

Proceedings of the
**ASME INTERNATIONAL DESIGN ENGINEERING
TECHNICAL CONFERENCES AND
COMPUTERS AND INFORMATION IN
ENGINEERING CONFERENCE
– 2012 –**

VOLUME 5

**6TH INTERNATIONAL CONFERENCE ON
MICRO- AND NANOSYSTEMS**

**17TH DESIGN FOR MANUFACTURING AND
THE LIFE CYCLE CONFERENCE**

presented at

ASME 2012 INTERNATIONAL DESIGN ENGINEERING TECHNICAL CONFERENCES AND
COMPUTERS AND INFORMATION IN ENGINEERING CONFERENCE
AUGUST 12–15, 2012
CHICAGO, ILLINOIS, USA

sponsored by

THE DESIGN ENGINEERING DIVISION, ASME
THE COMPUTERS AND INFORMATION IN ENGINEERING DIVISION, ASME

A S M E

Three Park Avenue * New York, N.Y. 10016

CONTENTS

6TH INTERNATIONAL CONFERENCE ON MICRO- AND NANOSYSTEMS

Introduction.....	1
 BIO MEMS/NEMS	
DETC2012-70299.....	3
In-Vitro Allergy Detection Using a Silver Nanoparticle Modified Nanostructured Biosensor <i>Gou-Jen Wang, Yi-Fen Liu, and Chia-Che Wu</i>	
DETC2012-70324.....	11
CNT Cantilevers Under Soft AC Actuation of Frequency Near Half Natural Frequency for Bio-Sensing Applications <i>Dumitru I. Caruntu and Le Luo</i>	
DETC2012-70356.....	19
Behaviors of Bio-Functionalized Magnetic Nanoparticle Clusters in a Rotating Magnetic Field <i>Chin-Yih Hong, Ji-Ching Lai, and Chia-Chung Tang</i>	
DETC2012-70471.....	25
Modeling, Fabrication, and Testing of a Nano-injection Lance Array for Simultaneous Multi-Cell Injections <i>Nathan C. Toone, Gregory H. Teichert, Steven J. Brewer, and Brian D. Jensen</i>	
DETC2012-70473.....	33
Effects of Voltage and Distance on Stand-Alone Lance Electrodes During Repulsion <i>Nathan C. Toone and Brian D. Jensen</i>	
 DYNAMICS OF MEMS AND NEMS	
DETC2012-70061.....	41
Effects of Air on Enclosure Design of Lead-Zirconate-Titanate (PZT) Thin-Film Diaphragm Microactuators <i>Chuan Luo, Kai-Yi Hsiao, Perry Cheung, Howard Lin, A. Q. Shen, G. Z. Cao, and I. Y. Shen</i>	
DETC2012-70114.....	49
Coupled Bending and Torsion Effects on the Squeezed Film Air Damping in Torsional Micromirrors <i>Hamid Moeenfar, Farzaneh Kaji, and Mohammad Taghi Ahmadian</i>	
DETC2012-70158.....	57
Symmetry Breaking in an Initially Curved Micro Beam Loaded by a Distributed Electrostatic Force <i>Lior Medina, Rivka Gilat, and Slava Krylov</i>	

DETC2012-70317	67
Mechanical Behavior Analysis of Micro-Scaled Functionally Graded Timoshenko Beams by the Strain Gradient Theory <i>S. A. Tajalli, M. H. Kahrobaian, M. Rahaeifard, M. T. Ahmadian, M. R. Movahhedy, and J. Akbari</i>	
DETC2012-70328	75
Low-G Electrostatically Actuated Resonant Switch <i>Abdallah Ramini, Mohammad I. Younis, and Quang T. Su</i>	
DETC2012-70505	87
An Imperfect Microbeam Electrically Actuated: Experimental Investigation and Parameter Identification <i>Laura Ruzziconi, Ahmad M. Bataineh, Mohammad I. Younis, and Stefano Lenci</i>	
DETC2012-70507	95
Nonlinear Dynamics of a NEMS Carbon Nanotube Resonator <i>Laura Ruzziconi, Mohammad I. Younis, and Stefano Lenci</i>	
DETC2012-70648	101
On the Nonlinear Dynamics of Electromagnetically-Transduced Microresonators <i>Andrew B. Sabater, Vijay Kumar, Aamer Mahmood, and Jeffrey F. Rhoads</i>	
DETC2012-70915	111
Shock-Induced Electrostatic Coupling of Modes of Vibration in the Response of a MEMS Ring Sensor <i>Stefan Sieberer, Atanas A. Popov, and Stewart McWilliam</i>	
DETC2012-71268	119
Low Voltage Electrostatic Actuation and Displacement Measurement Through Resonant Drive Circuit <i>Sangtak Park and Eihab Abdel-Rahman</i>	
DETC2012-71274	127
Stabilization of Electrostatic Actuators Through Variable Gain Amplifier <i>Sangtak Park and Eihab Abdel-Rahman</i>	
DETC2012-71529	133
Generalized Theory of Electro-Mechanical Resonators With Fractal Electrodes <i>Ankit Jain and Muhammad Ashraful Alam</i>	
DETC2012-71545	139
Tunability and Sub- and Superharmonic Entrainment of Limit Cycles in CW Laser Driven MEMS <i>David B. Blocher and Alan T. Zehnder</i>	
DETC2012-70671	145
A Coupled Two Degree of Freedom Model for Nano/Micromirrors Under Van Der Waals Force <i>Hamid Moeenfar, Ali Darvishian, and Mohammad Taghi Ahmadian</i>	

MICRO- AND NANOMANUFACTURING

DETC2012-70410	151
Low Cost Micro-Pump Valve Design <i>Sina Khalilian, Simon S. Park, and Theodor Freiheit</i>	
DETC2012-70975	161
Al-Mg Micro-Features Using Micro-EDM Milling <i>F. Modica, V. Marrocco, P. Moore, I. Fassi, and G. Wiens</i>	
DETC2012-71049	169
Effects of Process Parameters on the Properties of Replicated Polymeric Parts <i>Gianluca Trotta, Vincenzo Bellantone, Rossella Surace, and Irene Fassi</i>	
DETC2012-71436	177
Cooperative Micromanipulators for 3D Micromanipulation and Assembly <i>David J. Cappelleri and Zhenbo Fu</i>	
DETC2012-70122	187
A Micro-Scale Magnetic Tumbling Microrobot <i>Wuming Jing, Nicholas Pagano, and David J. Cappelleri</i>	
DETC2012-70475	197
A Metamorphic Erectable Cell Restraint (MECR) <i>Gregory H. Teichert, Quentin T. Aten, Melanie Easter, Sandra Burnett, Larry L. Howell, and Brian D. Jensen</i>	
DETC2012-71033	205
Near-Wall Dynamics and Photoresponse of Swimming Microbiorobots <i>Denise Wong, Edward B. Steager, and Vijay Kumar</i>	
DETC2012-71089	213
Design and Fabrication of a Three-DOF MEMS Stage Based on Nested Structures <i>Yong-Sik Kim, Nicholas G. Dagalakakis, and Satyandra K. Gupta</i>	
DETC2012-71214	221
Automated Indirect Optical Micromanipulation of Biological Cells Using Indirect Pushing for Minimizing Photo-Damage <i>Atul Thakur, Sagar Chowdhury, Petr Svec, Chenlu Wang, Wolfgang Losert, and Satyandra K. Gupta</i>	
DETC2012-71294	231
Large Stroke Comb-Drive Actuators Using Reinforced, Clamped, Paired Double Parallelogram (C-DP-DP) Flexure <i>Mohammad Olfatnia, Siddharth Sood, and Shorya Awtar</i>	

MICRO MECHANICS AND SURFACE ENGINEERING OF ARTIFICIAL AND BIOLOGICAL MATERIALS

DETC2012-71317	241
Prediction of Load and Shear of Ultra-Thin Multi-Species Surface Films <i>W. W. F. Chong, M. Teodorescu, and H. Rahnejat</i>	

DETC2012-71538	247
Characterization of Piezoelectric Nanofiber Composites Acoustic Emission Sensor for Structure Health Monitoring <i>Xi Chen and Yong Shi</i>	
 MICROSCALE ENERGY HARVESTING	
DETC2012-70964	253
Modeling Flutter-Based Microgenerators <i>Raed Kafafy, Abdulhakim Javeed, Moumen Idres, and Sany Ihsan</i>	
DETC2012-71439	263
Material Property Manipulation of Photopolymer Vibration Energy Harvesters <i>Evan Baker, Timothy Reissman, Fan Zhou, and Cheng Sun</i>	
DETC2012-71440	273
Prototypes of a Field Disruption Energy Harvester <i>Karim El-Rayes, Ahmed Abdel-Aziz, Eihab M. Abdel-Rahman, Raafat Mansour, and Ehab El-Saadany</i>	
DETC2012-71451	281
Performance of a Randomly-Excited Nonlinear Energy Harvester in Mono- and Bi-Stable Potentials: An Experimental Investigation <i>Ravindra Masana and Mohammed F. Daqaq</i>	
 NONLINEAR MECHANICS, DYNAMICS, AND CONTROL OF ATOMIC FORCE MICROSCOPY	
DETC2012-70098	291
Exploring Dynamic Non-Idealities in Multi-Frequency Atomic Force Microscopy <i>Santiago D. Solares</i>	
DETC2012-70228	297
Investigation of Protein/Lipid Interactions via Scanning Probe Acceleration Microscopy: Theory and Experiment <i>Justin Legleiter, Kathleen A. Burke, and Elizabeth A. Yates</i>	
DETC2012-70233	303
Correlation of Atomic Force Microscopy Tapping Forces to Mechanical Properties of Lipid Membranes <i>Nicole Shamitko-Klingensmith, Kelley M. Wambaugh, Kathleen A. Burke, George J. Magnone, and Justin Legleiter</i>	
DETC2012-70304	311
A Flexible Control System for Automated Atomic Force Microscope Based Micro /Nanomanipulation <i>Florian Krohs and Sergej Fatikow</i>	
DETC2012-70330	319
Non-Linear Frequency Response of Atomic Force Microscope Cantilevers at the Solid-Liquid Interface <i>Daniel R. Kiracofe and Arvind Raman</i>	

DETC2012-70397	329
Subatomic Resolution in Noncontact Atomic Force Microscopy: Electron Cloud Interactions or Harmonics Processing Artifacts? <i>C. Alan Wright and Santiago D. Solares</i>	

DETC2012-71404	335
Influence of Excitation Conditions in Dual-Frequency Tapping-Mode Atomic Force Microscopy <i>Andrew J. Dick and Wei Huang</i>	

17TH DESIGN FOR MANUFACTURING AND THE LIFE CYCLE CONFERENCE

Introduction	345
---------------------------	------------

CONCEPTUAL DESIGN, MANUFACTURABILITY ANALYSIS, MANUFACTURING COST ESTIMATION, AND TOTAL COSTS OF OWNERSHIP

DETC2012-70203	347
Methods of Robotics and the Pseudoinverse to Obtain the Least-Squares Fit of Measured Points on Line-Profiles <i>J. K. Davidson, S. B. Savaliya, Y. He, and Jami J. Shah</i>	

DETC2012-70911	359
Module Definition for Product-Service Systems <i>Katja Hölttä-Otto, Victor Tang, and Kevin Otto</i>	

DETC2012-70987	369
Representations: Reconciling Design for Disassembly Rules With Design for Manufacturing Rules <i>Vikrant C. Rayate and Joshua D. Summers</i>	

DETC2012-71030	381
Manufacturability and Viability of Different C-Gear Types: A Comparative Study <i>Hani A. Arafa and Mostafa Bedewy</i>	

DETC2012-71237	393
A Service Failure Modes Identifying Method to Realize Highly Reliable Services <i>Yusuke Kurita, Koji Kimita, and Yoshiki Shimomura</i>	

DESIGN FOR MANUFACTURING, LIFE CYCLE ISSUES, AND ENVIRONMENTAL ANALYSIS OF EMERGING TECHNOLOGIES (E.G., NANOTECHNOLOGY, BIOTECHNOLOGY, AND SUSTAINABLE ENERGY SOLUTIONS)

DETC2012-70067	401
An Experimental Study on Machinability of Austempered Ductile Irons During Dry Turning by Ceramic Cutting Tools <i>Xuhong Guo and Dongdong Wan</i>	

DETC2012-70197	407
Design of a Large Scale Vertical Stabilizer Wind Tunnel Model for Active Flow Control Research <i>Glenn Saunders, Edward Whalen, Helen Mooney, and Sarah Zaremski</i>	
DETC2012-70251	415
Combining Life Cycle Assessment and Linear Regression Analysis to Determine Significant Design Characteristics <i>Ashley DeVierno, Brian Thorn, and Andres L. Carrano</i>	
DETC2012-70547	425
Comparative Life Cycle Assessment of Complex Heavy-Duty Off-Road Equipment <i>Minjung Kwak, Louis Kim, Harrison M. Kim, Peter Finamore, and Herb Hazewinkel</i>	
DETC2012-70585	435
Sustainable Product Family Planning Based on Product Life Cycle Simulation <i>Jing Tao and Suiran Yu</i>	
DETC2012-70860	443
Structuring Requirements in a Multi-Project Environment in the Construction Industry: A Life Cycle Perspective <i>Michael Wörösch</i>	
DETC2012-71197	455
Principles of Green Design: Analyzing User Activities and Product Feedback <i>Nicole Esposito and Julie Linsey</i>	
DETC2012-71307	465
Direct and Indirect Water Consumption in Vehicle Manufacturing <i>Francisco Tejada, Bert Bras, and Tina Guldberg</i>	
DESIGN FOR QUALITY, ROBUST DESIGN, AND UNCERTAINTY MANAGEMENT	
DETC2012-70646	477
Combining Variation Simulation With Thermal Expansion for Geometry Assurance <i>Samuel Lorin, Lars Lindkvist, Rikard Söderberg, and Robert Sandboge</i>	
DETC2012-70659	487
Simulating Part and Assembly Variation for Injection Molded Parts <i>Samuel Lorin, Lars Lindkvist, and Rikard Söderberg</i>	
DETC2012-70765	497
Body in White Geometry Measurements of Non-Rigid Components: A Virtual Perspective <i>Björn Lindau, Alf Andersson, Lars Lindkvist, and Rikard Söderberg</i>	
DETC2012-70841	507
Modelling Uncertainty in Competitive Bidding <i>Melanie E. Kreye, Yee Mey Goh, and Linda B. Newnes</i>	

DESIGN FOR SUPPLY CHAIN

DETC2012-70462..... 517

A Methodology for the Comprehensive Assessment of International Procurement Costs
Michael D. Johnson, William J. Sawaya, III, and Malini Natarajarathinam

DETC2012-71180..... 529

Computer-Aided Generation of Modular Designs Considering Component
End-of-Life Options: Implications for the Supply Chain
Nirup Philip, Gül E. Okudan Kremer, Karl R. Haapala, and Kyoung-yun Kim

DETC2012-71322..... 541

Reverse Logistics Network Design for the Collection of End-of-Life Vehicles
Hang Dai and Qing Wang

DETC2012-71420..... 549

A Multi-Aspect Modeling Method for Service Flow Simulation Using Scene
Transition Nets (STNs)
*Takeshi Tateyama, Seiichi Kawata, Satoshi Mikoshiba, Koji Kimita, Kentaro Watanabe,
Ryosuke Chiba, and Yoshiki Shimomura*

EMERGING DESING FOR X METHODS (E.G., RELIABILITY, MAINTAINABILITY, AND RESILIENCE)

DETC2012-70138..... 559

A Study of Fatigue-Life Estimation and Reliability Analysis for Dental Implants
Yuo-Tern Tsai, Y. K. Lu, Y. Y. Hsu, and J. B. Lu

DETC2012-70280..... 569

Characterization of Task Specific Force Systems and the Rational Selection of
A-Frame Ladders
Ralph L. Barnett

DETC2012-70743..... 579

Design Refresh Planning Models for Managing Obsolescence
Liyu Zheng, Janis Terpenny, Peter Sandborn, and Raymond Nelson, III

DETC2012-71054..... 591

An Analysis of Critical Factors in Medical Device Development to Design for FDA
Lourdes A. Medina, Gül E. Okudan Kremer, and Richard A. Wysk

INTEGRATED ASSEMBLY DESIGN AND PLANNING

DETC2012-70430..... 601

Disassembly Sequence Planning for Product Maintenance
Yongtao Luo and Qingjin Peng

DETC2012-71075..... 611

Reasoning: Source of Variability in the Boothroyd and Dewhurst Assembly Time
Estimation Method
Essam Namouz, Joshua D. Summers, and Gregory M. Mocko

DETC2012-71528	619
Joint Design for 3-D Printing Non-Assembly Mechanisms <i>Xuan Song and Yong Chen</i>	
 INTEGRATED PRODUCT AND PROCESS DEVELOPMENT PROCESSES	
DETC2012-70431	633
Sustainable Design Using Integrated TRIZ and Eco-Checklist With Function Impact Matrix <i>Arash Hosseinpour and Qingjin Peng</i>	
DETC2012-70861	643
Design Method Selection Matrix for Facilitating Product Platform and Family Design <i>Yutaka Nomaguchi, Anders Askhøj, Kristian F. Madsen, Ryota Akai, and Kikuo Fujita</i>	
DETC2012-71160	659
Probabilistic Graphical Models as Tools for Evaluating the Impact of Usage-Context on the Environmental Performance of Products <i>Cassandra Telenko and Carolyn Seepersad</i>	
DETC2012-71444	673
A Method for Measuring Programmatic Dependency and Interdependency Between DoD Acquisition Programs <i>Matthew B. Christensen and J. Robert Wirthlin</i>	
 LIFE-CYCLE DECISION MAKING (LCDM)	
DETC2012-70451	687
Evolutionary System Topology Identification and its Application in Product Reuse <i>Vijitashwa Pandey and Zissimos P. Mourelatos</i>	
DETC2012-70803	703
The Transition to Alternative Powertrains: Concept for the Life-Cycle-Oriented Symbiosis of Technology, Product and Product Portfolio Planning <i>Christoph Herrmann, Thomas Stefan Spengler, Mark Mennenga, Katharina Wachter, and Karsten Kieckhäfer</i>	
DETC2012-71144	713
Increasing the Utility of Sustainability Assessment in Product Design <i>Dane D. Eastlick and Karl R. Haapala</i>	
DETC2012-71554	723
Modeling the Obsolescence of Critical Human Skills Necessary for Supporting Legacy Systems <i>Peter Sandborn, Varun J. Prabhakar, and Abisola Kusimo</i>	
 SUSTAINABLE DESIGN OF INDUSTRIAL SYSTEMS	
DETC2012-70414	731
An Approach to Study Impact of Public Policy, Exogenous Variables, and Vehicle Design on Greenhouse Gas Emission <i>Swithin S. Razu and Shun Takai</i>	

DETC2012-70695	743
Estimation of Long-Term Copper Demand Based on Sustainability Scenarios: A Challenge to Sustainable Manufacturing Industry <i>Yusuke Kishita, Yuta Inoue, Shinichi Fukushima, Yasushi Umeda, and Hideki Kobayashi</i>	
DETC2012-70785	753
A Network Flow Optimization Model for Automotive Glazing Recycling <i>Romain Farel, Kazuhiro Saitou, Yann Leroy, and Bernard Yannou</i>	
DETC2012-70850	767
Proposal of Design Support Method of Sustainability Scenarios in Backcasting Manner <i>Yuji Mizuno, Yusuke Kishita, Haruna Wada, Kazuhiro Kobayashi, Shinichi Fukushima, and Yasushi Umeda</i>	
DETC2012-71145	777
A Framework for the Integration of System Engineering and Functional Analysis Techniques to the Goal and Scope of Life Cycle Assessment <i>Marcos Esterman, Jr., Maria E. Fumagalli, Brian Thorn, and Callie Babbitt</i>	
THERMAL AND ENERGY MANUFACTURING SYSTEMS	
DETC2012-70246	789
Fuel Flexible Distributed Combustion for Gas Turbine Engines <i>Ahmed E. E. Khalil and Ashwani K. Gupta</i>	
DETC2012-70283	797
Holistic Approach to Green Buildings From Construction Material to Services <i>Essam E. Khalil</i>	
DETC2012-70284	807
Design of Energy Efficient Commercial Buildings in Developing Countries <i>Essam E. Khalil</i>	
DETC2012-70285	817
Numerical Computations of Flow Regimes in Enclosed Spaces <i>Ahmed E. A. El Degwy, Sami M. Morkos, Ashraf S. Sabry, and Essam E. Khalil</i>	
DETC2012-70559	825
Comparison of the Environmental Impacts of Innovative and Common Products <i>Brady P. Gilchrist, Irem Y. Tumer, Qi Gao, Karl R. Haapala, and Robert B. Stone</i>	
DETC2012-70571	835
Design for Micro Insert Moulding: A Review <i>P. Farrugia, P. Vella, and Luke Said</i>	
DETC2012-70679	843
CFD Analysis of Wind Turbine Blade With Winglets <i>Alka Gupta and R. S. Amano</i>	

DETC2012-70686.....	851
Experimental Analysis of the Heat Transfer Variations Within an Internal Passage of a Typical Gas Turbine Blade Using Varied Internal Geometries <i>Todd Hahn, Bryant Deakins, Andrew Buechler, Sourabh Kumar, and R. S. Amano</i>	
DETC2012-70688.....	859
Wind Turbine Blade Design and Analysis With Tubercle Technology <i>Sourabh Kumar and R. S. Amano</i>	
DETC2012-71522.....	873
Flow Analysis of Straight and Swept Edge Wind Turbine Blades in Blade and Wake Regions <i>Ryoichi S. Amano, Pradeep Mohan Mohan Das, and Mohammed Alnakhli</i>	
DETC2012-71524.....	881
Water Aeration in Wastewater Treatment <i>R. S. Amano, Ammar Alkhalidi, Patrick Bryar, and Wayel Alwayel</i>	
DETC2012-71526.....	885
Numerical Investigation and Experimental Lab Setting-Up for Analysis of Gas Turbine Combustor Dilution Process <i>R. S. Amano, Alka Gupta, Mohamed S. Ibrahim, Andrew Rux, Mark Lang, and Travis Moll</i>	
Author Index.....	893