

The North American Manufacturing Research Institution of the Society of Manufacturing Engineers invites you to attend the

*Thirty-Fourth North American  
Manufacturing Research Conference*

# NAMRC 34



**May 23-26, 2006**  
**Milwaukee, WI**  
**USA**

Hosted by  
**Marquette University**  
College of Engineering



Society of  
Manufacturing  
Engineers

**NAMRI** 

North American Manufacturing  
Research Institution of the  
Society of Manufacturing Engineers

## Dear Friends and Colleagues:

We are pleased to welcome you to the Thirty-Fourth Annual North American Manufacturing Research Conference. NAMRC is an established international forum for the presentation and critical discussion of research results and applications from universities, industry, and national laboratories. Since 1973, leaders in manufacturing research come to this conference to exchange findings and cutting edge technological information.

This year, 80 technical papers will be presented for discussion 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 34 and for publication in the Transactions of NAMRI/SME based on a stringent peer-review process conducted by the Scientific Committee of the North American Manufacturing Research Institution of SME (NAMRI/SME).

While participating in NAMRC 34 in Milwaukee, you will be visiting one of the most diverse industrial cities. A full social program will enable all attendees to sample and enjoy the rich heritage of Milwaukee and the natural beauty of the shores of Lake Michigan. You will also have the opportunity to tour and experience nationally renowned industries that have often characterized Milwaukee as a leader in manufacturing, and as a center for the production of goods, that is known throughout the world. In addition, you will discover that the Marquette University campus and greater downtown Milwaukee area will provide a full range of cultural experiences, including nationally renowned museums, professional sports activities, and superb ethnic food and dining.

Our College of Engineering is proud to host this premier gathering and Marquette University warmly welcomes you. We invite you to contact us with any questions that you may have regarding the NAMRC 34 conference. We look forward to seeing you in Milwaukee.

Regards,

### **G.E.O. Widera**

NAMRC 34 Conference Co-Chair  
Marquette University  
Milwaukee, Wisconsin, USA

### **Kyuil Kim**

NAMRC 34 Conference Co-Chair  
Marquette University  
Milwaukee, Wisconsin, USA

## 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 34 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 website at [www.sme.org/namri](http://www.sme.org/namri).

## Sponsorship

The NAMRC 34 Organizing Committee thanks the College of Engineering at Marquette University and the Briggs & Stratton Corporation for their sponsorship of this conference.



## Conference Publication

Papers accepted for and presented at NAMRC 34 will be contained in the hardbound Transactions of the North American Manufacturing Research Institution of SME, Volume 34, 2006. Participants who have paid the registration fee will receive a copy at the time of registration along with a CD of the papers. Additional copies of the Transactions may be purchased by contacting an SME Customer Service Representative at (313) 271-1500, ext. 4500 or (800) 733-4763.

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## Conference Site & Facilities

Marquette University, named to honor the French Jesuit Missionary Father Jacques Marquette, opened its doors on August 28, 1881. Marquette is a Catholic Jesuit institution dedicated to serving God by serving others and contributing to the advancement of knowledge. The mission of the University is the search for truth, the discovery and sharing of knowledge, the fostering of personal and professional excellence, the promotion of a life of faith, and the development of leadership expressed in service to others. Teaching and research play an important role in Marquette's educational mission. Students are privileged to work with and learn from faculty who are true teachers/scholars, whose research not only advances the sum of human knowledge, but also informs their teaching. No matter where you look on campus, from the College of Arts and Sciences to the College of Engineering you will find faculty involved in research that has the potential to enhance our lives.

Marquette University is located in the heart of Milwaukee, "A Genuine American City." Milwaukee is the largest city in Wisconsin and situated alongside the beautiful Lake Michigan. The city offers everything from cozy coffee shops to world class dining, major league sports, jazz clubs and an abundance of outdoor recreation, all within a few miles of the Marquette campus.

The NAMRC Conference will be held on the Marquette campus in the Alumni Memorial Union. The AMU is located at the center of the Marquette campus and is a favorite gathering spot for both faculty and students. This multi-purpose facility features full conference accommodations, spacious lounges, dining options and wireless internet throughout the building.

Marquette University has the largest Catholic College of Engineering in the Nation with 1075 undergraduates and 350 graduate students. Since 1908 Marquette has been uniquely blending professional engineering preparation with a liberal arts education to provide the world with well-balanced leaders in their profession. The College offers six undergraduate degrees in 11 programs through four departments. Students and faculty in each department of the college collaborate on research projects spanning a wide range of topics.

## Special Activities

In connection with NAMRC 34:

- NAMRI/SME Board Meeting on Tuesday, May 23, from 8:30 p.m. – 5:30 p.m. at AMU Room 305
- Welcoming Reception & Registration on Tuesday, May 23, from 5:30 p.m. – 8 p.m. at Monaghan Ballroom E and Lynch Lounge
- Welcoming Ceremony and Keynote Address on Wednesday, May 24, from 8:30 a.m. – 10:00 a.m. at Weasler Auditorium, AMU
- NAMRI/SME Awards Luncheon and Founders Lecture on Wednesday, May 24, from Noon – 2:00 p.m. at Monaghan Ballroom E
- NAMRC Banquet on Wednesday, May 24, from 5:30 p.m. – 10:00 p.m. at Milwaukee Art Museum
- Industrial Factory Tours on Thursday, May 25, from 1:00 p.m. – 4:00 p.m.
- ASME/MED and NAMRI/SME Membership Meeting on Thursday, May 25, from 4:00 p.m. – 6:00 p.m. at Monaghan Ballroom A
- NAMRC Reception on Thursday, May 25, from 5:30 p.m. – 8:30 p.m. at Monaghan Ballroom
- Global Manufacturing Panel on Friday, May 26, from 10:30 a.m. – Noon at Monaghan Ballroom D
- Forum on Brushing Tool Science, Technology, and Process Development on May 25 – 26 at AMU Room 163

## Student Research Presentation Contest

NAMRC 34 will host the second Student Research Presentation Contest to recognize students' contributions to NAMRC and to encourage young talents to pursue a career in manufacturing research, which is of vital importance to the long-term goals of the manufacturing community. The Contest is based on the student's oral presentation of a paper he/she co-authored. The student presentations will be part of regular technical sessions and have the same time limitation. The presentations will be judged by a panel, which comprises the NAMRI/SME Honors Committee members or their delegates. The judges will not judge their own students. The judgment will be primarily based on clarity of presentation including oral expression and use of visual aids. Originality and scientific merit of material presented may also be taken into account. 1st, 2nd, and 3rd place winners will be announced at the NAMRI General Membership Meeting on Thursday, May 25, 2006.

## Industrial Factory Tours

May 25, 2006, 1:00 p.m. - 4:00 p.m.

### Miller Brewing Plant

The Miller Brewing Company is a major national brewer with its corporate headquarters located in Milwaukee and owned by SAB. The original Milwaukee Brewery offers two tours of its facilities. The tour of the brew house and production facilities guides visitors through the entire brewing and packaging processes. The technical tour of the craft brewery offers guests a chance to view the place where new beers and products are developed. Tour participants must be 21 or older.

## **Harley-Davidson Plant**

Harley-Davidson is the only major US maker of motorcycles and the nation's #1 seller of heavyweight motorcycles. The company offers 32 models of touring and custom Harleys through a worldwide network of more than 1,300 dealers. Harley models include the Electra Glide, the Sportster, and the Fat Boy. Besides its bikes, Harley-Davidson sells attitude - goods licensed with the company name include a line of clothing and accessories (MotorClothes). The company also makes motorcycles under the Buell nameplate.

## **Forum on Brushing Tool Science, Technology, and Process Development**

May 25 - 26, 2006

This Forum will bring together those having a vested interest in the design, manufacture, and application of industrial brushing tools. The Forum will focus on basic principles, function, and technical underpinnings of brushing tools and processes, with the intention of extending their range of application into new market areas of surface finishing and surface modification processes. At the same time, the two-day seminar will examine the historical development of brushing tools, and will contemplate the course of their evolution as new technologies and needs emerge over the next decade.

## **Workshop on Impact of Manufacturing Globalization**

The effect of globalization on manufacturing is a common topic of discussion, with most of the debate centering on highly-visible issues related to labor and economic impact. An equally important but less visible question is this: In a global economy with high levels of outsourcing and offshoring, who is responsible for conducting the manufacturing research that will yield manufacturing process breakthroughs? This workshop focuses on how international companies address the need for breakthrough improvement in manufacturing processes and capabilities. A forum of representatives from companies heavily involved in manufacturing outsourcing and offshoring will describe how their companies address globalization issues.

## **Companion Program**

### **Milwaukee Art Museum**

The Calatrava-designed Quadracci Pavilion, the first Calatrava designed building to be completed in the United States, opened to the public on May 4, 2001. On that date the Milwaukee Art Museum opened new exhibition galleries, a larger museum store, and an auditorium in the Quadracci Pavilion along with the completely renovated and reinstalled permanent collection galleries in the adjacent museum building designed by Eero Saarinen. The widely acclaimed Calatrava addition has been praised by art critics from around the world and received ASCE's Outstanding Civil Engineering Achievement Award in 2003. The banquet will be held at the Windhover (Grand) Reception Hall, which is a magnificent cathedral-like space with lake views and a 90-foot high glass ceiling located directly below the building's signature element, the moveable sun screen, the Burke Brise Soleil.



## City highlights

A trip to Historic Cedarburg which is 45 minutes north of Milwaukee will include visiting many specialty shops, the Cedarburg Winery, and lunch at the Crème N Crepe Restaurant. Cedarburg is a charming community catering to its guests. There is a relaxed atmosphere among the shop owners and community members. It is truly a taste of a small Mid-west community with beautiful art work and interesting sites.

Milwaukee also holds so many interesting sites, and the day in Milwaukee will include a trip to Boerner Botanical gardens, the Milwaukee Market Place, and lunch in the 3rd Ward Historical District. There is no limit as to what to do in Milwaukee. We like to stay flexible in case there is something extra special our guests would like to do or visit.

We look forward to spending time with the spouses and highlighting our fine city and surrounding areas.

## Registration Fees

All fees are in U.S. dollars and payable to Marquette University/COE Joining Center. We accept VISA, MasterCard, checks, and money 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 forum and companion registration include entrance to all technical sessions, all conference materials, publications, meal functions and industry tours. The forum registration fees include forum materials, industry tours and meals on Thursday and Friday. Included in the companion registration fees are conference breakfasts, banquet and two receptions, and companion program tour (see Companion Program for details). There are no reduced registration fees for authors or session chairs.

## Cancellation and Refunds

Refunds, less an administrative fee of U.S. \$100, will be issued for all cancellations received in writing with a postmark before May 8, 2006. No refunds will be made after that date, but a substitution of attendees may be made by notifying the Conferencing 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 made the payment. Should this event cancel in entirety, the University's liability is limited to a refund of the registration fees paid.

## Lodging

### Hyatt Regency Milwaukee

333 West Kilbourn Avenue, Milwaukee, WI 53203

Tel: 800-233-1234 or 414-276-1234, Fax: 414-270-6069

Twelve blocks from the Marquette University Alumni Memorial Union.

Room Rate: \$139.00 plus tax for single & double occupancy.

Reservation reference: Marquette University NAMRC 34.

Special rate expires April 22, 2006.

Airport Limo: \$11.00, Taxi Fee: \$20.00

### Holiday Inn

611 West Wisconsin Avenue, Milwaukee, WI 53203

Tel: 800-465-4329 or 414-273-2950, Fax: 414-273-7662

Eight blocks from the Marquette University Alumni Memorial Union.

Room Rate: \$89.00 plus tax for single & double occupancy.

Reservation reference: NAMRC 34.

Special rate expires April 22, 2006.

Airport Limo: \$11.00, Taxi Fee: \$20.00

### Mashuda Hall (Dormitory)

1926 W. Wisconsin Avenue, Milwaukee, Wisconsin 53233

Tel: 414-288-7208, Fax: 414-288-5108

Four Blocks from the Marquette University Alumni Memorial Union.

Special Room Rate: \$38.00 for single, \$52.00 for double – reservations must be made by May 8, 2006 and reference the "NAMRC 34" to obtain this special rate.

Reservation can be made through Marquette University Conference Services

Carpenter Tower 203, P.O. Box 1881, Milwaukee, Wisconsin 53201-1881

Parking is available in nearby campus lots for \$5.00 per night.

\*Shuttle service will be provided in the morning and late afternoon from AMU to the Hyatt Regency and Holiday Inn hotels.

## Travel Information

Nestled in the heart of Milwaukee, Marquette's campus is within minutes of major highways, Mitchell International Airport, Milwaukee's Amtrak rail station and also accessible by bus service.

For more information, go to [www.marquette.edu/engineering/pages/GettingInvolved/namrc34](http://www.marquette.edu/engineering/pages/GettingInvolved/namrc34).

### By Air

General Mitchell International Airport is a state-of-the-art facility that services 14 airlines and offers approximately 230 departures and 230 arrivals daily. Approximately 90 cities are served nonstop or direct from the airport. General Mitchell International Airport is about a 8-mile cab ride to campus. The airport's taxi stand is located on West side of the baggage claim area. Shuttle operators provide scheduled service to downtown hotels and business locations. Airport Connection provides door-to-door airport service to hotels and all other locations in Milwaukee County. You can contact Airport Connection at 1-800-236-5450 or online.

## By Rail and Bus

Amtrak's terminal is located at North 5th Street and West St. Paul Avenue. Upon arrival in Milwaukee, you take a private cab or walk four blocks north to West Wisconsin Avenue and board any westbound local bus to North 12th Street. Bus fare is \$1.75.

Both Greyhound and Badger Bus lines are located on North 7th Street between West Wisconsin Avenue and West Michigan Street. Upon arrival in Milwaukee, you may walk the five blocks west to campus or take a private cab. Coach USA provides shuttle service between the Marquette campus and O'Hare and Midway airports in Chicago.

## By Car

To make your trip as convenient as possible, use the links at [www.marquette.edu/engineering/pages/GettingInvolved/namrc34](http://www.marquette.edu/engineering/pages/GettingInvolved/namrc34) to find the best routes to use to get to Marquette. For construction information, including local street and freeway ramp status, visit the road construction updates section of Marquette University's Web site.

## Climate

The average temperature in late May is 67 degrees Fahrenheit. The temperature can drop in the evening, so you may want to bring a light jacket.

## How to Register

**Mail or Fax:** Complete the registration form at the back of the program brochure or download the form from the conference Web site at [www.marquette.edu/engineering/pages/GettingInvolved/namrc34](http://www.marquette.edu/engineering/pages/GettingInvolved/namrc34). Send your completed registration form with your payment (credit card information, check, or money order) to:

Ms. Annette Wolak  
Department of Mechanical Engineering  
Marquette University  
Haggerty Engineering 233  
P.O. Box 1882  
Milwaukee, WI 53201-1881

Tel: (414) 288-7259

Fax: (414) 288-7790

E-mail: [NAMRC34@marquette.edu](mailto:NAMRC34@marquette.edu)

# NAMRC 34

## Technical Sessions and Programs

### TUESDAY, MAY 23, 2006

8:30 a.m. – 5:30 p.m.

#### **NAMRI/SME Board Meeting**

Room 305, Alumni Memorial Union (AMU)

5:30 p.m. – 8 p.m.

#### **Conference Registration and Welcoming Reception**

Ballroom E and Lynch Lounge

### WEDNESDAY, MAY 24, 2006

7:30 a.m. – 8:30 a.m.

#### **Registration and Breakfast**

Ballroom E

8:30 a.m. – 10 a.m.

#### **Welcoming Ceremony**

Weasler Auditorium, AMU

#### **Opening Remarks**

G.E.O. Widera, Senior Associate Dean, College of Engineering, Marquette University

#### **Welcoming Remarks**

Stanley Jaskolski, Dean, College of Engineering, Marquette University  
Ralph Resnick, President, NAMRI/SME

#### **Keynote Address**

To be Announced

10:00 a.m. – 10:30 a.m.

#### **Morning coffee break**

Lynch Lounge

10:30 a.m. – Noon

#### **Concurrent Technical Sessions**

#### **Session 1-A: Mechanics of Machining Process**

Ballroom A

Co-Chairs: A. Sherif El-Gizawy, University of Missouri-Columbia  
Tae-Jo Ko, Yeungnam University

*Determination of Parametric Uncertainties for Regression-Based Modeling of Turning Operations*

R.W. Ivester, L. Deshayes, M. McGlaufflin

*An Integrated Analytical Thermal Model for Orthogonal Cutting with Chamfered Tools*

Y. Karpat, T. Özel

*Uncertainty Propagation for Selected Analytical Milling Stability Limit Analyses*

G.S. Duncan\*, M.H. Kurdi, T.L. Schmitz, J.P. Snyder

### **Session 1-B: Super-plastic Forming**

Ballroom B

Co-Chairs: Raymond J. Cipra, Purdue University

Seung-Han Yang, Kyungpook University

*Accuracy and Efficiency Issues in Superplastic Forming Simulation*

V. Venkateswaran, G.T. Kridli, S.G. Luckey, Z.C. Xia, P.A. Friedman

*Simulation of Superplastic Forming Using Explicit Finite Element Analysis*

S.G. Luckey, P.A. Friedman, Z.C. Xia, K.J. Weinmann

*Experimental Investigation of Superplastic Forming Conditions on the Oxygen Absorption in Titanium*

F.S. Pitt, M. Ramulu

### **Session 1-C: Sensing Technology**

Ballroom C

Co-Chairs: Jaime A. Camelio, Michigan Technological University

H. Yagishita, Numazu National College of Technology

*Cutting Power Model-Sensor Integration for a Smart Machining System*

C.K. Schuyler, M. Xu, R.B. Jerard, B.K. Fussell

*Optimization of Sensor Locations for Spindle Condition Monitoring*

L. Zhang, R.X. Gao, K.B. Lee

*A Wireless Sensor for Tool Temperature Measurement and Its Integration within a Manufacturing System*

P.K. Wright, D.A. Dornfeld, R.G. Hillaire, N.K. Ota

### **Session 1-D: Process Optimization and Prediction**

Ballroom D

Co-Chairs: Thomas R. Kurfess, Clemson University

Albert J. Shih, University of Michigan

*Prediction of Manufacturing Resource Requirements for Mass-Customization Production*

P.R. Dean, D. Xue, Y. Tu

## Morning

|                                    |  |  |   |   |  |
|------------------------------------|--|--|---|---|--|
| <p><b>Tuesday<br/>May 23</b></p>   | <p>NAMRI/SME Board Meeting<br/>Alumni Memorial Union (AMU) Room 305<br/>8:30a.m. -----</p> |  |   |   |  |
| <p><b>Wednesday<br/>May 24</b></p> | <p><i>Registration &amp; Breakfast</i><br/>Ballroom E<br/>7:30 - 8:30a.m.</p>              | <p><i>Welcome Ceremony</i><br/>Weasler Auditorium<br/>8:30 - 10:00a.m.</p> | <p><i>Morning coffee break</i><br/>Lynch Lounge<br/>10:00 - 10:30a.m.</p> | <p><i>Concurrent Sessions</i><br/>Ballroom A,B,C,D<br/>10:30a.m. - Noon</p>   | <p><i>NAMRI/SME Awards Luncheon &amp; Founders Lecture</i><br/>Ballroom E<br/>Noon-2p.m.</p> |
| <p><b>Thursday<br/>May 25</b></p>  | <p><i>Registration &amp; Breakfast</i><br/>Ballroom E<br/>7:30-8:30a.m.</p>                | <p><i>Concurrent Sessions</i><br/>Ballroom A,B,C,D<br/>8:30-10a.m.</p>     | <p><i>Morning coffee break</i><br/>Lynch Lounge<br/>10:00 - 10:30a.m.</p> | <p><i>Concurrent Sessions</i><br/>Ballroom A,B,C,D<br/>10:30a.m. - Noon</p>   | <p><i>Luncheon</i><br/>Ballroom E<br/>Noon-1:30p.m.</p>                                      |
| <p><b>Friday<br/>May 26</b></p>    | <p><i>Registration &amp; Breakfast</i><br/>Ballroom E<br/>7:30-8:30a.m.</p>                | <p><i>Concurrent Sessions Ballroom</i><br/>A,B,C<br/>8:30-10a.m.</p>       | <p><i>Morning coffee break</i><br/>Lynch Lounge<br/>10:00 - 10:30a.m.</p> | <p><i>Concurrent Sessions</i><br/>Ballroom A,B,C<br/>10:30a.m.-Noon<br/><br/><i>Panel: Global Manufacturing</i><br/>Ballroom D<br/>10:30a.m.-Noon</p> | <p><i>Luncheon</i><br/>Ballroom E<br/>12-1:30p.m.</p>  |

The Forum on Brushing Tool Science, Technology, and Process Development will be held in AMU Room 163 on May 25 - 26. Detailed information about the conference program and schedule may be found on the NAMRC 34 website at [www.marquette.edu/namrc](http://www.marquette.edu/namrc)

# Program-at-a-Glance

University ■ Milwaukee, WI, USA

## Afternoon

## Evening

|   |  |   |   |
|---|--|---|---|
| <p><i>NAMRI/SME Board Meeting</i></p> <p>Alumni Memorial Union (AMU) Room 305</p> <p>----- 5:30p.m.</p> |  |   | <p><i>Registration &amp; Welcoming Reception</i></p> <p>Ballroom E<br/>Lynch Lounge</p> <p>5:30-8p.m.</p> |
| <p><i>Concurrent Sessions</i></p> <p>Ballroom A,B,C,D</p> <p>2:00 - 3:30p.m.</p>                        | <p><i>Afternoon Coffee Break</i></p> <p>Lynch Lounge</p> <p>3:30-4p.m.</p> | <p><i>Concurrent Sessions</i></p> <p>Ballroom A,B,C,D</p> <p>4-5:30p.m.</p> | <p><i>NAMRC Banquet</i></p> <p>Milwaukee Art Museum</p> <p>5:30-7p.m.: Tour</p> <p>7-10p.m.: Dinner</p>   |
| <p><i>Industrial Factory Tours</i></p> <p>1-4p.m.</p>   |  | <p><i>ASME MED Membership Meeting</i></p> <p>Ballroom A</p> <p>4-5p.m.</p>  | <p><i>NAMRC Reception</i></p> <p>AMU Ballroom</p> <p>5:30-8:30p.m.</p>                                    |
|   |  | <p><i>NAMRI/SME Membership Meeting</i></p> <p>Ballroom A</p> <p>5-6p.m.</p> |   |

*System Level Optimization of Preventive Maintenance in Industrial Automation Systems*  
Y. Lei, D. Djurdjanovic, J. Ni, R. Mayor, J. Lee, G. Xiao

*Process Capability Allocation in the Extended Enterprise Environment*  
R. Musa\*, F.F. Chen, R.H. Sturges

Noon – 2 p.m.

**Award Luncheon and Founders Lecture**

Ballroom E

*Road Map for Tube Making: from Tube Sinking to Tube Drawing with Floating Plugs*  
Betzalel Avitzur, Lehigh University

2:00 p.m. – 3:30 p.m.

**Concurrent Technical Sessions**

**Session 2-A: Tool Characteristics in Machining Process**

Ballroom A

Co-Chairs: Dong-Woo Cho, Pohang University of Sci. and Tech.  
Franna S. Pitt, The Boeing Company

*Comparison of Surface Roughness and Residual Stresses Induced by Coated Carbide, Ceramic and cBN Cutting Tools in High Speed Facing of Inconel 718*  
RM. Arunachalam, M.A. Mannan, A.C. Spowage

*Effect of Tool Inclination on Machining of Tungsten Carbide with a cBN Ball End Mill*  
T. Matsumura, T. Ono, Y. Takahashi

*Characterization of the Tool-Toolholder Connections*  
J.S. Agapiou

**Session 2-B: Laser Based Process**

Ballroom B

Co-Chairs: Jun Ni, University of Michigan  
Tony L. Schmitz, University of Florida

*A Hybrid Laser/Water-Jet Cutting Process for Brittle Materials*  
C. Barnes, P. Shrotriya, P. Molian

*Energy Level Effects on Deformation Mechanism in Micro-Scale Laser Peen Forming*  
Y. Wang, Y. Fan, S. Vukelic, Y.L. Yao

*Feasibility Study of Direct Laser Patterning of Flat Panel Display Based on Simulation*  
K.T. Lee\*, S.Y. Jin, J.A. Rice



## **Session 2-C: Diagnosis and Condition Monitoring**

Ballroom C

Co-Chairs: Joseph P. Domblesky, Marquette University  
Robert W. Ivester, National Institute of Standards and Technology

*Comparison of Diagnosis Methodologies on Sheet Metal Assembly*

J.A. Camelio, B. Heichelbech

*Monitoring of Micro-Drill Wear by Using the Machine Vision System*

Y.J. Choi, S.C. Chung

*Experimental Evaluation of a Smart Machining System for Feedrate Selection and Tool Condition Monitoring*

M. Xu, C.K. Schuyler, B.K. Fussell, R.B. Jerard

## **Session 2-D: Process Planning and Control**

Ballroom D

Co-Chairs: Robert X. Gao, University of Massachusetts  
Tugrul Özel, Rutgers University

*Adaptive Production Scheduling and Control for One-of-a-Kind Production Shop Floor*

W. Li\*, Y. Tu, D. Xue

*Design Candidate Identification for OKP Product Development Based Upon Operational QFD Planning*

X.D. Li, Y.L. Tu, D.Y. Xue

*Beyond Geometry: Process Planning for High Speed Machining of Monolithic Structures*

S. Smith, R.G. Wilhelm

3:30 p.m. – 4 p.m.

### **Afternoon coffee break**

Lynch Lounge

4:00 p.m. – 5:30 p.m.

### **Concurrent Technical Session**

## **Session 3-A: Tool and Fixture Design**

Ballroom A

Co-Chairs: RM. Arunachalam, Sona College of Technology  
Robert B. Jerard, University of New Hampshire

*End-Mill Design Methodology Using Cutting Simulation*

J.H. Kim, J.H. Kim, J.W. Park, T.J. Ko, H.S. Kim

*Contact Stiffness Identification for Computer-Aided Fixture Design*

Y. Zheng, Y. Rong, Z. Hou

*Design and Validation of a Magnetic Chuck for Reconfigurable Automotive Engine Assembly Pallets*

C.H. Shen

### **Session 3-B: Processing Composite Materials**

Ballroom B

Co-Chairs: Barry K. Fussell, University of New Hampshire

Patrick Y. Kwon, Michigan State University

*Development of Vacuum Assisted Resin Infusion Molding Process for High Temperature Polymer Composites*

A. Khattab, A.S. El-Gizawy

*Cutting Mechanism of Drilling CFRP Laminates and Effect of Ultrasonic Torsional Mode Vibration Cutting*

H. Yagishita

*Quantifying Edge Defects in Drilled FRP Composites*

A. Vijayaraghavan\*, C.K.H. Dharan, D.A. Dornfeld

### **Session 3-C: Test and Measurement Technology**

Ballroom C

Co-Chairs: John S. Agapiou, General Motors R&D Center

Y. Lawrence Yao, Columbia University

*Accurate Size Evaluation of Cylindrical Components Using Particle Swarm Optimization*

H. Ramaswami\*, Y. Kovvur, S. Anand

*An Image Analysis Technique to Assist in the Determination of Orientation Distributions of the Manufacture of Carbon Fiber Composites*

A.J. Mather\*, T.K. Bodily, R.J. Cipra, T.H. Siegmund

*Application of Beam Splitters and Position Sensing Detectors to Measure Five Degree-of-Freedom Geometric Errors with Miniaturized Linear Motion Stage*

W. Wang, S.H. Kweon, J.H. Lee, S.H. Yang

### **Session 3-D: Innovative Machining and Manufacturing**

Ballroom D

Co-Chairs: Sung-Hoon Ahn, Seoul National University

Scott Smith, University of North Carolina at Charlotte

*Dry Wire Electrical Discharge Machining of Thin Workpiece*

C.C. Kao\*, J. Tao, S.W. Lee, A.J. Shih

*Manufacturing of Shape Memory Alloy Based Monolithic Functional Structures with Shape Memory Effect Properties*

K. Malukhin\*, K. Ehmann

*Machine Non-Coaxial or Non-Round Features in the Middle of Rotational Parts with 3-Axis Mill-Turn Machines*

L. Qian, D. Ben-Arieh

5:30 p.m. – 10 p.m.

**NAMRC Banquet**

Milwaukee Art Museum

**THURSDAY, MAY 25, 2006**

7:30 a.m. – 8:30 a.m.

**Registration and Breakfast**

Ballroom E

8:30 a.m. – 10 a.m.

**Concurrent Technical Session**

**Session 4-A: Modeling and Simulation of Machining**

Ballroom A

Co-Chairs: B. Ramamoorthy, Indian Institute of Technology Madras

Robert Weber, Marquette University

*An Analysis of Machining with Honed Tools Using ALE Finite Element Model: Ploughing Force and Minimum Chip Thickness*

H.A. Kishawy, A.J. Haglund, M. Deiab

*Numerical Fracture Toughness Test for Improving Workpiece Model in Machining Simulation*

X. Shen\*, S. Lei

*Dependence of Metal Cutting Simulations on the Johnson-Cook Model Thermal Softening Parameter*

A. Deshpande, V. Madhavan, V. Pednekar, A.H. Adibi-Sedeh, R. Ivester

*Exit Order Sequence Burr Prediction Algorithm Based on Rectangular Coordinates*

M.C. Ávila, D.A. Dornfeld

**Session 4-B: Grinding and Drilling Research**

Ballroom B

Co-Chairs: Neil A. Duffie, University of Wisconsin-Madison

Wit Grzesik, Technical University of Opole

*On The Clarification of Surface Hardening by Hard Turning and Grinding*

A.W. Warren, Y.B. Guo

*Effect of Cold Working on Exit Burr Formation in Drilling*

D.W. Kim, P. Allen, T. Nam, H.J. Shin

*Trajectory Simulation and Material Removal Rate for Double Side Grinding of Advanced Ceramics with Diamond Wheels*

I.D. Marinescu, C. Spanu, M. Hitchiner

#### **Session 4-C: Micro/Nano Scale Machining System**

Ballroom C

Co-Chairs: Terry C. Lowe, Los Alamos National Laboratory

David J. Meade, Western Michigan University

*Development of an Automated Microfactory: Part 1 – Microfactory Architecture and Sub-Systems Development*

A.E. Honegger, G.Q. Langstaff, A.G. Phillip\*, T.D. VanRavenswaay, S.G. Kapoor, R.E.

DeVor

*Development of an Automated Microfactory: Part 2 – Experimentation and Analysis*

A.E. Honegger\*, G.Q. Langstaff, A.G. Phillip, T.D. VanRavenswaay, S.G. Kapoor, R.E.

DeVor

*Web-Based Design and Manufacturing System for Micro Machining*

H.J. Kim, D.M. Chun, S.H. Ahn, D.S. Kim, C.S. Jun, P.K. Wright

*Computer-Aided Design and Simulation for Nano-Scale Assembly*

S.K. Lai-Yuen, Y.S. Lee

#### **Session 4-D: Manufacturing System**

Ballroom D

Co-Chairs: O. Burak Ozdoganlar, Carnegie Mellon University

Mark Polczynski, Marquette University

*Cyber Manufacturing System for Small and Medium Enterprises: A Conceptual Framework*

S.A. Bareduan, S.H. Hasan, N.H. Rafai, M.F. Shaari

*Encapsulating Detailed Machining Data in Function Blocks for Adaptive Manufacturing*

L. Wang, C. Song, H.Y. Feng

*Towards Environmental Burden Modeling of Industrial Cleaning Processes for Metal Parts*

F. Román, B. Bras

10:00 a.m. – 10:30 a.m.

**Morning Coffee Break**

Lynch Lounge

10:30 a.m. – Noon

**Concurrent Technical Session**

**Session 5-A: Tool Wear and Life**

Ballroom A

Co-Chairs: Shiv G. Kapoor, University of Illinois at Urbana-Champaign  
Susana K. Lai-Yuen, University of South Florida

*Tool Life and White Layer Formation in Interrupted Hard Turning with Binderless cBN Tool*

S. Subbiah\*, T. Newton, S.N. Melkote

*Effect and Modeling of Tool-Edge Wear in High-Speed Finish Machining of Superalloy Inconel 718*

Q. Wu, N. Fang

*Tool Wear Evolution in Multilayer Coated Inserts Using Topographic Imaging*  
J.A. Olortegui-Yume\*, P.Y. Kwon

**Session 5-B: Surface Finishing Research**

Ballroom B

Co-Chairs: Raymond A. Fournelle, Marquette University  
Mike Hitchiner, Saint Gobain Abrasives Inc.

*Generation of Highly Repetitive Irregular Motion for Surface Finishing Processes*  
C. Ngo, N.A. Duffie, T.L. Perry

*Comparison of Surface Finish Produced in Hard Machining Using Different Cutting and Abrasive Tools*

W. Grzesik, T. Wanat, J. Rech

*Texture Measures for Classification of Machined Surfaces-Machine Vision Approach*  
B. Dhanasekar\*, B. Ramamoorthy

**Session 5-C: Micro/Nano Scale Characterization and Process**

Ballroom C

Co-Chairs: H.A. Kishawy, University of New Brunswick Fredericton  
Lihui Wang, National Research Council of Canada

*Nanoscale Features by Electro-Machining Using Atomic Force Microscope*  
A.H. Alkhaleel\*, Z. Yu, M.M. Sundaram, K.P. Rajurkar, A.P. Malshe

*The Viability of Micromilling for Manufacturing Mechanical Attachment Components for Medical Applications*

L. Xie\*, S.D. Brownridge, O.B. Ozdoganlar, L.E. Weiss

*Prediction of Cutting Forces in Micro-End-Milling Using the Cutting-Condition-Independent Cutting Force Coefficients*

H.U. Lee , D.W. Cho, T.J. Ko, K.F. Ehmann, W.S. Yun

## **Session 5-D: Manufacturing and Assembly Process**

Ballroom D

Co-Chairs: David A. Dornfeld, University of California, Berkeley

Dae-Wook Kim, Washington State University Vancouver

*Application of Data Dependent Systems Modeling to Failure Prediction in Non-Stationary Manufacturing Processes*

J.T. Dreyer, S.M. Pandit, T.A. Bett, P. Milbrodt, T. Ungpiyakul

*Mode-Based Tolerance Analysis in Multi-Station Assembly Using Stream of Variation Model*

Z. Kong, R. Kumar, S. Gogineni, Y. Zhou, D. Ceglarek

*Multi-Month Simulation of a Lean Manufacturing Implementation Program*

D.J. Meade, S. Kumar

Noon – 1:30 p.m.

### **Luncheon**

Ballroom E

1:00 p.m. – 4:00 p.m.

### **Industrial Factory Tours**

Miller Brewing Plant

Harley-Davidson Plant

4:00 p.m. – 5:00 p.m.

### **ASME/MED Membership Meeting**

Ballroom A

5:00 p.m. – 6:00 p.m.

### **NAMRI/SME Membership Meeting**

Ballroom A

5:30 p.m. – 8:30 p.m.

### **NAMRC Reception**

Ballroom, AMU

## FRIDAY, MAY 26, 2006

7:30 a.m. – 8:30 a.m.

### **Registration and Breakfast**

Ballroom E

8:30 a.m. – 10 a.m.

### **Concurrent Technical Session**

#### **Session 6-A: Material Behaviors**

Ballroom A

Co-Chairs: Rajiv Shivpuri, The Ohio State University

Zhishang Yang, Caterpillar Inc.

*Determination of Flow Stresses of Aluminum Tubes by Hydraulic Bulge Tests*

Y.M. Hwang, Y.K. Lin

*Robust Prediction of Forming Severity Using a Stress Based Failure Criterion for Sheet Metal*

B. Kinsey, S. Moondra, A. Sakash

*Sintering Strain of 316L Stainless Steel Parts Fabricated by Three-Dimensional Printing*

S. Johnston, D. Storti, R. Anderson

#### **Session 6-B: Machined Surface Waviness**

Ballroom B

Co-Chairs: Sung-Chong Chung, Hanyang University

Brian K. Paul, Oregon State University

*Bore Waviness Measurement Using an In-Process Gage*

K.W. Krueger, T.R. Kurfess

*Surface Roughness in Finish Turning of Hardened Steels*

J. Zhang, S.Y. Liang

*Fitting of a Robust Reference Profile for Separation of Form and Waviness from Surface Profiles*

J. Kumar, M.S. Shunmugam

#### **Session 6-C: Machinability and Performance Study**

Ballroom C

Co-Chairs: Keith Eglund, Caterpillar Inc.

Wei Li, University of Washington

*Experimental Investigation of Reciprocating Sawing*

J.P. Domblesky, G.E.O. Widera, T.P. James

*Experimental Investigation of the Machinability of Equal Channel Angular Pressing Processed Commercially Pure Titanium*

M.D. Morehead, Y. Huang, Y.T. Zhu, T.C. Lowe, R.Z. Valiev

*High Performance Machining of Sculptured Surfaces Using Pencil-Cut Machining and Material Side Tracing*

Y. Ren, Y.S. Lee, W. Zhu

10:00 a.m. – 10:30 a.m.

**Morning Coffee Break**

Lynch Lounge

10:30 a.m. – Noon

**Concurrent Technical Session**

**Session 7-A: Fluid and Thermal Effect in Process**

Ballroom A

Co-Chairs: Steven Y. Liang, Georgia Institute of Technology

James A. Rice, Marquette University

*Effect of Water Phase Surface Tension and Viscosity on Metalworking Fluid Functionality*

P.J. Bittorf, S.G. Kapoor, R.E. DeVor, N. Rajagopalan

*Development of Polymeric Based Lubricant for Cold Forging Processes*

G. Ngaile, J. Cochran, D. Stark

*Controlled Application of Differential Thermal Expansion in Diffusion Bonding of Bulk Microfluidic Devices*

B.K. Paul, C. Pluess

**Session 7-B: Welding Research**

Ballroom B

Co-Chairs: Yong Huang, Clemson University

Mark Nagurka, Marquette University

*Correction of Butt-Welding Induced Distortions by Laser Forming*

P. Cheng, A.J. Birnbaum, Y.L. Yao, Z. Yang, K. Eglund

*Material Flow and CDRX Phenomena Determining Joint Resistance in AA7075-T6 Friction Stir Welding*

L. Fratini, R. Shivpuri



*Reducing Buckling Distortion in Welded Structures Using Thermal Tensioning*  
J. Xu, W. Li

**Session 7-C: Control and Identification**

Ballroom C

Co-Chairs: Vikram Cariapa, Marquette University  
Joseph M. Schimmels, Marquette University

*Optimal Tuning of Biaxial Servomechanisms Using a Cross-Coupled Controller*  
H.K. Bae, S.C. Chung

*Swarm-Intelligent Neural Network System (SINNS) Based Multi-Objective Optimization of Hard Turning*  
Y. Karpat, T. Özel

*Application of a Linear Center Identification Scheme to Deterministic Polar Positioning*  
L. Mears, T.R. Kurfess

10:30 a.m. – Noon

**Panel on Global Manufacturing**

Ballroom D

Moderator: Mark Polczynski

Panelists: To be Announced

Noon – 1:30 p.m.

**Luncheon**

Ballroom E

**\* Student authors who have entered the Student Research Presentation Contest**

# NAMRC 34 CONFERENCE REGISTRATION FORM

May 23-26, 2006, Marquette University, Milwaukee, WI, USA

Complete a form for each individual attending (including Companion Program Registrants)

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

SME Membership #: \_\_\_\_\_  I am not an SME Member

Name (First and Last) Preference for Name Tag: \_\_\_\_\_

Title: \_\_\_\_\_

Company/Organization Affiliation: \_\_\_\_\_

Street Address: \_\_\_\_\_

Address (cont.): \_\_\_\_\_

City: \_\_\_\_\_ State/Province: \_\_\_\_\_

ZIP/Postal Code: \_\_\_\_\_ Country: \_\_\_\_\_

Daytime Phone Number: \_\_\_\_\_ Fax: \_\_\_\_\_

E-mail Address: \_\_\_\_\_

## REGISTRATION FEES (All fees are in U.S. Dollars)

- Full Conference Registration **before May 1, 2006** (SME member #: \_\_\_\_\_) .....\$450  
 Full Conference Registration **after May 1, 2006** (SME member #: \_\_\_\_\_) .....\$500  
 Full Conference Registration **before May 1, 2006** (Non-SME member) .....\$490  
 Full Conference Registration **after May 1, 2006** (Non-SME member) .....\$540  
 Student/Retiree Conference Registration **before May 1, 2006** (copy of student ID w/ registration).....\$175  
 Student/Retiree Conference Registration **after May 1, 2006** (copy of student ID w/ registration) .....\$200  
 Companion Program Registration .....\$180  
 Brushing Forum Registration **before May 1, 2006** .....\$298  
 Brushing Forum Registration **after May 1, 2006**.....\$350  
 Donation to NAMRI/SME Fund  \$20  \$50  \$100  \$ \_\_\_\_\_

**TOTAL:** \_\_\_\_\_

There will be a \$100 administration fee for cancellations made prior to May 8, 2006.

There will be no refunds after May 8, however your registration may be transferred to another delegate.

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Card Number: \_\_\_\_\_ Expiration Date: \_\_\_\_\_

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- Check or Money Order. Payable to: **Marquette University/COE Joining Center**

## OTHER INFORMATION

- Yes, I am presenting a paper or other lecture at NAMRC

- Yes, I have special needs (dietary or disability)

Please specify: \_\_\_\_\_

- Yes, I will attend the Luncheon on **Friday, May 26**.

- Yes, I will attend the factory tours:  Miller Brewing  Harley-Davidson.

**Please mail, fax or e-mail form with payment to:**

Ms. Annette Wolak  
Department of Mechanical Engineering  
Marquette University  
Haggerty Engineering 233  
P.O. Box 1882  
Milwaukee, WI 53201-1881  
Tel: (414) 288-7259  
Fax: (414) 288-7790  
E-mail: NAMRC34@marquette.edu

## Where educational opportunities and resources come together

The North American Manufacturing Research Institution (NAMRI/SME) is a significant part of the **Manufacturing Education & Research Community (MER)** of SME. The MER concentrates on the latest education and research in manufacturing through promoting manufacturing careers and educational opportunities that enhance the diverse workforce needs of the manufacturing enterprise.

Technical groups within this community include NAMRI/SME and :

- Credentialing
- Graduate Education in Support of Manufacturing
- Future of Manufacturing
- Industry/Continuing Education in Manufacturing
- Information Resources for Manufacturing Education
- Manufacturing Engineering Undergraduate Programs
- Manufacturing Technology Programs
- Technology Watch

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## Are you interested in hosting a future NAMRC?

Since 1973, NAMRC has been held on the campus of a host institution to encourage a dialogue between conference attendees, offer opportunities for laboratory tours and disseminate state-of-the-art manufacturing knowledge. Institutions wishing to host a NAMRC are encouraged to submit a proposal.

The NAMRI/SME Board of Directors reviews proposals annually. NAMRC site selections are usually made two to three years in advance to allow for adequate planning and promotion. The NAMRI/SME Operating Procedures detail the responsibilities of the host institution and the Society of Manufacturing Engineers. Submission of a written proposal and formal presentation of the proposal at a NAMRI/SME Board of Directors meeting is required. If the proposal is selected, the host institution will enter into a conference agreement with SME. The NAMRI/SME Board of Directors requires conference planning updates at its semi-annual meetings. An outline of information to include when submitting a proposal is online at: [www.sme.org/namri](http://www.sme.org/namri). The deadline for receipt of the proposals is April 15 to allow for review by the NAMRI/SME Board of Directors prior to its meeting at NAMRC. Proposals should be submitted to:

Mark Stratton  
Community Relations Manager  
Society of Manufacturing Engineers  
One SME Drive  
Dearborn, MI 48121-0930  
Phone: (313) 425-3307  
E-mail: [mstratton@sme.org](mailto:mstratton@sme.org)



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# NAMRC 34

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May 23-26, 2006