



The North American Manufacturing Research Institution of  
the Society of Manufacturing Engineers Announces its...

## TWENTY SECOND NORTH AMERICAN MANUFACTURING RESEARCH CONFERENCE



**NAMRI** SME



**NAMRC XXII**  
May 25-27, 1994



Including the  
**S.M. Wu Symposium**  
May 27-28, 1994



**Robert R. McCormick School of Engineering and Applied Science**  
**Northwestern University**  
**Evanston, Illinois, USA**



Northwestern University  
 Center for Manufacturing Engineering  
 Robert R. McCormick School of  
 Engineering and Applied Science

Dear Friends:

Northwestern University is delighted to host the twenty second North American Manufacturing Research Conference. The Conference continues its historic role of providing a forum for the discussion of basic and applied research in material removal, material forming and manufacturing systems.

This year, there will be 76 papers presented at the Conference from universities, research institutes and industrial research laboratories from North America and nine overseas countries. All the papers have been accepted based on a peer review process conducted by the NAMRI/SME Scientific Committee. Featured speakers include Dr. Jay Hook who will provide some new ideas on university-industry interactions and professor Bill Rice who will tell us about the history of the Conference.

Immediately following the Conference there will be a week-end Symposium in honor of the late Professor S. M. Wu and his many contributions to manufacturing research and education.

The conjunction of the NAMRC Conference and Wu Symposium presents a unique opportunity for practitioners to discover what is going on in the manufacturing research community. We wish especially to encourage our colleagues in industry to attend one or both events. Be assured that we will do our best to provide a warm welcome and a productive environment. To misquote William Butler Yeats:

" there are no strangers at NAMRC, only friends who have not yet met "

We look forward to renewing old acquaintances and meeting new friends in Evanston at NAMRC XXII and the Wu Symposium. We hope that you will enjoy and profit from the experience.

Cordially yours,

*Kory Ehmann* *Bill Wilson*

Kory Ehmann and Bill Wilson, Co-Chairs,  
 NAMRC XXII Organizing Committee

## PROGRAM AT A GLANCE

### NAMRC XXII

TIME	8:30-10:00	10:30-12:00	1:30-3:10	3:30-5:00	EVENING
WEDNESDAY MAY 25	Plenary Session	C1 F1 S1	C2 S2A S2B	C3A C3B S3	Banquet
THURSDAY MAY 26	C4 F4 S4	C5 F5 S5	C6 S6A S6B	Lab. Tour	Beach Party Membership ASME PED
FRIDAY MAY 27	C7A C7B S7	C8 F8 S8			

LEGEND: F: FORMING SESSIONS  
 C: CUTTING SESSIONS  
 S: SYSTEMS SESSIONS

### FIRST S.M. WU SYMPOSIUM

TIME	8:00-10:00	10:30-12:00	1:00-3:00	3:30-5:00	EVENING
FRIDAY MAY 27			Plenary Session	FA-I FA-II FA-III	Banquet
SATURDAY MAY 28	SM1-I SM1-II SM1-III	SM2-I SM2-II SM2-III	SA1-I SA1-II SA1-III	SA2-I SA2-II	

## TWENTY SECOND NORTH AMERICAN MANUFACTURING RESEARCH CONFERENCE - NAMRC XXII

### Prospectus

The twenty-second North American Manufacturing Research Conference, to be held May 25-27, 1994, is designed to provide a forum for the timely presentation and critical discussion of the results of basic and applied research in material forming, material removal and manufacturing systems. The papers to be presented have been accepted based upon review of their full text. They report manufacturing research from universities, research institutes and industrial research laboratories from North America and nine overseas countries.

### Transactions

All the papers to be presented at NAMRC XXII will be contained in either the hardbound "Transactions of the North American Manufacturing Research Institution of SME-1994" or a soft bound proceedings. All registered NAMRC XXII participants will receive one copy of each at the time of registration. Additional copies of either document may be purchased at registration for \$60 and \$20 respectively. After the Conference they may be purchased from the SME Publications Department.

### Conference Site

The conference will be held in the Norris Center at Northwestern University, Evanston, Illinois, which is located on the shore of Lake Michigan about 12 miles north of downtown Chicago. Guest rooms will be available at the nearby Omni Orrington Hotel. Travel to the site is facilitated by the wide variety of air, road and rail arteries which converge in Chicago. Evanston provides an excellent selection of shops and restaurants, while all the delights of the Chicago Loop are within half an hour by car or public transportation.

The conference banquet will be held on the evening of Wednesday, May 25, on board the cruise vessel "Odyssey". The vessel will depart from Navy Pier in Chicago at 7 P.M. and return at 10 P.M. The cruise will present spectacular views of Lake Michigan and Chicago's glittering skyline. Transportation will be provided from, and back to, Evanston.

### Registration Fees

Registration fees for the full conference are \$315 for registrations postmarked, faxed or phoned on or before May 13. The one day registration fee is \$185 while the student or retiree registration is \$75. These registrations include all NAMRC meals, the transactions and proceedings. There are no reduced registrations for authors or session chairs. Fees are refundable for cancellations received up to five working days prior to the start of the Conference. Cancellations after this date but prior to the start of the Conference will be assessed a \$50 cancellation charge. No refunds will be given after the start of the Conference.

### Accompanying Persons' Program

A non-technical program will be provided on Wednesday, May 25 and Thursday, May 26 for visiting spouses, guests and others who do not wish to attend the technical sessions. The program will include visits to the Art Institute of Chicago, the Field Museum, the Baha'i Temple and the Chicago Botanical Gardens. There will also be time to shop and socialize. The program fee of \$70 includes lunches, transportation and admission fees.

## FIRST S.M. WU SYMPOSIUM ON MANUFACTURING SCIENCE

### Prospectus

The First Wu Symposium on Manufacturing Science, USA Venue, has been organized to provide a forum for the presentation and discussion of basic and applied research in the field of manufacturing. It is dedicated to Professor S. M. (Sam) Wu [1924 - 1992] who devoted more than thirty years of his professional life to the introduction and refinement of innovative approaches to the design, analysis, optimization, and control of manufacturing processes and systems. Professor Wu's legacy of graduate education and research continues through all of those that he touched and mentored.

### Proceedings

A hard-bound proceeding, containing all of the papers presented during the symposium, including the keynote addresses, will be available at the symposium. All registrants will receive a copy of the proceedings of the Wu Symposium.

### Symposium Site

The symposium will be held in the Orrington Hotel adjacent to Northwestern University, Evanston, Illinois. Evanston is located on the shore of Lake Michigan about 12 miles North of downtown Chicago. Guest rooms will be available at the Orrington Hotel. Travel to the site is facilitated by the wide variety of air, road and rail arteries which converge in Chicago. Evanston provides an excellent selection of shops and restaurants, while all the delights of Chicago are within half an hour by car or public transportation.

### Social Events

The Wu Symposium will feature a banquet on Friday night with a special tribute to Professor Wu, a continental breakfast buffet on Saturday morning, and a lunch on Saturday with a featured speaker. All of the social events for the symposium will be co-sponsored by The Chrysler Corporation, Modern Engineering, Inc. of Troy, MI, and Perceptron, Inc. of Farmington Hills, MI.

### Registration Fees

The registration fee is \$150 for the full symposium, which includes a copy of the proceedings, the Friday banquet, continental breakfast on Saturday morning, Saturday lunch, and refreshment breaks. A \$50 registration fee is available to graduate students, which includes all of the privileges of the full registration, including all meals and a copy of the bound proceedings.

NAMRC XXII registrants may attend the Friday afternoon plenary session and Friday afternoon concurrent paper presentation sessions without registering for the Wu Symposium. Wu Symposium Banquet tickets may be separately purchased. The Wu Symposium Proceedings is available to all Wu Symposium registrants. Extra copies will be available for purchase.

## GENERAL INFORMATION (Both Events)

### Travel

Evanston is served by two major Chicago airports, O'Hare and Midway, which are about 15 miles and 25 miles away respectively. Cab, limousine and light rail service to Evanston is available from both airports. Cab companies based near Evanston which offer special flat rates to and from the airports are: Norshore Cab (phone 743 0066 at airport) and 303 Cab (phone 763 0303 at airport). All the major car rental companies also operate facilities at both O'Hare and Midway.

Northwestern University has negotiated a 7% reduced rate from any United Airlines published fare which is available if you make your flight reservations through American Express, our official travel service. Simply call American Express at 1-800-848-5010. Mention that you are attending the North American Manufacturing Research Conference (and/or Wu Symposium).

If traveling to Evanston by car, take the Dempster Street exit from either I-294 (Tri-State Tollway) or I-94 (Edens Expressway) and drive east into Evanston. Then take Chicago Avenue or Sheridan Road to reach the campus, or Chicago Avenue, Davis Street and Orrington Avenue to reach the Omni Orrington Hotel. A map is provided for your convenience.

### Hotel

The Omni Orrington Hotel, 1710 Orrington Avenue, Evanston, IL 60201, has been designated as the Conference Hotel. A block of rooms has been reserved for conferees. Rates are \$85 single, \$95 double, per night. Please make your reservation by calling 1-800-THE-OMNI (1-800-864-6664) or (708)-866-8700 prior to May 3, 1994. Mention that you are attending the North American Manufacturing Research Conference and/or the Wu Symposium.

### Parking

The Omni Orrington Hotel will provide valet parking for its guests at \$8 per day. Limited on-campus parking is also available at a cost of \$2.00 per day. Please inquire about this at registration.

### To Register

Fill out the attached registration form and:

MAIL to: Conference Registration, Center for Manufacturing Engineering,  
Northwestern University, 2145 Sheridan Road,  
Evanston, IL 60208-3111, USA.

or FAX to: Conference Registration, Center for Manufacturing Engineering,  
FAX Number (708) 491 - 4816

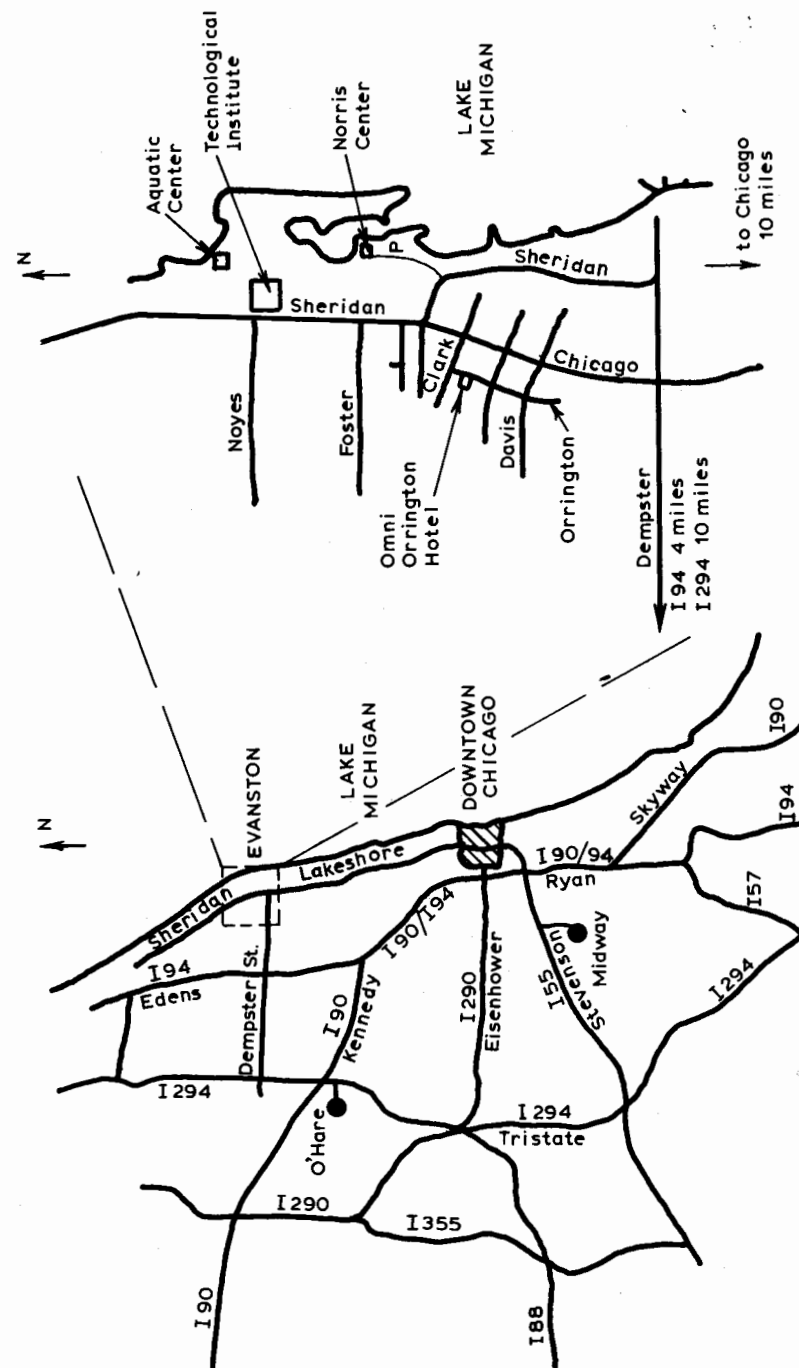
or PHONE: (708) 491 - 4814

Payment using a personal or corporate check is preferred but we will also be able to accept purchase orders, VISA or MasterCard.

### Further Information and Messages

If you need further information, or wish to send a message to someone attending the Conference, you can:

PHONE: (708) 491 - 4814  
FAX: (708) 491 - 4816  
or E-MAIL: NAMRC@PLATO.NWU.EDU



TWENTY SECOND NORTH AMERICAN  
MANUFACTURING RESEARCH  
CONFERENCE

NAMRC XXII  
May 25-27, 1994

1993-1994 NAMRI/SME  
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B. F. von Turkovich	University of Vermont
Klaus J. Weinmann	Michigan Technological University
William R.D. Wilson	Northwestern University

# NAMRC XXII TECHNICAL SESSIONS AND PROGRAM

## TUESDAY, MAY 24

05:00 - 07:00 **Registration and Reception** Orrington Hotel  
Heritage Room

07:00 - 08:00 **NAMRI/SME Board of Directors Dinner**  
Orrington Hotel  
Mulford Room

08:00 - 12:00 **NAMRI/SME Board of Directors Meeting**  
Orrington Hotel  
Mulford Room

## WEDNESDAY, MAY 25

07:30 - 08:30 **Registration and Continental Breakfast**  
Norris Center  
2nd Floor

08:30 - 10:00 **Opening Ceremony** Norris Center  
McCormick Auditorium

**Opening Remarks** W. R. D. WILSON, Co-Chair  
K. F. EHMANN, Co-Chair

**Welcoming Remarks** C. W. KERN, Vice President Research  
J. B. COHEN, Dean, McCormick School

**Introductory Remarks** R. E. DeVOR, NAMRI/SME President

09:30 - 10:00 **Keynote Address** Norris Center  
McCormick Auditorium

**Balancing Conflicting Demands**  
JAMES "JAY" WESLEY HOOK

**About our Keynote Speaker:** Jay Hook is currently a consultant to MascoTech Inc. and a visiting Professor at the McCormick School. Prior to this he was Group President at Masco Industries Inc. He has also worked for Rockwell International, Chrysler, the Cincinnati Reds and New York Mets.

10:00 - 10:30 **Coffee Break** Norris Center  
2nd Floor

## WEDNESDAY, MAY 25

10:30 - 12:00 **Three Concurrent Technical Sessions**  
Norris Center, Rooms as noted

**C1: MACHINING INNOVATIONS - 1** Room: 1 B/C

Co-Chairs: J. M. FILDES, Basic Industry Research Laboratory  
D. W. CHO, Pohang Institute of Science & Technology

**Development of a New Type of Magnetic Finishing Tool for Internal Finishing of Tubes Using Rotating Magnetic Field**, H. YAMAGUCHI and T. SHINMURA, Utsunomiya University, Japan.

**The Design of the Turn Milling Machine as a Function of the Process Dynamics and Accuracy** J. KOPAC, M. POGACNIK and S. DOLINSEK, Katedra Za Obdelovalno Tehniko, Slovenia.

**Titanium Ti32F Using JAM - A Way to Achieve High Productivity of Titanium Components for Transportation Products**, R.R. LINDEKE, F.C. SCHOENIG, JR., A. ATHERTON and M. CRIBB, Cleveland State University, OH.

**F1: METAL FORMING - 1** Room: 2 A

Co-Chairs: B. HOWSER, Steel Technologies Inc.  
S. R. SCHMID, University of Notre Dame

**Expert System for Multi-stage Cold Forging Process Design**, H. KIM, Korea Advanced Institute of Science & Technology, Korea, S. YOON, Seoul National University, Korea, and Y.T. IM, Korea Advanced Institute of Science & Technology, Korea.

**Preform Design in Forging Processes Using Nonlinear Finite Element Method**, G. ZHAO, E. WRIGHT and R. GRANDHI, Wright State University, OH.

**Development of a Practical Software Tool for the Design of Rolls for NNS Profile Rolling**, C.E. FISCHER and J.S. GUNASEKERA, Ohio University, OH.

**S1: PROCESS PLANNING - 1** Room: 2 G

Co-Chairs: J. I. MOU, National Institute of Standards and Technology  
A. BAGCHI, Clemson University

**PPS: An Integrated Process Planning System**, S.H. HUANG, J. MEI, H.C. ZHANG, Texas Tech University, TX, and S.R. RAY, National Institute of Standards & Technology, MD.

**An Integrated Approach of Revised Agglomerative Hierarchical Clustering and Neural Networks to the Design of Self-Adaptive Part Family Formation Systems**, S.C. SHIH, Auburn University, AL, and I. HAM, Pennsylvania State University, PA.

**Knowledge Based Generative CAPP Overcoming the Constraints of Part Families**, H.J. WARNECKE, H. DURR, A. WAUER and H. MUTHSAM, Universitat Zwickau, Germany.

**WEDNESDAY, MAY 25**

**12:00 - 13:30 Lunch**

Norris Center  
Lewis Room

**History of NAMRC**

Professor WILLIAM B. RICE, Queen's University

**13:30 - 15:10 Three Concurrent Technical Sessions**

Norris Center, Rooms as noted

**C2: MECHANICS OF CUTTING - 2**

Room: 1 B/C

Co-Chairs: **D. J. MASS**, National Center for Manufacturing Sciences  
**W. ENDRES**, University of Illinois at Urbana-Champaign

**A New Approach for Chip-form Characterization in Metal Machining**, J. FEI and I.S. JAWAHIR, University of Kentucky, KY.

**Modelling Chip Formation Along the Tool-Chip Interface in Machining**, X. LI, National University of Singapore, Singapore.

**Rotation of Shear Plane at Exit in Intermittent Cutting**, Z.Y. WANG, State University of New York-Binghamton, NY, C. SAHAY, Q. WU and Z.J. YUAN, Harbin Institute of Technology, China.

**The Importance of Considering Size Effect Along the Cutting Edge in Predicting the Effective Lead Angle for Turning**, W.J. ENDRES and D.J. WALDORF, University of Illinois at Urbana-Champaign, IL.

**S2A: SYSTEM DESIGN - 1**

Room: 2 A

Co-Chairs: **R. N. JOHNSON**, Basic Industry Research Laboratory  
**K. KIM**, University of Illinois - Chicago

**Feature Sequencing in the Rapid Design System Using a Genetic Algorithm**, S. LECLAIR and H. KAMHAWI, Wright Laboratory (AFMC), OH, and C.L. PHILIP CHEN, Wright State University, OH.

**Formalizing the Engineering Change Process for Concurrent Engineering of Printed Circuit Assembly: Mechanisms for Feeding Back Manufacturing Experience**, Y. JOO and R.R. BARTON, Pennsylvania State University, PA.

**A Symbolic and Computational Method for Design and Flat Pattern Development of Bifurcation, Trifurcation-Type Transition Surfaces**, R. VORUGANTI, Virginia Tech, VA, S.G. DHANDE, Indian Institute of Technology, India, and C.F. REINHOLTZ, Virginia Tech, VA.

**Operation-Driven Manufacturing Cell Design Methodology: Its Premises and Applications**, F. F. CHEN and S. R. SAGI, University of Southwestern Louisiana, LA.

**WEDNESDAY, MAY 25**

**13:30 - 15:10 Three Concurrent Technical Sessions (Continued)**

**S2B: PRECISION ENGINEERING - 1:  
ERROR COMPENSATION**

Room: 2 G

Co-Chairs: **J. W. GRANT**, Ford Motor Company  
**P. M. FERREIRA**, University of Illinois at Urbana-Champaign

**An Adaptive Prediction of Machining Accuracy in Turning Operation**, T. MATSUMURA, Tokyo Denki University, Japan, T. OBIKAWA and T. SHIRAKASHI, Tokyo Institute of Technology, Japan, and E. USUI, Tokyo Denki University, Japan.

**Error Link Metrology and Flexible Error Synthesis Model for Correcting Quasi-Static Machine Errors**, C.H. LO, J.X. YUAN and J. NI, University of Michigan, MI.

**Compensation Movements in 5-Axis Milling and Its Computational Solutions in CAM and/or CNC System**, G. YU, Swiss Federal Institute of Technology (ETH), Switzerland.

**An Error Correction Method for CNC Machine Tools Using Reference Parts**, J. MOU, University of Illinois-Chicago, IL.

**15:00 - 15:20 Coffee Break**

Norris Center  
2nd Floor

**15:30 - 17:00 Three Concurrent Technical Sessions**

Norris Center, Rooms as noted

**C3A: MACHINING INNOVATIONS - 2**

Room: 1 B/C

Co-Chairs: **D. STEPHENSON**, General Motors Corporation  
**J. SUTHERLAND**, Michigan Technological University

**Pulse Electrochemical Machining (PECM) of Ti-6Al-4V Alloy**, B. WEI, J. KOZAK and K.P. RAJURKAR, University of Nebraska-Lincoln, NE.

**Hot Machining In Retrospect and Review**, E.M. MIELNIK, University of Iowa, IA.

**Drilling and Reaming Aluminum Based Metal Matrix Composites (MMC) Using PCD Tooling**, R.T. COELHO, D.K. ASPINWALL and M.L.H. WISE, University of Birmingham, England.

## THURSDAY, MAY 26

10:00 - 10:30 Coffee Break

Norris Center  
2nd Floor

10:30 - 12:00 Three Concurrent Technical Sessions

Norris Center, rooms as noted

**C5: CUTTING TOOLS AND TOOLING**

Room: 1 B/C

Co-Chairs: R. C. REUTER, JR., Sandia National Laboratories  
S. Y. LIANG, Georgia Institute of Technology

**Machining Performance of Thin Film Diamond Coated Inserts on 390Al,**  
C.H. SHEN, General Motors Corporation.

**Modeling of Thermal Behavior for Diamond Coated Alumina Tool Inserts,**  
M. D. DIEHL, Martin-Marietta, and D.R. DURHAM, University of Vermont, NE.

**Wear of Diamond Tools in Ultra-Precision Machining of Of-Copper, Z.Y.**  
WANG and C. SAHAY, Binghamton University, NY.

**F5: DIE CASTING**

Room: 2 A

Co-Chairs: L. G. HECTOR, Alcoa Laboratories  
V. MALIN, Basic Industry Research Laboratory

**Application of Dynamic Viscoplastic Finite Element Method to Shot-  
Peening Process,** K. MORI and K. OSAKADA, Osaka University, Japan.

**Numerical Simulation of Cavity Filling and Its Influence on Wear in Die  
Castings,** K. VENKATESAN and R. SHIVPURI, Ohio State University, OH.

**Minimization of Entrained Gas Porosity in Aluminum Horizontal Cold  
Chamber Die Castings,** J.R. BREVICK, Ohio State University, OH, D.J.  
ARMENTROUT, Findlex Corp., OH, and Y.L. CHU, Ohio State University, OH.

**S5: QUALITY ASSURANCE**

Room: 2 G

Co-Chairs: J. HU, University of Michigan  
B. BAHR, Wichita State University

**A Process Model-Based Dual Off-line/On-line Methodology for Short Run  
Quality Control,** M.R. DeVRIES, R.E. DeVOR and S.G. KAPOOR, University of  
Illinois at Urbana-Champaign, IL.

**The Development of a Generic Total Productive Maintenance (TPM)  
System,** M.L. PHILPOTT, J.E. MCCONKEY, C.M. VESSSELL and T.A. GYAW,  
University of Illinois at Urbana-Champaign, IL.

**Loss Function Modeling of Time Variant Quality Characteristics,** S.  
VADREU, K. PHILLIPPS, J. SUTHERLAND and W. OLSON, Michigan  
Technological University, MI.

## THURSDAY, MAY 26

12:00 - 14:00 SME Awards Luncheon

Norris Center  
Lewis Room

13:30 - 15:10 Three Concurrent Technical Sessions

Norris Center, rooms as noted

**C6: MILLING OPERATIONS**

Room: 1 B/C

Co-Chairs: R. STANGO, Marquette University  
J. NI, University of Michigan

**Face Milling Process Modeling with Bearing Nonlinearity,** Y.C. SHIN and  
A.J. WATERS, Purdue University, IN.

**Geometrical Analysis of Flute Grinding and Application to End Mill,** S.L.  
KO, Korean Tungsten Co., Korea.

**The Effect of Identification of Chatter in the Audio Spectrum of Milling,** S.  
SMITH and W.R. WINFOUGH, University of Florida, FL.

**S6A: PRECISION ENGINEERING - 3:  
ERROR COMPENSATION**

Room: 2 G

Co-Chairs: M. MANI, North American Philips Corporation  
S. S. SPIEWAK, University of Wisconsin - Madison

**A Fraction Differential Equation Model for Polymer and Composite  
Material Robotic Structures,** M.J. POTVIN, J.C. PIEDBOEUF and J. JESWIET,  
Queen's University, Canada.

**Minimisation Pose Deviation of Industrial Robots by an Error  
Compensating Modelling and Simulation of the Kinematic Chain,** G.  
THATER and A. BEHRENS, Mercedes Benz AG, Germany.

**Compensation of Geometric and Quasi-Static Errors of a Multi-Axis  
Machine,** S.M. WANG and K.F. EHMANN, Northwestern University, IL.

**Automated Evaluation of Volumetric Errors of a Multi-Axis Machine,** S.M.  
WANG and K.F. EHMANN, Northwestern University, IL.

**S6B: SYSTEM SIMULATION**

Room: 2 A

Co-Chairs: T. S. BABIN, Motorola  
K. YAMAZAKI, University of California-Davis

**An Integrated Approach to Simulation, Control and Real-Time Diagnostic  
of Manufacturing Systems Based on Adaptive Augmented Timed Petri  
Nets,** O. MASORY, Florida Atlantic University, FL.

**An Activity Based Costing Interface to Manufacturing Simulation,** M.  
KRISHNAMURTHI and R. JAYASHANKAR, Northern Illinois University, IL, D.T.  
PHILLIPS, Texas A&M University, TX.

**Testing the Variance Homogeneity of the Machine Vision System's Gray  
Level Response,** C.C. WANG, C.C. CHEN, Northeastern University, MA.



## THURSDAY, MAY 26

- 15:30 - 17:00 **Laboratory Tour** Technological Institute
- 17:30 - 19:00 **Beach Party** Aquatics Center
- 19:00 - 20:00 **NAMRI/SME Membership Meeting**  
Technological Institute  
Lecture Room M351
- 20:00 - 21:00 **ASME Production / Manufacturing Division**  
Technological Institute  
Lecture Room M351

## FRIDAY, MAY 27

07:30 - 08:30 **Registration and Continental Breakfast**  
Norris Center  
2nd Floor

08:30 - 10:00 **Three Concurrent Technical Sessions**  
Norris Center, rooms as noted

### C7A: FINISHING PROCESSES Room: 2 A

Co-Chairs: N. SONTI, Pennsylvania State University  
K. NYAMEKYE, University of Missouri - Rolla

**Post-Finishing of Electrodischarge Machined Surfaces by Electrochemical Machining**, A.B. KHAIRY and Z. SADOLLAH, Sultan Qaboos University, Oman.

**The Effect of Tool Wear on the Wavelength Structure of a Turned Surface Profile**, J. RUNOLA, K. MOON, J. SUTHERLAND, Michigan Technological University, MI.

**Vision Parameters for Description of Machined Surfaces**, M. GUPTA and S. RAMAN, University of Oklahoma, OK.

### C7B: PROCESS CONTROL AND DYNAMICS Room: 2 G

Co-Chairs: J. RAJA, University of North Carolina - Charlotte  
S. SHEU, Alcoa Laboratories

**Adaptive Control of WEDM by On-Line Identifying Workpiece Height**, W.M. WANG and K.P. RAJURKAR, University of Nebraska-Lincoln, NE.

**Cylindricity Error Compensation in Diamond Turning via P-Integrator Repetitive Control**, S.Y. LI, Changsha Institute of Technology, Hunan, and C. J. LI, Rensselaer Polytechnic Institute, NY.

**Influence of Process Parameters on Change in Dynamic Behavior of the Workpiece in Lathe Turning**, K. KIM, Iowa State University, IA. and B.E. KLAMECKI, University of Minnesota, MN.

### S7: ASSEMBLY AUTOMATION Room: 1 B/C

Co-Chairs: S. WANG, Cornell University  
G. WIENS, Auburn University

**Shape Recognition by DDS Approach**, R. GUO, S.M. PANDIT, Michigan Technological University, MI.

**A Flexible Robotic Assembly System for Automated Disk Drive Manufacturing**, J. FUH and Y. ZHANG, National University of Singapore, Singapore.

**New Development of an Evaluation System of Assembly Sequences Based on Ease of Assembly**, B. JEONG and I. HAM, Pennsylvania State University, PA

## FRIDAY, MAY 27

10:00 - 10:30 Coffee Break

Norris Center  
2nd Floor

10:30 - 12:00 Three Concurrent Technical Sessions

Norris Center, rooms as noted

**C8: GRINDING**

Room: 1 B/C

Co-Chairs: **D. A. LUCCA**, Oklahoma State University  
**M. FUGELSO**, University of Minnesota - Duluth

**Computer Simulation for Creep-Feed Form Grinding**, N. CHIU and S. MALKIN, University of Massachusetts - Amherst, MA.

**Computer Simulation of 2D Internal and External Cylindrical Grinding**, Z. YAO and Y. LI, University of Connecticut, CT.

**Grinding Performance of Superabrasive Wheel Dressed by Gentle Wet Blasting**, H. Yagishita, Numazu College of Technology, Japan, and S. Kobayashi, Fuji Seiki Machine Works, Limited, Japan.

**F8: SHEET FORMING**

Room: 2 A

Co-Chairs: **D. KORZEKWA**, Los Alamos National Laboratory  
**D. LEE**, Rensselaer Polytechnic Institute

**Factors Affecting the Accuracy and Control of the Sheet Metal Forming Simulator**, P.K. SAHA and W.R.D. WILSON, Northwestern University, IL.

**On The Effects of Variable Blank Holder Force in Deep Drawing of Axisymmetric Parts**, Y. WANG and S. A. MAJLESSI, Michigan Technological University, MI.

**Tribo-characteristics of Galvanized Sheet Steel Evaluated by Strip-Ironing Type Tribometer**, K. DOHDA, S. KASHIWAYA, Z. WANG and M. NAOI, Gifu University, Japan.

**S8: MACHINE AND PROCESS MONITORING** Room: 2 G

Co-Chairs: **M. HASHISH**, Flow Research, Inc.  
**A. S. C. BOSE**, University of Texas Pan American

**Drill State Monitoring During Multispindle Machining**, A. SOKOLOWSKI and D.A. DORNFELD, University of California - Berkeley, CA.

**Real-Time Monitoring of AWJ Nozzle Wear Using Artificial Neural Network**, R. MOHAN, R. KOVACEVIC, and R. DAMARLA, University of Kentucky, KY.

**Using Neural Network and Kinematics for Machine Tools Error Monitoring and Correction**, J. MOU, University of Illinois - Chicago, IL.

## FRIDAY, MAY 27

12:00 - 13:30 Buffet Luncheon  
Joint with S.M. Wu Symposium

Orrington Hotel  
Heritage

Adjournment

NAMRC XXII registrants may attend the Friday afternoon plenary session and Friday afternoon concurrent paper presentation sessions without registering for the Wu Symposium. Wu Symposium Banquet tickets may be separately purchased. The Wu Symposium Proceedings is available to all Wu Symposium registrants. Extra copies will be available for purchase.



**FRIDAY, MAY 27**

**15:30 - 17:00 Three Concurrent Technical Sessions**

Orrington Hotel, rooms as noted

**FA - I: ON-LINE MONITORING AND CONTROL 1: Grand C  
PROCESS IMPROVEMENT**

Co-Chairs: Y. PANDELIDIS, The Gillette Company  
N. WEIL, National Center for Manufacturing Sciences

**Intelligent System for Cutting Parameter Optimization and Design of Cutting Process Monitoring Systems**, A. SOKOLOWSKI, and D. A. DORNFELD, University of California - Berkeley.

**A Model for Cutting Tool Load Simulation and Monitoring in Turning Operation**, J. E. STAHL, J. M. ZHOU, and M. ANDERSSON, Lund University.

**Monitoring of the Abrasive Flow Machining Process Using Acoustic Emission**, R. E. WILLIAMS, and K. P. RAJURKAR, University of Nebraska-Lincoln.

**Surface Topography Control in Single-Point Cutting**, C. WANG, M. S. HONG, and K. F. EHMANN, Northwestern University.

**FA - II: MEASUREMENT/ACCURACY 1: Evans II  
MACHINE-TOOL ERROR ANALYSIS**

Co-Chairs: G. ROMITO, Saginaw Machine Systems, Inc.  
C. S. SHEN, General Motors Corporation

**Quick Testing and Real-time Thermal Error Compensation of Thermally Induced Errors for CNC Machine Tools**, J. S. CHEN, and G. CHIOU, National Chung Cheng University.

**Optimal Modeling of Thermal Error Components for Machine Tool Error Compensation**, C. H. LO, J. X. YUAN, and J. NI, University of Michigan.

**Geometric Error Analysis of a Multi-Axis Machine Tool Machining Sculptured Surfaces**, J. H. CHO, and K. KIM, University of Illinois - Chicago.

**Some Thoughts and New Developments on Precision Machining**, K. K. WANG, Cornell University.

**FRIDAY, MAY 27**

**15:30 - 17:00 Three Concurrent Technical Sessions  
(Continued)**

**FA - III: MACHINING PROCESSES AND SYSTEMS 1: Mulford  
MACHINING DYNAMICS**

Co-Chairs: F. NASSIRPOUR, Learnstar, Inc.  
D. STEPHENSON, General Motors Corporation

**Design of Feedrate Profile for Constant Force Milling Involving Varying Workpiece Geometry**, Y. L. YAO, University of New South Wales, and X. D. FANG, University of Wollongong.

**Analysis of the Cutting Force System in Slot End Milling Operations**, S. N. MELKOTE, and W. J. ENDRES, University of Illinois at Urbana-Champaign.

**Analysis of the Multi-Cut Beveling Operation**, J. B. LIBRIZZI and J. A. RICE, University of Illinois - Chicago.

**Modeling and Monitoring Drill Bit Transverse Motions**, S. A. BASILE, Johns Hopkins University.

**18:00 - 19:00 Social Hour (Cash Bar)**

**19:00 - 20:00 Banquet Dinner** Heritage

**20:00 - 22:00 Banquet "Sam Wu Roast"** Heritage

D. A. DORNFELD, Master of Ceremonies  
Comments by Ph.D. students, colleagues, and friends of S. M. Wu

**SATURDAY, MAY 28**

**07:15 - 08:00 Continental Breakfast Buffet** Heritage

**08:00 -10:00 Three Concurrent Technical Sessions**  
Orrington Hotel, rooms as noted

**SM1-I: TOOLING AND TOOL DESIGN** Grand A

Co-Chairs: **M. F. DeVRIES**, University of Wisconsin - Madison  
**M. FUGELSO**, University of Minnesota - Duluth.

**Tool Wear in Mico-Machining of OF-Copper with Diamond Tools**, W. ZHIYONG, State University of New York - Binghamton.

**Development of Flexible Fixturing Technique in Manufacturing Industry**, Y. RONG, S. Li, and Y. BAI, Southern Illinois University - Carbondale.

**The Development of Continuum-Based Models of Machine-Tool Spindle Drive Shafts**, G. JIZHONG, Hefei University of Technology, and B. H. WILSON, Northeastern University.

**Further Improvement of Multifacet Drills**, J. L. WANG, J. SHA, and J. NI, University of Michigan.

**SM1-II: QUALITY DESIGN AND CONTROL 1: CONTEMPORARY CONCEPTS AND METHODS** Grand B

Co-Chairs: **T. N. GOH**, National University of Singapore  
**T. UNGPIYAKUL**, Kimberly-Clark

**Design and Analysis of Ultra-Reliable Systems**, M. R. MARTINEZ-HEATH, AT&T Bell Labs.

**Statistical Characterization and Analysis of Process Capability Indices**, S. GRAEFE and S. HORN, Technische Hochschule Darmstadt, and R. E. DEVOR, and S. G. KAPOOR, University of Illinois at Urbana-Champaign.

**Taguchi Approach for Reliability Engineering**, M. S. PHADKE, Phadke Associates.

**DOE, A Tool for Product Evaluation**, FARHAD TADAYON, Boeing Commercial Airplanes.

**How to Reduce Tooling Cost - A Study of Tool Replacement Strategies Using Taguchi's Quality Loss Function**, R. DU, University of Windsor.

**SATURDAY, MAY 28**

**08:00 -10:00 Three Concurrent Technical Sessions (Continued)**

**SM1-III: MACHINING PROCESSES AND SYSTEMS 1: PROCESS IMPROVEMENT** Grand C

Co-Chairs: **P. BANYOPADHYAY**, General Motors Corporation  
**S. OWUSU-OFORI**, North Carolina A&T University

**Influence of Cutting Conditions on Chatter Frequency of a Machining System**, Z. L. ZHANG, and K. F. EHMANN, Northwestern University.

**Machining Chatter Suppression by Means of Spindle Speed Variation, Part I: The numerical simulation**, H. ZHANG, H. SHI, and J. NI, University of Michigan.

**Machining Chatter Suppression by Means of Spindle Speed Variation, Part II: The experimental investigation**, H. ZHANG, H. SHI, and J. NI., University of Michigan.

**Application of Stochastic Geometry in Characterizing Random Phenomena in Material Removal Processes**, P. R. SHIRKEY, Z. J. PEI, and P. M. FERREIRA, University of Illinois at Urbana-Champaign.

**Thermal Aspects, Material Considerations and Cooling Strategies in Cryogenic Machining**, S. Y. HONG and Z. B. ZHAO, Wright State University.

**10:00 - 10:30 Refreshment Break**

**10:30 - 12:00 Three Concurrent Technical Sessions**  
Orrington Hotel, rooms as noted

**SM2 - I: ON-LINE MONITORING AND CONTROL: PROCESS IMPROVEMENT** Grand A

Co-Chairs: **W. A. KLINE**, Montronix, Inc.  
**C. WU**, Ford Motor Company

**On-line Evaluating Dynamic Machining Performance for Different Cutting Tools in Finish-Machining**, X. D. FANG, University of Wollongong, and Y. L. YAO, University of New South Wales.

**Integrating Vibration and Vision System for Monitoring Cutting Process**, BEHNAM BAHR and SAEID MOTAVALLI, Wichita State University.

**Characteristic Frequency Analysis for Tool Wear Monitoring**, H. PAN, Y. CHEN, and E. ORADY, University of Michigan - Dearborn.

**SATURDAY, MAY 28**

**10:30 - 12:00 Three Concurrent Technical Sessions  
(Continued)**

**On Line Metal Removing Process Control Using Neural Networks**, N. TARABISHY, B. BAHR, and J. STECK, Wichita State University.

**SM2 - II: MEASUREMENT/ACCURACY 2: Grand B  
CMM TECHNOLOGIES**

Co-Chairs: **D. CARLSON**, Perceptron, Inc.  
**G. GARZON**, Eastman-Kodak

**An Optimization Strategy for Maximizing Coordinate Measuring Machine Productivity: Part I: Quantifying the Effects of Operating Speed on Measurement Quality**, S. D. JONES and C. L. WU, Ford Motor Co., and A. G. ULSOY, University of Michigan.

**An Optimization Strategy for Maximizing Coordinate Measuring Machine Productivity: Part II: Problem Formulation, Solution and Experimental Results**, S. D. JONES, and C. L. WU, Ford Motor Company, and A. G. ULSOY, University of Michigan.

**Compensation of Measuring Machines in Real Time**, J. A. BOSCH, Giddings & Lewis.

**The Automated Nonlinear Calibration of Machine Vision Systems For Dimensional Measurement**, I. N. TANSEL, W. LI, E. PAZ, and C. LEVY, Florida International University, and B. HIMMEL, and D. BOARD, DME Corporation.

**SM2 - III: MANUFACTURING PROCESSES 1: Grand C  
MATHEMATICAL MODELING**

Co-Chairs: **W. R. DeVRIES**, Rensselaer Polytechnic Institute  
**W. R.D. WILSON**, Northwestern University

**Modeling of Thin-Walled Tube Bending at Large Deformations**, H. Z. Li, R. FAGERSON, and K. A. STELSON, University of Minnesota.

**On the Plastic Deformation of a Tube During Bending**, K. PAN, and K. STELSON, University of Minnesota.

**A Parallel Approach for Inverse Kinematics of a Redundant Robot Using a Transputer Network**, J-S. FANG, and S. C. BOSE, University of Texas - Pan American.

**Crack-Tip Equation of Motion Due to Non-Uniform Residual Stresses in a Weldment**, C-K. FANG, E. KANNATEY-ASIBU, JR., and J. R. BARBER, University of Michigan.

**SATURDAY, MAY 28**

**12:00 - 13:00 Lunch**

**Heritage**

Speaker: **D. CARLSON**, Perceptron, Inc.,  
**Industry-University Collaborative Research Relations**

**13:00 - 15:00 Three Concurrent Technical Sessions**  
Orrington Hotel, rooms as noted

**SA1 - I: MANUFACTURING PROCESSES 2: Grand A  
STATISTICAL MODELS/TIME SERIES**

Co-Chairs: **H. CHAO**, Consolidated Paper Co.  
**B. CHU**, Electric Power Research Institute

**Precision Surface Characterization via 2-D Spectral Analysis**, E. J. SALISBURY, K. S. MOON, and J. W. SUTHERLAND, Michigan Technological University.

**Use and Abuse of Linear Regression Analysis in Machine Vision System Calibrations**, S. J. DEUTSCH, and C. C. WANG, Northeastern University.

**On-Line DDS Modeling for a Piecewise Stationary Process**, J. SHI, Z-G. HUANG, and J. NI, University of Michigan.

**Extensions to Modeling Capabilities of Autoregressive-Moving Average Model Forms**, S. J. DEUTSCH, Northeastern University.

**Reliability Measure Estimation for Repairable Systems with Non-Constant Failure Rate**, Y. CHEN, University of Michigan - Dearborn.

**SA1 - II: CAD/GEOMETRIC MODELING Grand B**

Co-Chairs: **A. HUANG**, Max Group Corporation  
**S. G. KAPOOR**, University of Illinois at Urbana-Champaign

**Blend Surface with the Flexible Shape and GC Continuity for CAD/CAM**, H-K. LEE, and G. E. YANG, Chonbuk National University.

**Parametric Investigation of Plastic Snap Fastener Design**, J. E. RENAUD and P. KAR, University of Notre Dame.

**Optimal Fitting of Objects Based on Dense-Range Images - A Planning Approach Assisted by Local and Global Measurement Matching**, E. ZUSSMAN, H. SCHULER, and G. SELIGER, Technical University of Berlin.

**The Rebuilding of Free-Form Surface with Neural Network Method and Continuous Tracing**, K-H. FUH, T-H. LIOU, and Y-H. HSYU, Tatung Institute of Technology.

**About the New Type of Metal-Cutting Tool Partial Motions in NC Machining of Sculptured Part Surfaces**, S. P. RADZEVITCH, Dneprodzerzhinsk Industrial Institute, Ukraine.

**SATURDAY, MAY 28**

**13:00 - 15:00 Three Concurrent Technical Sessions  
(Continued)**

**SA1 - III: QUALITY DESIGN AND CONTROL 2: Grand C  
TOLERANCES AND ASSEMBLY ISSUES**

Co-Chairs: **R. E. DeVOR**, University of Illinois at Urbana-Champaign  
**J. W. SUTHERLAND**, Michigan Technological University

**On the Use of Principal Components for Manufacturing Tolerance Design and Control**, T.-D. CHOU, Marquette Electronics, and T.-H. CHANG, University of Wisconsin-Milwaukee.

**Variance Minimization In Selective Assembly**, W. A. BEREZOWITZ, General Electric Medical Systems, and T.-H. CHANG, University of Wisconsin - Milwaukee.

**Process Navigator for Automobile Body Assembly Process**, J. SHI, and S. J. HU, University of Michigan.

**Variation Stack-up for Deformable Sheet Metal Assembly - One Dimensional Models**, C. S. LIU, and S. J. HU, University of Michigan.

**An Adaptive Assembly System for Automotive Applications**, Z. J. PASEK, S. M. WU, and A. G. ULROY, University of Michigan.

**15:00 - 15:30 Refreshment Break**

**15:30 - 17:00 Two Concurrent Technical Sessions**  
Orrington Hotel, rooms as noted

**SA2 - I: MANUFACTURING PROCESSES 3: Grand A  
DESIGN AND ANALYSIS ISSUES**

Co-Chairs: **T. S. BABIN**, Motorola, Inc.  
**W. J. ZDEBLICK**, Institute for Advanced Manufacturing Sciences

**Optimization in Cutting**, N. N. SMIRNOV, Volgograd Construction Institute.

**Concurrent Engineering and the Environment**, S. VADREU, K. K. PHILLIPS, J. W. SUTHERLAND, and W. W. OLSON, Michigan Technological University.

**Adaptive Optimization of Face Milling Operations Using Neural Networks**, T. J. KO, and D. W. CHO, Pohang Institute of Science and Technology.

**Micro-Tool Inspection by Following the Laser Beam Reflection and the Abductory Induction Mechanism (AIM)**, I. N. TANSEL, M. TRUJILLO, and C. LEVY, Florida International University, and B. HIMMEL and D. BOARD, DME Corporation.

**SATURDAY, MAY 28**

**15:30 - 17:00 Two Concurrent Technical Sessions  
(Continued)**

**SA2 - II: ON-LINE MONITORING AND CONTROL 3: Grand B  
CONTROLLER DESIGN AND ANALYSIS**

Co-Chairs: **C. H. SHIOU**, Weltronics, Inc.  
**S. SPIEWAK**, University of Wisconsin - Madison

**Robust Control System for High Speed Motion Drives**, R. D. HAYES, Y. C. SHIN, and O.D.I. NWOKAH, Purdue University.

**Cutting Force Regulation by Using an Adaptive Servocontroller**, J. KIM, and T.-Y. KIM, Seoul National University.

**Gain Scheduling Centralized Controller Design for a Spindle Unit Supported by Magnetic Bearings**, J. KIM, and D. SHIN, Seoul National University.

**Hierarchical Direct Neural Network Learning Controller for Trajectory Tracking of Robots**, N. W. CHBAT, and C. J. LI, Columbia University.

**Adjournment**

**Registration Form: NAMRC XXII, May 25-27, 1994 and/or  
S. M. Wu Symposium, May 27-28, 1994.**

*Duplicate this form for additional registrations. Please print or type.*

Dr. Mr. Ms. First Name \_\_\_\_\_ Last Name \_\_\_\_\_  
Organization \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Postal Code \_\_\_\_\_  
Country \_\_\_\_\_  
Phone (\_\_\_\_) \_\_\_\_\_ FAX (\_\_\_\_) \_\_\_\_\_  
Special Meal Requirements \_\_\_\_\_

**NAMRC XXII, May 25-27, 1994.**

\_\_\_\_\_ \$315 Full registration postmarked, faxed or phoned on or before  
May 13.  
\_\_\_\_\_ \$340 Full registration after May 13.  
\_\_\_\_\_ \$75 Student or retiree registration.

*Above registrations include all NAMRC meals and one copy of Transactions.*

\_\_\_\_\_ \$185 One day registration for \_\_\_\_\_ (give day),  
includes meals for day and one copy of Transactions.  
\_\_\_\_\_ \$17 Guest lunch ticket for Wednesday May 25.  
\_\_\_\_\_ \$55 Guest banquet ticket for Wednesday May 25.  
\_\_\_\_\_ \$17 Guest lunch ticket for Thursday May 26.  
\_\_\_\_\_ \$25 Guest beach party ticket for Thursday May 25.  
\_\_\_\_\_ \$20 Guest lunch ticket for Friday May 27.  
Guest name(s) \_\_\_\_\_  
\_\_\_\_\_ \$70 Accompanying person program  
Accompanying person name(s) \_\_\_\_\_

**Note:** The NAMRC lunch on Friday May 27 will be held jointly with the Wu Symposium. Registrants of either NAMRC or the Wu Symposium may attend. NAMRC registrants may also attend the sessions of the Wu Symposium to be held on the afternoon of Friday May 27, at no additional charge, and/or purchase a ticket to the Wu Symposium Banquet to be held on the evening of Friday May 27.

**S.M. Wu Symposium, May 27-28, 1994.**

\_\_\_\_\_ \$150 Full registration.  
\_\_\_\_\_ \$50 Student or retiree registration.

*Above registrations include all Symposium meals and one copy of Proceedings.*

\_\_\_\_\_ \$30 Guest banquet ticket for Friday May 27.  
Guest name(s) \_\_\_\_\_

\_\_\_\_\_ **TOTAL PAYMENT (U. S. Dollars)**

Check enclosed \_\_\_\_\_ (preferred) Will pay at conference \_\_\_\_\_  
Charge: \_\_\_\_\_ MasterCard or \_\_\_\_\_ Visa , Card # \_\_\_\_\_  
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