionisio Bernal, Arash Nasseri</i>	
<b>Operational Modal Analysis and Earthquake Engineering .....</b>	270
<i>Carlo Rainieri, Giovanni Fabbrocino, Edoardo Cosenza</i>	
<b>A Simple Approach to Develop Analytical Models for Multi-Story Buildings by Using Earthquake Response Records .....</b>	278
<i>Erdal Safak, Eser Cakti</i>	
<b>Damping Estimation of Camus 1 Specimen through OMA .....</b>	282
<i>L. Martinelli</i>	
<b>Model Updating of Structures Under Base Excitation and RFM: A Comparative Study .....</b>	290
<i>E. Jamshidi, M. Ashory, N. NematiPoor</i>	
<b>Wireless and Stand-Alone Measurement System for Dynamic Identification of Structures.....</b>	299
<i>Mariano Modano, Donato Cancellara, Mario Luiso</i>	
<b>Vibration Based Fault Detection in a Time-Varying Link Structure via Non-Stationary FS-VTAR Models.....</b>	307
<i>Minas Spiridonakos, Spiliros Fassios</i>	
<b>Exponential Data Fitting for Features Extraction in Condition Monitoring of Paper-Based Wet Clutches .....</b>	315
<i>Agusmian Ompusunggu, Jean-Michel Papy, Steve Vandenplas, Paul Sas, Hendrik Van Brussel</i>	
<b>A Null Space Technique for Damage Location in OMA .....</b>	323
<i>Dionisio Bernal</i>	
<b>Bayesian Methodology for Structural Damage Identification and Reliability Assessment .....</b>	331
<i>Costas Papadimitriou, Evangelos Ntotsios</i>	
<b>Modal Testing of an Unreinforced Masonry House.....</b>	339
<i>Claudio Oyarzo-Vera, Abdul Razak Abdul Karim, Nawawi Chouw</i>	
<b>Identification of the Modal Properties of an Instrumented Building .....</b>	347
<i>M. Diaferio, D. Foti, N. Giannoccaro</i>	
<b>Modal Analysis and Identification of a Low Frame Steel Bridge Type System in an Automatic Container Terminal.....</b>	355
<i>X. Qin, Q. Zhang, Y. Hu, R. Xu</i>	
<b>The Identifications of Modal Parameters of a Large Industrial Structure.....</b>	361
<i>J. Grosel, W. Sawicki, Z. Wojcicki</i>	
<b>Overview of Feature Extraction Techniques.....</b>	369
<i>C. Cremona, S. Yang, L. Dieleman</i>	
<b>Experimental and Computational Analysis of Floors Submitted to Dynamic Loads.....</b>	379
<i>Daniela David, Gustavo Tristao, Liana Becocci, Marco Antonio Juliani</i>	
<b>Monitoring Masonry Chimneys with Operational Modal Analysis.....</b>	389
<i>Francisco Pallarés, Salvador Iborra, José Adam</i>	
<b>EMA and OMA Techniques for Vibro-Acoustically Coupled Systems: The Example of a Helicopter Cabin.....</b>	396
<i>E. Pierro, E. Mucchi, L. Soria, A. Vecchio</i>	
<b>Blind Source Separation for Acoustic and Modal Analysis: A Comparative Assessment .....</b>	404
<i>Carlo Rainieri, Giovanni Fabbrocino, Tiziano Polito, Francesco Marulo</i>	

<b>2D-Coherent Acoustic Intensity Estimation from Operational Scanning Laser Vibrometry</b>	
<b>Measurements for Source Identification in Reverberant Fields</b>	412
<i>G. Revel, M. Martarelli, P. Chiariotti</i>	
<b>Output-Only Acoustic Analysis of a Rigid Enclosure</b>	420
<i>Francesco Marulo, Tiziano Polito</i>	
<b>Vibro-Acoustic Operational Modal Analysis Using Engine Run-Up Data</b>	428
<i>B. Peeters, Peter Gajdatsy, Pieter Aarnoutse, Karl Janssens</i>	
<b>Experimental Dynamic Analysis of Cultural Heritage Buildings</b>	437
<i>G. Buffarini, P. Clemente, D. Rinaldis</i>	
<b>Rejection of Temperature Effect in Subspace-Based Damage Monitoring Systems: Application to Two Historical Monuments</b>	445
<i>Mohammad Abdolvahab, Laurent Mevel, Luis Ramos</i>	
<b>Dynamic Identification of the St. Martin Bell-Tower of Burano, Venice</b>	453
<i>Filippo Casarin, Claudio Modena, Elena Simonato</i>	
<b>Comparison of the Dynamic Behaviour of 16 Historical Twin Bell Towers</b>	461
<i>Thomas Schmidt</i>	
<b>Operational Modal Analysis of the Hagia Sophia Bell-Tower</b>	469
<i>A. Bayraktar, T. Turker, A. Sahin, D. Ozcan</i>	
<b>Operational Modal Analysis and FE Modelling of a Masonry Tower</b>	477
<i>Carmelo Gentile, Antonella Saisi, Nicola Gallino</i>	
<b>Structural Identification of Masonry Arch Bridges</b>	485
<i>A. Bencich, D. Sabia</i>	
<b>Operational Modal Analysis of Ramses II Statue</b>	494
<i>Tamer Elnady</i>	
<b>Design, Testing, and Evaluation of Scaled Reinforced Bell Towers</b>	502
<i>Thomas Schmidt</i>	
<b>Dynamic Identification of Reduced Scale Masonry Bridges</b>	510
<i>A. Bencich, S. Lagomarsino, G. Riotti</i>	
<b>Modal Identification of Heritage Structures: Lecce's &lt;&gt;Star Vaults&lt;&gt;</b>	518
<i>Carlo Rainieri, Giovanni Fabbrocino, Carla Conte, Maria Aiello</i>	
<b>Assessment of the Structural Safety and the Dynamic Behavior of the "Monument and Mausoleum to the Paulista Soldier of 1932"-Obelisk</b>	526
<i>Marco Antonio Juliani, Liana Becocci</i>	
<b>Monitoring Experiences on Integral Bridges</b>	534
<i>Roman Geier</i>	
<b>Vibration Investigation of Traffic Sign Bridges and Toll Gantries in Austria</b>	542
<i>Marko Heiden, Thomas Reiter, Gudrun Stettner</i>	
<b>Dynamical Tests on a Damaged Bridge</b>	551
<i>M. Dilena, A. Morassi, F. Benedettini, F. Eusani</i>	
<b>Experimental Modal Analysis for Assessing Prestress Force in PC Bridges: A Sensitivity Study</b>	559
<i>A. Materazzi, M. Brecciolotti, F. Ubertini, I. Venanzi</i>	
<b>Modal Identification of a Prestressed Concrete Bridge Through Ambient Vibration Tests</b>	569
<i>A. Materazzi, M. Brecciolotti, F. Ubertini, I. Venanzi</i>	
<b>Global and Local Dynamic Behaviour of the Sesia Viaduct, a Steel-Concrete Composite Railway Bridge on the HS Line Turin-Milan</b>	577
<i>Giuseppe Chellini, Luca Nardini, Walter Salvatore, Marco Tisalvi, Giovanni Sorrentino</i>	
<b>Frequency Domain Decomposition Revisited</b>	586
<i>Rune Brincker, Lingmi Zhang</i>	
<b>Operational Modal Analysis in the Presence of Multiple Arbitrary Ambient Forces Using Multivariable Transmissibilities</b>	598
<i>Christof Devriendt, Gert De Sitter, Patrick Guillaume</i>	
<b>Operational Modal Analysis Using Ambient Support Excitation: An OMAX Approach</b>	605
<i>Edwin Reynders, Stijn Francois, Guido De Roeck</i>	
<b>Artificial Excitation in Operational Modal Analysis</b>	613
<i>Pelayo Fernandez, Manuel Lopez Aenlle, Rune Brincker, Alfonso Fernandez Canteli</i>	
<b>Improvement of Time-Frequency Domain Identification Through PCA</b>	621
<i>A. de Stefano, E. Matta, A. Quattrone</i>	
<b>Identification of Operational Mode Shapes of a Soil Deposit Using a Grid of Microtremor Measurements</b>	629
<i>Juan Caevajal, Carlos Ventura</i>	
<b>Optimal Estimation the Building System Characteristics for Modal Identification</b>	637
<i>Azer Kasimzade, Sertac Tuhta</i>	

<b>Stress Estimation in Structures Using Operational Modal Analysis .....</b>	645
<i>Pelayo Fernandez, Manuel Lopez Aenlle, Rune Brincker, Alfonso Fernandez Canteli</i>	
<b>Deriving Stochastic Subspace Identification Algorithm Using Unified Matrix Ploynomial Approach .....</b>	653
<i>S. Chauhan</i>	
<b>A Generalized Multiple Random Decrement Method for Modal Parameter Identification of Structures.....</b>	661
<i>Wen-Hwa Wu, Mu-Sheng Xu, Chien-Chou Chen</i>	
<b>Scaling of Mode Shapes Using Mass-Stiffness Change Method.....</b>	669
<i>M. Khatibi, M. Ashory, A. Malekjafarian</i>	
<b>A Review on Operational Modal Analysis Researches: Classification of Methods and Applications .....</b>	677
<i>M. Masjedian, M. Keshmiri</i>	
<b>Optimization of Measurement Points for Damage Detection.....</b>	687
<i>C. Cremona, L. Adelaide</i>	
<b>Identification of Damage in Structural Elements Not Directly Accessible.....</b>	697
<i>Vincenzo Sepe, Gabriele Bellizzotti</i>	
<b>A Methodology Based on Symbolic Data Analysis for Structural Damage Assessment.....</b>	705
<i>Alexandre Cury, C. Cremona, Edwin Diday</i>	
<b>Damage Detection of a Steel Frame Subjected to Ground Motion.....</b>	716
<i>F. Cavalieri, M. Imbimbo, R. Betti, A. Brügger</i>	
<b>Seismic Wave Velocities in Histotical Structures: A New Parameter for Identification and Damage Detection.....</b>	724
<i>Erdal Safak, Eser Cakti, Yavuz Kaya</i>	
<b>A Damage Detection Approach Based on Responses Interpolation .....</b>	732
<i>M. Limongelli</i>	
<b>Damage Detection of a 7-Storey Concrete Building Utilizing the Frequency Domain Decomposition Method and Independent Component Analysis for Modal Parameter Extraction .....</b>	740
<i>R. Rodriguez-Rocha, F. Rivero-Angeles, E. Gomez-Ramirez</i>	
<b>The Influence of Off-Centred Crack on the Dynamics of Beam.....</b>	748
<i>Ahmad Azlan Mat Isa, Zamri Abdul Rahman</i>	
<b>Structural Damage Detection by Measurements of Vibration Characteristics .....</b>	755
<i>Nguyen Tien Khiem, Do Dinh Khang</i>	
<b>Identification of Crack Location and Depth in Beams .....</b>	768
<i>A. Siami, M. Farid, M. Asayesh</i>	
<b>Estimation of Zeros from Cepstra of the Measured Responses .....</b>	777
<i>Omer Tigli, Dionisio Bernal</i>	
<b>Improving Signal Resolution Within Engine Analysis .....</b>	784
<i>Andreas Friedmann, Michael Kauba</i>	
<b>Online Frequency Adjustment of IIR Filters .....</b>	788
<i>Pierre Vacher</i>	
<b>Modal Identification Process Using Wavelet Transform.....</b>	796
<i>M. Jafari, M. Ashory, M. Khatibi</i>	
<b>Author Index</b>	