

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

Twenty-Eighth North American Manufacturing Research Conference

NAMRC XXVIII

May 23-26, 2000
Lexington, Kentucky

hosted by

**CENTER for
ROBOTICS and
MANUFACTURING
SYSTEMS**
College of Engineering

manufacturing
manufacturing

research

manufacturing

education
manufacturing

manufacturing

extension
manufacturing

NAMRI eme®

Sponsored by the
North American Manufacturing Research Institution of
the Society of Manufacturing Engineers

Dear Colleagues and Friends,

We would like the opportunity to provide you with a good old southern welcome to the Bluegrass Region of the Commonwealth of Kentucky. The Center for Robotics and Manufacturing Systems and the Department of Mechanical Engineering in the College of Engineering at the University of Kentucky in Lexington, KY, are pleased to host the 28th North American Manufacturing Research Conference (NAMRC) on May 23-26. Despite its regional name, this conference has evolved as a major international forum for the dissemination and discussion of research results in the field of manufacturing science and technology. It provides a unique forum for academic and industrial based researchers to exchange and discuss in-progress, or newly completed, research applicable to manufacturing technology and productivity.

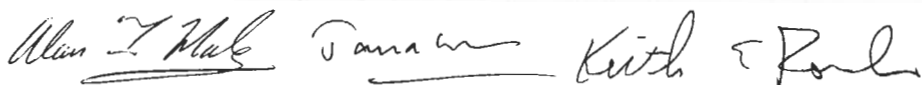
This year 75 technical papers will be presented at the conference by researchers from universities, research institutes, and industrial research laboratories located around the world. All of these complete manuscripts have been accepted for presentation at and publication in the Transactions of the conference 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 23, with a welcoming reception at the Radisson Plaza Hotel situated in downtown Lexington. On Wednesday, May 24, the conference Opening Ceremony will feature a keynote address by the founder and president of DataBeam Corporation, Dr. Lee Todd, who will discuss the relationship between entrepreneurship, high technology companies, research and academia. The conference banquet will be held at the Kentucky Horse Park, the world's preeminent equestrian and show facility. An accompanying guest program will also be available and is designed to provide a flavor of the Kentucky Bluegrass Region, the international capital of the thoroughbred racehorse. In fact, there is so much of interest in the Bluegrass Region, you may want to consider bringing the whole family and spending the long weekend exploring its attractions.

Every year, this conference attracts over 200 manufacturing research engineers and scientists, research and development managers, production engineers and managers, design specialists, metallurgists, manufacturing managers, research professors, graduate students, research assistants, manufacturing educators, and industry representatives from around the world. It provides not only an excellent forum for information transfer, but also a first-rate opportunity for informal discussion and networking.

We look forward to 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 XXVIII will be both an intriguing and beneficial experience for you.

Cordially,



Alan T. Male, Chair

I. S. Jawahir, Co-Chair

Keith Rouch, Co-Chair

NAMRC XXVIII 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 between 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 XXVIII 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.

Sponsorship

The NAMRC XXVIII Organizing Committee thanks the University of Kentucky, its College of Engineering's Center for Robotics and Manufacturing Systems and the Mechanical Engineering Department as well as all the industrial affiliates for their sponsorship of this conference.

Conference Publication

Papers accepted for and presented at NAMRC XXVIII will be contained in the hardbound Transactions of the North American Manufacturing Research Institution of SME, Volume 28, 2000. Participants who have paid the registration fee will receive a copy at the time of registration. Additional copies may be purchased by contacting an SME Customer Service Representative at (313) 271-1500, ext. 1600 or (800) 733-4763.

NAMRC XXVIII PROGRAM-AT-A-GLANCE

Hosted by the University of Kentucky • Lexington, Kentucky, USA

MORNING

AFTERNOON

EVENING

Tuesday May 23	Registration & Breakfast UK Student Center 7:30-8:30 a.m.	Welcoming Ceremony Worsham Theatre UK Student Center 8:30-10:00 a.m.	Concurrent Sessions UK Student Center 10:30 a.m.-12:00 p.m.	COMEC Meeting Lincoln Room, Radisson Plaza Hotel 1:00 - 5:00 p.m. <i>(limited space, advance registration only)</i> Toyota Motor Manufacturing	Registration/Welcoming Reception Radisson Plaza Hotel 5:00 - 9:00 p.m.	Old Kentucky Night Kentucky Horse Park 6:00 - 10:00 p.m. <i>(Transportation will be provided, dress-casual)</i>	NAMRI/SME Member Meeting UK Student Center 3:30-4:30 p.m.	ASME MED Meeting UK Student Center 4:30-5:30 p.m.	Wine & Cheese Reception Spindletop Hall 6:00 - 9:30 p.m. <i>(Transportation will be provided)</i>	Conference Adjournment
Wednesday May 24	Registration & Breakfast UK Student Center 7:30-8:30 a.m.	Concurrent Sessions UK Student Center 10:30 a.m.-12:00 p.m.	Luncheon Founders Lecture Grand Ballroom UK Student Center 12:00-1:30 p.m.	Concurrent Sessions UK Student Center 1:30-5:00 p.m.	Concurrent Sessions UK Student Center 1:30-5:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Luncheon NAMRI/SME Awards Grand Ballroom UK Student Center 12:00-1:30 p.m.	Luncheon UK Student Center 12:00-1:30 p.m.	Laboratory Tours 3:30-5:00 p.m. Special Session: Assessment of Machining Models UK Student Center 5:00-6:00 p.m.	Painting Technology Workshop 10:30 a.m.-5:00 p.m.
Thursday May 25	Registration & Breakfast UK Student Center 7:30-8:30 a.m.	Concurrent Sessions UK Student Center 8:30 a.m.-12:00 p.m.	Concurrent Sessions UK Student Center 10:30 a.m.-12:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.
Friday May 26	Registration & Breakfast UK Student Center 7:30-8:30 a.m.	Concurrent Sessions UK Student Center 8:30 a.m.-12:00 p.m.	Concurrent Sessions UK Student Center 10:30 a.m.-12:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.	Concurrent Sessions UK Student Center 1:30-3:00 p.m.

2000 NAMRI/SME Board of Directors

PRESIDENT

Chi-Hung Shen
General Motors Corporation

PRESIDENT-ELECT

Rajiv Shivpuri
The Ohio State University

SECRETARY

Philip H. Abramowitz
Ford Motor Company (Retired)

PAST PRESIDENT

Kamlakar P. Rajurkar
University of Nebraska-Lincoln

DIRECTORS

Lienjing Chen
Pratt & Whitney

Don A. Lucca
Oklahoma State University

John W. Sutherland
Michigan Technological University

Gunter Warnecke
University of Kaiserslautern

Kornel F. Ehmman
Northwestern University

Hoda A. ElMaraghy
University of Windsor

SCIENTIFIC COMMITTEE CHAIR

Shiv G. Kapoor
University of Illinois at Urbana-Champaign

NAMRC XXVIII Organizing Committee

CHAIR

A.T. Male
Center for Robotics and Manufacturing Systems (CRMS) and the Department of Mechanical Engineering, University of Kentucky

CO-CHAIRS

I.S. Jawahir
CRMS and the Department of Mechanical Engineering
University of Kentucky

K.E. Rouch

Department of Mechanical Engineering
University of Kentucky

COMMITTEE MEMBERS

F. Cheng
Department of Computer Science
University of Kentucky

J. Graves

Center for Robotics and Manufacturing Systems
University of Kentucky

L. Holloway

CRMS and the Department of Electrical Engineering
University of Kentucky

M.R. Lovell

University of Pittsburgh

J.K. Lumpp

Department of Electrical Engineering
University of Kentucky

K. Saito

Department of Mechanical Engineering and CRMS
University of Kentucky

B. Seals

Department of Computer Science
University of Kentucky

Y. Tamura

Toyota Motor Manufacturing,
North America, Inc.

Y. Tanigawa

Toyota Motor Corporation, Toyota-Shi, Japan

R. Vallance

Department of Mechanical Engineering
University of Kentucky

B. Walcott

College of Engineering Administration and the Department of Electrical Engineering
University of Kentucky

ADDITIONAL ASSISTANCE FROM THE UK STUDENT CHAPTER

2000 NAMRI/SME Scientific Committee

CHAIRMAN

S.G. Kapoor
University of Illinois at Urbana-Champaign

MEMBERS

P.H. Abramowitz
Ford Motor Company

A. Bagchi

MTD Products, Inc.

P. Bandyopadhyay

General Motors

A.E. Bayoumi

University of South Carolina

V. Chandrasekharan

Caterpillar, Inc.

L. Chen

Pratt & Whitney

E.C. DeMeter

The Pennsylvania State University

D.R. Durham

National Science Foundation

K.F. Ehmman

Northwestern University

M. Elbestawi

McMaster University

H.A. ElMaraghy

University of Windsor

W. J. Endres

University of Michigan

P.M. Ferreira

University of Illinois at Urbana-Champaign

B.K. Fussell

University of New Hampshire

J.S. Gunasekera

Ohio University

S.J. Hu

University of Michigan

I.S. Jawahir

University of Kentucky

K. Kim

Northern Illinois University

B.E. Klamecki

University of Minnesota

R. Kovacevic

Southern Methodist University

B.M. Kramer

National Science Foundation

T.R. Kurfess

Georgia Institute of Technology

M. Lovell

University of Pittsburgh

D.A. Lucca

Oklahoma State University

S. Malkin

University of Massachusetts

S.N. Melkote

Georgia Institute of Technology

K. Mori

Toyohashi University of Technology

S.M. Pandit

Michigan Technological University

K.P. Rajurkar

University of Nebraska at Lincoln

S. Raman

University of Oklahoma

C-H. Shen

General Motors Corporation

J. Shi

University of Michigan

Y.C. Shim

Purdue University

R. Shivpuri

The Ohio State University

S. Smith

University of North Carolina at Charlotte

K.A. Stelson

University of Minnesota

J.W. Sutherland

Michigan Technological University

M. Tomizuka

University of California-Berkeley

G. Warnecke

University of Kaiserslautern

K.J. Weinmann

Michigan Technological University

R.E. Williams

University of Nebraska at Lincoln

W.R.D. Wilson

University of Washington

R.R. Winfough

Ingersoll Milling Machine Company

P.K. Wright

University of California at Berkeley

Y.L. Yao

Columbia University

B. Zhang

University of Connecticut

G. Zhang

University of Maryland

Conference Site

The University of Kentucky (UK) is the flagship institution of higher education for the Commonwealth of Kentucky. UK has long recognized the pivotal role it plays in the life of the commonwealth - a role that brings intellectual prosperity to Kentucky's citizens, to America and to the world at large. UK is designated a Research I University by the Carnegie Foundation, one of only 59 public universities in the country and the only one in Kentucky.

The Center for Robotics and Manufacturing Systems (CRMS), a unit within the College of Engineering, became fully operational in 1990. The 60,000 square foot facility is home to the administrative offices, laboratories and programs of the CRMS, the office of the dean of engineering, and the department of mechanical engineering.

Laboratories located in the facility support the research focus areas of system controls, laser prototyping, welding research and development, machining, CAD/CAE, materials joining, nontraditional processing, metal working, finite element analysis, robotics and painting technology. The facility also houses a net-working laboratory jointly operated by the department of computer science and the technology commercialization center.

The center is home to manufacturing research, technical assistance and education programs designed to help industry maintain a competitive edge in today's markets. Center researchers and staff work closely with industry to develop and improve processes for the manufacture of new materials, modeling and simulation, and automation and system integration.

The CRMS facility also contains instructional television classrooms and satellite uplink and downlink equipment used to broadcast distance learning courses throughout the Commonwealth and the world.

Facilities

Various sites and facilities have been chosen for NAMRC XXVIII. The Radisson Plaza Lexington will be the host hotel and the site for the Tuesday Evening Registration and Welcoming Reception. All conference technical sessions will be held in the University of Kentucky Student Center located on campus and special events will be held at the Kentucky Horse Park and Spindletop Hall.

Special Presentations

The winners of the 1999 Machining Technology Association of SME (MTA/SME) Best Paper Awards will present their papers at NAMRC XXVIII. The awards were presented at the 3rd International Machining & Grinding Conference.

Special Activities

NAMRC begins with the Welcoming Reception Tuesday, May 23 at the Radisson Plaza Lexington. The hotel is located at 369 West Vine Street in downtown Lexington. The phone number is (606) 231-9000*.

Wednesday, May 24 takes the attendees to the Kentucky Horse Park, which is dedicated to man's relationship with the horse. The Kentucky Horse Park is unlike any other park in the world - a showcase of museums, galleries, theaters, and working farm exhibits. More than 45 breeds of horses graze upon its lush pastures. Participants will enjoy a casual evening of dinner, entertainment by area cloggers/square dancers, hayrides and tours of the grounds of this beautiful theme park.

Thursday evening, May 25, a wine and cheese reception will be held at the University of Kentucky's faculty/staff/alumni club, Spindletop Hall. Built in 1935, the club facility includes an elegant mansion with over 45,000 square feet of floor space. The grounds include ten tennis courts, four swimming pools and a bathhouse, snack barn, picnic areas, jogging/walking trails and a playground.

Other special activities include a COMEC meeting on Tuesday, May 23 from 1:00 - 5:30 p.m. in the Lincoln Room at the Radisson Plaza Hotel; the annual NAMRI/SME membership meeting on Thursday, May 25 from 3:30 - 4:30 p.m. in the UK Student Center; and the ASME MED meeting on Thursday, May 25 from 4:30 - 5:30 p.m. in the UK Student Center.

Laboratory Tours: Thursday, May 25, from 3:30 - 5:00 p.m.

The tours will highlight laboratories in the facilities of the Center for Robotics and Manufacturing Sciences. The following is a list of available tour sites and tour hosts:

CRMS Manufacturing Research Laboratories

- Electronics Manufacturing Laboratory, Jerry Tackett
- Laser Diagnostics for Thermal Fluid Systems, Professor Kozo Saito, Dr. Mohamed I. Hassan
- Laser Processing Laboratory, Professor Janet Lumpf
- Machining Research Laboratory, Professor I.S. Jawahir
- Rapid Prototyping Laboratory, R.J. Robinson
- Welding Research Laboratory, Professor YuMing Zhang

You may also want to take a tour of the University of Kentucky campus on your own. Maps outlining a self-guided walking tour are available at the visitor's center located on the first floor of the student center near the University Book Store.

Special Tour

Toyota Motor Manufacturing, Kentucky, Inc. opened in 1988, and is the first in North America to build minivans and passenger cars on the same production line. A pre-conference tour of the facility has been scheduled for the afternoon of Tuesday, May 23, 2000. Visitors will board trams to view the automobile assembly plant. Space is extremely limited and will be reserved for the first 27 attendees who register for the tour. Please check Web site for availability. Advance registrations only.

* The (606) area code is scheduled to change to (859) effective April 1, 2000.

Guest Program

Shaker Village of Pleasant Hill, Wednesday, May 24

Enjoy a tour of nearby Shaker Village of Pleasant Hill, the nation's largest restored Shaker Village community where you will be able to see demonstrations by spinners, weavers, broommakers and others. Lunch will be served Shaker style in the Trustees House and there will be ample time to explore the original 19th century buildings. You will be back at the Radisson in time to board the buses for the Kentucky Horse Park for the evening banquet.

Kentucky Horse Park, Wednesday, May 24

The Kentucky Horse Park will be home to the World Premiere of *Imperial China: The Art of the Horse in Chinese History* during NAMRC. This exhibit will feature more than 300 artifacts, many of which have never before been allowed to leave China, and will cover more than 3,000 years of Chinese history. Your ticket is included in the registration fee.

Horse Farm Country, Thursday, May 25

Thursday, a visit to Horse Farm Country and historic downtown will give you a behind-the-scenes look at the multi-billion dollar thoroughbred industry. A short ride through the beautiful Bluegrass countryside will take you to Irish Acres with over 30,000 square feet of antiques from all over the world. Lunch will be served at the Glitz, an eclectic restaurant at Irish Acres. During the afternoon, you will go to Labrot and Graham Distillery where you will be introduced to the history of bourbon made by the *pot still* method.

Additional Information

Vegetarian meals will be provided at each meal for those who request them. Please indicate your dietary requirements on the registration form. Also, those who require accommodations for disabilities should inform the University of Kentucky through the registration form.

Registration Fees

Registration fees can be paid by check, money order, purchase order or credit card in U.S. dollars only. Complete one form per person. Make additional copies as needed.

Registration for the full conference is \$350.00 (U.S. Funds) for registrations postmarked or faxed (with credit card information) on or before May 3, 2000. After that date registration will be \$400.00. The student/retiree registration is \$120.00 and the guest registration fee is \$135.00. All fees except the guest registration include all NAMRC meals and conference publications. Included in the guest registration fees are conference breakfasts, the conference banquet, two receptions, and tours of the Bluegrass Region on Wednesday and Thursday (see Guest Program). There are no reduced registration fees for authors or session chairs. There are no single-day registrations.

Cancellations and Refunds

Cancellations made ten (10) working days or less before the conference are subject to a cancellation service charge of \$100.00. The conference registration may be transferred to another colleague without charge.

To be eligible for any refund of fees, less a \$100.00 administrative fee, please notify us in writing (fax or email) by May 10, 2000. Unfortunately we cannot offer refunds after that date. Please note that "no shows" do not receive refunds and are responsible for the entire fee. Refunds are processed immediately following the conference. Please allow six to eight weeks to receive the refund.

Travel

Lexington, Kentucky is located at the major junction of interstates 75 and 64. The Blue Grass Airport is just 10 minutes from downtown, with Northern Kentucky/Cincinnati International Airport, just 83 miles away via I-75. The University of Kentucky campus is only 15 minutes from Lexington's Bluegrass Airport and 90 minutes from Louisville and Cincinnati.

Visa & Health Insurance

All international participants are requested to make arrangements for their U.S. Visa and health insurance.

Lodging

The Radisson Plaza Lexington is the primary lodging site for the conference. It is located in the heart of downtown Lexington and is about a mile from the University of Kentucky campus and ten minutes from the Lexington Bluegrass Airport. The group rate is \$109.00 per night single/double/triple/quad.

IMPORTANT NOTICE - Reservations at the Radisson Plaza Lexington must be made by April 23, 2000 to receive the conference rate of \$109.00 per night single/double/triple/quad. Phone (606)231-9000* or fax (606)281-3704* to make your reservations.

The Radisson offers an indoor pool, jacuzzi, sauna, exercise room, free airport shuttle service, free self-parking in an enclosed garage, valet parking, restaurant, cocktail lounge, entertainment, gift shop and wheelchair accessible rooms. Other hotels in the vicinity include:

Holiday Inn North - Holidome Indoor Recreation Center
1950 Newtown Pike
Lexington, KY 40511
(606) 233-0512* or (800) HOLIDAY
FAX: (606) 253-1505*

Campbell House Inn, Suites & Golf Club
1375 Harrodsburg Road
Lexington, KY 40504
(606) 255-4281*
In State (800) 432-9254
Out of State (800) 354-9235
FAX: (606) 254-4368*

Greenleaf Inn
2280 Nicholasville Road
Lexington, KY 40503
(606) 277-1191*
In State (800) 432-9027
Out of State (800) 354-9096
FAX: (606) 277-1191*, ext. 199

The Springs Inn
2020 Harrodsburg Road
Lexington, KY 40503
(606) 277-5751*
(800) 354-9503
FAX: (606) 277-3142*

* The (606) area code is scheduled to change to (859) effective April 1, 2000.

Parking

On-campus parking is very limited and driving to conference sessions is discouraged. The Radisson Plaza Lexington offers parking and is about a mile from campus. Limited bus transportation will be offered to and from the hotel to campus.

Climate

The average temperature in May is 65 degrees Fahrenheit, however spring temperatures may range anywhere between 34-74 degrees Fahrenheit.

Time Zone

October to April: Eastern Standard Time
April to October: Daylight Savings Time

To Register

Mail:

Complete the registration form at the back of this brochure and mail it with your payment using check, money order, purchase order, or charge card number to:

Juanita Graves, Conference Manager
Center for Robotics and Manufacturing Systems
220 B CRMS Building
UK College of Engineering
Lexington, KY 40506-0108

Fax:

To register by fax please complete the form, include your credit card number or your purchase order number and fax to (606) 323-1035*. This line is available 24 hours a day.

E-mail:

E-mail your registration to: jgraves@enr.uky.edu.

On-line:

Visit www.sme.org/namri and link to the NAMRC XXVIII information. Please fill out the form, print and transmit by one of the above methods. The site is NOT a secure site for transmitting credit card numbers.

* The (606) area code is scheduled to change to (859) effective April 1, 2000.

NAMRC XXVIII Technical Sessions and Programs

Tuesday, May 23, 2000

1:00 - 3:00 p.m.

Tour of Toyota Motor Manufacturing Kentucky, Inc.

(Space is limited. Check Web site at www.sme.org/namri for availability)

1:00 - 5:30 p.m.

COMEC Meeting

Lincoln Room, Radisson Plaza Hotel

5:00 - 9:00 p.m.

Conference Registration and Welcoming Reception

The Radisson Plaza Hotel, Downtown Lexington, Kentucky

Wednesday, May 24, 2000

7:30 - 8:30 a.m.

Registration and Continental Breakfast

University of Kentucky, Student Center Complex

8:30 - 10:00 a.m.

Welcoming Ceremony

Worsham Theater, University of Kentucky, Student Center Complex

Opening Remarks:

Alan T. Male, Chair NAMRC XXVIII

Welcoming Remarks:

Chi-Hung Shen, President, NAMRI/SME

Elisabeth Zinser, Chancellor, University of Kentucky Lexington Campus
Thomas W. Lester, Dean, University of Kentucky College of Engineering

Keynote Address:

Lee Todd, Founder and President, DataBeam, Lexington, Kentucky

10:00 - 10:30 a.m.

Refreshment Break

10:30-12:00 noon

Concurrent Technical Sessions

Session 1-A: Forming I - Forging

Co-Chairs: Rajiv Shivpuri, The Ohio State University
Alvin Sabroff, Metal Working Consultants

Forging Preform Design Using Element Power Minimization

by R.J. Heimann, Jr. and J.L. Frater, Cleveland State University

Finite Element Simulation of Orbital Forging of Large Disk with Rocking Die Using Axi-Symmetric Approximation by K-I. Mori, Toyohashi University of Technology; O. Ebihara, Topy Industries, Ltd.

Optimal Condition for Embossing Process of Electron Gun Part by E.S. Lee, Navistar International Transportation Corporation; K.I. Kim, Samsung Display Devices; K. Kim, Northern Illinois University

Session 1-B: Material Removal I - Friction and Material Behavior

Co-Chairs: Abdel E. Bayoumi, University of South Carolina
Pankaj K. Mehrotra, Kennametal, Inc.

* **Material Behaviour of Aluminum 7075 and AISI 1045 Steel in High Speed Machining** by S. Siems, R. Dollmeier and G. Warnecke, University of Kaiserslautern

* **Characterization of Friction in Machining: Evaluation of Asperity Deformation and Seizure-Based Models** by S. Bhattacharya, University of Kentucky, and M.R. Lovell, University of Pittsburgh

* **The Influence of Thin Hard Coatings on Friction in the Orthogonal Cutting Process** by W. Grzesik and P. Nieslony, Technical University of Opole

Session 1-C: Manufacturing Systems I - Process Planning

Co-Chairs: Hoda ElMaraghy, University of Windsor
Thomas Kurfess, Georgia Institute of Technology

Decision Making in a Multi-Constraint Agent-Based Process Planning System by P.K. Wright, D.A. Dornfeld, F-C. Wang and C-H. Chu, University of California at Berkeley

Managing Machine Tool Information: The Path from Standardization to Implementation by M.G. Montero, University of California at Berkeley; P.M. Ferreira, University of Illinois at Urbana-Champaign; J.G. Katter, Jr., Caterpillar, Inc.

Geometric Tolerance Normalization and Its Application by Q. Liu and S. H. Huang, University of Toledo

12:00 Noon - 1:30 p.m.

Luncheon and Founders Lecture

Grand Ballroom, UK Student Center

Presiding: Chi-Hung Shen, NAMRI/SME President

Presentation by Taylan Altan, The Ohio State University

1:30 p.m. - 3:00 p.m.

Concurrent Technical Sessions

Session 2-A: Forming II - Sheet Metal I

Co-Chairs: Don A. Lucca, Oklahoma State University
James C. Malas, Air Force Research Laboratory

✓ **Open-Loop Optimization of the Sheet Metal Drawing Process with Active Drawbeads** by M.L. Bohn, Pactiv Corporation Technical Center; K.J. Weinmann, Michigan Technological University

✓ **Influence of Temperature and Strain Rate on Plastic Instability during Deep Drawing** by E. Zussmann, Technion-Israel Institute of Technology

An Experimental Investigation of Curved Surface-Straight Edge Hemming by G. Zhang, H. Hao, X. Wu and S.J. Hu, University of Michigan; K. Harper and W. Faitel, Lamb Technicon Body Assembly Systems

Session 2-B: Material Removal II - High Speed Machining

Co-Chairs: Günter Warnecke, University of Kaiserslautern
Matthew A. Davies, National Institute of Standards and Technology

Comparison of Sialon and Silicon Carbide Whisker Reinforced Alumina Ceramic for High-Speed Milling of Inconel 718™ by R. M. Arunachalam and M.A. Mannan, National University of Singapore

Effects of Cutter Orientation When Ball Nose End Milling Inconel 718™ by E-G. Ng, R.C. Dewes, and D.K. Aspinwall, University of Birmingham; D-W. Lee, Pusan National University

1999 MTA/SME Best Paper Award Winner

✓ **High Speed Machining of Unsupported Thin-Walled Structures** by E. Agba, J.T. Berry and D. Ishee, Mississippi State University

Session 2-C: Manufacturing Systems II - Burr Control in Drilling, AE Sensors in Milling

Co-Chairs: Elijah Kennatey-Asibu, Jr., University of Michigan
Sivakumar Raman, University of Oklahoma

✳ **Development of a Drilling Burr Control Chart for Stainless Steel**
by J. Kim and D.A. Dornfeld, University of California at Berkeley

✳ **Basic Study on Development of Sensor to Detect Cutting Force Components
Based on Villari Effect** by H. Aoyama, A. Amemiya and I. Inasaki, Keio University;
H. Ohzeki, Mitsubishi Materials Company

**Progressive Tool Wear Monitoring in Milling Operations Based on Frequency
Analysis of Acoustic Emission Root Mean Square**
by A.K.T. Chung and A. Geddam, City University of Hong Kong

3:00 - 3:30 p.m.
Refreshment Break

3:30- 5:00 p.m.
Concurrent Technical Sessions

Session 3-A: Forming III - Sheet Metal II

Co-Chairs: Klaus J. Weinmann, Michigan Technological University
Amit Bagchi, MTD Products, Inc.

Convex Laser Forming with High Certainty by W. Li and Y. L. Yao, Columbia
University

Modeling and Control of Plasma-Jet Forming Process by A.T. Male, Y.W.
Chen, P.J. Li and Y.M. Zhang, University of Kentucky

**Analysis and Design of Hydroforming Processes by the Rigid-Plastic Finite
Element Method** by B-S. Kang, L-P. Lei and D-H. Kim, Pusan National
University

Session 3-B: Material Removal III - Predictive Models for Machining

Co-Chairs: Robin Stevenson, General Motors
Joseph A. Arsecularatne, University of New South Wales

**A Predictive Model for Temperature Distributions in 'Classical' Orthogonal
Cutting** by C.B. Aluwihare, E.J.A. Armarego and A.J.R. Smith, The University of
Melbourne

**Prediction and Validation of Chip Up-Curl in Machining Using the Universal
Slip-Line Model** by N. Fang and I.S. Jawahir, University of Kentucky

**Mechanistic Prediction of Drilling Forces Incorporating a Minimum Cutting
Energy Model for Chip Flow Angle** by A.J. Bergstrom, J.W. Sutherland,
A.J. Filipovic and W.W. Olson, Michigan Technological University

Session 3-C: Manufacturing Systems III - CMMs, Datums, Reverse Engineering

Co-Chairs: Kornel F. Ehmann, Northwestern University
Shreyes N. Melkote, Georgia Institute of Technology

A Complete and Efficient Algorithm that Identifies all Valid Planar Datums by
S. Bapat, Structural Dynamics Research Corporation; R.G. Wilhelm, University of
North Carolina at Charlotte

Accessibility and Measurement Clustering for CMM Inspection by
A. Vafaeseefat, H.A. ElMaraghy, University of Windsor

**Reduction in Number of Data Collected for Reverse Engineering of
Free-Form Surfaces** by K.K. Krishnan, P.P. Chowdhury, B. Bahr and Y.K. Wong,
Wichita State University

6:00-10:00 p.m.
Old Kentucky Night
Kentucky Horse Park
(Transportation provided, dress - casual)

Thursday, May 25, 2000

7:30 - 8:30 a.m.

Registration and Continental Breakfast

8:30 - 10:00 a.m.

Concurrent Technical Sessions

Session 4-A: Forming IV - Rolling and Extrusion

Co-Chairs: Oscar W. Dillon, University of Kentucky
Chi-Hung Shen, General Motors Technical Center

Process Optimal Design in Metal Forming by Double-Objective Genetic Algorithm by J.S. Chung, Research Institute of Industrial Science and Technology; S.M. Byon, H.J. Kim and S.M. Hwang, Pohang University of Science and Technology

✓ **Prediction of Ductile Fracture in Forward Extrusion with Spherical Dies** by J. Hoffmann, DaimlerChrysler; C. Santiago-Vega, GE-Medical Systems; V.H. Vazquez and T. Altan, The Ohio State University

Investigation of a Double Reduction Die for Reduced End Cracking During Cold Extrusion by A. Pabalkar, S. Kini and R. Shivpuri, The Ohio State University

Session 4-B: Material Removal IV - Cutting Fluids

Co-Chairs: John Sutherland, Michigan Technological University
Shane Y. Hong, Columbia University

✓ **Environmentally-Conscious Minimum Quantity Lubrication (MQL) for Internal Cylindrical Grinding** by D. Hafenbraedl and S. Malkin, University of Massachusetts

Cutting Fluid Aerosol Generation in Turning Operation by Z. Chen, A. Atmadi, S.Y. Liang, Georgia Institute of Technology; D.A. Stephenson, General Motors Corporation

✓ **Tool Life When Turning Gamma Titanium Aluminide Using Carbide and PCD Tools with Reduced Depths of Cut and High Pressure Cutting Fluid** by A.C. Sharman, D.K. Aspinwall, R.C. Dewes and P. Bowen, University of Birmingham

Session 4-C: Manufacturing Systems IV - Cell Design, Plant Layout

Co-Chairs: Robert G. Wilhelm, University of North Carolina at Charlotte
Yuan-Shin Lee, North Carolina State University

Cell Design for Lean Manufacturing by J.T. Black, Auburn University

Mass vs. Lean Plant Design Evaluation Using the Production System Design Decomposition by D.S. Cochran and D.C. Dobbs, Massachusetts Institute of Technology

A Pattern Recognition Approach for Facility Compaction and Selection of Flexible Automation by S.A. Irani and H. Huang, The Ohio State University

10:00- 10:30 a.m.
Refreshment Break

10:30 - 12:00 noon
Concurrent Technical Sessions

Session 5-A: Forming V - Friction and Bar/Rod Drawing

Co-Chairs: Alan T. Male, University of Kentucky
Taylan Altan, The Ohio State University

Intermediate Die Design System for the Multi-Stage Drawing Process by Y-C. Kim, D-J. Kim and B-M. Kim, Pusan National University

Skin Pass Wire Drawing of Stainless Steel with Chlorine-Free Lubricant with the Aid of Ultrasonic Vibration by M. Murakawa, P. Kaewtatip and M. Jin, Nippon Institute of Technology

Friction in Compression Testing by J. Jeswiet, P. Wild and T. Moore, Queen's University

Session 5-B: Material Removal V - FE Modeling

Co-Chairs: Richard Liu, Purdue University
Ranajit Ghosh, Kennametal, Inc.

- * **Mechanically and Thermally Coupled Finite Element Analysis of Chip Formation in Metal Cutting** by J-D. Oh and G. Warnecke, University of Kaiserslautern
- * **Tool-Workpiece Interface in Orthogonal Cutting - Application of FEM Modeling** by M. Shatla, Y-C. Yen and T. Altan, The Ohio State University
- * **Residual Stress Formation Mechanism and its Control by Sequential Cuts** by Y.B. Guo and C.R. Liu, Purdue University

Session 5-C: Manufacturing Systems V - Sculptured Surfaces and Measurement

Co-Chairs: Radovan Kovacevic, Southern Methodist University
Steven Liang, Georgia Institute of Technology

Sculptured Surface Localization Using Generalized Hopfield Networks by R. Gudla, S. Anand and R. Kothari, University of Cincinnati

NC Tool Path Planning for Sculptured Surface Machining Based on Constant Scallop Height by H-Y. Feng and H. Li, The University of Western Ontario

A New Area-Based Stereo Algorithm for Measurement of 3D Shapes by G-B. and S-C. Chung, Hanyang University

12:00 noon - 1:30 p.m.

NAMRI/SME Awards Luncheon

Presiding: Chi-Hung Shen, NAMRI/SME President
Grand Ballroom, UK Student Center

1:30 - 3:00 p.m.

Concurrent Technical Sessions

Session 6-A: Forming VI - Casting, Welding and Polymers

Co-Chairs: YuMing Zhang, University of Kentucky
Michael Lovell, University of Pittsburgh

Integration of Process Modeling and Design of Experiments for Improving the Pouring Phase of the Die Casting Process by V. Sankararaman, S. Kannan and R. Shivpuri, The Ohio State University

Modeling of Welding Arc Light Radiation by P.J. Li and Y.M. Zhang, University of Kentucky

Investigating Process Induced Micro Voids Effect on the Elastic Properties of LCM Polymer Composites by L. Lu, R. Shivpuri and L.J. Lee, The Ohio State University

Session 6-B: Material Removal VI - Performance Evaluation

Co-Chairs: Jun Ni, University of Michigan
Walter W. Olson, University of Toledo

- ✓ **The Frequency Content of Turned Surface Profiles** by K-N. Kim and K.F. Ehmann, Northwestern University
- ✓ **A Study of Apparent Negative Rake Angle and Its Effect on Shear Angle during Orthogonal Cutting with Edge-Radiused Tools** by J. Manjunathaiah, Lamb Technicon Machining Systems; and W.J. Endres, University of Michigan
- ✓ **An Analytical Model for Prediction of Chatter Stability in Boring** by S. Jayaram, Caterpillar, Inc.; M. Iyer, Michigan State University

Session 6-C: Manufacturing Systems VI - Agile Manufacturing, Enterprise System

Co-Chairs: Ming C. Leu, University of Missouri-Rolla
Shonak Athavale, Ford Motor Company

Agility Within a Manufacturing Industry - A Case Study at ABB Robotics by M. Jackson, ABB Management Consultants AB; and C. Johansson, Linköpings Universitet

Using CIMOSA and Free-Choice Petri Nets for Modeling and Verification of Manufacturing Enterprise Business Processes by M. Dong and F.F. Chen, Virginia Polytechnic Institute and State University

A Quality Forecasting System for Glass Melting Processes using Genetic Algorithms by B. Jeong and H. Jung, Yonsei University

Session 6-D: Material Removal/Manufacturing Systems I - Fixtures

Co-Chairs: Yung C. Shin, Purdue University
Stephen A. Batzer, University of Arkansas – Little Rock

On the Prediction of Friction Force at Workpiece-Fixture Interface by B. Fang, R.E. DeVor and S.G. Kapoor, University of Illinois at Urbana-Champaign

A Minimum Clamping Force Algorithm for Machining Fixtures by B. Li and S.N. Melkote, Georgia Institute of Technology

An Experimental Investigation into the Deflection of a Fixture-Workpiece System by Y.G. Liao and R. Stevenson, General Motors Corporation; R. Khetan, Delphi Automotive Systems

✓ 3:00 - 3:30 p.m.
Refreshment Break

✓ 3:30 - 4:30 p.m.
NAMRI/SME Member Meeting

4:30- 5:30 p.m.
ASME MED Meeting

3:30-5:00 p.m.
Concurrent Laboratory Tours
University of Kentucky Campus (Self guided)

5:00 - 6:00 p.m.
Special Session on Assessment of Machining Models
Moderators: Matthew A. Davies, National Institute on Standards and Technology
Robin Stevenson, General Motors Corporation
Shonak Athavale, Ford Motor Company

Note: all above afternoon events will be held at the UK Student Center

✓ 6:00-9:30 p.m.
Wine & Cheese Reception
University of Kentucky Spindletop Hall
Faculty/staff/alumni club

Transportation to and from the reception will be provided. Buses will depart from the Radisson Plaza Hotel at 5:45 p.m. and again at 6:30 p.m.

Friday, May 26, 2000

7:30 - 8:30 a.m.
Registration and Continental Breakfast

8:30 - 10:00 a.m.
Concurrent Technical Sessions

Session 7-A: Material Removal VII - Tool Wear and Surface Quality

Co-Chairs: Edward J. A. Armarego, University of Melbourne
Christopher A. Brown, Worcester Polytechnic Institute

An Investigation of Tool Wear and Surface Quality in Hard Turning by T.G. Dawson and T.R. Kurfess, Georgia Institute of Technology

Effect of Process Parameters Upon Tool Wear of Ball-Nose End Mills by C.A. Rodriguez, Instituto Tecnológico y de Estudios Superiores de Monterrey; T. Altan, The Ohio State University

A Study of the Effect of Process Parameters on Surface Finish of Drilled Holes by D. Ramaswamy, A. Tucker, A. Olmez, S. Chandrasekar and W.D. Compton, Purdue University

Session 7-B: Material Removal VIII - Electro-processes

Co-Chairs: Robert E. Williams, University of Nebraska
Ryan Vallance, University of Kentucky

Generation of Complex Micro Cavities by Micro EDM by Z. Yu and K.P. Rajurkar, University of Nebraska-Lincoln

Influence of Electrode Materials and Polarities on the Electrode Erosion Rates in EDM Process by R. Saha, Tata Consultancy Service; R. Kumar and M.K. Muju, Indian Institute of Technology

The Applications of CM-ECM Technology to Metal Surface Finishing by J.J. Sun, E.J. Taylor, L.E. Gebhart, M.E. Inman and R.P. Renz, Faraday Technology, Inc.

Session 7-C: Manufacturing Systems VII - Controls

Co-Chairs: Michael E. Finn, Institute of Advanced Manufacturing Sciences, Inc. (IAMS®)
Scott Stephens, University of Kentucky

Auto-Tuning Adaptive Supervisory Control of Single-Plane Active Balancing Systems by S.W. Dyer and Z. Zhuang, BalaDyne Corporation; J. Ni and J. Shi, University of Michigan

Supervisory Adaptive Balancing of Rigid Rotors During Acceleration by S. Zhou and J. Shi, University of Michigan

Cutting Tool Identification System for Accident-free Machining by J. Liu, K. Yamazaki and T. Koide, University of California at Davis

10:00 - 10:30 a.m.
Refreshment Break

10:30 a.m. - 12:00 noon
Concurrent Sessions

Session 8-A: Material Removal IX - Sensors

Co-Chairs: Mohammad A. Mannan, National University of Singapore
Hazim A. El-Mounayri, Indiana University-Purdue University Indianapolis

A New Approach for the Detection of Worn Tool Status by M. Murugan and V. Radhakrishnan, Indian Institute of Technology

Analysis of Sound Signal Characteristics Associated with Adhesive Wear in Machining by M-C. Lu and E. Kannatey-Asibu, Jr., University of Michigan

Application of New Acoustic Emission Monitoring Technique to Nontraditional Machining by R.E. Williams, E.L. Clark, O.M. Kinyungu, S. Sarikonda and K.P. Rajurkar, University of Nebraska-Lincoln

Session 8-B: Material Removal X - Microshape and High Speed Grinding

Co-Chairs: Ioan Marinescu, University of Toledo
Guangming Zhang, University of Maryland

Fabrication of Micro Shapes of Advanced Materials by ELID-Grinding by J. Qian, H. Ohmori and T. Kato, The Institute of Physical and Chemical Research; I. Marinescu, University of Toledo

1999 MTA/SME Best Paper Award Winner Innovative Approach of Electrolytic In-Process Dressing for High-Speed Grinding by X. Liu and Z. Zhu, Stevens Institute of Technology

Development of a Quartz Dissolution Model for Vitrified Grinding Wheel Bonding Systems by M.J. Jackson and B. Mills, University of Liverpool

Session 8-C: Material Removal/Manufacturing Systems II - Thermal Modeling, Thermal and Surface Integrity

Co-Chairs: Y. Lawrence Yao, Columbia University
Anil Srivastava, Institute of Advanced Manufacturing Sciences, Inc. (IAMS®)

Real Time Estimation of 1-Dimensional Temperature Distribution for Precision Machine Tools Using Modal Analysis and Observer by J-Y. Ahn and S-C. Chung, Hanyang University

A Computational Approach to Evaluate Surface Integrity of Glass Ceramics by G. Zhang and Y. Cao, University of Maryland at College Park; D. Rekow, University of Medicine and Dentistry at New Jersey

Vitrification Heat Treatment and the Dissolution of Quartz by M.J. Jackson and B. Mills, University of Liverpool

12:00 noon - 1:30 p.m.
Lunch

10:30 - 5:00 p.m.
Painting Technology Workshop
Chair: Kozo Saito, University of Kentucky

This workshop is open to all participants of NAMRC XXVIII and non-participants. There is no cost to attend the workshop but registration is required.

The painting technology consortium at the University of Kentucky is designed to develop a new generation of higher energy efficiency, which is more environmentally friendly than those currently available. Its current focus is on the application of computational fluid dynamics and scale modeling techniques.

5:00 p.m.
Conference Adjournment

TO REGISTER: Complete the information below and fax or mail the form with payment information to the University of Kentucky address provided. Registration fees can be paid by check, money order, purchase order or credit card in **U.S. dollars** only.

Please check appropriate box.

Dr. Mr. Ms. First Name _____ Last _____

Name Preferred on Name Tag: _____

Organization: _____

Address: _____

City: _____ State: _____

Postal Code: _____ Country: _____

Daytime Phone: _____ FAX: _____

E-Mail: _____

Special Needs (diet or handicap access, etc.) _____

Authors Audio/Visual Requirements: _____

REGISTRATION

Full Registration before May 3, 2000 \$350.00

Full Registration after May 3, 2000 \$400.00

Student/Retiree Registration \$120.00

Guest Registration (include guest name) \$135.00

Painting Technology Workshop no charge

TOTAL PAYMENT: \$

Check here if you want to attend a special tour of Toyota Motor Manufacturing Kentucky, Inc. on Tuesday afternoon May 23, 2000. Space is limited. Advance registration only. Check Web site for availability at www.smc.org/namri.

To pay your registration with a credit card, complete the following:

Card Member Name: _____

Type of Card (please circle one): VISA MASTERCARD AMERICAN EXPRESS

Account Number: _____

Expiration Date _____ Payment Amount: \$ _____

Authorization Signature: _____

MAIL your registration to:

Juanita Graves, Conference Manager
Center for Robotics and Manufacturing Systems
220 B CRMS Bldg.

UK College of Engineering
Lexington, KY 40506-0108

ON-LINE Registration: See our home page at www.smc.org/namri

E-MAIL your registration to:

jgraves@enr.uky.edu. Please include all information requested on the registration form including your method of payment.

FAX the registration form along with your credit card information to (606) 323-1035*. This line is available 24 hours a day.

IMPORTANT NOTICE - Reservations at the Radisson Plaza Lexington must be made by April 23, 2000 to receive the conference rate of \$109.00 per night single/double/triple/quad. Phone (606)231-9000* or fax (606)281-3704* to make your reservations.

* The (606) area code is scheduled to change to (859) effective April 1, 2000.