

Society for Experimental Mechanics

22nd IMAC
Conference & Exposition
2004

IMAC XXII

“A Conference & Exposition on Structural Dynamics”

January 26-29, 2004
Dearborn, Michigan, USA

Volume 1 of 4

Printed from e-media with permission by:

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

ISBN: 978-1-60423-802-0

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

PUBLICATION POLICY

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by SEM, provided that the base fee of US \$2.00 per copy, plus US \$.25 per page is paid directly to Copyright Clearance Center, 27 Congress Street, Salem, MA 01970 USA. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Service is: 1046-6770/YR \$2.00 + \$.25.

For further information concerning publication policy, contact:

Society for Experimental Mechanics, Inc.
7 School Street
Bethel, Connecticut 06801 USA
203-790-6373
203-790-4472 Fax
e-mail: services@sem1.com
www.sem.org

Society for Experimental Mechanics, Inc. 2004

ISSN: 1046-6770

TABLE OF CONTENTS

Volume 1

1. Modal Parameter Identification I

SIMO Extension of the Algorithm of Mode Isolation	1
<i>M.S. Allen, J.H. Ginsberg</i>	
Improvement of Frequency Domain Output-only Modal Identification from the Application of the Random Decrement Technique.....	17
<i>Jorge Rodrigues, Rune Brincker, Palle Andersen</i>	
A Poly-reference Implementation of the Maximum Likelihood Complex Frequency-domain Estimator and Some Industrial Applications	26
<i>Bart Cauberghe, Patrick Guillaume, Peter Verboven, Eli Parloo, Steve Vanlanduit</i>	
Automotive and Aerospace Applications of the PolyMAX Modal Parameter Estimation Method	38
<i>Bart Peeters, Patrick Buillaume, Herman Van Der Auweraer, Bart Cauberghe, Peter Verboven, Jan Leuridan</i>	
The Impact of Measurement Condensation and Modal Participation Vector Normalization on the Estimation of Modal Vectors and Scaling.....	49
<i>Randall J. Allemang, Allyn W. Phillips</i>	
Changes of Modal Properties of Stadium Structures Occupied by a Crowd.....	61
<i>Paul Reynolds, Aleksandar Pavic, Zainah Ibrahim</i>	

2. Linking Test to Design: Model Updating & Correlation I

Model Updating of Aero Engine Casings.....	71
<i>H. Shahverdi, C. Mares, J.E. Mottershead</i>	
An Automated Parameter Selection Procedure for Updating Finite Element Model	79
<i>Gyeong-Ho Kim, Youn-sik Park</i>	
Model Correlation with Closely Spaced Modes	91
<i>Howard Walther, Lubomyra Kmetyk, Wil Holzmann, Daniel Segalman</i>	
Assessment of Non-linear Distortions in Modal Testing and Analysis of Vibrating Automotive Structures.....	99
<i>P. Verboven, P. Guillaume, S. Vanlanduit, B. Cauberghe</i>	

3. Experimental Techniques I

Cyclostationary Analysis of Boring Bar Vibrations.....	113
<i>Anders Brandt</i>	
Chaos and Aspiration to Regulate Structure and a Methodical Aspects of Dynamic Measurements for Tasks of Control.....	120
<i>George Abramchuk, Kristina Abramchuk</i>	
Soil and Building Response to a Compaction Hammer and Sheet Piler.....	123
<i>Robert Hildebrand, Juha Miettinen, Jori Montonen, Yrjo Raunisto</i>	
Damping and Modal Density - Structure vs. Substructure	131
<i>George Bissinger</i>	

Prediction of Harmonic Force Acting on Cantilever Beam	137
<i>Bor-Tsuen Wang, Kuan-Yuan Lin</i>	
4. Experimental Techniques/Civil Structures	
Wind Induced Vibration Analysis of Roof Tiles	146
<i>Satoru Okamoto, Reiji Nanba</i>	
A Comparison of Ambient and Forced-vibration Testing of a Full Scale Concrete Structure	152
<i>Charles-Philippe Lamarche, Sebastien Mousseau, Patrick Paultre</i>	
Low Frequency Vibration Excitation Performance Evaluation of Force-frequency Shifting Configurations	160
<i>Christopher J. Hudson, Scott W. Murdoch, Martin W. Trethewey, Leonard L. Koss</i>	
Finite Element Simulation of Wave Propagation in Layered and Void Soils	170
<i>Choo-Keong Ong, Shen-en Chen</i>	
Simulations and Tests on Bridge Stay-cable Dynamics Based on Experimental Deck Motion Measurements	178
<i>Jennie E. Campbell, John R. Baker, Suzanne W. Smith</i>	
5. Impact of Field Monitoring & Testing on Structural Design & Rehabilitation	
Design of a New Foundation for Offshore Wind Turbines	186
<i>Lars Bo Ibsen, Rune Brincker</i>	
Automated Model Updating Using Ambient Vibration Data from a 48-story Building in Vancouver	194
<i>Jean-Francois Lord, Carlos E. Ventura, Eddy Dascotte</i>	
6. Transducers	
Review of Power Harvesting Advances and Applications	201
<i>Henry A. Sodano, Gyuhae Park, Daniel J. Inman</i>	
Methodology to Project Load Cells Type Coupled Dual-beam with Hole	212
<i>Carlos Roberto Cauduro, Albano Luiz Weber, Alvaro Piccoli Mores</i>	
The Use of Electrical Impedance Moments for Structural Health Monitoring	220
<i>Amanda C. Rutherford, Gyuhae Park, Hoon Sohn, Charles R. Farrar</i>	
7. Dynamics of Bridges	
Modal Identification and Finite Element Updating of a Stress-ribbon Footbridge	229
<i>Elsa Caetano, Alvaro Cunha</i>	
Simulation of Bridge Vibrations Induced by High Speed Train Passages	237
<i>Dr. Rainer Flesch, DI Roman Geier</i>	
Cable-stayed Bridges and their Dynamic Response	246
<i>Dr. Rainer Flesch, DI Roman Geier</i>	
Identification from the Natural Response of the Vasco da Gama Bridge	254
<i>Alvaro Cunha, Elsa Caetano, Rune Brincker, Palle Andersen</i>	
A Wavelet-based Damage Detection Indicator for Reinforced Concrete Structures	262
<i>Dr.-Ing. Volkmar Zabel</i>	
8. Linking Test to Design: Automotive Applications	
Parametric Study of Engine Rigid Body Modes	269
<i>Basem Alzahabi, Samir Nashef</i>	

Modal Analysis Tests for Correlating an Automobile Rear Suspension Model	284
<i>Douglas A. Feldmaier, Shung H. Sung, Donald J. Nefske, Spencer J. Doggett</i>	
Model-based Design of a Power Window System: Modeling, Simulation and Validation	293
<i>Sameer M. Prabhu, Pieter J. Mosterman</i>	
Hybrid Vehicles Technology: Dynamic Analysis of Synchronously Rotating Components.....	304
<i>Marco Scionti, Francesco Petrone, Antonio Vecchio, Herman Van Der Auweraer</i>	
Analysis of the Drivetrain Bending Response for a Heavy Truck Driveline	314
<i>Arnaldo Mazzei, Basem Alzahabi, Logesh Kumar Natarajan</i>	
Suspension Based on Artificial Fluidic Muscle for Vibration Damping	321
<i>V. Ostasevicius, J. Sapragonas, K. Pilkauskas, D. Staliulionis</i>	
An Investigation of Rolling Tire Vibration Caused by Road Roughness	329
<i>N. Tsujiuchi, T. Koizumi, R. Tamaki, I. Shima</i>	
9. Diagnostics of Rotating Machinery	
Natural Frequency Identification in Torsional Vibration with High Level Order Content	337
<i>Brian R. Resor, Charles L. Groover, Martin W. Trethewey, Kenneth P. Maynard</i>	
Fault Detection in Gearboxes with Vibration Stimulus Applied Representative of In-field Operating Environment.....	346
<i>Fred M. Discenzo, Kenneth A. Loparo, Michael L. Adams, Charles E. Mitchell, Donald D. Theroux</i>	
Half Sine Shock Tests to Assure Machinery Survival in Explosive Environments.....	356
<i>Howard A. Gaberson</i>	
Geometric Non-linearity Effect on the Stability Behavior of Drivelines	368
<i>Arnaldo J. Mazzei Jr., Alan Argento</i>	
Fault Detection and Diagnosis in Turbine Engines Using Hidden Markov Models.....	374
<i>Sunil Menon, Onder Uluyol, Kyusung Kim, Emmanuel O. Nwadiogbu</i>	
Modal Based Predictive Design and Analysis of Electric Motors	381
<i>M.A. Nasser</i>	
10. Uncertainty Quantification & Model Validation I	
A Brief Tutorial on Verification and Validation - Part 1: Concepts.....	403
<i>Francois M. Hemez, Scott W. Doebling, Mark C. Anderson</i>	
Explicit Finite Element Code Verification Problems.....	420
<i>Miles Buechler, Amanda McCarty, Derek Reding, Ryan Maupin</i>	
Model Validation for the Collapse of Spherical Shells	435
<i>Ben H. Thacker, Jason E. Pepin, Peter C. McKeighan</i>	
11. Linking Test to Design: Civil Structures	
Robustness-to-uncertainty, Fidelity-to-data, and Prediction-looseness of Models.....	445
<i>Yakov Ben-Haim, Francois M. Hemez</i>	
Modal Testing of a Unique Cantilevered Structure Above the Smith Lake.....	455
<i>Robert Tolbert, Lei Zheng, Shen-en Chen</i>	
Detection for In-operation Structures: A Scilab Toolbox - Use of the GUI for the Localization.....	463
<i>Laurent Mevel, Michele Basseville, Maurice Goursat</i>	

Tuned Ball Damper Acting in One Direction	471
<i>Miros Pimer, Shota Urushadze</i>	
Optimal Design of Lattice Foundation on Expansive Soils	479
<i>Rangel J. Horta, Garrido A. Zepeda, Rea L. Perez</i>	
Modal Experiments for the Validation of Masonry Vault Models	487
<i>Ece Erdogmus, Linda M. Hanagan, Thomas E. Boothby</i>	
Wave Passage Effects on Torsional Structural Response	496
<i>Mario Juarez Ramirez</i>	
12. Modal Testing Methods I	
Application of Operating Data Scaling Techniques	504
<i>Brian Huot, Dr. Peter Avitabile</i>	
Sensor Set Expansion for Modal Vibration Testing	514
<i>Daniel C. Kammer</i>	
Operational Modal Analysis on an Automotive Transmission System	523
<i>N. Moller, S. Gade</i>	
Output Only Analysis Applied on a Reinforced Concrete Building, Lisbon	531
<i>Paulo Mendes, Maria Ana Baptista</i>	
Numerical Experiments with Vincent's Circle	540
<i>Cristinel Mares, John E. Mottershead, Yitshak M. Ram</i>	
Scaling the Mode Shapes of a Building Model by Mass Changes	549
<i>Rune Brincker, Jorge Rodrigues, Palle Andersen</i>	

Volume 2

Effective Usage of Dynamic Tester for Magnetic Disk Head	557
<i>Nobuyuki Okubo, Kenichi Yoshida, Takeshi Toi</i>	
Sensitivity-based Operational Mode Shape Normalization: Application to a Bridge.....	565
<i>E. Parloo, B. Cauberghe, F. Benedettini, R. Alaggio, P. Guillaume</i>	
13. Laser Techniques	
Laser-based Vibration Technique for Weight Measurement of Commercial Vehicles	576
<i>F.A. Moslehy, A.A. Oloufa</i>	
The Novel Image-based Tracking Laser Doppler Vibrometer.....	584
<i>P. Castellini, E.P. Tomasini</i>	
Comparison of Scanning Laser Measurements and Inverse Boundary Element Method.....	592
<i>J. Morkholt, N.J. Jacobsen, A. Schuhmacher</i>	
OMA Testing by SLDV with FEM Pre and Post-test Analysis.....	600
<i>Brian MacMillan, Mehdi Batel, Eddy Dascotte</i>	
14. Linking Test to Design: Model Updating & Correlation II	
Helicopter Missile Launcher Dynamics Prediction with Model Updating and Correlation	617
<i>Larry D. Lucas, Russell Garner, Brock Birdsong</i>	
Determining Operational Loading from Operational Displacement Shapes.....	635
<i>Arja Saarenheimo, Heikki Haapaniemi, Pekka Luukkanen, Pekka Nurkkala, Ari Vepsa</i>	

Hotspot Identification Methods for the Derivation of Acoustic Equivalent Source Models	643
<i>S. Gade, J. Morkholt, A. Schuhmacher, J. Hald</i>	
Model Updating With the Use of Principal Submatrices	653
<i>P.A. Tarazaga, Y. Halevi, D.J. Inman</i>	
Shuttle-ISS Flight-7A on Orbit Test Verification: Pre and Post Flight Analysis	665
<i>Mohamed Kaouk, Scot McNeill, Sydney Haley, Michael Grygier, Theodore Bartkowitz, P. Brian Rachal, Walter Peart</i>	
15. Experimental Techniques II	
Experimental Methodology to Estimate Dynamic Characteristics of Vehicle System/Subsystem	677
<i>Joonhyung Park, Archie Ni, Perry Gu</i>	
Deflection Shape Visualization Using White Light Projected Fringes	685
<i>A.K. Mitchell</i>	
A Complete Scilab Toolbox for Output-only Identification	693
<i>Laurent Mevel, Maurice Goursat</i>	
16. Uncertainty Quantification & Model Validation II	
Measurements Required for Displaying Operating Deflection Shapes	701
<i>Brian Schwarz, Mark Richardson</i>	
Uncertainty Propagation in Modal Analysis	707
<i>Etienne Balmes, Florian Ravary, Dominique Langlaist</i>	
Bolted Joints: Model Uncertainty vs. Test Variability	717
<i>Howard Walther, Lubomyra Kmetyk</i>	
A Model for Stochastic Mechanical Joints	725
<i>Richard Aumann, William Gregory, Thomas L. Paez, Angel Urbina, Danny L. Gregory</i>	
On a Strategy of Reduction of the Lack of Knowledge (LOK) of a Structural Dynamics Model	735
<i>P. Ladeveze, G. Puel, T. Romeuf</i>	
17. Aircraft/Aerospace I	
Ground Vibration Test of an Advanced Composite Structure	744
<i>Robert J. Dieckelman, Anthony J. Hauenstein, Jeffrey D. Puryear, Richard P. Ritzel</i>	
Compliance Maps: A Graphical Tool for Making Structural Comparisons	750
<i>Gary C. Foss</i>	
Improvements in Flight Flutter Testing, Including XML 'Common Data Stream' Network Data Transfer	760
<i>Charles R. Pickrel, Philip J. White</i>	
Blind Modal Identification for Large Aircrafts	767
<i>Laurent Mevel, Auguste Sam, Maurice Goursat</i>	
18. Vibroacoustics Modeling & Experimentation	
Predicting Structural Vibration and Sound Radiation from an Engine Cover	775
<i>D.W. Herrin, Z.G. Tao, F. Martinus, A.F. Seybert</i>	
Determining Vibration and Acoustic Particle Velocity Using Inverse Numerical Acoustics	783
<i>F. Martinus, D.W. Herrin, A.F. Seybert</i>	

On a Set of Multipoles Applied to the HELS Method	791
<i>Alexander L. Chapman</i>	
An Energy Boundary Element Formulation for Predicting the Acoustic Field around a Vehicle at High Frequencies due to Airborne Noise Sources	798
<i>Aimin Wang, Nickolas Vlahopoulos, Jason Zhu, Mike Qian</i>	
Speeding-up Acoustic Predictions	807
<i>M. Tournour, J.P. Rossion, L. Briceux, C. McCulloch</i>	
Failure Prediction in Composite Plates with Impact-induced Damage	815
<i>Stuart Taylor, Cory Rupp, David Johnson, Charles Farrar, Peter Avitabile</i>	
Shaker Control in the Presence of Nonlinearities	823
<i>Kai Yu, Steve Holman, Kelly Brinkley</i>	
Structural Damage Detection Using Chaotic Time Series Excitation	833
<i>Lillian Y. Chang, Karl A. Erickson, Kenton G. Lee, Michael D. Todd</i>	
Modifying Self-sensing Circuit to Increase Stability of Vibration Control	842
<i>Jeffrey Hodgkins, David Mascarenas, Garnett Simmers Jr.</i>	
Enhancing Power Harvesting Using a Tuned Auxiliary Structure	855
<i>Michael Damianakis, Jan Goethals, Jeffrey Kowtko, Phillip Cornwell</i>	
Online Damage Detection for Theme Park Rides	866
<i>Hoon Sohn, Gordon Thompson, Amy N. Robertson, Gyuhae Park, Charles R. Farrar</i>	
19. Damage Detection I	
Impedance-based Health Monitoring of Composites	876
<i>Benjamin L. Grisso, Daniel M. Peairs, Daniel J. Inman</i>	
The Roles of Excitation and Prediction Horizon in Attractor-based Damage Diagnostic Capability	883
<i>Jonathan Nichols, Stephen Trickey, Michael Todd, Mark Seaver</i>	
Piezoelectric Structural Excitation using a Wireless Active Sensing Unit	892
<i>Jerome P. Lynch, Arvind Sundararajan, Kincho H. Law, Hoon Sohn, Charles R. Farrar</i>	
Impedance-based Health Monitoring: Frequency Band Evaluation	901
<i>Jose dos Reis Vieira de Moura Jr., Valder Steffen Jr.</i>	
A Robust Singular Value Decomposition to Detect Damage Under Changing Operating Conditions and Structural Uncertainties	909
<i>Steve Vanlanduit, Eli Parloo, Patrick Guillaume</i>	
Monitoring Damage Growth in a Composite Plate Using a Continuous Sensor	926
<i>Mannur Sundaresan, Gangadhararao Grandhi, Mark J. Schulz, James C. Kemerling</i>	
20. Linking Test to Design: Case Studies I	
Bounding Natural Frequencies in Structures I: Gross Geometry, Material and Boundary Conditions	935
<i>Keith B. Smith, William C. Shust</i>	
Bounding Natural Frequencies in Structures II: Local Geometry, Manufacturing and Preload Effects	946
<i>Keith B. Smith, William C. Shust</i>	
Modal Analysis of a Tetrahedral Machining Structure	961
<i>L.J. Hyde, M.J. Jackson, B. Vasantharao, S.J. Pardue, J. Peddieson</i>	
On the Sufficiency of Classical Response Models in Predicting the Dynamic Behavior of Flexible Structures	973
<i>Demian G. Da Silva, Paulo S. Varoto</i>	

NVH Experimental Validation of an Axle Tube Design	994
<i>Kuang-Jen Liu, Jennifer Headley</i>	
Modal Testing Diagnosis of Bus Seat Failures	999
<i>Dennis M. McCann, Brian T. Weaver, Steven J. Smith, Elizabeth M. Meacham</i>	
Experimental and Analytical Ride Comfort Evaluation of a Railway Coach	1008
<i>K.V. Gangadharan, C. Sujatha, V. Ramamurti</i>	
21. Modeling, Simulation & Experimentation of MEMS I	
A Base Excitation Test Facility for Dynamic Testing of Microsystems	1023
<i>David S. Epp, O. Burak Ozdoganlar, Pavel M. Chaplya, Bruce D. Hansche, Thomas G. Carne</i>	
Determination of Dynamic Characteristics of MEMS Engines Rotating at High Speeds	1036
<i>Ryszard J. Pryputniewicz, Emily J. Pryputniewicz</i>	
22. Uncertainty Quantification & Model Validation III	
Calibrating Finite Element Model Damping to Experimental Shock Data	1047
<i>Randall L. Mayes</i>	
Validation Study of a Hopkinson Bar Experiment	1055
<i>Miles Buechler, Amanda McCarty, Derek Reding, Ryan Maupin</i>	
Information-gap Robustness of a Neural Network Regression Model	1068
<i>S.G. Pierce, K. Worden, G. Manson</i>	
INTL - A Strategy for the Identification and Characterization of Non-linearities Within Modal Survey Testing	1077
<i>Dennis Goge, Ulrich Fullekrug, Michael Sinapius, Michael Link, Lothar Gaul</i>	
A Robust Model-based Test Planning Procedure	1092
<i>P. Vinot, S. Cogan</i>	
System Identification of Nonlinear Structures Using Embedded Sensitivity Functions	1100
<i>Chulho Yang, Douglas E. Adams, Sam Ciray</i>	
Uncertainty Analysis for Surface Ship Subjected to Underwater Detonation	1109
<i>Sonjoy Das, Roger Ghanem</i>	

Volume 3

23. Aircraft/Aerospace II	
Transient Response Tuning of a Cantilevered Remote Sensing Camera Stand	1122
<i>Austin Zeller, William Semke</i>	
Recursive Output Only Subspace Identification for In-flight Flutter Monitoring	1130
<i>Ivan Goethals, Laurent Mevel, Albert Benveniste, Bart De Moor</i>	
Quick Detection of Flutter Onset, A Statistical Approach	1138
<i>Laurent Mevel, Michele Basseville, Albert Benveniste</i>	
Automated On-line Monitoring During a Flight	1147
<i>Laurent Mevel, Auguste Sam, Maurice Goursat</i>	
Design and Tests of an Experimental Flutter Mount System	1155
<i>Carlos De Marqui Jr., Eduardo M. Belo, Roberto H. Tsunaki, Daniela C. Rebolho, Flavio D. Marques</i>	
Experimental Characterization of Vibrations of a NASA Active Twist Rotor Blade	1165
<i>Emily J. Pryputniewicz, Gary A. Flemming, Ryszard J. Pryputniewicz</i>	

Three-dimensional Multiharmonic Analysis of Contact and Friction in Dovetail Joints	1173
<i>D. Charleux, F. Thouverez, J.P. Lombard</i>	
24. Automotive Testing & Analysis	
Non-linear MDOF Vehicle Suspension Testing	1182
<i>Filip De Coninck, David Vaes, Jan Swevers, Wim Desmet, Paul Sas</i>	
A Robust Singular Value Decomposition to Detect Damage under Changing Operating Conditions and Structural Uncertainties	1191
<i>Masahiro Okamura, Takayuki Koizumi, Nobutaka Tsujiuchi</i>	
Experimental Transfer Path Analysis Without Disassembling the Structure	1198
<i>Gert De Sitter, Patrick Guillaume, Bart Cauberghe</i>	
Dynamic Determination of Local Bracket Compliance	1206
<i>David Griffiths, William J. Stevenson</i>	
Performance of Miniature Shakers for Vehicle Component Testing	1214
<i>Bart Peeters, Peter Van Der Linden, Christophe De Veuster</i>	
Evaluation of Rotating Driveshaft Breathing Mode with Nearfield Acoustic Holography	1225
<i>Ming-Te Cheng, Liqun Na, Takeshi Abe, Chris Nouhan, Chuck Joseph</i>	
25. Experimental Techniques III	
Dynamic Model of the Human Pelvis - Parameters Identification	1231
<i>Nadine E. Conza, Daniel J. Rizen</i>	
Experimental Modal Analysis of Scale-model Solar Sails	1240
<i>Carrie L. Puschmann, Kara N. Slade, Richard S. Pappa</i>	
Development of a Constitutive Model for a Carbon Foam Material	1248
<i>Eric C. Stasiunas, Todd W. Simmermacher</i>	
Effect of Soil Plasticity on Damping of Clayey Silty Soils Using Improved Transfer Function Estimators	1259
<i>Farshad Amini</i>	
Vibration Study Based on Hydroelastic Models of Radial Gates	1262
<i>Ling Yu, D.Y. Xu, J.F. Wu, L.R. Zhang, C.L. Peng, L.X. Gao</i>	
26. Linking Test to Design: Damping Estimation for Models	
Design Strategies for Viscoelastic Damping Treatment Applied to Automotive Components	1270
<i>Etienne Balmes, Sylvain Germes</i>	
Experimental Determination of Loss Factors on Coupled Structures Using the Power Injection Method	1282
<i>Ana Lucia Libardi, Paulo Sergio Varoto</i>	
Identification of Highly Damped Systems and Its Application to Vibro-acoustic Modeling	1298
<i>Patrick Guillaume, Bart Peeters, Bart Cauberghe, Peter Verboven</i>	
Expansion of the Experimentally Identified Damping Matrix to Formulate an Analytical-experimental Hybrid Model	1311
<i>Gokhan O. Ozgen, Jay Kim</i>	

27. Modeling, Simulation & Experimentation of MEMS II

Application of Micro Scanning Laser Doppler Vibrometer or Dynamic Characterization and Quality Factor Assessment in Micro Electro Mechanical Devices (MEMS)	1323
<i>Paolo Castellini, Barbara Marchetti, E.P. Tomasini</i>	
Multiscale Multiphysics Computational Environment for MEMS	1331
<i>Ryszard J. Pryputniewicz, Andrzej J. Przekwas, Marek Turowski, Michal Furmanczyk, Andreas Hieke, Dariusz R. Pryputniewicz</i>	
Characterization of the Dynamic Behavior of LIGA Fabricated Beams	1339
<i>Wei-Yan Lu, John Korellis, Grant Shoji</i>	
Coupling Effects in the Modal Vibration of Nonsymmetrically Laminated MEMS Microcantilever Beams	1347
<i>Ronald F. Gibson, Zhengyu Liu, Niranjan Srinivasan</i>	

28. Brakes

On the Acoustic Properties of Brake NVH Dynamometer Test Cell	1357
<i>Dr. Mohamed Khalid Abdelhamid</i>	
Investigation of Mounted Disc Brake In-plane and Out-of-plane Min Brake Squeal Study	1366
<i>Dr. Michael Yang, Dr. Abdul-Hafiz Afaneh</i>	
Mechanism of Brake Squeal - From Theory to Experimentally Measured Mode Coupling	1375
<i>R. Schroth, N. Hoffmann, R. Swift</i>	
Eigenpath Dynamics of Non-conservative Mechanical Systems such as Disc Brakes	1386
<i>Lothar Gaul, Nils Wagner</i>	
Analysis and Evaluation of Ride Comfort on Standing Posture	1393
<i>T. Koizumi, N. Tsujiuchi, M. Okamura, Y. Hashimoto</i>	
Mathematical Modelling of Brake Noise Vibrations Using Spectral Methods	1401
<i>C. Talbot, J.D. Fieldhouse, A. Crampton, W.P. Steel</i>	
Predicting Disc Brake Squeal Frequencies Using Two Distinct Approaches	1408
<i>H. Ouyang, Q. Cao, J.E. Mottershead, T. Treyde</i>	

29. Signal Processing

Summary of Spectrum Estimators for Vibration Signals and Their Errors	1416
<i>Anders Brandt, Thomas Lago, Kjell Ahlin</i>	
A Historical Perspective of the FFT Algorithm	1427
<i>Ingvar Claesson, Thomas L. Lago</i>	
High Accuracy Windows for Today's 24 Bit ADCS	1432
<i>To Tran, Mattias Dahl, Ingvar Claesson, Thomas Lago</i>	
Application of Gabor Expansion for Order Analysis	1439
<i>Shie Qian</i>	
Real Signal Synthesis Using an Inverse Time-frequency Method	1450
<i>Mark French</i>	

30. Analytical Methods I

Coupling of Bending and Torsion of a Cracked Composite Beam	1460
<i>Kaihong Wang, Daniel J. Inman</i>	

Free Vibration Analysis of Free Plates Using NDIF Method	1473
<i>Il Soon Kim, Han Gil Park, Sung Ho Kim, Eun Jun Han, Jang Moo Lee, Sang Wook Kang</i>	
Modally Enhanced Dynamic Absorber (MEDA)	1483
<i>Dr. Peter Avitabile, Jeffrey Hodgkins</i>	
In-plane Vibrations of Circular Arches with Varying Cross-sections	1493
<i>Oznur Ozdemirci, Ekrem Tufekci</i>	
Fast Simulation of Non-linear Mechanical Systems	1500
<i>Yogeshwarsing Calleecharan, Kjell Ahlin</i>	
Modal Interaction of Random Dynamical Systems	1510
<i>Roger Ghanem, Debraj Ghosh</i>	
Roy Craig, Engineering Educator and Pioneer Contributor to Component Mode Synthesis	1517
<i>Francois M. Hemez, Roy R. Craig Jr., Jeff Bennighof, Yung-Tseng Chung, Daniel Kammer, Charlie Pickrel</i>	
31. Active Control	
Robust Control of Truss Structure Using Linear Matrix Inequalities	1529
<i>Samuel Da Silva, Vincente Lopes Jr., Edvaldo Assuncao</i>	
Adaptive Designs in Vibration Control	1537
<i>M.A. Nasser</i>	
Active Noise Control in an Aircraft Cabin	1565
<i>Christian Gerner, Delf Sachau, Harald Breitbach</i>	
Active-mass-damper Control of Traffic Vibration of a Four-story Steel-framed Building	1574
<i>Masayasu Miwa, Shinji Nakata, Shin-ichi Kiriyaama, Yukio Tamura, Akihito Yoshida</i>	
The Study of Vibration Absorber Based on Electrorheological and Piezoelectric Intelligent Material	1580
<i>Yaozhi Huang, Lu Huang, Xiangping Xu</i>	
32. Linking Test to Design: Testing Technology	
Digital Imaging for Dynamic Structural Testing	1589
<i>Upendra P. Poudel, GongKang Fu, Jian Ye</i>	
Measurement of Yield-stress at High Material Crush-rates for a Constitutive Model	1597
<i>Thomas G. Carne</i>	
Towards Accelerated Endurance Testing	1607
<i>S. Vanlanduit, P. Verboven, P. Guillaume, B. Cauberghe, G. Van Der Linden</i>	
Use of Photogrammetry for Sensor Location and Orientation	1616
<i>Michael J. Dillon, David L. Brown</i>	
Maximizing the Design Information from Test	1626
<i>Mary Baker, Ralph D. Brillhart, Kevin Napolitano, Paul A. Blelloch</i>	
Optimal Placement of Sensor and Actuator for Large Structures	1633
<i>Teo Lenquist Da Rocha, Samuel Da Silva, Vicente Lopes Jr.</i>	
33. Acoustic/Noise	
Identification of Noise Sources in an Aircraft Cabin	1641
<i>Joachim Drenckhan, Ingo Schafer, Delf Sachau</i>	
Experimental Validation of an "Hybrid" IBEM Technique for Acoustic Source Localization	1648
<i>A. Di Giuseppe, M. Martarelli, G.M. Revel, E.P. Tomasini</i>	

Operational Acoustic Modal Analysis: Acoustic Mode Shape Normalization 1655
Gert De Sitter, Patrick Guillaume

**Efficient Procedures for Modifying Structural Dynamics to Solve Structural
Vibration and Acoustic Noise Problems** 1660
M.A. Nasser

Volume 4

Torsionally Coupled Response Control of Structures Using Circular TLCD 1681
Lin-Sheng Huo, Hong-Nan Li

The Instantaneous Frequency Estimation In Rotating Machinery 1694
Qin Shuren, Liang Yu Qian, Guo Yu

34. Signal Processing - Wavelets

**Time-frequency Distribution and Wavelet Transform Analyses of Aerospace
Structures** 1702
James C. Goodding

Damage Detection Using Wavelet Transforms for Theme Park Rides 1711
Amy N. Robertson, Hoon Sohn, Charles R. Farrar

**On the Use of Wavelet Transform to Characterize Chaotic Behavior of an Impact
Oscillator** 1722
Issam Abu-Mahfouz

**Application of Morlet Wavelet Filter to Frequency Response Functions
Preprocessing** 1730
Lin Yue, Lingmi Zhang

A Parametric System Identification Approach Based on Wavelet Analysis 1742
Volkmar Zabel

**Wavelet-based Validation Methods and Criteria for Finite Element Automobile
Crashworthiness Modeling** 1753
Zhiqing Cheng, Joseph A. Pelletiere, Annette L. Rizer

35. Damage Detection II

Structural Failure Localization Using Direct Update Methods 1770
Ney Roitman, Carlos Magluta, L.A. Aragao Filho

Considerations on Damage Detection of a Structure Using Vibration Test Data 1779
Titus Gh. Cioara, Sreenivas Alampalli

Damage Characterization in Concrete Dams Using Output-only Modal Analysis 1787
Sergio Oliveira, J. Rodrigues, Paulo Mendes, A.C. Costa

**Multi-functional Transformation of Disturbance of Processes in Structure,
Measuring Information, and Dynamics of Damages** 1797
George Abramchuk, Kristina Abramchuk

Fault Diagnosis in Rotation System Using Well Conditioned State Observer 1802
Gilson Ferreira De Lemos, Gilberto Pechoto De Melo

Crack Detection on Steel-framed Housing Element: Gusset Plate 1810
B.S. Kim, S.H. Yoo, K.S. Ryu, J.W. Kim

36. Analytical Methods II

**Reallocation of System Mass and Stiffness for Achieving Target Specifications
Using a Superelement/Substructuring Methodology** 1819
Dr. Peter Avitabile, Hiromichi Tsuji, Dr. John O'Callahan, Dr. James P. DeClerck

Dynamic Analysis of a Beam with Discretely Spaced Elastic Supports	1834
<i>Nam-Gyu Park, Sang-Youn Jeon, Shin-Ho Lee, Kyeong-Lak Jeon, Joon-Ro Lee, Kyu-Tae Kim, Mark E. Dye</i>	
Multiobjective Optimisation Augmented with a Robustness Function	1841
<i>B. Ait Brik, S. Cogan, N. Bouhaddi</i>	
Coupling Stochastic Finite Elements - Robust Condensation Methods in Optimization of Structures	1850
<i>M. Guedri, R. Majed, N. Bouhaddi</i>	
Effect of Joint Linearization on the Probabilistic Predictions in Dynamical Systems.....	1858
<i>Roger Ghanem, John Red-Horse</i>	
Experimental Verification of Analytical and Numerical Solutions of In-plane and Out-of-plane Free Vibrations of Circular Arches	1865
<i>Ekrem Tufekci, Yasar Dogruer, Ozgur Ozdemirci</i>	
Vibro-impact Response of a Gear Pair to Periodical Excitations.....	1872
<i>Wang Jun, Wei Laisheng</i>	
37. Modal Testing Methods II	
Output-only Modal Identification on Multi-span Continuous Viaducts	1879
<i>Jorge Rodrigues, Xu Min, Luis Oliveira Santos</i>	
Effect of Frequency Content on Shear Moduli of Silty Sands Under Random Excitation Conditions	1891
<i>Farshad Amini</i>	
Modal Analysis of a Laboratory Floor for Vibration Control Applications.....	1894
<i>John Kenneth Ritchey, Mehdi Setareh, Thomas M. Murray, Alfred Wicks</i>	
Dynamic Load Rating of Rural Bridges	1900
<i>Patra Eldina Siswobusono, Shen-en Chen, Lei Zheng, Bilal El Yamak, Steven L. Jones, Dale Callehan</i>	
Vibrations of a Slightly Inclined Variable-Arc-Length Beam: Analytical and Experimental.....	1907
<i>T. Pulngern, S. Chucheepsakul, M.W. Halling</i>	
Damage Detection of Bridges: Experimental Research with Strain Mode Approach.....	1918
<i>Yan Deng, Taopeng Qiao, Qi Fu, Puqiang Yan</i>	
AMD Active Control for Irregular Buildings Using GA-BP Neural Network	1925
<i>Hong-Nan Li, Qiao Jin, Guo-Xin Wang</i>	
A New Micro Tremor Measurement System for Engineering Application.....	1938
<i>Taopeng Qiao, Yan Deng, Puqiang Yan</i>	
38. Linking Test to Design: Model Updating & Correlation III	
A Comprehensive Vehicle NVH Performance Correlation Study	1945
<i>Farshid Haste, Ravi Kumar, Ramandeep Gill, Sukhpal Pannu, Kuang-Jen Liu, Robert Shaver</i>	
Modal Testing and Modeling Considerations for a Thin Simply Supported Plate	1954
<i>Matthew J. Spruit, Chuck Van Karsen, Carl R. Vilmann</i>	
Using a Reduced Modal Basis to Update Acoustic Models.....	1964
<i>V. Decouvreur, Ph. Bouillard, A. Deraemaeker, P. Ladeveze</i>	
Output-only Modal Identification and Model Updating of a Reinforced Concrete Bridge	1976
<i>S. El-Borgi, C. Ventura, H. Smaoui, F. Cherif, S. Bahlous</i>	

Ambient Vibration-based FE Model Calibration of a Prestressed Concrete Cable-stayed Bridge..... 1984
Zhou-Hong Zong, Yi Ruan, Wei-Xin Ren

Finite Element Model Updating based on Response Surface Methodology..... 1990
Qintao Guo, Lingmi Zhang

40. Finite Element & Substructuring Techniques

Identification and Modelling of Structural Dynamics Characteristics of a Water Jet Cutting Machine 1998
Johan E. Wall, Thomas L. Englund, Ansel J. Berghuvud

MAC Evaluations Utilized in FEA Analysis for Mode Identification 2008
Lawrence V. Burns

Parameter Uncertainty and Variability in the Structural Dynamics Modeling Process..... 2017
Stijn Donders, Joost Van De Peer, Steven Dom, Herman Van Der Auweraer, Dirk Vandepitte

Combining Test-based and Finite Element-based Models in NASTRAN 2028
Ronald N. Hopkins, Thomas G. Carne, Clark R. Dohrmann, Curtis F. Nelson, Christian C. O'Gorman

A Method for Substructure Synthesis..... 2034
Xiaobo Liu

Efficient Component Mode Synthesis With a New Interface Reduction Method..... 2043
Geng Zhang, Matthew P. Castanier, Christophe Pierre

Vibration Analysis on the Laminas of Turbo-charger Compressor 2056
Hulbin Li, Yuxing Ma, Yidi Wang, Jun Cai, Huaming Zhang

41. Sports & Musical Equipment

On Structural Modification of Stringed Instruments 2061
Mark French

Modal Analysis of a Road Bike's Front Components..... 2073
Simon Richard, Yvan Champoux

42. System Identification

An Experimental Study on the Influence of Compound Bow Draw Cycle Characteristics on Vibratory Response..... 2081
Chris G. Meyer, John R. Baker

Identification of Structural Parameters Based on Inverse Modification Theory 2090
Michael Link

Mass Matrix Identification Considering the Effect of Stiffness..... 2099
Masayoshi Misawa, Tomohiro Ito

System Identification of an Inflatable Hexapod Reflector..... 2106
Jiann-Shiun Lew

Solutions to Multi-axle Vehicle Load Identification 2114
Ling Yu, T.H.T. Chan, S.Z. Lin, D.Y. Xu, C.L. Peng

43. Modal Parameter Identification II

Dynamic Characterisitcs of an Integral Deck-abutment Single-span Bridge 2122
Carlos E. Ventura

Frequency Domain Subspace Identification for Modal Analysis: How to Deal with Leakage and Transients?	2128
<i>Bart Cauberghe, Patrick Guillaume, Peter Verboven, Eli Parloo, Steve Vanlanduit</i>	
An Overview of Major Developments and Issues in Modal Parameter Estimation	2138
<i>Lingmi Zhang</i>	
Effects of High Confining Pressures on Shear Moduli of Clayey Soils Under Random Excitation Conditions	2146
<i>Farshad Amini</i>	
Parallel Multi-species Genetic Algorithm for Parameter Estimation in Structural Dynamics	2149
<i>David C. Zimmerman, Soren S.F. Jorgensen</i>	
System Identification of Instrumented Bridge Using Earthquake-induced Record	2159
<i>Dionysius M. Siringoringo, Masato Abe, Yozo Fujino</i>	
Operational Modal Analysis of a Piping System	2168
<i>Pekka Nurkkala, Heikki Haapaniemi, Pekka Luukkanen, Arja Saarenheimo, Ari Vepsa</i>	
99. Accepted Papers Unable to be Presented	
Technique for Dynamic Response Optimization of Shock Test Fixtures	2175
<i>Yongjian Mao, Yongqiang Ji, Qilu Wang, Haiying Huang, Xiaohong Yue, Qi Yang, Chenggang Zhang</i>	
Dynamic Characteristics Analysis of High-speed Rotary Tools	2184
<i>H. Jiang, W.X. Tang, Y.P. Qu</i>	
The Application of PID Fuzzy Algorithm in Idle Speed Control of Gasoline Engine	2190
<i>Cui-ping Zhang, Yuan Xia, Qing-fo Yang</i>	
The Research of the Automatic Control System of Synthesizing Transformer Substation	2196
<i>Xin-Hui Du, Yan-Fang Zhu, Jian-Cheng Song, Zhi-Hong Xue</i>	
A Method of the Fault Diagnosis for Gear Using Torsional Vibration Signals	2202
<i>Xiaoyan Xiong</i>	
Modelling and Optimal Placement of Self-sensing Actuators in Smart Board	2209
<i>Wenfeng Zhang, Jinhao Qiu, Junji Tani, Xianrong Qin</i>	
Author Index	