Thirty-first North American Manufacturing Research Conference

NAMRC 31

May 20-23, 2003
Hamilton, Ontario, Canada

Hosted by:
McMaster University
Faculty of Engineering
McMaster Manufacturing Research Institute

The North American Manufacturing Research Institution of the Society of Manufacturing Engineers
Dear Colleagues and Friends:

We welcome you to the Thirty-first North American Manufacturing Research Conference. The Faculty of Engineering at McMaster University is pleased to host the 31st North American Manufacturing Research Conference (NAMRC) from May 20-23, 2003. NAMRC has been an established international forum for the presentation of cutting-edge research results throughout universities and industries from around the world since 1973. Leaders in manufacturing research have come to this conference to exchange findings and leading-edge technological information. Participation in NAMRC 31 provides the authors with far-reaching recognition of their work, as well as yields valuable insight from other leaders in manufacturing research.

This year, 82 technical papers will be presented at the conference by researchers from universities, research institutes, and industrial research laboratories located around the world. All of these complete manuscripts have been accepted for presentation at NAMRC 31 and published in the Transactions of the conference based upon a stringent peer review process conducted by the Scientific Committee of the North American Manufacturing Research Institution of the Society of Manufacturing Engineers (NAMRI/SME).

The conference will begin in the early evening of Tuesday, May 20, with a welcoming reception at the Sheraton Hotel, downtown Hamilton. On Wednesday, May 21, the conference Opening Ceremony will feature welcoming remarks by Mr. Norm Lockington, Vice President of Technology at Dofasco, Inc.

We want to extend a special invitation to our colleagues and friends in industry and academia to attend the conference. We look forward to your participation in this important event, renewing acquaintance with those of you who are regular attendees at this conference, and to meeting many of you who will be attending for the first time. We believe that participation in NAMRC 31 will be both an intriguing and beneficial experience for you.

Sincerely,

Mohamed A. Elbestawi and Tin Nye
Co-Chairs
NAMRC 31 Organizing Committee

What is NAMRC

NAMRC is an international forum for the presentation and critical discussion of the results of basic and applied research in material forming, material removal, and manufacturing systems and controls. It is one of only a few events of its kind where technical innovations, new methods and applications of leading-edge technology from throughout the world are shared among manufacturing research, design, engineering, and production professionals from academia and industry. Because NAMRC takes place every year, the findings and breakthroughs presented here are topical and of current interest.

Why Should You Attend?

By attending NAMRC 31, you will:

- Gain insight on the most recent developments in material removal and forming processes, automation and control of processes and systems, equipment accuracy and precision, and many other manufacturing related topics,
- Participate in a dialogue between industry and academia on future needs for manufacturing processes and applications,
- Enhance your knowledge of alternative manufacturing processes and applications,
- Make valuable contacts with other leading manufacturing researchers and professionals.

About NAMRI/SME

The North American Manufacturing Research Institution of the Society of Manufacturing Engineers (NAMRI/SME) is an organization dedicated to manufacturing research and technology development. Its mission is to advance manufacturing engineering by promoting research and its application in industry. To learn more about NAMRI/SME or to become a member, visit the Web site at www.sme.org/namri.

Sponsorship

The NAMRC 31 Organizing Committee thanks the McMaster Manufacturing Research Institute at McMaster University for their sponsorship of this conference.

Conference Publication

Papers accepted for and presented at NAMRC 31 will be contained in the hardbound Transactions of the North American Manufacturing Research Institution of SME, Volume 31, 2003. Participants who have paid the registration fee will receive a copy at the time of registration. Additional copies may be purchased by contacting NAMRI/SME Customer Service Representative at (313) 271-1500, ext. 4500 or (800) 733-4763.
<table>
<thead>
<tr>
<th>Day</th>
<th>Morning</th>
<th>Afternoon</th>
<th>Evening</th>
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<tbody>
<tr>
<td>Tuesday</td>
<td>NAMRC 31 Opening Meeting 9:30 a.m. - 5:30 p.m.</td>
<td>Concurrent Sessions 1:30 - 3:30 p.m.</td>
<td>NAMRC Banquet, Canadian Vap QUALITY Heritage Museum, 7:00 - 10:30 p.m.</td>
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</table>
| May 20    | Wednesday  
|           | Registration and Breakfast 7:30 - 8:30 a.m.  | Concurrent Sessions 4:00 - 6:00 p.m.          | McKAY Laboratory Tours, 4:00 - 6:00 p.m. |
|           | Welcoming Ceremony 8:30 - 9:15 a.m.          |                                               | Student BBQ, McMaster Campus, 7:00 - 10:30 p.m. |
|           | Concurrent Sessions 10:30 a.m. - 12:00 p.m.   |                                               | NAMRC Reception, 7:30 - 10:30 p.m. Hamilton Museum of Steam and Technology |
|           |                                               |                                               |                                               |
| Thursday  | NAMRC Opening Meeting 9:30 a.m. - 5:30 p.m.  | NAMRC/MED Membership Meetings 4:00 - 6:00 p.m. |                                               |
| May 21    | Registration and Breakfast 7:30 - 8:30 a.m.  | Panel Discussion 1:30 - 3:30 p.m.             |                                               |
|           | Welcoming Ceremony 8:30 - 9:15 a.m.          |                                               |                                               |
|           | Concurrent Sessions 10:30 a.m. - 12:00 p.m.   |                                               |                                               |
|           | Industry Tour - St Lawrence, 9:30 a.m. - 12:00 noon |                                               |                                               |
| Friday    | NAMRC Opening Meeting 9:30 a.m. - 5:30 p.m.  | NAMRC/MED Membership Meetings 4:00 - 6:00 p.m. |                                               |
| May 22    | Registration and Breakfast 7:30 - 8:30 a.m.  | Panel Discussion 1:30 - 3:30 p.m.             |                                               |
|           | Welcoming Ceremony 8:30 - 9:15 a.m.          |                                               |                                               |
|           | Concurrent Sessions 10:30 a.m. - 12:00 noon   |                                               |                                               |

Detailed information about the conference program and schedule may be found on the NAMRC 31 website at marm.mcmaster.ca/namrc.
Wednesday, May 21, 2003 – Technical Paper Presentations

**Forming Design and Analysis**

One-Piece Press Forming of Automobile Steel Wheels Without Welding
Ken-ichiro Mori, Seijo Miaki, Daikiu Nakagawahara

An Optimum Design Model for Down Acting Press Brakes of High Precision and Medium Span
Wenting Li

Design of a Fastener Clinching Process Using FEM
Patrick H. Wenneker, Staffan Njireh, Taylan Altan, Ken Cardina

Three Dimensional UBT Simulation Tool for Seamless Ring Rolling of Complex Profiles
Vipul Ranatunga, Jay S. Gunasekera, Sahas P. Vaize, Urban De Souza

**Machining Models**

An Analytical Solution to Cutting Forces and Chip Thickness in Machining with a Grooved Tool Including the Tool-Chip Contact on the Tool Secondary Rake Face
N. Fang, C. Wood, W. Wang

A Hybrid Model for Analysis of 3D Machining Operations
Arni H. Adibi-Sadeh, Vis Madhusan

Off-Line Feed Rate Scheduling for 3D Ball-End Milling Using a Mechanistic Cutting Forces Model
Jeong Hoon Ko, Dong-Woo Cho, Tae Jo Ko

A Simplified Approach for Determining Empirical Cutting Force Coefficients for Ball-End Milling
Abdullahi Azeem, Hsi-Yang (Steve) Feng, Lihui Wang

**Microsystems**

Development of a Low F-Number Micro-Lens and Micro-Injection Mold Master Using Micro-Stereolithography Technology
In Hwan Lee, Dong-Woo Cho, Dong Sung Kim, Tai Han Kwon, Kijang Oh, Seung-Han Yang

Study of Pulse Electrochemical Micro Machining
J. Koza, K.P Rajurkar, Y. Maikar

Manufacturing of Micro-Scale Open-Cell Polymeric Foams Using the Solid-State Foaming Process
Wee U, Krishna Nadeka, Vipin Kumar

An Evaluation of Packaging Architectures for Tissue-Based Microsystems
Brian K. Paul, Chuckaphan Anamphanphun, Frank Chapman, Rosalyn Upon

**Formability**

An Advanced Method to Describe the Forming Limit of Metals
Fritz Klocke, Dirk Brauer, Hans-Wilf Reardt

Microstructure-Based Modeling of Anisotropic Superplastic Deformation
Manwan K. Kharash, Tadi K. Abu-Farha

Formability Improvement in Aluminum Tailor Welded Blanks via Material Combinations
Amir V. Bhagvan, Ghassan T. Kordli, Peter A. Friedman

An Experimental Investigation of Coating Durability in Forming Pre-Coated Sheet Metal
Jyhwen Wang, Richard Alexander, Sony Pauly

**Machinability**

Ultra High Speed Machining of Aluminum Alloys: Machinability Aspects and Attainable Accuracy
M. Dumitrescu, T. D. Werdany, E-G. Ng, M.A. Elbestawi, H.A. Kishawy

A New Approach to Characterize the Machinability of Powder Metals
Edward Illa, Michael O’Neill, Aarti Shrivastava, Michael Finn

Machinability of Sintered and Hipped Fe-Mo Components
Ke Li, M.A. Marrian

Nano-meter Scale Ductile Cutting of Tungsten Carbide
Kui Liu, Xiaoping Li, Steven Y. Liang

**Manufacturing Systems Design**

Virtual Visualization and Prototyping Environment for Component-Based Production Machinery
D.A. Vera, A.A. West, R. Harrison, D.W. Thomas

An Innovative Reconfigurable and Totally-Automatic Fixture System for Agile Machining Applications
Chi-Hung Shen, Yiu-Tin Lin, John S. Agapios, Gary L. Jones, Mark A. Kramarczyk, Polak Bandypadhyay

Fixture Configuration Synthesis for Reconfigurable Assembly Using Procruster-Based Fairwise Optimization
Zhimyu Kong, Darisz Ceglarek

Integrated Machining of a Centrifugal Impeller
Hong-Tsu Young, Li-Chang Chuang
Rapid Prototyping

Rapid Prototyping Non-Uniform Shapes from Sheet Metal Using CNC Single Point Incremental Forming
J. Jerwiet, E. Hagan

Design and Fabrication of Injection Mould Insert via Laminated Metal Tooling Process
Mingliang Chen, Abdulhadi Al-Atami, Gene Zak

FEM Based Process Design for Laser Forming of Doubly Curved Shapes
Chao Liu, Y. Lawrence Yao

Three-Dimensional Laser Forming of Sheet Metal Using Triangular Patches
Masaaki Otsu, Hideshi Miura, Michiya Matsushima, Koio Osakiida

Cutting Tools

Facing of Inconel 718 Using Alumina Based Ceramics and PVD TiAIN Coated Carbide Tools - A Comparison
RM. Arunachalam, M. A. Mannan

Experimental Study of PCO Tool Performance in Drilling AI-Jg316/8561 Metal Matrix Composites
M. Ramulu, D. Kim, H. Kao, P. N. Rao

Experimental Analysis of Turning Centrifugally Cast SiCp-Aluminum Matrix Composites with PC0 and Thick Film CVD Diamond Tools
William E. Pedersen, M. Ramulu

An Assessment of Carbide Self-Propelled Rotary Tools During Machining Hardened Steel
Y. Zhang, J. Wilcox, H. A. Kissahy

Tool Path Planning

Teach Path Planning for Solid Freeform Fabrication Based on Welding
Rajeev Dwivedi, Zoran Jandric, Radovan Kovačević

A New Tool Path Generation Method for 3-Axis Sculptured Part Machining
Zherong C. Chen, Geoffrey W. Vickers, Zuomin Dong

Edge Point Extraction for Two Dimensional Analysis
Meghan Shilling, Thomas Kurfees

A Study on Geometric Feature Recognition of Free Form Surface Product
Xingqun Zhang, Jie Wang, Kazuo Yamazaki

Modeling 1

Modeling Schemer, Transmision, and Strain Measurement for Microscale Laser Shock Peening
Hongqiang Chen, Y. Lawrence Yao

Model Based Tempering for Improved Process Performance - An Application to Grinding of Shafts
Rajkumar Palanna, Sarath Buvakapram

Neuro-Fuzzy Process Control System for Sinking EDM
A. Behrens, J. Girzen

Modeling of Bond Formation in EDM Process
Longnei Li, Peihua Gu, Qian Sun, Celine Bellehumeur

Machine Tool Accuracy Control

Valid Machine Tool Setup for Helical Groove Machining
Zhongde Shi, Stephen Makin

Diagnosis of Multiple Fixture Faults in Machining Processes Using Designated Component Analysis
Jaime Camelo, S. Jack Hu, Weiping Zhong

Accuracy Improvement of the On-Machine Inspection System by Correction of Geometric and Transient Thermal Errors
Kyung Don Kim, Sung-Chong Chung

Experimental Validation of Prediction Accuracy Using a Hybrid Thermal Error Model in Machine Tool Positioning Error Compensation
R. Ramesh, M. A. Mannan, A. N. Poo

Neural Network Applications

A Radial Basis Neural Network for Integrated Modeling and Optimization of CNC End Milling
Hazim El-Mounayri, Hayaan Deng, Snehasta Mishopadhyay

Accuracy Prediction in Flat End Milling Using Neural Network Approach
Zakir G. Duga, Hazim El-Mounayri, Mohamed Gadalah

Neural Networks Modeling of Turning Surface Roughness Parameters Defined by ISO13065
Chang-Xue (Jack) Feng, Zhiguan (Samuel) Xu

Investigation of Inverse ANN - FEM Frameworks for Grain Size and Temperature Control in MultiAxis Hot Forging
Menxing Ji, Qiezh Kim, Raja Shivpuri
Non-Traditional Machining

Instrumentation, Experimentation, and Mapping Techniques for Vibrations in Drilling
David N. Dillae, Philip V. Bayly, Adam J. Schaeff

Study on Ultrasonic Vibration Milling Using Small-Diameter Ball-Nosed End Mill
Masahiko Jin, Hidenari Kanai, Masao Murakawa, Shigjirou Yamaoka

SEM Characteristics of 15 and 35 Vol% SiCp/Al Metal Matrix Composites
D. Kim, M. Ramulu, W.E. Pedersen, Y.W. Soo

Metrology

Development of a 3D Laser Ball Bar for the Volumetric Error Measurement of Multi-Axis Machines
Kuang-Chao Fan, Hai Wang, Fang-Jung Shou, Chih-Wei Ke

A Study on the Vibration Free High-Speed Operation of Three Dimensional Coordinate Measuring Machine
Pinet Sinyotha, Xingquan Zhang, Kaisuo Yamazaki

On the Selection of OMM Based Inspection Methodology for Circularity Tolerance
Sam Anand, Nitin Maheshwari, Christopher McCord

Sensors

Multisensor Process Performance Assessment Through the Use of Autoregressive Modeling and Feature Maps
Nicolas Cassetto, Dragan Djordjevic, Rhett Mayer, Jan Ne, Jay Lee

Sensor to Detect Cutting Force Components, Cutting Torque, and Cutting Tool Deflections
Hidetani Aoyama, Tomoya Ishii

Analysis of Grain Size Measurement Methods in Semiautomatic Image Analysis Setup
Chaiya Prameetpongprang, Jaraporn Hassanomtr

Grinding

Analysis and Design of Grinding Processes Within Process Chains of Ceramic Components
Kirstian Eichgrä, Lothar Schafer, Günter Wannecke, Jan C. Aurich

Analysis of Wheel Topography and Grit Force for Grinding Process Modeling
Ragelaya L. Hecker, Igor M. Ramoneda, Steven Y. Liang

Experimental Comparison Between Two- and Three-Body-Abrasion Processes as Applied to Alumina Ceramics
Christian E. Spanu, Ioan D. Marinescu, Mariana Pruteanu, Mike Hitchiner

Tribological Properties of ECLD-Sliding Wheel Based on In-Process Observation by Using CCD Microscope Tribosystem
Teruko Kato, Hitoshi Ohnori, Ioan Marinescu

Emerging Technologies on Web-enabled E-Manufacturing Research
Panel Discussion

Tolerancing

Optimal Tolerance Allocation and Process-Sequence Selection Incorporating Manufacturing Capacities and Quality Issues
Natalia Robles, Upal Roy

Simultaneous Tolerance Synthesis Through Variation Propagation Modeling of Multistage Manufacturing Processess
Giang Huang, Jianjun Shi

Functional Tolerancing of a Gearbox

Process Capability Analysis for Production Tolerance Assignment
Anshum Jain, Nuo Xu, Samuel H. Huang, Y. Kevin Rong

Friday, May 23, 2003 - Technical Paper Presentations

Modeling 2

Modeling and Control of Process-Induced Warpage and Residual Stresses in Molded Composite Components
A. Shorf El-Gazawy, Yuan-Der Kuan

A Predictive Modeling Methodology for Part Quality From Machining Lines
John S. Agapiou, Eric Steinhilper, Fangming Gu, Pulak Bandyopadhyay

Analysis of the Real Area of Contact and Interfacial Friction in Cutting Tool Coatings
Zhenhua Tao, Michael R. Lovell

Machine Tools

Fast Response Control for Machine Tool Feed Drives
Mohamed F. Aly, Gary M. Bone, Stephen C. Veldhuis

A Shop-Floor-Programming System for STEP-CNC

An Approach to Trigonal Optimization and Remote Manipulation
Lihui Wang, Fenglong Xi, Dan Zhang, Marcel Vernier
Process Planning
Probabilistic Precision Process Planning - PT
Arvind Narganganj, David A. Donnell, Paul K. Wright

A Process Model Based Methodology for Comprehensive Process Planning of Contour Turning Operations
Jingdong Lu, G. Bunker Ondrusek, Shiv G. Kapoor, R.E. DeVor

A Grammar-Based Approach to Capturing and Managing Processes: An Industrial Case Study
Yicheng Wang, Patrick Kwon, Brian T. Pentland, Ameet Chabria

Thermal Measurement and Modeling
Nonintrusive, Position Measurement of Temperature in the Presence of Strong Disturbances
Thamar E. Mara, Svetko A. Spievak

A Thermal Interface Model for Finite Element Simulation of Hot Forging
William R.D. Wilson, Steven A. Schmid, Jing-Pu Lu

Thermal fatigue Prediction in Die Casting Shot Sleeves
Q. Shi, Jalal R. Brebrick, Blaine W. Lilly

Metalworking Fluids and Environment
Expedious Identification and Quantification of Mycobacteria Species in Metalworking Fluids
Using Peptide Nucleic Acid Probes
Steven J. Sieradzki, Laura A. Skorfas, Carlos A. Aguilar, Fu Zhao

Evaluating Performance Changes Due to Gradual Component Depletion in Metalworking Fluids
M.H. Greaves, R.E. DeVor, S.G. Kapoor, N. Rajagopolan

Endometrially Benign Manufacturing: Status and Vision for the Future

Process Design
Designed Experimental Study on Setup Parameters of Laser Scanning System
J.M. Zhang, Z.J. Pei, J.G. Sun

Development of an Automated System for Measuring Grinding Wheel Wear Rates
Stephanie Lachance, Andrew Wachter, Robert Bauer

Frequency Design of an Ultrasonic Transmitter for Injection Molding Pressure Measurement
Li Zhang, Charles E. Neufer, Robert X. Sato, David D. Kamer

SME's People Network

Professional Information

Manufacturing and Inventory in Applications of
MANUFACTURING RESEARCH

Professional Development Council

SME provides you with the latest news and technical information—resources to help you face your daily challenges in manufacturing and the application of manufacturing technology.

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<tr>
<th>Name</th>
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Check Your Preferred Address for Receiving Information from SME

**Work**

**Home**

### B. Work Address (required)

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<th>Company/Organization Name</th>
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**Number of People Employed at This Address**

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**Job Function**

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<tr>
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<td>3</td>
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<td>Engineering</td>
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<td>Product Design &amp; Development</td>
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<td>Control Engineering</td>
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Your Company’s End Product

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**E-Mail**

**Education**

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**Technical Specialty List**

- Assembly & Joining
- Automation & Controls
- Communication Systems
- Computer Manufacturing
- Computer Integrated Manufacturing
- Computer-aided Training Systems
- Contract Manufacturing Services
- Education & Training
- Electronics Manufacturing
- Environmental Equipment & Protective
- Finishing & Coating
- Food Processing
- Forging & Fabricating
- Fossil & E Machining
- Lenses & Related Equipment
- Lean Manufacturing
- Machining & Material Removal
- Machine Vision Systems
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- NC, CNC & DNC
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<td>E. Kannatev-Asibu, Jr.</td>
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<td>Oregon State University</td>
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<td>R. Rasnick</td>
<td>Exxite Home Corporation</td>
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<td>R. Schimmele</td>
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<td>Y. C. Shin</td>
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<td>R. Shippert</td>
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<td>S. Smith</td>
<td>University of North Carolina at Charlotte</td>
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<td>K. A. Stelson</td>
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<td>J. W. Sutherland</td>
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<td>R. R. Vallance</td>
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<td>Y. L. Yao</td>
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<td>B. Zhang</td>
<td>University of Connecticut</td>
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<td>G. Zhang</td>
<td>University of Maryland</td>
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Special Activities

- NAMRI Board Meeting, Tuesday, May 20 from 8:30 a.m. - 5:30 p.m.
- Industry tour of Dofasco, Tuesday, May 20, 2:00 p.m. - 4:30 p.m.
- Welcoming Reception & Registration on Tuesday, May 20 from 5:30 p.m. - 8:00 p.m. at the Sheraton Hotel
- Welcoming ceremony and keynote address by Mr. Norm Lockington, VP of Technology at Dofasco, Inc. on May 21 from 8:30 a.m. - 9:45 a.m.
- NAMRI/SME Awards Luncheon and Founders Lecture on Wednesday, May 21 from 12:00 noon - 1:30 p.m.
- NAMRIC Banquet on Wednesday, May 21 from 7:00 p.m. - 10:30 p.m. at the Canadian Warplane Heritage Museum
- NAMRI/SME BBQ lunch on the terrace, on Thursday, May 22 from 12:00 noon - 1:30 p.m.
- NAMRI and ASME/EDM member meetings on Thursday, May 22 from 4:00 p.m. - 6:00 p.m.
- NAMRI Reception on Thursday, May 22 from 7:30 p.m. - 10:30 p.m. at the Hamilton Museum of Steam and Technology
- Industry tour of Siemens Westinghouse, Friday, May 23, 2:00 p.m. - 5:00 p.m.

Laboratory and Campus Tours

Tour the McMaster Manufacturing Research Institute
May 21 & May 22, 4:00 pm - 6:00 pm

The McMaster Manufacturing Research Institute (M3RI) is a part of the largest University Manufacturing Research Institutes in Canada, which supports academic programs that compete favorably with existing international research institutes.

The institute was created in 2000 as a result of major funding grants from the Canadian Foundation for Innovation (CFI), Ontario Innovation Trust (OIT), Ontario Research and Development Challenge Fund (ORDCF), Industry, and McMaster University. The M3RI provides a focus for high profile research, and it is a vehicle for University - Industry - Government interaction in the field of Manufacturing Engineering. The Institute promotes, encourages, and performs fundamental and applied research, in cooperation with its industrial partners, and provides systematic mechanisms for technology transfer and diffusion of knowledge and research results.

Industry Tours

Dofasco, Inc.
Hamilton, Ontario
Tuesday, May 20, 2:00 pm

Dofasco is North America's most successful integrated steel producer, serving customers throughout North America with premium quality flat rolled and tubular steels and laser-welded blanks. This position was recently bolstered when Dofasco was selected by the Dow Jones Sustainability Index as the global leader in the basic resources market sector.

Dofasco's facilities in Hamilton, Ontario, produce hot rolled, cold rolled, galvanized, ExtragalTM, GalvalumeTM, Inflatex, chrome coated and prepainted flat rolled steels, as well as tubular products.

We will have the opportunity to tour the Steelmaking Business Unit which includes a KOBM furnace, Lead Refining Facility and Continuous Caster. Our tour will also include the DoSol Geneva Line which produces galvanized steel for the automotive industry.

Siemens Westinghouse
Hamilton, Ontario Canada
Combustion Turbine Manufacturing and Industrial Turbines
Friday, May 23, 9:30 am - limited space - please register

Combustion turbine manufacturing
The Hamilton turbine manufacturing and service facility, established in 1993, focuses on gas turbine manufacturing and provides parts and service for mature frame gas turbines and industrial steam turbines. The employee population consists of 1,000 talented individuals challenged with meeting the demands of our customers. This 550,000 square foot facility is distinguished by a superior safety record, and the organization is made up of process teams supported by business and engineering teams. Hamilton's Engineering Department, utilizing design expertise in a number of disciplines, provides our customers with unparalleled levels of quality in all stages of development.

Industrial Turbines
The Industrial Turbine Group has a Regional Center of Competence located in Hamilton Canada and services North America and Westinghouse Turbines worldwide. This group is fully integrated into the Siemens Westinghouse and managed by the SWPC Diverse Business Organization. The Industrial Group provides turbines as generator sets and as mechanical drives. The main products and services include factory repairs and refurbishment of Westinghouse or Siemens turbines, services for Siemens and Westinghouse turbines 100MW or less, new Siemens Steam Turbines 100MW or less with or without generators, new mechanical drives for process applications 2 - 100MW, and boiler Feed Turbine pumps - turbine driven.
Companion Program

The Companion Program will involve scenic trips to the Niagara Region, St. Jacobs village and the Royal Botanical Gardens. A variety of activities are being planned and the Companion Program coordinator will work with the participants to plan the activities to suit the interests of the participants.

Niagara Falls

No trip to Canada is complete without a visit to the beautiful Niagara Falls area. A geological feature known as the Niagara Escarpment cradles the Niagara region in a beautiful setting of natural splendor. At the center of interest is the Falls itself, which consists of two waterfalls: the Horseshoe, or Canadian, Falls (57 m/187 ft high), and the American Falls (55 m/182 ft high).

The region is known for its excellent cuisine, wine vineyards, as well as interesting shops and boutiques. The day will be planned to sample from many of the attractions that the Niagara region has to offer. More details on the Niagara region can be found at www.infoniagara.com

St. Jacobs

The village of St. Jacobs provides an excellent sample of what rural Ontario has to offer. The village is the center of commerce of a wide region of Mennonite farmers. It is known for its farmer’s market as well as antique, art and crafts, heartwarming attractions and gracious hospitality. Information about St. Jacobs can be found at www.stjacobs.com

Hamilton’s Royal Botanical Gardens

The Royal Botanical Gardens is made up of a collection of sites representing a cross section of the horticulture of the region. In May we expect that the Lilac Dell will be in full bloom and the site will also be very fragrant. Also, depending on the weather, the Iris and Peony displays in the Laking Garden may be in bloom. Please visit www.rbg.ca for more details.

Registration Fees

All fees are in U.S. dollars and payable to McMaster University. We accept VISA, MasterCard, checks, money orders, and purchase orders. Please complete one registration form per person. Companion Program participants should complete their own registration form. Make additional copies of the form as needed.

All fees except the companion registration include entrance to all technical sessions, all conference materials, publications, meal functions, laboratory tours and industry tours. Included in the companion registration fees are conference break/fast, banquet and two receptions, and companion program tour (see Companion Program for details). There are no single-day registration fees. There are no reduced registration fees for students or sessions.

A special student rate is offered to full-time students, and will include the proceedings and a special student barbecue dinner.

Cancellation and Refunds

Refunds, less an administrative fee of US $100, will be issued for all cancellations received in writing with a postmark before May 9, 2003. No refunds will be made after that date, but a substitution of attendees may be made by notifying the Conference Center prior to the conference. Please allow six to eight weeks to receive check refunds. Credit card refunds will be issued to the credit card that had made the payment. Should this event cancel in entirety, the University’s liability is limited to a refund of the registration fees paid.

Lodging

A block of rooms is reserved at the Sheraton Hamilton Hotel, located just 5 km from campus. Reservations must be made before April 20, 2003 to guarantee the conference rate of CDN $119/129 single/double. Be sure to mention ‘NAMRC’ when making your reservation.

Sheraton Hamilton, 116 King Street West, Hamilton, Ontario
Tel: (905) 529-5551
Fax: (905) 529-6266

Underground parking with in/out privileges is available $7.99 per night. A shuttle service will run daily from the hotel to the McMaster Campus. Rates for on-campus parking are $12.00 per day.

A block of rooms has also been reserved on campus in one of McMaster’s residences. Conference rates are CDN $44.80/$36.96 single/person, double, and include parking.

Travel Information

Hamilton is conveniently located in the heart of Southeastern Ontario, one of Canada’s most prosperous areas. The Great Lakes and the Niagara region are within easy driving, and the flight possibilities are excellent. The McMaster campus is a 45-minute drive from Toronto’s Pearson International Airport, a 26 minute drive from Hamilton’s John C. Munro International Airport, and a 30 minute drive from Buffalo Niagara International Airport.

Airport shuttle service has been arranged through Airways Transit, www.airwaystransit.com. Mention NAMRC to obtain the conference rate.

All international participants are responsible for their own visa and health insurance needs.

Climate: the average temperature in May is 70 degrees Fahrenheit. The temperature can drop in the evening, so you may want to bring a light jacket.
For More Information: Visit the NAMRC 31 Web site: mmsf.mcmaster.ca/namrc
Call: Janet Delsey, 905-525-9140, ext. 24910
Email: delsey@mcmaster.ca
FUTURE NAMRC HOSTS

NAMRC 32
June 1-4, 2004
The University of North Carolina at Charlotte
William States Lee College of Engineering
Charlotte, North Carolina, USA
Conference Co-Chairs, Robert G. Wilhelm and Scott Smith

NAMRC 33
May 24-27, 2005
Columbia University
School of Engineering and Applied Science
New York, New York, USA
Conference Chair, Y. Lawrence Yee

Are you interested in hosting a future NAMRC?
Since 1973, NAMRC has been held on the campus of a host institution to encourage dialogue between conference attendees and offer opportunities for tours of the host's laboratory and other research facilities. Institutions wishing to host a future NAMRC are encouraged to submit a proposal.

The Board of Directors of NAMRI/SME reviews proposals annually. Selections are usually made two to three years ahead to maximize planning and promotion of the conference. Operating procedures which detail the responsibilities of the host institution and the Society of Manufacturing Engineers are available. Submission of a written proposal and willingness to attend and present a brief overview and answer questions at the NAMRI/SME Board of Directors meeting is required.

The deadline for receipt of proposals is April 15 of each year. Proposals will be reviewed at the spring NAMRI/SME Board of Directors meeting held immediately prior to the opening of the NAMRC conference. For more information on hosting the conference and preparing the proposal, visit the NAMRI/SME website at www.sme.org/namri or contact Marcie Celing, NAMRI/SME Association Manager. Email her at mcolling@sme.org or telephone at (313) 426-2223.

The Society of Manufacturing Engineers is the world's leading professional society supporting manufacturing education. Through its member programs, publications, expositions, and professional development resources, SME promotes an increased awareness of manufacturing engineering and helps keep manufacturing professionals up to date on leading trends and technologies. Headquartered in Michigan, SME influences more than half a million manufacturing engineers and executives annually. The Society has members in 70 countries and is supported by a network of hundreds of chapters worldwide. Visit us at www.sme.org

Membership in NAMRI/SME
Senior or Affiliate membership in SME is necessary before an individual can be considered for membership in NAMRI/SME. Membership grades include Senior Member and Student Member.

Election to Senior Member requires approval of the NAMRI/SME Board of Directors. The candidate should complete an application demonstrating active participation in manufacturing or manufacturing research.

Student member grade requires an application demonstrating the SME qualification for student membership. Attendance at the annual NAMRC is also required.

Use the NAMRI/SME membership form located in the center of the brochure to apply. The membership form is also available on line at www.sme.org/namri.