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Assistant Professor Margaret S. Wooldridge uses the laser pictured above in her particle research, as seen on the cover and page 27.
Although Ann Arbor is home to many faculty and students in the Department of Mechanical Engineering and Applied Mechanics (MEAM) at the University of Michigan (U-M), Detroit Metro Airport is often a second home of sorts. Whether it’s national awards, keynote and plenary lectures at international destinations, service on advisory committees, involvement in start-up companies, global teaching assignments, consulting engagements, or research collaborations worldwide, the members of our academic community are constantly in demand and constantly on the go.

Their activities, in turn, help make Ann Arbor a world center for new directions in mechanical engineering; a center that last year attracted over 1,000 VIP visitors—including CEOs, presidents, vice presidents, government officials, and deans—from the world over to our Department. During the past academic year, MEAM faculty also organized four major national conferences, each of which attracted hundreds of participants to the Ann Arbor area during the summer of 2000. In this 1999–2000 Annual Report for the Department, which covers a time frame extending from May 1 of 1999 through April 30 of 2000, we highlight some of the many national and international activities that demonstrate the innovative, high-impact leadership of our faculty and students.

In recent years, mechanical engineering has been redefining itself in ways that are simply amazing. As you look through this report, you will read about the synthesis of nanoparticles, compliant mechanisms for micro-electromechanical systems (MEMS), self-assembly of MEMS devices, “active velcro” for docking satellites, cochlear implants for the hearing impaired, and the mechanics of fibrous materials in sea urchins. Even in the traditional mechanical engineering domains, things are quite different from what they once were. Cars are hybrid electric, powered by fuel cells and with computer-vision based co-pilots. Machine tools use laser-beams for
material processing, are designed to be reconfigurable and have smart tooling with embedded lasers for high-precision.

It is definitely an exciting time to be a mechanical engineer and, in this report, we’re proud to share some of the remarkable advances that are originating in our Department. In keeping with this ongoing redefinition of the field, the Department will change its name from Mechanical Engineering and Applied Mechanics to simply Mechanical Engineering, effective July 1, 2000.

The 1999–2000 Academic Year was marked by important and noteworthy changes within the faculty. We welcomed six new faculty members, all of whom are introduced in this report, and we bid farewell to Vennema Professor of Engineering Albert B. Schultz who retired after 40 years of world leadership in biomechanics. Former Department Chair Panos Y. Papalambros was appointed to an endowed chair professorship established recently by one of our outstanding alumni, Donald C. Graham (BSE ’55, MSE ’56). You will find that story on page 28, as well as on page 15, along with features on other distinguished graduates such as MIT President Charles M. Vest (MSE ’64, PhD ’67), in a special section devoted to alumni achievements.

In this Annual Report you will also find a variety of other information regarding our activities. Please note that during 1999–2000, undergraduate and graduate enrollments and degrees awarded both increased slightly, as did our research expenditures. Also, in this past year more undergraduates matriculated than ever before in the Department’s history.

As you read this year’s report, I feel that you cannot help but be impressed with the creativity and innovation of the faculty and students within the Department, and with the national and international leadership they provide in mechanical engineering education and research. Please enjoy!

—A. Galip Ulsoy, MEAM Department Chair
New Global Product Development Course Introduced

As manufacturing operations become increasingly global, students must have a working knowledge of environmental issues, trade regulations and rules governing intellectual property. They must also be able to work comfortably and effectively within multicultural teams.

To help prepare the next generation of technical leaders in design and manufacturing, Associate Professor Debasish (Deba) Dutta is working with colleagues at the Technical University of Delft in The Netherlands and Seoul National University in Korea to develop a new graduate-level course. Beginning in the fall of 2000, Global Product Development will be co-taught by professors from all three universities and will be offered simultaneously to students on each campus.

In this project-based course, as Professor Dutta explains, “international student teams will develop a global product which will then be customized for local markets. During the semester, the student teams will work remotely via the Internet and video conferencing. Final presentations and prototypes will be judged by a jury of three professors and three industry representatives.” The site of final presentations will be rotated among the three participating institutions, with University of Michigan (U-M) hosting the first event at the end of Fall Term 2000.

Reconfigurable Manufacturing Named Top Priority

Two major national reports have recognized manufacturing and reconfigurability as critical technologies for the future. In a report commissioned by Congress and entitled New Forces at Work: Industry Views Critical Technologies, the Office of Science and Technology Policy (OSTP) cited advanced manufacturing technologies as being of great concern across all industry sectors.

In addition, Professor Yoram Koren, Director of MEAM’s National Science Foundation (NSF) Engineering Research Center for Reconfigurable Machining Systems (ERC/RMS), participated in a study conducted by the National Research Council (NRC), the operating agency of the National Academy of Sciences (NAS). The group’s final report, Visionary Manufacturing Challenges for 2020, offers six grand manufacturing challenges, one of which is Reconfigurable Enterprises, and ranks reconfigurable manufacturing systems as the top priority among all emerging manufacturing technologies.

“The NRC report is based on a Delphi study,” Professor Koren explains. “The final outcome is refined in multiple rounds of questionnaires sent to over 1,000 experts worldwide. Reconfigurability was not even mentioned in the first round of the survey. After I submitted it as a critical technology, it caught fire, and in the end reconfigurable manufacturing systems and their theoretical foundations were ranked priority number one.”

This multimedia classroom, one of two such facilities located in the Chrysler Center and operated by the Center for Professional Development (CPD), is specially equipped to accommodate distance learning, teleconferences, and continuing education courses.
Ceccio Recruited to Defense Science Study Group

Every two years, the Institute for Defense Analysis (IDA) solicits nominations from major universities and government agencies for membership in the Defense Science Study Group (DSSG), an organization that seeks to develop links between the national security community and young, emerging leaders in science and technology. Associate Chair Steven L. Ceccio was one of 15 individuals accepted into the DSSG class of 2000–02. As part of the program, Ceccio will visit military installations around the country, meet with senior commanders, tour defense laboratories and industrial facilities, and help prepare studies on national security issues. DSSG alumni have continued opportunities for involvement with the Department of Defense (DoD), serving as advisors, consultants, and members of boards, study groups, and task forces that address technological issues of national significance.

Innovation and Impact

The Annual Rankings Are In...

In April of this year, U.S. News & World Report issued its annual guide to America’s best graduate schools. Among the nation’s 219 graduate engineering programs, the University of Michigan (U-M) occupied the #4 slot. This marks the third year in a row that the College of Engineering (CoE) has been ranked in the top five. Also, within the category of specialty engineering programs, Mechanical Engineering was rated #5 by engineering school deans. (The Department has ranked among the top five since 1996.) As Robert J. Vlasic Dean of Engineering Stephen W. Director noted, “Overall, according to these rankings, the College remains extremely strong, and we can all take great pride in what we have been able to accomplish.”
MECHANICAL ENGINEERING STUDENT LEADER BOARD (MESLB)

Academic Year 1999–00 (F99 and W00)

Frederick Barrigar (SAE)
Stacey Durham (ASME)
Mari Endo (ASME)
Michael Forbis (ASME)
Timothy Jacobs (GRIME)
Jonathan Keener (ΠΤΣ/PTS; MEAM Planning Committee Representative)
Kristalyn Mack (UMME)
Kristin Miller (ΠΤΣ/PTS)
Tiffany Miller (SAE)
Julie A. Reyer (GRIME)

STUDENT LEADERS

May 1, 1999–April 30, 2000 (Sp/Smr99, F99 and W00)

Eren Anlar
Pi Tau Sigma (ΠΤΣ/PTS) Initiate of the Term (W00).

Frederick Barrigar
President (F99), Epeians Leadership Honor Society; CoE Distinguished Leadership Award (99–00); Special CoE award in appreciation of his outstanding service and commitment to the CoE and U-M; Mechanical Engineering and Applied Mechanics (MEAM) Marshall, Winter Term Commencement.

Sara Bernal
Secretary (99–00), Society of Hispanic Professional Engineers (SHPE).

National Society of Black Engineers (NSBE) Benefits from MEAM Student Leadership

MEAM senior Jason Morris has been named National Business Diversity Chair for the National Society of Black Engineers (NSBE). This is not the first time that Morris has filled a leadership slot within the organization. Since joining NSBE in 1996, he has served as regional and, more recently, national Finance Chair, working directly with the organization’s many corporate supporters. As National Business Diversity Chair, he is responsible for expanding the opportunities for contact between corporate affiliates and student members, identifying new venues for students to network, learn, and access entrepreneurial concepts.

As Jason is quick to point out, “The College of Engineering (CoE) has strong ties to NSBE through its membership as well as a long tradition of supplying student leaders to the organization.” He goes on to note that Michigan engineering students and alumni currently hold a variety of regional and national leadership positions. Established in 1976, NSBE is an international student- and professional-based organization dedicated to increasing the number of culturally responsible black engineers who excel academically, succeed professionally, and positively impact the community. With over 10,000 members, the organization maintains an active presence in Canada, the U.S., Jamaica, and Ghana.

Jason Morris, ME undergraduate and National Business Diversity Chair for NSBE, greets Assistant Professor Kazuhiro (Kazu) Saitou, one of many guests attending a Unified Minority Mechanical Engineers (UMME) faculty/staff/student mixer.
LEADERSHIP: STUDENT NEWS

Sunny News from Down Under

Although engineering students engage in any number of annual design competitions, the World Solar Challenge is probably the best known and most anticipated of all competitive events. The 1999 race was held from November 17 through 26 in Australia, along a grueling 3,100 km (1,800+ miles) course that traversed the country north to south, beginning in Darwin and finishing in Adelaide. The U-M entry, MaizeBlaze, finished ninth in a field of 40, just six hours behind the lead vehicle.

Although the prospect of funding, designing, building, transporting, and racing a solar car attracts students from a wide range of disciplines and departments, MEAM is always well represented. This past year was no exception. Vik Sahney, one of two drivers, also assisted with design, manufacturing and testing. Joining him were Heather Nettle, responsible for the car’s solar array; Hiroumi Kitajima (BSE ’00), in charge of Australian logistics; Nader Shwayhat, head of operations and new team leader for 2001; and Sean Kennedy, Web master, photographer, and semi-trailer construction assistant.

According to team leader Jed Christiansen, “To take ninth place against international teams with funding in the multi-million-dollar range is amazing. We also finished just hours away from first place, when usually the top three are separated by days. All five of our mechanical engineers were very involved in making this happen.”

Diversity of Program Enrollment

as a percentage of total population

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<th>Undergraduates</th>
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<td>Under Represented Minorities</td>
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Dual degree candidate Hiroumi Kitajima was one of the speakers at a CoE reception held in Wilson Student Project Center to celebrate the achievements of the MaizeBlue solar car team.

Sandhya Clarke
Pi Tau Sigma (ΠΤΣ/PTS) Initiate of the Term (F99).

Aimée Constantine
CoE Distinguished Leadership Award.

Vinay A. D’Souza
Treasurer (F99), American Society of Mechanical Engineers (ASME).

Stacey Durham
Secretary (F99), University of Michigan Engineering Council (UMEC).

Carlin Early
Secretary (99–00), Unified Minority Mechanical Engineers (UMME).

Mari Endo
Internal Vice President (F99), University of Michigan Engineering Council (UMEC).

Michael Farina
CoE Distinguished Leadership Award (MEAM).

David Fedewa
Secretary (99–00), Society of Manufacturing Engineers (SME).

Michael Forbis
President (99–00), American Society of Mechanical Engineers (ASME).

Robert Gifford
Secretary (99–00), Society of Automotive Engineers (SAE).

Ronald Gifford
Coordinator, MEAM Detroit Area Pre-College Engineering Program.

Jennifer Gruits
Secretary of Affairs (W00), Pi Tau Sigma (ΠΤΣ/PTS).

Doria Hickman
Vice Chair (99–00), National Society of Black Engineers (NSBE) Regional Executive Board.

Mahmoud Hussein
President (99–00), U-M Egyptian Student Association.

Ekenem Isichei

Ami Kapadia
Vice President (99–00), Society of Automotive Engineers (SAE).

Samir Karamchandani
Representative for Pi Tau Sigma (ΠΤΣ/PTS) (W00), University of Michigan Engineering Council (UMEC).

Jonathan Keener
President (F99), Pi Tau Sigma (ΠΤΣ/PTS); Representative (99–00), MEAM Planning Committee; CoE Distinguished Leadership Award.

Ryan Kennel
Co-Secretary (F99), Vice President (W00), Pi Tau Sigma (ΠΤΣ/PTS).

Dual degree candidate Hiroumi Kitajima was one of the speakers at a CoE reception held in Wilson Student Project Center to celebrate the achievements of the MaizeBlue solar car team.
Several years ago, with funding from the W.K. Kellogg Foundation, student members of the Pi Rho (ΠΡ) chapter of Pi Tau Sigma (ΠΤΣ/PTS), the national mechanical engineering honor society, established the Program for Community Engagement in Engineering Design (ProCEED). Every semester, ProCEED contacts community service and nonprofit agencies throughout the region, seeking out service projects of a technical or engineering nature. Members of ProCEED then confer with engineering course instructors, who may assign students to work on a specific project.

In November of 1999, the Edward Ginsberg Center for Community Service and Learning awarded the organization a grant of $2,000 to be used for expanding the work of ProCEED into other departments of the College. In the Winter 2000 Term, student representatives made presentations to faculty members in the fields of mechanical, electrical, and civil engineering.

On a related note, Pi Tau Sigma won the Most Outstanding Chapter Award at the PTS National Convention, held in Georgia during the Fall 1999 Term.

ME450 students (l.–r.) Melinda Ball, Adam Silver, Amy Ladwig, and Craig Williams designed and built an adjustable-height garden for seniors and children at Ann Arbor’s Jewish Community Center. The project was sponsored by ProCEED.

Larry Mercier Secretary (W00), Epeians Leadership Honor Society.

Kristin Miller Vice President (F99), President (W00), Pi Tau Sigma (ΠΤΣ/PTS).

Tiffany Miller President (99–00), Society of Automotive Engineers (SAE).

Jason Morris National Finance Chair (99–00), National Society of Black Engineers (NSBE); Representative for Unified Minority Mechanical Engineers (UMME) (99–00), University of Michigan Engineering Council (UMEC); CoE Distinguished Leadership Award.

Cynthia Phillips Secretary of Affairs (F99), Pi Tau Sigma (ΠΤΣ/PTS).

David Joseph Piech Representative for Pi Tau Sigma (ΠΤΣ/PTS) (F99), University of Michigan Engineering Council (UMEC).

Carrie Presdorf Vice President (F99), American Society of Mechanical Engineers (ASME).

Julie A. Reyer The Spirit of Martin Luther King, Jr. (MLK) Student Recognition Award.

Jeffrey Roselli CoE Distinguished Leadership Award.

Julie Sanchez External Vice President (F99), University of Michigan Engineering Council (UMEC).

Jeff Sawka Chair (99–00), Society of Manufacturing Engineers (SME).

Brett Thompson Treasurer (99–00), Unified Minority Mechanical Engineers (UMME).

Adam Weber Treasurer (W00), Pi Tau Sigma (ΠΤΣ/PTS).
American Society of Mechanical Engineers (ASME) Board on Engineering Education—John and Elsa Gracik Scholarship
Vinay D’Souza

Garland Duncan Scholarship
Anastasios John Hart

BP Amoco Foundation Inc.—Outstanding Student Scholarship
Brock Partee

Scholarships
Bobby Johnson
Nkechiye Okwumabua
Jason Twymon

David Aspland Scholarships
Regina Bousson
Arthur Geldres
Matthew Middleton

William E. Bandemer Scholarships
Stephen Kim
Jason Kline
Nkechiye Okwumabua
Ariel Schuger

Charles F. Barth, Jr. Prize
Elena Marin

George H. Benzenberg Scholarship
Brian McMillion

Joseph Boyer Scholarships
William Kasiske
Holly Mann

J.A. Bursley Prize
Jonathan Weinert

Robert M. Caddell Memorial Awards—Undergraduate Scholarship
Anastasios John Hart

Darl F. and Lorene O. Caris—Dean’s Scholar Awards
Dawn O’Sullivan
David Vander Werp

CoE Class of 1912E Memorial Scholarship
Raymond Zondervan

CoE Class of 1931E Scholarships
Patrick Goleski
Anastasios John Hart
Crystal Komak
Andrew Leutheuser
Katharine Polasek

CoE Class of 1934E Scholarship
James Henahan

CoE Class of 1939E Scholarships
Christopher Grimmer
Samir R. Karamchandani

CoE Distinguished Achievement Award
Anastasios John Hart

Lawrence D. Corlett Scholarships
Andrew Ickes
Jean Kang
Ryan Shea
William Shurtliff
Erin Worrell

Harland P. Dodge and Russell A. Dodge Memorial Scholarship Fund
Sterling Imfeld

Cornelius and Margaret Donovan Scholarships
Kenneth Fleck
Kendra Lohmeyer
Peggie Sayre

Dow Chemical Scholarships
Samir R. Karamchandani
Joseph Klamo
Elena Marin
Jason Mayol
Nicholas Post
Aleta Sutterfield

Richard Earhart Scholarships
Sara Bernal
Robert Billington
Alan Fortunate
Elizabeth Oatley
Ryan Schrieber

James M. Edmunds Scholarship Fund
Margaret McArthur

John P. and Nora B. Everett Recognition Fund
Kevin Clements

Alvah B. and Salome K. Frederick Scholarship
Matthew Weber

James W. Freeman Memorial Scholarship Fund
Karmen N. Lappo
Mechanical Engineering Students Flying High... with NASA

Earlier this year, a team of CoE undergraduates became the first people in the world to create carbon nanotubes in zero gravity. The group included two MEAM undergraduate students, James Karlavage and Julie Stahmer, as well as Aerospace Engineering (AeroE) students Erik and Kristian Waldorff and Edward A. Van Cise, who served as project manager. In November of 1999, the team submitted a proposal to the Texas Space Grant Consortium to fly an experiment on National Aeronautics and Space Administration (NASA)’s KC-135A reduced gravity aircraft. The consortium administers the NASA Reduced Gravity Student Flight Opportunities (RGSFO) Program, which enables undergraduates to gain real-world engineering research experience.

In early March, the experiment was flown from the NASA Johnson Space Center in Houston, Texas, with Karlavage and Stahmer on board. For details, visit the group’s Web site at http://aoss.engineering.umich.edu/umseds/kc135/nanotubes.

These samples, collected at the end of the second day of flight, prove the team’s success in producing microgravity nanotubes. This image was photographed through a Scanning Electron Microscope.
GRADUATE STUDENT FELLOWSHIPS AND AWARDS
F99 and/or W00

American Society for Engineering Education (ASEE), Student Chapter—Outstanding Graduate Student Instructor Award
Mahmoud Hussein

Robert M. Caddell Memorial Awards—Graduate Student Research Achievement Award
Qingda Yang

CoE Distinguished Achievement Award (MEAM)
Shiyu Zhou

CoE Fellowships—Dwight F. Benton Fellowships
Leslie Berhan
Michael Donovan
David Hall
Brian Jensen

Lawrence D. Corlett Fellowships
Jeremy Michalek
Andrew Sievers

Regents’ Fellowships
Gregory Aloe
Jarrod Beglinger
William Cook

DeVlieg Fellowship
Jeremy Michalek

James A. and Hazel Lee Hughes Fellowship
David Hall

Society of Women Engineers (SWE) Awards—
Lucent Scholarship
Ami Shah
Motorola Scholarship
Brianna Thomson

Outstanding Junior SWE Member Award
Tiffany Viant

Pratt and Whitney Scholarship
Amy Derault

Senior Service to SWE Award
Diana Bitleris

Jane Morris Soop Engineering Scholarships
Aimée Constantine
Bernard Drew

Matthew J. Spence, Jr. and Sarah Patterson Spence Scholarship Fund
Jason Gauss

Tau Beta Pi (ΤΒΠ/TBP) National Chapter Fellowship
Suzanne Volkman

Frank H. and Matilda M. Tranzow Scholarship Fund
Kevin Kwiatkowski

Pearl Wheeler Scholarship in Engineering
Ryan Majkrzak

GRADUATE STUDENT FELLOWSHIPS AND AWARDS
F99 and/or W00

American Society for Engineering Education (ASEE), Student Chapter—Outstanding Graduate Student Instructor Award

Robert M. Caddell Memorial Awards—Graduate Student Research Achievement Award

CoE Distinguished Achievement Award (MEAM)

CoE Fellowships—Dwight F. Benton Fellowships

Lawrence D. Corlett Fellowships

Regents’ Fellowships

DeVlieg Fellowship

James A. and Hazel Lee Hughes Fellowship

Society of Women Engineers (SWE) Awards—

Lucent Scholarship

Motorola Scholarship

Outstanding Junior SWE Member Award

Pratt and Whitney Scholarship

Senior Service to SWE Award

Jane Morris Soop Engineering Scholarships

Matthew J. Spence, Jr. and Sarah Patterson Spence Scholarship Fund

Tau Beta Pi (ΤΒΠ/TBP) National Chapter Fellowship

Frank H. and Matilda M. Tranzow Scholarship Fund

Pearl Wheeler Scholarship in Engineering
Bartlett Matched Field Processor output for measurements from four microphones and a $10^{-5}$ cm$^3$/s leak. Combining these results determines a single, unambiguous leak location. Read more about Associate Professor David R. Dowling and doctoral student Serdar Yönak’s research below.

National Aeronautics and Space Administration (NASA) Graduate Student Researchers Program Award/Training Grant
Melissa (Anderson) Chernovsky

The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc.–Graduate Engineering Minorities (GEM) Fellowships
Adriana Holguin
Vil Johnson

National Science Foundation (NSF)–Fellowship
Brian Jensen

Traineeship
Lonnell Peters

National Science Foundation (NSF)–Engineering Research Center for Reconfigurable Machining Systems (ERC/RMS)–Student of the Year Award
Osman Ozdoganlar

Horace H. Rackham–Dean’s Fellowship
Brian Jensen

Distinguished Dissertation Award
Stephen Dyer

Engineering Fellowships
Melissa (Anderson) Chernovsky
Wendy (Hudson) Gendler
Sara Kelly
Leslie King
Michelle Liedtke
Lonnell Peters
Tershia Pinder

Pre-Doctoral Fellowship
Kurt DeGoede

Sloan Summer Fellowships
Maria Alvarez-Sanz
Laila Guessous
Kerr-Jia Lu
Katherine Patek

U.S. Association for Computational Mechanics (USACM)–Fifth U.S. National Congress on Computational Mechanics Scholarship
Jianmin Gu

Whirlpool Fellowship
Christopher Deyer

Doctoral student Serdar Yönak (W00) and Associate Professor David R. Dowling (l.–r.) make a presentation during an External Advisory Board (EAB) tour of Dowling’s laboratory in the fall of 1999. The two have recently applied for a patent on a device that has successfully tested leaks as small as $10^{-6}$ standard cubic centimeters per second. Most ME graduate students are actively involved in research, and many of them work closely with faculty on projects that ultimately lead to patents and widespread use in real-world applications.
Students Participate in International Summer Exchange Program

With globalization an ever-larger reality, MEAM students are learning skills that will serve them well in international settings. And with the help of the International Association for the Exchange of Students for Technical Experience (IAESTE), some of those students are going beyond the classroom setting, to spend their summers working abroad.

Each IAESTE member country has local committees that look within their communities for companies or universities willing to hire an international intern. At an annual international conference, the committees exchange available internships, most of which are related to engineering and other hard sciences.

The University of Michigan (U-M) IAESTE committee was among the first group of its kind to be started in the United States.

With the help of IAESTE, April Nelson (BSE ’00) spent the spring and summer of 1999 at the Technical University of Lodz, Poland, testing steel samples and researching the properties of hard coatings such as vanadium and titanium. Erik Chubb (BSE ’00) worked at Ulster Carpet Mills in Portadown, Ireland, while Michelle Rogers served as a university intern in Gotheburg, Sweden.

We salute these young people for their initiative and sense of adventure.
Fall (December) 1999

Chien-Ming Chen
An Enhanced Asymptotic Homogenization Method of Elastic Composite Laminates
Chair: N Kikuchi

Ching-Hui Chiang
Long Term Effects of the Friction Behavior in a Sliding Lip Seal
Chair: KC Ludema

Laila Guessous
A Pseudo-Spectral Numerical Scheme for the Simulation of Natural Flows
Chair: VS Arpaci

Joel Hetrick
An Energy Efficiency Approach for Unified Topological and Dimensional Synthesis of Compliant Mechanisms
Chair: S Kota

Deanna Winton Hoffman
In-Line Internal Combustion Engine Dynamics and Vibration
Chair: DR Dowling

Hui-Min Huang
Plastic and Fracture Analyses of Sheet Metal Forming and Metal Cutting Processes
Chair: J Pan

Per Tomas Larsson
Controller Design for Linear Systems Subject to Actuator Saturation
Chair: AG Ulsoy

Sejoong Oh
Dynamic Stability of Interacting Spur Gears
Coauthors: JR Barber, K Grosh

Osman Ozdoganlar
Stability of Single- and Parallel-Process Machining Including Geometry of Corner-Radiused Tooling
Chair: WJ Endres

Craig Scholar
Modeling Tracked Vehicle Dynamics Using Vibration Modes
Chair: NC Perkins

Elizabeth Smith
Monitoring Laser Weld Quality Using Acoustic Signals
Chair: E Kannatey-Asibu Jr

Winter (April/May) 2000

Emad Al-Regib
Machining Systems Stability Analysis for Chatter Suppression and Detection
Coauthors: J Ni, J Yuan

John Batteh
Chair: MM Chen

Bernard Bunner
Numerical Simulation of Gas-Liquid Bubbly Flows
Chair: G Tryggvason

William Corpus
An Added Stability Phenomenon in Machining Processes with Periodic Time Variation
Chair: WJ Endres

Jin-Young Jung
Numerical Simulation of Solidification
Chair: MM Chen

Sunny Khosla
Performance Analysis of an Acoustic Time Reversal System in Dynamic and Random Oceanic Environments
Chair: DR Dowling

Heewook Lee
An Optimal Design Method for Brake Squeal Noise Based on Complex Eigenvalue and Sensitivity Analysis and Response Surface Methodology
Chair: N Kikuchi

Yufeng Long
Variation Simulation for Compliant Sheet Metal Assemblies with Applications
Chair: SJ Hu

Yuhai Mei
Stress Evolution in a Conductive Adhesive during Curing and Cooling
Coauthors: AS Wineman, A Yee

Yong-Mo Moon
Reconfigurable Machine Tool Design: Theory and Application
Chair: S Kota

Eric Pesheck
Reduced Order Modeling of Nonlinear Structural Systems Using Nonlinear Normal Modes and Invariant Manifolds
Coauthors: C Pierre, S Shaw

Stephen Riley
Model Reduction of Multibody Systems by the Removal of Generalized Forces of Inertia
Chair: JL Stein

Fayyaz Saleem
Multiple Criterions Structural Topology Optimization for Automotive Structure Design
Coauthors: GM Hulbert, N Kikuchi

He Tang
Machine Mechanical Characteristics and their Influences on Resistance Spot Welding Quality
Chair: SJ Hu

Fan-Chung Tseng
Multibody Dynamics Simulation in Network-Distributed Environments
Chair: GM Hulbert

Qingda Yang
Fracture Analyses of Plastically-Deforming Adhesive Joints
Chair: M Thouless

Serdar Yönak
Characterization and Matched-Field Processing Localization of Photoacoustic Signals
Chair: DR Dowling
Graham Creates Endowed Chair Professorship

It was in 1960 that Donald C. Graham (BSE ’55, MSE ’56) founded Graham Engineering, operating from an office in the basement of his rural Pennsylvania farmhouse. Today, Graham Companies is a billion-dollar enterprise with worldwide industrial interests in machinery, building products and plastic packaging, and a fast-growing investment business focused on equity and marketable securities.

Mr. Graham’s civic and philanthropical interests are wide ranging. In addition to serving on numerous boards for colleges, secondary schools, banks, nonprofit organizations, and corporations, he has been involved with several business organizations including World Presidents’ Organization, Chief Executive Organization, and American Business Council. He established the York Opportunity Program, which provides scholarships and mentors for minority youth seeking a college education.

Over the years, Mr. Graham has maintained close ties with the College, serving on its National Advisory Committee (NAC) from 1994 to present and co-endowing a fund with his brother, Robert (BS NAM ’45, MSE ’48), to support the recruitment efforts of U-M’s Tauber Manufacturing Institute (TMI). In May of 1999, he strengthened those ties even further through an endowed chair professorship that made Professor Panos Y. Papalambros the first Donald C. Graham Professor of Engineering (see related story, page 28).

Tichy Heads Up Mechanical Engineering at Rensselaer Polytechnic Institute

Since 1996, John Alfred Tichy (BS ’66, MS ’67, PhD ’70) has been Professor and Chair of the Department of Mechanical Engineering, Aeronautical Engineering and Mechanics at Rensselaer Polytechnic Institute in Troy, New York. A Fellow of the American Society of Mechanical Engineers (ASME) and the Society of Tribologists and Lubrication Engineers, he serves as editor of the ASME Journal of Tribology and is a past recipient of the ASME Board of Governors Award and the ASME Award for Best Paper in Tribology. In 1991, he received the Key Research Achievement Award from the U.S. Army Research Office and currently pursues a vigorous research program. A faculty member at Rensselaer since 1976, Tichy also maintains an active consulting practice, working with clients that have included Pratt and Whitney and the U.S. Department of Energy (DoE).

Dr. Tichy is also something of an icon to rock and roll aficionados, who remember his work in the 1960s and ’70s as singer, songwriter, and guitarist for Commander Cody and His Lost Planet Airmen. He is listed in Who’s Who in Rock & Roll (1996) and the Rolling Stone Encyclopedia of Rock & Roll (1998).

“Serving now as a department chair for a competing institution,” he says, “I am constantly reminded of the esteem in which the University of Michigan’s College of Engineering and Department of Mechanical Engineering and Applied Mechanics are held. At Rensselaer, we try to attract Michigan graduates to join our faculty, we try to avoid losing our best bachelor’s degree graduates to your master’s and doctoral programs, and we look to MEAM for the latest trends in research and educational pedagogy.”

CURRENT ENDOWED PROFESSORSHIPS

Dionissios (Dennis) N. Assanis
Arthur F. Thurnau Professor
Term: 07/01/99–05/31/02

Steven A. Goldstein
(The First) Henry Ruppenthal Family Professor of Orthopaedic Surgery and Bioengineering
Term: 06/99–open

Bruce H. Karnopp
Arthur F. Thurnau Professor
Term: 07/01/96–06/30/99

Yoram Koren, PE
Paul G. Goebel Professor of Engineering
Term: 09/01/93–08/31/03

Jyotirmoy (Jyoti) Mazumder
Robert H. Lurie Professor of Engineering
Term: 09/01/96–05/31/01

Panos Y. Papalambros
(The First) Donald C. Graham Professor of Engineering
Term: 01/01/00–12/31/04

Albert B. Schultz
Vennema Professor of Engineering
Terms: 09/01/83–12/31/99

A. Galip Ulsoy
William Clay Ford Professor of Manufacturing
Term: 01/01/96–12/31/01
Vest Continues to Build Illustrious Career

Charles M. Vest (MSE ’64, PhD ’67) is a name that’s familiar to many Michigan alumni. Prior to becoming President and Professor of Mechanical Engineering at Massachusetts Institute of Technology (MIT) in 1990, Dr. Vest served the University of Michigan (U-M) as Professor of Mechanical Engineering, Dean of the College of Engineering (CoE), and U-M Provost and Vice President for Academic Affairs.

While a faculty member in MEAM, Dr. Vest received the College of Engineering 1938E and Research Excellence Awards. Regarded as a pioneer in the use of optical techniques for diagnostics in combustion, he has authored numerous papers and his book, *Holographic Interferometry*, has been widely used throughout the world.

Intent on helping to build public support for higher education and research, Dr. Vest serves as a member of the President’s Committee of Advisors on Science and Technology (PCAST), the Massachusetts Governor’s Task Force on Economic Growth and Technology, and the National Research Council Board on Engineering Education. He is Vice Chair of the Council on Competitiveness and has chaired the President’s Advisory Committee on the Redesign of the Space Station. Dr. Vest is slated to receive the MEAM Alumni Society Merit Award for 2000–01.

Wallace Setting a Brisk Pace at University of Toronto

James S. Wallace (MSF ’74, PhD ’78) continues to lead the Department of Mechanical and Industrial Engineering at the University of Toronto. He assumed the post of departmental chair in 1998, 20 years after joining the faculty, and has since presided over a major strategic planning exercise and led a successful proposal that resulted in the introduction of new undergraduate programs in mechatronics and information engineering.

His recent research projects, focused on combustion in engines and the reduction of exhaust emissions through alternative fuel usage, have received funding from British Gas, the National Science and Engineering Research Council, GM Canada, and Natural Resources Canada. In conjunction with C.J. Green, he holds a patent for an electrically actuated gaseous fuel timing and metering device.

Dr. Wallace is a member of the Society of Automotive Engineers (SAE), the American Society of Mechanical Engineers (ASME), and the International Association of Hydrogen Energy. He serves on the Board of Directors, Canadian Section, of the Combustion Institute.

Established in 1994, the Mechanical Engineering External Advisory Board (EAB) meets twice a year to offer guidance on a wide range of issues impacting the Department. Pictured here are EAB members for 1999–00. Standing (l.–r.): Charles Hutchins, Michael E. Korybalski, John B. Heywood, Carroll J. Haas, Sr., Richard T. Heglin, Robert Transou, and Roger L. McCarthy. Sitting (l.–r.): Eugene A. DeFouw, EAB chair, and A. Galip Ulsoy, MEAM chair.
Donors

May 1, 1999–April 30, 2000

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General Motors Corporation (GMC)
International Business Machines Corporation (IBM)
Minnesota Mining and Manufacturing Company (3M)
Motorola, Inc.
Navistar International Transportation Corporation
Raybestos Products Company
Sandia National Laboratories
Alfred P. Sloan Foundation
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University of Michigan Horace H. Rackham School of Graduate Studies
University of Michigan, Office of the Vice President for Research
Vanderbilt University
Whirlpool Corporation
Yanmar Diesel Engine Co., Ltd.
The Enduring Legacy of Professor Shien-Ming (Sam) Wu

When Professor Sam Wu died unexpectedly in 1992, the Department lost not only an outstanding research scientist and teacher but also a beloved mentor and an innovative, often visionary leader. Professor Wu came to Michigan in 1987, following a highly successful 25-year career at the University of Wisconsin–Madison. His wife, Daisy, who recently retired from her post as Director of the Engineering and Science Libraries, notes that her husband arrived in Ann Arbor with the goal of “making Michigan a mecca of manufacturing, determined to shift the research environment from theory to practice and to make research relevant to the specific needs of industry.”

Professor Jun Ni concurs with Mrs. Wu, adding that “Professor Wu’s most significant contribution was his leadership role in rebuilding Michigan’s manufacturing research programs. He had a vision of transforming manufacturing from an art to a science and recognized the importance of developing a healthy collaborative relationship with industry. He not only helped change the culture within the Department and College, but also earned the trust from industry which greatly helped the reputation of Michigan’s manufacturing research programs.”

Professor Ni goes on to note that under Dr. Wu’s leadership, the National Science Foundation (NSF) established an Industry/University Cooperative Research Center (NSF-I/UCRC) at the University of Michigan (U-M) in 1990. “This Center has since become the cornerstone of two other much larger entities, one of them being the S.M. Wu Manufacturing Research Center (WuMRC). Today, thanks in no small part to the efforts of Professor Wu, Michigan is the world’s indisputable leader in manufacturing research programs.”

Happily, Professor Wu’s influence can still be seen and felt in tangible ways throughout the College. During his lifetime, Professor Wu established an endowed fund to benefit scholars and students in manufacturing. Later, following her husband’s untimely death, Mrs. Wu created an endowed memorial fund in his name within the Department. In addition, scholars from throughout the world flock to an annual symposium on manufacturing held in Professor Wu’s honor. We are grateful for the many contributions that Sam Wu made to the Department and the College during his life and for the generosity that has created a legacy for generations to come.
**NEW FACULTY**

**Krishna Garikipati** received his MS and PhD in Aeronautics and Astronautics from Stanford University, where he also completed a postdoctoral research fellowship in the Division of Mechanics and Computation. Prior to joining the Mechanical Engineering and Applied Mechanics (MEAM) faculty as assistant professor in January 2000, he served as a research associate in Stanford’s Center for Integrated Systems. For the past several years, he has also carried out research in collaboration with several major semiconductor manufacturers in Silicon Valley.

Professor Garikipati’s current research is focused on theoretical and computational aspects of nonlinear solid mechanics, with an emphasis on multiscale phenomena. He sees his work as following two major tracks. “One involves applying the principles of mechanics and computational methods to problems in microelectronics and semiconductor processing,” he says. “Within the semiconductor industry, coupled problems involving electric fields, reactions, diffusions through media, and mechanics are ubiquitous. The industry is turning to mechanicians to model these phenomena and increasingly using computational methods to solve the models and design new processes.”

The second major track has to do with bridging length scales. “All materials have phenomena that occur at various scales, from the macroscopic down to the atomic domain,” he says. “Taking a macroscopic perspective, I hope to improve continuum descriptions of material behavior by incorporating information from so-called fine scales.”

**R. Brent Gillespie** was awarded an MS in Mechanical Engineering from Stanford University. He then went on to earn a PhD, also from Stanford. It was his dual abilities in music and engineering that led to what is now one of his major research interests: the design and analysis of robotic devices for human-computer interaction.

Professor Gillespie has developed a haptic interface for synthesizers that replicates the physical qualities of a piano keyboard. He has also assisted in the creation of cobots—robotic devices intended explicitly to work in collaboration with human beings.

Building on his past expertise, Gillespie, who joined the Department in January of 2000 as an assistant professor, hopes one day to establish a cobot engineering center at the University of Michigan (U-M). “Thus far,” he says, “robots really haven’t lived up to their promise. They can’t assemble parts or do other tasks that are relatively simple for human beings. The solution is to create devices that share control by augmenting human capabilities.” Another area of interest is creating haptic interfaces that could, among other things, help in the training of surgeons by replacing animal models with “a virtual human.”

**Hong G. Im**, who joined the MEAM faculty in January of 2000 as assistant professor, received his MS in Mechanical Engineering from Seoul National University and earned a PhD in Mechanical and Aerospace Engineering from Princeton University. He completed a research fellowship in the Center for Turbulence Research at Stanford University and, most recently, was a postdoctoral researcher in the Combustion Research Facility at Sandia National Laboratories.

Professor Im’s research interests are focused primarily on combustion, computational methods for reacting flows, direct numerical simulation, large eddy simulation, reacting flows in microsystems, and pollutant reduction and control. “The main thrust of my research is environmental concerns,” he says, “and the ultimate goal of my work is to reduce greenhouse gases by developing engines with higher thermal efficiency, and to reduce pollutant formation by controlling the reacting flow conditions, as opposed to after-treatments such as catalytic converters. Rather than relying on empirical models, I’m using what I call a high-fidelity numerical method to resolve every detail of the fundamental physics involved in the mechanisms of combustion and pollutant formation processes.”
Since joining the MEAM faculty in January, Assistant Professor Steven J. Skerlos has founded the Environmental and Sustainable Technology (EAST) Laboratory in pursuit of his mission: to reduce the environmental impact and health hazards associated with products and manufacturing processes. “The inspiration for the lab was twofold,” he says. “First, to focus on the design of environmentally responsible products and, second, to develop technology that reduces the environmental impact of manufacturing them.”

According to Professor Skerlos, metalworking fluids are a major environmental problem currently confronting manufacturers. “The fluids are expensive and, over time, lose their ability to perform. They contain microorganisms that can pose health hazards, and disposal is problematic. Our approach to this multi-faceted problem has been to develop membrane-based solutions that, by removing the factors responsible for spoilage, avoid health hazards, improve performance, and save money by making the product fully recyclable.” The EAST Laboratory has also been researching microchip technology to quantify microbial contamination.

Katsuo Kurabayashi supervised undergraduate and graduate research projects in the area of robotics and developed graphic design tools for discrete time control systems. All of these topics are reflected in his current research interests, which focus on distributed manipulation, controls, robotics, and mechatronics. “Orienting small parts properly on assembly lines is an ongoing challenge for manufacturers,” he says. “I’m interested in developing distributed manipulation technology that can move, position, and orient objects by applying force over a whole area. One possible solution, for example, might be to equip workers with hand-held, palm-sized plates that enable them to orient and grab parts using air flow fields.” Luntz, who joined the faculty in January of 1999 as an assistant professor, is also conducting research in the development of prehensile robots—snake-like and elephant trunk mechanisms for potential use in search and rescue missions.

As a teacher, one of his goals is to introduce more lab experiments, augmenting classroom lectures in control theory with hands-on experience that will enable students to learn by doing. In collaboration with Assistant Professors R. Brent Gillespie and Diann Brei, he has also begun concept work on a new senior-level course in smart product design and a mechatronics project competition.
NEW PRIMARY RESEARCH STAFF (PRS)

Loucas S. Louca  
Assistant Research Scientist, (effective 03/13/00), formerly a Mechanical Engineering and Applied Mechanics (MEAM) Research Fellow.

Zbigniew J. Pasek  
Assistant Research Scientist, (effective 07/14/99). Pasek also continues his 50% staff appointment as Project Manager, NSF Engineering Research Center for Reconfigurable Machining Systems (ERC/RMS).

PROMOTIONS

Faculty

Ellen M. Arruda  
Assistant Professor, to Associate Professor with tenure (effective 09/01/99).

Johann Borenstein  
Associate Research Scientist, to Research Scientist (effective 09/01/99).

David R. Dowling  
Assistant Professor, to Associate Professor with tenure (effective 09/01/99).

Jwo Pan  
Associate Professor, to Professor with tenure (effective 09/01/99).

Huei Peng  
Assistant Professor, to Associate Professor with tenure (effective 09/01/99).

Noel C. Perkins  
Associate Professor, to Professor with tenure (effective 09/01/99).

Jwo Pan

Staf

Denise Burrell  
Academic Secretary III, to Office Assistant IV (01/19/00).

Susan Clair  
Administrative Assistant II, to Administrative Associate I (10/01/99).

Claudia M. Hill  
Administrative Associate I, to Associate II (effective 05/01/99).

Kathy Hoover  
Academic Secretary II, to Office Assistant III (effective 03/06/00).

Aleda Thomas  
Administrative Assistant II, to Administrative Associate I (effective 10/08/99).

Teresa Camille Young  
Administrative Assistant I, to Administrative II (effective 05/01/99).

Marcy Brighton

New Administrative Manager for MEAM

In January 2000, MEAM welcomed Marcella (Marcy) A. Brighton back to the Department as its new Administrative Manager. A 1987 graduate of the University of Michigan (U-M), her career in administration has included posts with Oxford Housing, the School of Nursing, and the School of Information (SI). Marcy’s arrival was actually something of a homecoming, since she served as the Department’s personnel administrator from 1994 to 1996. As Administrative Manager, she is responsible for management of the budget as well as oversight of daily operations, personnel, facilities, machine shops, and academic and student services.

In the coming year, Marcy will be spearheading two major administrative projects. The first involves shifting clerical and financial support services to a more decentralized model by establishing satellite office clusters or “pods” located throughout the G.G. Brown Building and W.E. Lay Automotive Laboratory. She will also be working with key people in the Department to create business units for several MEAM laboratories and establish related fee structures for non-Departmental users.

MEAM Faculty Trends

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<th>95–96</th>
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<td>12</td>
<td>13</td>
<td>11</td>
<td>15</td>
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</table>
New Administrative Appointments

**Steven L. Ceccio** (BSEME ’85)
Associate Professor, was appointed Mechanical Engineering and Applied Mechanics (MEAM) Associate Chair (09/01/99–06/30/01).

**Dariusz (Darek) J. Ceglarek** (PhD ’94)
Assistant Research Scientist, was appointed Assistant Director, National Science Foundation (NSF) Industry/University Cooperative Research Center for Dimensional Measurement and Control in Manufacturing (NSF-I/UCRC), (01/99–present).

**Maria Comninou** (JD ’96)
Professor, was appointed Patent Advisor for the NSF Engineering Research Center for Reconfigurable Machining Systems (ERC/RMS), (09/99–present).

**Debasish (Deba) Dutta**
Associate Professor, was appointed Director, Interdisciplinary Professional Graduate Programs (InterPro), (09/01/99–08/31/01).

**Donald E. Geister** (BSEAA ’57, MSE ’63)
Lecturer (jt.), was appointed Director of the College of Engineering’s new Walter E. Wilson Student Team Project Center, (09/01/99–present). The Center is named for the late Walter E. Wilson (BSEME ’33), whose generous gift provides a workspace for student teams to develop projects for engineering and society competitions.

**S. Jack Hu** (MSE ’86, PhD ’90)
Associate Professor, was appointed MEAM Graduate Programs Chair (09/01/99–06/30/01).

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**Noel C. Perkins**
Professor, was appointed MEAM Undergraduate Program Director (09/01/99–08/31/01).

**Christophe Pierre**
MEAM Associate Chair, was appointed Associate Dean of Academic Programs and Initiatives in the Horace H. Rackham School of Graduate Studies (09/01/99–present).

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**Staff U-M Anniversaries**

**Twenty Years:**

- **Kevin Morrison**
  Senior Engineering Research Associate (11/19/79).

- **Martha (Martii) I. Smith**
  Academic Secretary IV (01/11/80).

**Fifteen Years:**

- **Aleda Thomas**
  Administrative Associate I (01/15/85).

**Ten Years:**

- **Betty J. Alperovitz**
  Academic Secretary III (04/16/90).

- **Marvin Cressey**
  Senior Engineering Technician (02/21/90).

- **Pamela Fitzgerald**
  Executive Secretary (11/16/87).

- **William Kirkpatrick**
  Senior Engineering Technician (01/29/90).

- **Linore Latham**
  Office Assistant IV (08/21/89).

- **Charles Wiykovich**
  Senior Computer Systems Specialist (01/08/90).

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**Cross-Disciplinary Projects Underscore Changes in Mechanical Engineering**

Describing his work as “the softer side of mechanical engineering,” Professor **Noboru Kikuchi** notes that, depending on the venue and the task at hand, he functions as a traditional engineer, a mathematician, and a business consultant. This past year, Kikuchi spent approximately two months working with fellow mathematicians on joint projects at the University of Paris, Stuttgart University, the Technical University of Denmark, the Technical University of Lisbon, and the Imperial College and Technical University of Munich, helping colleagues translate pure mathematics into real-world applications.

Equally at home in the world of business, Kikuchi also spent a month in the Pacific Rim, consulting for companies such as Toyota, Fujitsu, Suzuki Motor Corporation, Subaru, and various software manufacturers. “Typically,” he says, “I help corporations decide on new directions for R&D, establish supporting organizational structures, and identify methods for measuring outcomes and evaluating designs from a management point of view.”

Back in the States, Professor Kikuchi functions primarily as a researcher and engineer, focusing on the application of computer-related technologies to the design of new structures and manufacturing methods. Among his many projects, most of which are federally funded, he is developing materials to prevent thermal deformation of substrates during microchip manufacture. Other projects include new materials for applications ranging from scar reduction in soft-tissue wounds to bulletproof vests, textiles, and cosmetics.

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**MEAM Faculty Diversity**
as a percentage of total population

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<tr>
<td>Female</td>
<td>11.1</td>
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<td>12.7</td>
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<tr>
<td>Under Represented Minorities</td>
<td>3.7</td>
<td>3.7</td>
<td>3.6</td>
</tr>
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</table>

**Key to Abbreviations Used:**

- *jt.* — joint
- *adj.* — adjunct
- *emer.* — emeritus
In Memoriam

Faculty

Hadley J. Smith (BSEME ’40, PhD ’57)
Professor Emeritus (pictured below), died November 14, 2000, in Ann Arbor, MI, at the age of 81. He served on the MEAM faculty for 30 years, retiring in 1985. His primary research areas included fluid mechanics, heat transfer, and dynamics. His avid research activities were highly published and supported by NASA and the Army’s Land Locomotion Laboratory. He served at the Los Alamos Scientific Laboratory as a Harvard University Fellow sponsored by the National Science Foundation (NSF). Professor Smith also actively served the University and CoE. He was a member of the committee that developed the Dearborn Campus. He is survived by his wife, Maureen, and their six children.

Staff

Milo Kaufman
Retired Technician, died September 13, 1999, in Ann Arbor, MI, at the age of 92. He served the MEAM faculty and students as an engineering technician from 1945 to 1970. Professor Emeritus Walter R. Debler, (BSEME ’50, PhD ’59) who says Kaufman was extremely well liked and respected by both students and faculty, wrote an article at the time of Kaufman’s retirement: “Milo was quite a guy; he still is. In my opinion, he represents the type of person who, having joined the University for reasons unknown, eventually takes on its image and distills its very essence...Milo was the kind of person who, upon seeing that a job needed doing, would go ahead and do it—even if he had to teach himself a few things beforehand.”

Retirement

ALBERT B. SCHULTZ RETIRES AS PROFESSOR EMERITUS

During his career at the University of Michigan (U-M), Albert B. Schultz compiled a remarkable record of achievement, not only in the field of mechanical engineering but also in biomedical engineering and geriatrics research. In addition to being the Vennema Professor of Mechanical Engineering and Applied Mechanics (MEAM), he was a professor of biomedical engineering in the College of Engineering (CoE), and a research scientist in the Institute of Gerontology. He joined the Michigan academic community in 1983, having previously served on the faculties of the University of Delaware and the University of Illinois at Chicago.

Internationally recognized for his research on biomechanics of the human musculoskeletal system, which is recorded in more than 130 publications, Schultz’s early work focused on the mechanics of idiopathic scoliosis and low back pain. More recently, he explored the use of engineering mechanics in assessing, treating, and preventing physical problems common in older populations.

When asked to describe the high points of his career at Michigan, Professor Schultz noted, “My entire time at Michigan was a high point. I enjoyed being there and working with so many fine colleagues. But one of the best things was being able to cooperate closely with geriatric medicine and gerontology researchers on some very challenging problems.”

Upon his retirement, effective December 31, 1999, Schultz was named by the Board of Regents: the Vennema professor emeritus of Mechanical Engineering and Applied Mechanics, and of MEAM; professor emeritus, Biomedical Engineering; and research scientist emeritus, Institute of Gerontology.

Vennema Professor of Mechanical Engineering and Applied Mechanics Albert B. Schultz
FACULTY, STAFF, AND ALUMNI HONORS AWARDED BY THE UNIVERSITY OF MICHIGAN (U-M) AND AFFILIATES

May 1, 1999–April 30, 2000

Department of Mechanical Engineering and Applied Mechanics (MEAM)

Alumni Honors

Robert H. Transou (MSE ’67)
Retired Group Vice President of Manufacturing at Ford Motor Co. Automotive Operations, and MEAM External Advisory Board (EAB) Member, was awarded the 1999–00 MEAM Alumni Society Merit Award, Oct. 1999, by the College of Engineering (CoE).

Faculty Honors

Vedat S. Arpaci
Professor, received a Teaching Incentive Fund Award, MEAM (1998–99).

Dionissios (Dennis) N. Assanis
Professor, received a Teaching Incentive Fund Award, MEAM (1998–99).

David R. Dowling
Associate Professor, received a Teaching Incentive Fund Award, MEAM, U-M (1998–99).

S. Jack Hu (MSE ’86, PhD ’90)
Associate Professor, was awarded an Outstanding Accomplishment Award for MEAM, by the CoE, Feb. 2000. Hu was recognized for his contributions to research.

Elijah Kannatey-Asibu, Jr.
Professor, received a Robert M. Caddell Memorial Faculty Research Achievement Award (1999–00).

Bruce H. Karnopp
Associate Professor, received a Teaching Incentive Fund Award, MEAM (1998–99).

NEW MOLD MAKING TECHNOLOGY LAUNCHES START-UP FIRM

“When you consider that nearly 85% of consumer products use molds of some sort and that $1.3 trillion of the American economy depends on manufacturing processes that involve injection, stamped or die-cut molds, you begin to appreciate the fundamental importance of mold making,” says Jyotirmoy (Jyoti) Mazumder, Robert H. Lurie Professor of Mechanical Engineering. Several years ago, Mazumder, who describes his work as “making materials that Mother Nature can’t produce,” was asked by General Motors (GM) to develop a rapid prototyping alternative capable of making metal prototype components directly from CAD dimensions. Mazumder, who also directs the University of Michigan (U-M) Center for Laser Aided Intelligent Manufacturing (CLAIM), has developed a variety of non-equilibrium alloys using laser-assisted direct metal deposition.

Ultimately, it was venture capitalist Shrik Mehta who provided the research funding that enabled Professor Mazumder to devise an interactive, laser-cladding process capable of producing a new generation of metals which, according to several prominent industry journals, could revolutionize mold making. In January of 1999, Mazumder’s invention launched Precision Optical Manufacturing Inc., a start-up firm in Plymouth, Michigan. Although Mazumder holds the title of CEO, his interests and energies remain firmly rooted in academia. “My real work is here at the University,” he affirms, “coming up with new technologies. This is where I can be most useful to people.”
Massoud Kaviany
Professor, received a Teaching Incentive Fund Award, MEAM (1998–99).

Arthur D. Kuo
Associate Professor, received a Teaching Incentive Fund Award, MEAM, (1998–99).

Kenneth C. Ludema (BSEIE '55, MSE '56, PhD '63)
Professor Emeritus, received a Robert M. Caddell Memorial Faculty Research Achievement Award (1999–00).

Noel C. Perkins
Professor, received an Outstanding Accomplishment Award for MEAM, by the College of Engineering (CoE), Feb. 19, 2000. He was recognized for his achievements in research, teaching, and service.

Richard A. Scott
Professor, was named Pi Tau Sigma (ΠΤΣ/PTS) Professor of the Term for Winter Term 2000.

Volker Sick
Associate Professor, received a Teaching Incentive Fund Award, MEAM, (1998–99).

Michael Thouless
Professor, received a Teaching Incentive Fund Award, MEAM (1998–99).

Alan S. Wineman (BSEE '59) Professor, was named Pi Tau Sigma (ΠΤΣ/PTS), Professor of the Term for Fall Term 1999. He also received a Teaching Incentive Fund Award, MEAM (1998–99).

Margaret S. Wooldridge
Assistant Professor, received a U-M Career Development Award from the Michigan Agenda for Women, May 1999. She also received a Teaching Incentive Fund Award, MEAM (1998–99).

College of Engineering (CoE)

Faculty Honors

Dionissios (Dennis) N. Assanis
Professor, was awarded a CoE Teaching Excellence Award (1999–00).

Dariusz (Darek) J. Ceglarek (PhD '94)
Assistant Research Scientist, was awarded the CoE Outstanding Research Scientist Achievement Award (1999–00).

Yoram Koren, PE
Professor, continued his endowed professorship as the Paul G. Goebel Professor of Engineering (09/01/93–08/31/03).

Jyotirmoy (Jyoti) Mazumder
Professor, continued his endowed professorship as the Robert H. Lurie Professor of Engineering (09/01/96–05/31/01).

Panos Y. Papalambros
Professor, was the first-time recipient of a new endowed professorship; he is now distinguished as the Donald C. Graham Professor of Engineering (01/01/00–12/31/04). The endowment was established by MEAM alumnus, Donald C. Graham (BSEIE '55, MSE '56), Chairman of The Graham Companies, member of the CoE National Advisory Committee (NAC), and past member of the MEAM External Advisory Board (EAB).

In March 1999, Professor Jun Ni was appointed by the Ministry of Education of the People’s Republic of China to serve as an Endowed Changjiang Scholar Professor. This was the first such endowed professorship ever established by the Chinese government. Dr. Ni will work with Shanghai Jiao Tong University to provide strategic guidance on the development of its manufacturing research and educational programs. He is one of only three endowed professorship holders who are from outside China.

Professor Jun Ni’s research on a micro internal combustion swing engine, located in the MEAM Stamping Lab, could contribute to future development of portable high-density power generation devices.
Noel C. Perkins
Professor, was the first-time recipient of the Ruth and Joel Spira Outstanding Teaching Award. The award was presented to Perkins at the American Society for Engineering Education (ASEE) Outstanding Student Instructor Awards Ceremony, April 12, 2000. Perkins was also named Professor of the Year by the University of Michigan (U-M) chapter of Tau Beta Pi (ΤΒΠ/TBP), Apr. 2000.

Albert B. Schultz (emeritus)
Professor, continued his endowed professorship as the Vennema Professor of Mechanical Engineering and Applied Mechanics (1983–12/31/99).

Grétar Tryggvason
Professor, received the College of Engineering (CoE) Service Excellence Award (1999–00) on Feb. 19, 2000.

A. Galip Ulsoy
Professor, continued his endowed professorship as the William Clay Ford Professor of Engineering (01/01/96–12/31/03).

University of Michigan (U-M)

Faculty Honors

Dionissios (Dennis) N. Assanis
Professor, received an endowed professorship; he is now distinguished as an Arthur F. Thurnau Professor (06/01/99–05/31/02).

Diann E. Brei
Assistant Professor, received a U-M Career Development Award from the Michigan Agenda for Women, May 1999.

Maria Comninou (JD ’96)
Professor, served as judge for the 76th Annual Henry M. Campbell Moot Court Competition at the U-M Law School, Nov. 16, 1999.

Steven A. Goldstein (MS ’77, PhD ’81)
Professor, was the first time recipient of a new endowed professorship; he is now distinguished as the Henry Ruppenthal Family Professor of Orthopaedic Surgery and Bioengineering (06/14/99–open). The Ruppenthal Professorship was established through the generosity of Alma and Rena Ruppenthal to honor the keen interest of their late brother, Norman, in medical engineering.

Karl Grosh
Assistant Professor, received the Order of Omega’s Panhelenic Teaching Excellence Award, for 1999–00.

Bruce H. Karnopp
Associate Professor, continued as an Arthur F. Thurnau Professor (07/01/96–06/30/99).

Ann Marie Sastry
Assistant Professor, received the 1999–00 CoE 1938E Award for outstanding teaching, counseling and mentorship of students, and scholarly integrity, Feb. 19, 2000.

Margaret S. Wooldridge
Assistant Professor, received a U-M Career Development Award from the Michigan Agenda for Women, May 1999.

Staff Honors

Linore Latham
Office Assistant IV, received a “UMatter!” award, Aug. 1999, for outstanding initiative and contribution to the Coe S.M.Wu Manufacturing Research Center (WuMRC), and to MEAM.

Wooldridge Receives Pi Tau Sigma (ΠΤΣ/PTS) Gold Medal
Assistant Professor Margaret S. Wooldridge was awarded the Pi Tau Sigma (ΠΤΣ/PTS) Gold Medal at the 1999 International Mechanical Engineering Congress and Exposition. Established in 1938 by PTS in conjunction with the American Society of Mechanical Engineers (ASME), the award recognizes outstanding achievement by a young graduate in mechanical engineering within ten years of receiving the baccalaureate degree.

Dr. Wooldridge received her bachelor’s degree in mechanical engineering from the University of Illinois–Champaign-Urbana in 1989 and went on to earn a doctorate degree from Stanford University in 1995. During her two years at the University of Michigan (U-M), she has maintained an active research program focused primarily on combustion phenomena and combustion synthesis. Her work has resulted in the generation of nanostructured materials and high-surface-area materials for applications such as fuel cell catalysts, flame retardants, and electrodes. She is also working to develop non-intrusive, optical-based system diagnostics for high-temperature, multi-phased, and chemically reactive environments. In 1998, her research earned her the National Science Foundation (NSF) CAREER Award.

Among her numerous accomplishments as a teacher, Professor Wooldridge has, in collaboration with Professor Michael M. Chen, revitalized and restructured a graduate-level course in advanced heat transfer. She also initiated an educational outreach program that has introduced more than 220 middle school students to engineering through workshops and competitions.
Faculty Honors

Ellen M. Arruda
Associate Professor, continued as recipient of a National Science Foundation (NSF) CAREER Award (06/01/97–05/31/01). Arruda also continued the 3M Untenured Faculty Research Grant Award (06/97–05/99).

James A. Ashton-Miller
Research Scientist, was elected President-Elect (1999–00) of the American Society of Biomechanics (ASB), Oct. 1999. He assumed the position of President (2000–01) thereafter.

Diann E. Brei
Assistant Professor, was invited to be included in the National Academy of Engineering’s (NAE) Celebration of Women in Engineering Web site at www.nae.edu/cwe, “Gallery of Women Engineers.”

Steven L. Ceccio (BSEME ’85)
Professor, was one of only 15 people in the country appointed to the Defense Science Studies Group (DSSG) of the Institute of Defense Analyses (IDA) and the U.S. Department of Defense (DoD). The group consults on national security issues and is sponsored by the Defense Advanced Research Project Agency (DARPA).

David E. Cole (BSEME ’60, BSEM ’60, MSE ’61, PhD ’66)
Professor, received the Horace H. Rackham Award from the Engineering Society of Detroit, MI, May 31, 1999, for humanitarian service. He also was awarded the Chevalier of Merit from the French Government for services rendered through their Trade Commissioner in Detroit. The honor was bestowed at a reception in Detroit, MI, March 6, 2000.

William J. Endres
Assistant Professor, continued as recipient of a National Science Foundation (NSF) CAREER Award (04/15/98–03/31/02).

Thomas D. Gillespie, PE
Adjunct Professor, received the General Motors Corporation (GMC) Outstanding Distance Learning Faculty Award, May 1999, for courses taught via the College of Engineering (CoE) Center for Professional Development (CPD), for GM.

Karl Grosh
Assistant Professor, continued as an Office of Naval Research (ONR) Young Investigator (05/01/99–04/30/02). He also continued as a recipient of a National Science Foundation (NSF) CAREER Award (09/99–08/03).

Gregory M. Hultbert
Associate Professor, was elected a Fellow of the American Society of Mechanical Engineers (ASME), Dec. 1999.

Yoram Koren, PE
Professor, received the 1999 American Society of Mechanical Engineers (ASME) William T. Ennor Manufacturing Technology Award for his outstanding research contributions in the field of manufacturing and production engineering. The award was presented at the American Society of Mechanical Engineers International Mechanical Engineering Congress and Exposition (ASME-IMECE), Las Vegas, NV, Sept. 1999.

Nestor F. Michelenas
Assistant Research Scientist, received the Ford Motor Company University Research Program Award (1999–01).

Double Honors for Papalambros

Panos Y. Papalambros was the recipient of the 1999 Machine Design Award, conferred at the Design Engineering Technical Conference in Las Vegas in September. Since 1958, the award has recognized eminent achievement and distinguished service in the field of machine design. In the case of Professor Papalambros, the honor was bestowed for leadership in bridging academia with industry and for research in design optimization that has paved the way for new paradigms in machine design and improved protocols in the automotive industry.

In reflecting on the award, Papalambros notes that his work has always been directed toward making the design process quantifiable and amenable to research. “I’ve tried to study design as a process that can be defined in rigorous ways and to conduct research that is meaningful for those involved in design and manufacturing as well as those who value scholarship. In pursuit of that goal, I have worked extensively and closely with automotive manufacturers in order to understand the problems they face, translate those problems into scholarly pursuits, and help devise effective methods and tools.”

In May of 2000, Papalambros will receive another major honor, becoming the Donald C. Graham Professor of Engineering. “As a faculty member,” he notes, “I appreciate the recognition that this represents. From my administrative experience, I’m grateful for alumni such as Donald Graham (BSE ’55, MSE ’56) who understand the vital importance of endowed chairs to the overall caliber of the MEAM Department.”
Jun Ni
Professor, continued the Changjiang Endowed (visiting) Professorship from the Ministry of Education in the People’s Republic of China (02/99–02/04). He also continued as a recipient of a National Science Foundation (NSF) Presidential Faculty Fellows Award (10/94–09/00).

Nicolae (Nick) V. Orlandea (PhD ’73)
Adjunct Professor, received an honorary doctorate degree from Technical University Cluj-Napoca, Romania, June 1999, for his contributions to computer aided dynamic analysis of mechanical systems, and his role in the development of the Automatic Dynamic Analysis of Mechanical Systems (ADAMS) software.

Zbigniew J. Pasek
Assistant Research Scientist, was co-leader along with Mechanical Engineering and Applied Mechanics (MEAM) faculty members, Yoram Koren, PE, and A. Galip Ulsoy, on the Boring for Optimum Accuracy (BOA) project, which was named one of Industry Week magazine’s Top 25 Technology Developments for 1999 as published in the Dec. 6, 1999 issue. BOA is a collaboration between MEAM and Lamb Technicon Machining Systems, and was funded by the National Institute of Standards and Technology’s (NIST) Advanced Technology Program (ATP).

Huei Peng
Associate Professor, continued as recipient of a National Science Foundation (NSF) CAREER Award (05/98–04/02).

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American Society of Mechanical Engineers (ASME)

MEAM Faculty Members
Elected as Fellows in 1999–00

| Gregory M. Hulbert | (Fellow of ASME, 1999) |
| William W. Schultz | (Fellow of ASME, 2000) |
| Alan S. Wineman    | (Fellow of ASME, 1999) |

American Society of Mechanical Engineers (ASME) Fellows

<table>
<thead>
<tr>
<th>MEAM Faculty Member</th>
<th>Inaugural Year when known</th>
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<tr>
<td>Vedat S. Arpaci</td>
<td>1996</td>
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<tr>
<td>Jay A. Bolt, PE (emeritus)</td>
<td>unknown</td>
</tr>
<tr>
<td>Michael M. Chen</td>
<td>1983</td>
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<tr>
<td>John A. Clark (emeritus)</td>
<td>Elected Life Fellow</td>
</tr>
<tr>
<td>Maria Comninou</td>
<td>1993</td>
</tr>
<tr>
<td>David K. Felbeck, PE (emeritus)</td>
<td>1992</td>
</tr>
<tr>
<td>Gregory M. Hulbert</td>
<td>1999</td>
</tr>
<tr>
<td>Elijah Kannatey-Aelbu, Jr.</td>
<td>1995</td>
</tr>
<tr>
<td>Massoud Kaviany</td>
<td>1992</td>
</tr>
<tr>
<td>Yoram Koren, PE</td>
<td>1990</td>
</tr>
<tr>
<td>Edward R. Lady (emeritus)</td>
<td>Elected Life Member</td>
</tr>
<tr>
<td>Herman Merte, Jr., PE (emeritus)</td>
<td>Elected Life Fellow</td>
</tr>
<tr>
<td>Jvo Pan</td>
<td>1997</td>
</tr>
<tr>
<td>Panos Y. Papalambros</td>
<td>1995</td>
</tr>
<tr>
<td>J. Raymond Pearson (emeritus)</td>
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<tr>
<td>Christophe Pierre</td>
<td>1996</td>
</tr>
<tr>
<td>Leland J. Quackenbush (emeritus)</td>
<td>unknown</td>
</tr>
<tr>
<td>Albert B. Schultz (emeritus)</td>
<td>1986</td>
</tr>
<tr>
<td>William W. Schultz</td>
<td>2000</td>
</tr>
<tr>
<td>Leonard Segel (emeritus)</td>
<td>unknown</td>
</tr>
<tr>
<td>Richard E. Sonntag (emeritus)</td>
<td>Elected Life Fellow</td>
</tr>
<tr>
<td>A. Galip Ulsoy</td>
<td>1993</td>
</tr>
<tr>
<td>Alan S. Wineman</td>
<td>1999</td>
</tr>
<tr>
<td>Wen-Jei Yang, PE</td>
<td>1983</td>
</tr>
</tbody>
</table>

James Patrick “J.P.” Boylan (BSE ’96, MSE ’99) participated in an experiment conducted by Mechanical Engineering (ME) doctoral student Kurt DeGoede. Much of the research in the Biomechanics Laboratory, directed by Research Scientist James Ashton-Miller, is focused on physical challenges of the elderly.
Ann Marie Sastry
Assistant Professor, was invited to be included in the National Academy of Engineering’s (NAE) Celebration of Women in Engineering Web site at www.nae.edu/cwe, “Gallery of Women Engineers”. She also continued as recipient of a National Science Foundation (NSF) Presidential Early Career Award for Scientists and Engineers (PECASE, 01/98–09/00), as well as an NSF CAREER Award, augmented by PECASE (06/97–09/00).

William W. Schultz
Professor, was elected a Fellow of the American Society of Mechanical Engineers (ASME), Feb. 2000, for his outstanding contributions to research and education in fluid mechanics.

Volker Sick
Associate Professor, received the Forest R. McFarland Award from the Society of Automotive Engineers (SAE) Engineering Meetings Board (EMB), Mar., 2000, in recognition of his leadership and organizational contributions in the division for Fuels and Lubricants.

Michael Thouless
Associate Professor, continued as a recipient of a National Science Foundation (NSF) CAREER Award (07/01/96–06/30/00).

Dawn M. Tilbury
Assistant Professor, received a National Science Foundation (NSF) CAREER Award (09/99–08/03).

Grétar Tryggvason
Professor, was appointed a Visiting Scientist, U-Paris VI, Paris, France (04/19/98–05/08/99).

A. Galip Ulsoy
Professor, received the Ford Patent Incentive Award from Ford Motor Company (07/26/99).

Juris Upatnieks
Adjunct Associate Research Scientist, was presented the Grand Medal from the Latvian Academy of Sciences, in Riga, Latvia, July 5, 1999, for the development of optical holography and its applications in the world.

Alan S. Wineman (BSEEM '59)
Professor, was elected a Fellow of the American Society of Mechanical Engineers (ASME), June 1999.

Margaret S. Wooldridge
Assistant Professor, continued as recipient of a National Science Foundation (NSF) CAREER Award (05/98–04/02) and was invited to be included in the National Academy of Engineering’s (NAE) Celebration of Women in Engineering Web site at www.nae.edu/cwe, “Gallery of Women Engineers.”

Wen-Jei Yang (MSE ’56, PHD ’60)
Professor, was named an honorary member of the Combustion Institute, Taiwan (R.O.C.), 1999.
At right, a transmission clutch disk after a single engagement. The dark areas correspond to regions in which high local temperatures (hot spots) have been experienced, resulting from an unstable interaction between frictional heating and thermoelastic deformation. Read more about Professor Barber's research below.

Key to acronyms used:
Please refer to the Appendix on page 52.

Barber Addresses International Congress

Professor James R. Barber delivered a plenary lecture at the Third International Congress on Thermal Stresses, hosted by the Cracow University of Technology in Poland from June 13–17, 1999. At the conference, which drew participants from around the world, Professor Barber spoke on the subject of thermoelasticity and contact. Following a summary of research spanning the past three decades, he discussed recent results of analytical and numerical perturbation methods, which, as he noted, “enable us to make good predictions of the conditions under which unstable thermoelastic deformations occur.”

The inevitable microscopic roughness of contacting surfaces causes incomplete contact, interposing a thermal contact resistance. Interaction between this resistance and thermoelastic deformation of the contacting bodies can be unstable, leading to non-uniform contact pressure. The figure above shows a section cut from an interrupted continuous casting process for aluminum alloy. The sinusoidal perturbation in the solidification boundary was caused by thermoelastic instability associated with the mold/casting contact interface. The resulting non-uniform temperature field can cause thermal stresses, material damage and undesirable spatial variation in alloy composition.

Faculty Keynote and Plenary Presentations

May 1, 1999–April 30, 2000

Ellen M. Arruda

James R. Barber, C Eng

James R. Barber, C Eng

Steven Goldstein (MS ‘77, PhD ’81)
“Mechanical and Biologic Stimulation of Bone Repair,” First Jack Pushkin Lecturer (keynote), Visiting Professor, Dept. of Orthopedics, West Virginia University, Morgantown, WV, May 21, 1999.

Massoud Kaviany

Jun Ni

Noel C. Perkins

Yoram Koren

Herman Merte, Jr., PE (emeritus)

Barber Addresses International Congress

Professor James R. Barber delivered a plenary lecture at the Third International Congress on Thermal Stresses, hosted by the Cracow University of Technology in Poland from June 13–17, 1999. At the conference, which drew participants from around the world, Professor Barber spoke on the subject of thermoelasticity and contact. Following a summary of research spanning the past three decades, he discussed recent results of analytical and numerical perturbation methods, which, as he noted, “enable us to make good predictions of the conditions under which unstable thermoelastic deformations occur.”

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Faculty Honors and Awards
Professor Yoram Koren in the ERC/RMS testbed of the Integrated Manufacturing Systems Laboratory (IMSL), located in the H.H. Dow Building. Koren is director of the Center for Reconfigurable Machining Systems.

INTERNATIONAL RECOGNITION FOR KOREN

Last year, Yoram Koren, Paul C. Goebel Professor of Engineering, continued to garner international acclaim for his expertise in the domain of computerized controls for manufacturing systems. Professor Koren was chosen to receive the 1999 William T. Ennor Manufacturing Technology Award. Established in 1990 by the American Society of Mechanical Engineers (ASME) Manufacturing Engineering Division and the Alcoa Company, the award is intended to recognize an individual or team for developing or contributing significantly to an innovative manufacturing technology, the implementation of which has resulted in substantial economic or societal benefits. Also in 1999, Professor Koren presented a keynote paper on the subject of reconfigurable manufacturing systems for the CIRP general assembly, held in Switzerland. CIRP is the acronym (from the French) for the International Institution for Production Engineering Research. The paper was co-authored by six additional researchers from four countries, including A. Galip Ulsoy, Chair of MEAM. An ASME Fellow since 1990, Professor Koren serves as director of the NSF-funded Engineering Research Center for Reconfigurable Machining Systems (ERC/RMS).

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FACULTY INVITED PRESENTATIONS

May 1, 1999–April 30, 2000

Faculty Honors

James A. Ashton-Miller

Ellen M. Arruda

Arvind Atreya

Diann E. Brei

Maria Comninou (JD ’96)

David R. Dowling

Steven Goldstein (MS ’77, PhD ’81)

Gregory M. Hulbert
Massoud Kaviany

Sridhar Kota

Liwei Lin

Jyotirmoy (Jyoti) Mazumder

Jun Ni

Jwo Pan

Noel C. Perkins
Sridhar Kota: Design for Compliant Mechanisms in MEMS

One of the most urgent challenges facing the telecommunications industry today involves finding a way to provide users with faster access to the Internet and other communication media. In collaboration with colleagues at Sandia National Laboratories, MEAM Associate Professor Sridhar Kota has helped to solve this problem by developing compliant stroke amplifier systems, essential components within a microelectromechanical beam steering mirror—known as the Sandia Mirror—that will allow the telecommunications industry to switch increasing amounts of data between fiber optic cables. When coupled with Sandia’s new high-force actuators, the amplifier systems provide the necessary driving force and displacement. The micro engine developed by Professor Kota and featured in this photo above is driven by two electrostatic actuators, each connected to a compliant transmission. The output of the compliant transmissions are then connected through a system of ratchet-pawl mechanisms to a series of compound gears. The entire assembly (patent pending) occupies approximately one-half square millimeter. Using the same drive voltage, the compliant transmissions generate 50 times more torque than the actuators by themselves. The project is being sponsored by Sandia National Laboratories’ Intelligent Micromachine Initiative.

Associate Professor Sridhar Kota

Christophe Pierre


Kazuhiro (Kazu) Saitou


Ann Marie Sastry


William W. Schultz


Volker Sick

Michael Thouless

Grétar Tryggvason

A. Galip Ulsoy

Juris Upatnieks

Alan S. Wineman (BSEEM ’59)

Margaret S. Wooldridge

Jingxia Yuan

Stress contours from atomic diffusion and thermal mismatch in an aluminum inter-connect line are shown in the figure at right. Interconnects, typically a micron in width, form the “wires” of modern integrat-ed circuits. Read more about Assistant Professor Garikipati’s research below.

Garikipati and Micromechanics
Macromechanics and micromechanics have traditionally occupied separate realms of research. The former is concerned with the behavior of large objects and structures seen in the macroscopic world, while the latter focuses on microscopic—and even nanoscopic—features and phenomena in the materials that make up these structures. The research of Assistant Professor Krishna Garikipati reflects a growing interest in modeling large structures (bridges, aircraft, ship hulls, etc.), while suitably accounting for the fine-scale physics governed by micromechanics. Among other things, this requires the development of mathematical and computational frameworks to allow “micromechanical embedding.” While working at the scale of microns, Professor Garikipati also incorporates the influence of the atomic structure on continuum theories. He is particularly interested in building such formulations for coupled problems of mechanics and diffusion in microsystems. The calculations on the aluminum interconnect (bottom image) are an example of this.
DESIGN AND MANUFACTURING

Area Coordinator: Jun Ni
Contributing Faculty: Dionissios (Dennis) N. Assanis; Diann E. Brei; Michael M. Bridges; Dariusz (Darek) J. Ceglarek; Debasish (Deba) Dutta; William J. Endres; Zoran S. Filipi; Scott J. Hollister (i.t.); S. Jack Hu; Gregory M. Hubert; Elijah Kannatey-Asibu, Jr.; Noboru Kikuchi; Yoram Koren, PE; Sridhar Kota; Katsuo Kurabayashi; Robert G. Landers; Liwei Lin; Zheng-Dong Ma; Jyotirmoy (Jyoti) Mazumder; Mostafa (Moses) G. Mehrabi; Nestor F. Michelena; Jun Ni; Panos Y. Papalambros; Zbigniew J. Pasek; Huei Peng; Kazuhiro (Kazu) Saitou; William W. Schultz; Michael Thouless; A. Galip Ulsoy; Jingxia Yuan; Hongyan Zhang.

Journal Articles


Conference Proceedings


Kota S. “Design of Compliant Mechanisms with Applications to MEMS and Smart Structures,” Proc. 10th World Congr. on the Theory of Machines and Mechanisms (FiToMM) 7: 2722–28, Oulu, Finland, June 1999.


**Book Chapters**

DYNAMICS, SYSTEMS AND CONTROLS

Area Coordinator: Huei Peng
Contributing Faculty: James A. Ashton-Miller; Dionisios (Dennis) N. Assanis; James R. Barber, C Eng; Johann Bornstein; Michael M. Bridges; Matthew P. Castanier; William J. Emides; Zoran S. Filipi; R. Brent Gillespie; Thomas D. Gillespie, PE (adj.); Steven A. Goldstein (jt.); Karl Grosh; Gregory M. Hulbert; Yoram Koren, PE; Sridhar Kota; Arthur D. Kuo; Loucas S. Louca; Jonathan E. Luntz; Zheng-Dong Ma; Nicolae (Nick) V. Orlandea (adj.); Panos Y. Papalambros; Huei Peng; Noel C. Perkins; Christophe Pierre; Albert B. Schultz (emer.); Richard A. Scott; Jeffrey L. Stein, PE; Dawn M. Tilbury; A. Galip Ulsoy; Juris Upatinieks (adj.).

Journal Articles


Conference Proceedings


This experimental prototype of a microphone is based on mimicking the cochlea’s structure (biomimetic design). Designs of noise control devices (mufflers) are also being developed. Read more about Assistant Professor Grosh’s research below.


MATERIALS AND SOLID MECHANICS

Area Coordinator: Ellen M. Arruda
Contributing Faculty: Ellen M. Arruda; James R. Barber, C Eng; Krishna Ramakrishna; R. Gankipati; Steven A. Goldstein (jt.); Karl Grosh; John W. Holmes; Gregory M. Hubert; Elijah Kannatey-Asibu, Jr.; Noboru Kikuchi; Sridhar Kota; Kenneth C. Ludema (emer.); Jyotirmoy (Jyoti) Mazumder; Jwo Pan; Ann Marie Saxty; William W. Schultz; Michael Thouless; Alan S. Wineman.

Journal Articles
**Conference Proceedings**


Book Chapters


Books


Rayhanet Ahavan

Vedat (Vee) S. Arpaci

Dionissios (Dennis) N. Assanis

Arvind Atreya

Claus Borgnakke

Steven L. Cecchio

Michael M. Chen

David A. Everest

David R. Dowling

Zoran S. Filipi


**Conference Proceedings**


**Book Chapters**


**Books**


APPENDIX: ACRONYMS KEY

The following key defines the acronyms used in the Presentations and Publications sections of this annual report.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Name</th>
</tr>
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<tbody>
<tr>
<td>AAM</td>
<td>American Academy of Mechanics</td>
</tr>
<tr>
<td>AAPMR</td>
<td>American Academy of Physical</td>
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<td></td>
<td>Medicine and Rehabilitation</td>
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<tr>
<td>ABA</td>
<td>American Bar Association</td>
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<tr>
<td>ACC</td>
<td>American Control Conference</td>
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<tr>
<td></td>
<td>[sponsored jointly by AIAA, AIChE,</td>
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<tr>
<td></td>
<td>AISE, ASCE, ASME, IEEE, ISA and</td>
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<tr>
<td></td>
<td>SCS.]</td>
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<tr>
<td>ACM</td>
<td>Association of Computing Machinery</td>
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<td>ACS</td>
<td>American Chemical Society</td>
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<tr>
<td>AGS</td>
<td>American Gerontological Society</td>
</tr>
<tr>
<td>AIAA</td>
<td>American Institute of Aeronautics</td>
</tr>
<tr>
<td>AIAS</td>
<td>Italian Association for Stress</td>
</tr>
<tr>
<td></td>
<td>Analysis [Non-English acronym]</td>
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<td>AIP</td>
<td>American Institute of Physics</td>
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<td>AISI</td>
<td>American Iron and Steel Institute</td>
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<td>American Nuclear Society</td>
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<td>Automotive Research Center</td>
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<td>American Society of Biomechanics</td>
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<td>-EM Engineering Mechanics</td>
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<td>American Society for Engineering</td>
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<td>-IMECE International Mechanical</td>
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<tr>
<td></td>
<td>Engineering Congress and Exposition</td>
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<td>-AM Applied Mechanics</td>
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<tr>
<td></td>
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<td></td>
<td>-DSC Dynamic Systems and Control</td>
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<td>-FD Fluid Dynamics</td>
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<td>-FE Fluids Engineering</td>
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<td>-HT Heat Transfer</td>
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<td>-ICE Internal Combustion Engine</td>
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<td>-MEMS Micro-Electro-Mechanical</td>
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<td>-NCA Noise Control and Acoustics</td>
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<td>-ND Nonlinear Dynamics</td>
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<tr>
<td>ERC/RMS</td>
<td>NSF Engineering Research Center</td>
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<td>-EMBS Engineering in Medicine</td>
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<td>-ISCAS International Symposium</td>
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