University of Michigan

College of Engineering

MECHANICAL ENGINEERING ANNUAL REPORT

2002-03

MichiganEngineering

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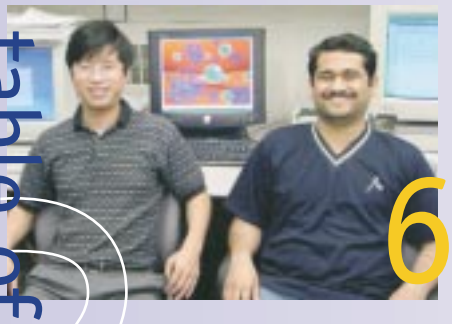


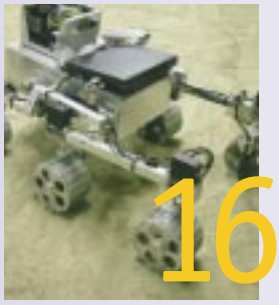
On the cover: Color-enhanced image of an intracellular simulation of carbonic anhydrase (CA) proteins binding free zinc ions in a red blood cell (~7.8microns in diameter). CA molecules bound to zinc are shown encased by transparent green spheres representing fluorescence (emission: 558nm), and apo-CA molecules are shown in blue. CA concentration is ~20nM. These simulations were developed collaboratively, by the groups of ME Associate Professor Ann Marie Sastry, Civil and Environmental Engineering Associate Professor Christian Lastoskie and Chemistry Professor Carol Fierke. The images shown here were generated in Sastry's group by ME Assistant Research Scientist Yun-Bo Yi and ME Ph.D. candidate Munish Inamdar (pictured at left). The complete story and original image are on page 6.

Driving the Technology of the Future

research

Guiding the Pioneers of Tomorrow

teaching



Inspiring Innovation & Excellence

faculty&staff

Heralding Tomorrow's Leaders

students

Recognizing a Lifetime of Distinction

alumni

A Message from ME Chair Dennis Assanis

THE PAST YEAR HAS BEEN FULL OF SUCCESS STORIES AND OUTSTANDING ACCOMPLISHMENTS for the Mechanical Engineering Department at The University of Michigan. We have continued to excel in curricular reform, innovative research and outstanding service. Our undergraduate and graduate programs were both ranked fourth in the nation by *US News and World Report*. Our research expenditures increased by 22% and reached an all-time high ($26.3 million), despite the difficult economy. And our students, alumni, faculty and staff have been recognized at the highest levels for their professional accomplishments and innovations.

ME faculty members are breaking new ground in developing the next generation of teaching methods that are necessary to instill interdisciplinary thinking and hands-on experiences in an asynchronous, web-based format. Award winning examples are the introduction of a new engineering class in sustainable systems engineering, a life sciences initiative class in sound, hearing and deafness, and a self-paced instrumentation lab with web-based tutorials to enable students to design, build and test useful electronic circuits. Our global partnerships have also continued to flourish and to provide valuable international cultural and educational experiences for our students and faculty. Among the highlights for the year, the first group of SJTU exchange students received their U-M MS degrees in April 2003, and the first KAIST-UM joint workshop on reacting flows was a big success.

Among our major manufacturing and automotive research partnerships that continued into 2002-03 are the NSF-sponsored Engineering Research Center for Reconfigurable Manufacturing Systems, which was renewed until 2007, and the Department of Defense-funded Automotive Research Center. Building on the successes of the former GM/U-M Collaborative Research Laboratory (CRL) on Vehicle Systems (1998-2002), ME has forged an enhanced partnership with General Motors with the establishment of two new CRLs for the next five years, one focusing on Engine Systems Research and the other on Advanced Vehicle Manufacturing. In parallel, we have made

Dennis N. Assanis

great strides into the emerging areas of Mechanical Engineering, notably in bio-systems, nano-systems and energy/eco-systems. In a path-breaking collaborative effort, researchers from the ME Department are attempting to capture never-before-seen views of the chemical activity inside living cells in real time and three dimensions, bringing together public health, engineering, chemistry, biology, physics and statistics. In other bio-mechanics projects, our faculty engineer muscle actuators, cells and tissues and conduct research that holds the promise for improving the health and quality of life for injured, disabled and aging people. And as our quest for energy independence and a cleaner environment intensifies, our faculty and students are investigating novel forms of fuel cell and hybrid power and pioneering approaches to reduce drag of high speed vessels and submarines in state-of-the-art, large scale water tunnels.

Working with the College of Engineering's Office of Technology Transfer, a large number of our faculty have commercialized the fruits of their research, thus making a difference for our community through innovative applications

ranging from laser materials processing, to an active velcro for a space station docking, and to miniature wireless instrumentation modules that can help you improve your backswing or even land a trout!

We are delighted to have added to our professorial faculty a new colleague as of January 2003, Dr. Albert Shih who joined the U-M faculty as an Associate Professor, with research interests in design and manufacturing. In tandem with the large expansion of our research volume and the growth of our multi-disciplinary work, we have also welcomed the addition of nine primary research faculty to our ranks. In December 2002, though, the ME family mourned the untimely loss of one of its finest research faculty, Dr. Nestor Michelena. Nestor's many contributions in the area of design and optimization of complex engineering systems will continue to be used by his colleagues for many years.

The Mechanical Engineering Department was again proud to herald tomorrow's leaders, emerging from a supportive intellectual environment that encourages curiosity, discovery, collaboration, and innovation and celebrates diversity, integrity, and excellence. Over the past year, our students have been recognized with highly competitive and prestigious national fellowships and leadership awards for their outstanding commitment and contributions to the community, on and off-campus. Our vibrant engineering society student chapters were not only among the largest, but also among the best organized and motivated in the nation.

Our staff members have continued to strive for excellence and their outstanding performance and spirit of teamwork have once again set the standards in the College of Engineering. And among our many truly distinguished and loyal alumni, Commanding General Paul J. Kern has been honored with the 2002 Alumni Society Medal in recognition of his outstanding accomplishments and his tremendous leadership in service to our country.

In reading our Annual Report, I am certain you will conclude that as the College of Engineering enters its sesquicentennial year, the ME Department indeed has a lot to celebrate. On behalf of our students, faculty and staff, I thank you for your enthusiastic support of our endeavors.

Dennis N. Assanis
Professor and Chair, Mechanical Engineering
Jon R. and Beverly S. Holt Professor of Engineering

"Our research expenditures increased by 22% and reached an all-time high ($26.3 million)...And our students, alumni, faculty and staff have been recognized at the highest levels for their professional accomplishments and innovations."

ME Chair Professor DENNIS ASSANIS

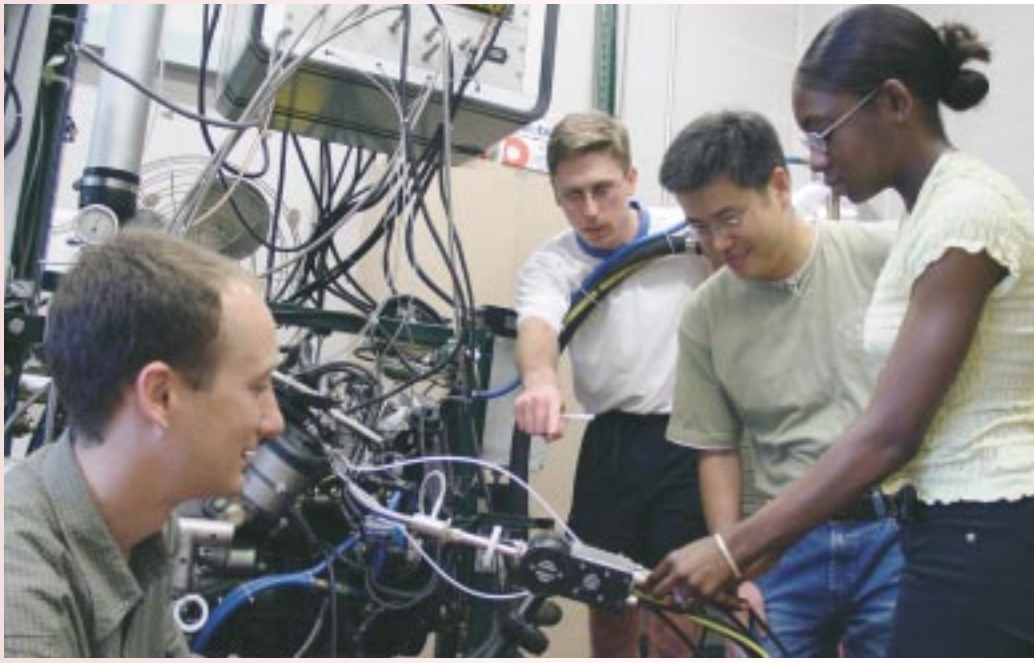
GM, ME Establish New Levels of Cooperation

In the evolving world of cooperation between academia and industry, ME has forged an enhanced partnership with General Motors with the establishment of two new Collaborative Research Laboratories (CRLs). Building on the successes of the former GM CRL, which was funded from 1998-2002, one new lab focuses on Advanced Vehicle Manufacturing (AVM) and the other concentrates on Engine Systems Research (ESR). The former is housed in G.G. Brown building, while the latter is in the W. E. Lay Automotive Laboratory.

In announcing the extended partnership, Dr. Alan Taub, Executive Director of Science Laboratories at GM noted, "This partnership brings together an impressive group of top notch minds to help GM tackle some important issues around engine efficiencies and vehicle manufacturing." This commitment represents the largest single corporate grant ever made to ME, totaling approximately $9 million for the two CRLs over five years.

The goal of both CRLs is to conduct fundamental research into specific areas of concern to GM, and is the result of the truly collaborative nature of the entire project. "We're doing long-range research in key areas that are important to GM, working directly with GM staff as partners in this essential work. The projects we're undertaking are important to GM's energy future, yet they are generic in nature," said ME Department Chair Professor Dennis Assanis.

The Engine Systems Research CRL is under the guidance of Assanis and Dr. Rodney Rask of GM and is funded by a $5.25 million, five-year grant. Research focuses on four key areas: heat transfer and combustion in homogeneous charge compression ignition (HCCI) engines, high-speed direct injection diesel engines, after-treatment systems for diesel engines, and optical diagnostics. The goal is to develop high fuel efficiency and low emission gasoline and diesel engines.



Nicole Carter (right), an Oxon Hill High School student and participant in the Summer High School Apprenticeship Research Programs, assists graduate students Manbae Han and Tim Jacobs (center and second from right), and Assistant Research Scientist Stani Bohac (far left) in adjusting the Ultra Fast NDIR Analyzer used for diagnosing the response of the EGR system on a high-speed diesel engine.

The HCCI engines are combining the best features of spark ignition engines and compression ignition diesel engines. The compression ignition and throttle-less operation gives them diesel-like efficiency, while lean, premixed burning leads to minimal production of nitrous oxides and practically no soot in the exhaust. However, the absence of the direct "trigger" for combustion makes these engines very sensitive to the thermal environment. Hence, this thrust area aims at providing understanding of heat transfer in HCCI engines and using that knowledge to devise strategies for better control of ignition.

"This is a perfect example of a technology that is highly promising, but which is not yet ready to be a commercially viable product. That's exactly what this CRL is all about," said Assanis.

Research in the high-speed diesel engines focuses on advanced fuel injection systems. A diverse range of areas is being explored, including using high-pressure, common rail injection systems allowing multiple injection strategies for better mixing. Homogenizing the mixture and control of combustion temperature allows a diesel engine to jump over the hurdle called NOx-soot trade-off, thus significantly reducing engine-out emissions.

"This partnership brings together an impressive group of top notch minds to help GM tackle some important issues around engine efficiencies and vehicle manufacturing."

DR. ALAN TAUB
Executive Director of Science Laboratories at GM

The ESR CRL's research into after-treatment systems for diesel engines concentrates on developing specially formulated catalysts for diesels to cut down on tail-pipe emissions of nitrous oxides and soot. Various media are being investigated, including lean NOx catalysts, diesel particulate filters and diesel oxidation catalysts. The need for regeneration of some of these devices motivates research into novel modes of combustion, such as the rich premixed burning.

The optical diagnostics thrust area focuses on laser-based imaging and is led by Associate Professor Volker Sick. New imaging techniques allow the study of processes inside engines, enabling researchers to both identify opportunities for substantial improvements for fuel economy and pollutant formation and to understand what is causing sub-optimal performance. The "inside look" is accomplished by using transparent parts and/or optical windows in various parts of an engine.

"We can use the insight from these investigations to model what's happening inside the engine," said Assanis. "We can develop 3-D computational fluid dynamics models of fuel/air mixing, ignition, combustion, and pollutant formation."

Sick also noted the additional educational benefits of the collaboration with GM. "One of the keys to the success of the CRL is our continued interaction with researchers at GM and the fact that our students also spend time at the research labs at GM's Tech Center in Warren," said Sick, "two of our graduate students were hired by GM and now work at the Tech Center." A growing number of domestic and international students are becoming involved in the CRL's research projects, which include undergraduate research projects.

The Vehicle Manufacturing CRL is being led by Professor S. Jack Hu and Dr. Samuel Marin of the Manufacturing Systems Research Laboratory at GM. Funding will total $3.8 million through 2007, and will support research into four primary areas: forming, joining, assembly, and manufacturing systems. For Hu, the grant means that his research team can continue to develop methodologies and technologies to design future manufacturing systems, with an emphasis on producing lightweight body structures and optimizing manufacturing systems to help achieve new levels of flexibility, efficiency, and quality.

Five projects are underway. Two projects focus on the forming of new materials for body structures. This includes, for example, how to hem an aluminum sheet without breaking. Another project concentrates on joining different materials, such as hydroformed tubular structures.

Hu's assembly research attempts to develop models to predict the quality and productivity of manufacturing systems. "We're concentrating on the basics, like the body shop and assembly plant," said Hu, "to see how we can make the entire process better."

Industrial and Operations Engineering Professor Robert L. Smith leads the manufacturing systems research. The objectives of this project are to develop an integrated model of plant investment, production planning, production scheduling, and maintenance.

"We're very pleased with GM's five-year commitment," said Hu, "because it enables us to do some long-range research and be innovative." The former CRL experienced several notable successes, including an ASME Design Technical Conference Best Paper Award; an INFORMS Best Paper Award; and a Holm Award from the Royal Institute of Technology in Sweden. In addition, five patents have been submitted.

The original research laboratory was established in 1998, under the leadership of then-ME Department Chair Professor Panos Y. Papalambros. Hu and Assanis were associate directors of the original GM Satellite Research Laboratory, which conducted research on engine systems, vehicle manufacturing, and systems optimization. In 2000, the name was changed to the GM Collaborative Research Laboratory to reflect the collaborative nature of the facility. The GM CRL at ME was the first established by the company; seven others are now located throughout the world.

In the background: Quasi-3D laser-induced fluorescence imaging visualizes the fuel spray in an optical engine to reveal the impact of in-cylinder flow on fuel/air mixing and engine performance. At left: Dr. Zoran Filipi, Associate Research Scientist (left) and recent graduate Dr. Kukwon Cho (right) discuss modifications of the telemetry linkage system used for measurements of piston top temperatures and heat fluxes.

It's What's Inside That Counts

By pursuing something that's never been done before—exploring the chemical activity inside living cells in 3D and in real time—an interdisciplinary team of researchers is developing groundbreaking technologies for interrogating the intracellular movement of biometals.

The team is in search of metal ions inside cells, said ME Associate Professor Ann Marie Sastry, the principal investigator and team co-leader. A $1.5 million grant from the W.M. Keck Foundation provides funding for the three-year project, and U-M has committed an additional $500,000 to the project.

"The goal of the project is to understand how biometals are exchanged by proteins inside cells," said Sastry. This work will help researchers understand how changes in concentrations are related to clinical events such as strokes and heart attacks, and their role in progressive diseases such as Alzheimer's.

"Biometals like zinc and copper are key initiators," said Sastry, "so it's critical to understand how they move around inside cells, in order to control cell response." Zinc and copper ions, for example, are recognized as key players in many neurological diseases.

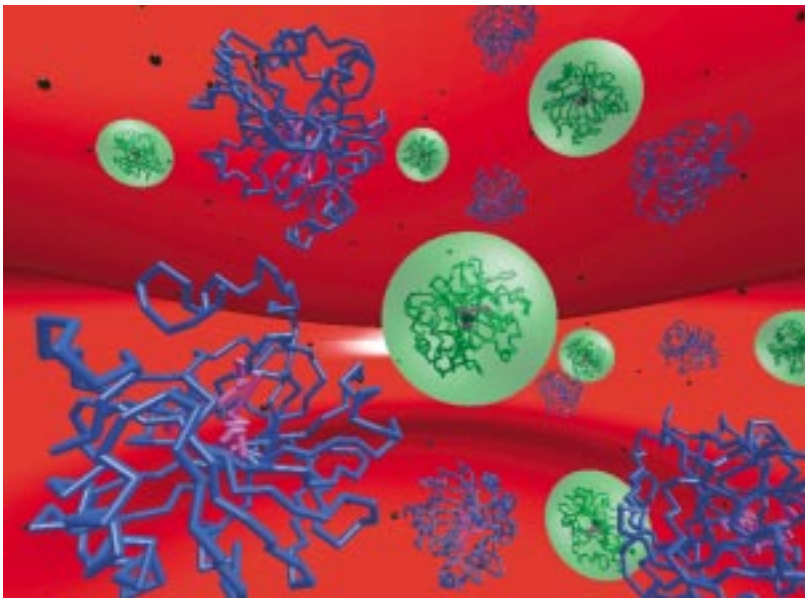
Using Monte Carlo simulations to model the dynamic competition of proteins for ions in the cell, Sastry and Associate Professor Christian Lastoskie (Civil and Environmental Engineering) are mapping the concentrations of each. "It's actually our third favorite collaboration," laughed Lastoskie, citing his two children with wife Sastry as his favorite joint efforts. "The Keck project takes us from the atomistic scale to the cellular scale, using statistical modeling to allow us to bridge these five orders of magnitude." Lastoskie and Sastry were also recently the recipients of a supercomputing cluster by Sun Microsystems, which will allow realization of these intensive computations.

The joint work of Lastoskie and Sastry with Chemistry Professor Carol Fierke on zinc binding is providing first-ever models for zinc exchange in the presence of multiple proteins. One of the key tasks in this part of the research is to understand the "competition" for zinc ions in the cell by the various proteins that bind, or store, zinc. Fierke estimated that the understanding of zinc transport is about 20 years behind what we know about calcium transport. "In the zinc field, we are just beginning to learn how to think about the complexity of ion exchange," she said. Fierke's well-known work in developing fluorescent proteins (carbonic anhydrase) as biological sensors for zinc has provided a key framework for modeling this competition. Professor Dennis Thiele (Biological Chemistry, Medical School) is the team's expert on copper, the other key biometal to be studied.

"The simulations will ultimately allow us to deduce key concentrations of signaling proteins—we are moving from a continuum framework to one in which we use actual cell structure in modeling binding events," said Sastry, "and our students in engineering are developing skills in computational biology, which we can readily transfer to our collaborators in the form of software. Fortunately, we're at a point where computing technologies are able to meet biotechnologies halfway."

The U-M team plans to use nanoprobes invented by team co-leader and Associate Professor of Toxicology Martin Philbert, School of Public Health, and Physics and Applied Physics Professor Raoul Kopelman, College of Literature, Science and the Arts. "Raoul and Martin have developed an array of probes, able to sense a number of key ions and also to provide a platform for new, protein-based sensors," explained Sastry, "and so their technology provides a unique tool for these studies."

The W. M. Keck Foundation was established in 1954 by William Myron Keck, founder of The Superior Oil Company. The foundation's grantmaking is focused primarily on the areas of science, engineering, medical research, and higher education. Sun Microsystems, founded in 1982, is one of the world's leading providers of industrial-strength hardware, software, and services



Simulation of the capture of zinc ions using carbonic anhydrase molecules, which fluoresce when they bind zinc. The simulated domain is a single red blood cell.

Water Tunnel Research is No Drag

"Fish gotta swim and birds gotta fly," as the old song goes. In turn, water tunnels and wind tunnels are used by engineering to study the hydro- and aerodynamics of aircraft, ships, and submarines.

"Water tunnels are similar to wind tunnels in their design and purpose," said Professor Steven L. Ceccio. "Water tunnels require much more power to move the flow, and the structure of the vessel must be able to sustain higher pressures, not to mention the leaks!"

Ceccio has been using water tunnel facilities in his own laboratory and in government laboratories around the country to study the hydrodynamics of ships and submarines, including the largest water tunnel in the world: the William B. Morgan Large Cavitation Channel in Memphis. He has just completed the construction of a new test facility in his ME laboratory.

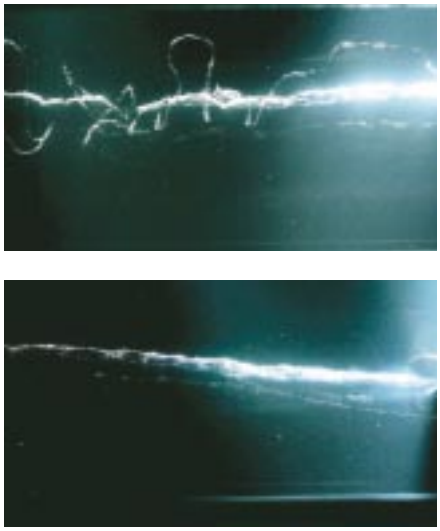
Large water tunnels are mainly used to test scale models of ships and submarines as they are designed. Ceccio's research work is meant to aid the designers of these devices through exploration of their fundamental flow processes.

"We go to the large test facility to examine flows at the size and speeds of real ships, and then we come back to our own laboratory to examine small pieces of the flow in detail." The new water tunnel was built to explore vortex-interactions that were identified by Ceccio and his U.S. Navy collaborators as they examined cavitation inception on a large ducted propeller at the Naval Surface Warfare Center near Washington, D.C. "An unexpected flow mechanism was identified on this propulsor that resulted in the emission of unwanted cavitation noise. After identifying this flow process at the Navy lab, we can now study it in detail with our new test facility."

The water tunnel is a closed loop of flowing water with a test section that has a nine-inch diameter inlet. The tunnel is twenty-two feet long, ten feet high, and has a circular cross section made of stainless steel. The pump is powered by a variable speed 150 horsepower motor, which drives water through a flow management system and a contraction to reduce turbulence in the flow test section.

"We wanted the tunnel to be as flexible as possible," said Ceccio, "so we designed both an open- and closed-end test section. This way we can put a small propeller in the chamber, if we wish." The flow in the closed test section can reach up to 18 meters/second (40 mph) with variable pressure. The tunnel, for which planning began in 1999, took over two years to construct. The design was completed by Ceccio and masters student Daniel Peterman. Construction was done by members of the ME instrument shop, including Warren Eaton, Bill Kirkpatrick, and Kent Pruss. "We are now conducting three different research projects in the tunnel, even as we continue to enhance its capabilities." The tunnel and its associated instrumentation is supported by the U. S. Navy's Office of Naval Research (ONR).

Ceccio and his collaborators have continued to work in the Large Cavitation Channel as well. A study of hydrofoil noise sources conducted in collaboration with Associate Professor David Dowling has just been successfully completed. Ceccio, Dowling, and Associate Professor Marc Perlin of Naval Architecture and Marine Engineering (NAME) have been working with ONR and the Defense Advanced Research Project Agency (DARPA) to study how friction drag can be reduced on the hulls of ships and submarines. Reduction in drag can lead to increased fuel savings and increases in the maximum attainable speed. In this study, a large, flat test model thirteen meters (forty-two feet) long and three meters (ten feet) wide was installed in the LCC test section. Gas injection was used to reduce the friction drag over the model surface, and plans are underway to explore the use of polymer injection for drag reduction. These large-scale tests are essential in order to understand how gas or polymer injection leads to drag reduction at practical sizes and speeds.



Cavitating vortices interact in the wake of two hydrofoils mounted in the U-M nine-inch water tunnel.

Finally, Professor Robert Beck of NAME has joined with Ceccio, Dowling, and Perlin to develop a large-scale high-speed drag reduction experiment. "The Office of Naval Research held a competition with the goal of developing a series of experiments to study drag reduction at speeds up to thirty-five meters/second (seventy-eight mph) and at large size scales. We proposed a series of experiments in an upgraded LCC capable of reaching these high speeds."

Working with researchers at the NSWC, the Applied Research Laboratory at Pennsylvania State University, and General Dynamics, the U-M team completed a proof-of-concept engineering study and a preliminary design. ONR announced in May 2003 that the U-M design was selected, and the team is proceeding with completion of the project engineering.

"We will complete the program design by the early Fall 2003, and we will know by then if sufficient funds will be appropriated by Congress to build and conduct the experiment over the next two to three years," Ceccio said. "I think one reason the Navy keeps supporting us is because we can do both the science and the engineering."

Energy Studies Hold Promise for the Future

If, in the future, fuel cells hit the road, powering automobiles, or sneak down your basement, heating and cooling your house, chances are much of the credit might go to the Fuel Cell Control Laboratory established last year at the Walter E. Lay Automotive Laboratory at the University of Michigan. The research center, the result of some sixteen months of planning, was conceived by co-developers Associate Professors Anna G. Stefanopoulou and Huei Peng. The research team includes graduate students Denise McKay, Ardalan Vahidi, Min Joong Kim, and Kyung Won Suh. The group will soon welcome another PhD student, Bill Tsourapas, who will be supervised by Associate Professor Jing Sun that recently joined the Department of Naval Architecture and Marine Engineering. The 350 square foot lab seems definitely packed when all of them need to take measurements.

Approximately $250,000 was spent to build the experimental facility and support the lab with upgraded infrastructure for hydrogen research. The laboratory was designed to enable the implementation of multivariable controllers, fault detection, and diagnostic algorithms for the regulation of reactant flow and pressure, stack temperature, and membrane humidity. The laboratory's chief goal is the development and testing of real-time control and diagnostic systems to accelerate the use of fuel cells by enhancing their safety, increasing their efficiency, and validating their productive effectiveness in real-world applications. The laboratory is a collaborative effort between ME and the Schatz Energy Research Center (SERC), and United Technologies. Funding has been provided by the National Science Foundation and the Automotive Research Center (US. ARMY- TACOM).

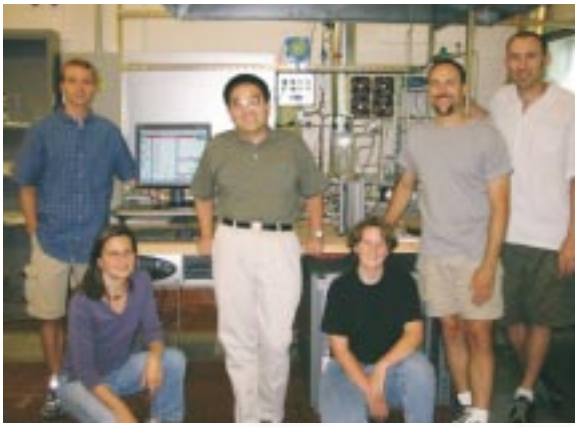
There are three primary areas of concentration for the laboratory. One is creating and implementing real-time embedded control algorithms for fuel cell breathing (aka control of oxygen and hydrogen reactant supply), thermal, and water management. The laboratory's focus in this area will be on understanding, predicting, and controlling the transient behavior of the fuel cell system.

Another sphere of interest is the modeling of fuel cell power systems. In this area, instrumentation and equipment are integrated to collect fuel cell input/output and performance data. Miniature sensors will be placed inside several single-cell stacks to study their thermal and humidity behavior. The collected data will be used to develop fuel cell dynamics and durability models. The experimental set-up also allows the implementation of fault detection, and diagnostic algorithms.

A third primary focus of the laboratory's research is the integration of servo-loop controls such as hydrogen and air flow controls with vehicle-level control algorithms. The goal is to develop the analytical framework and the methodology for calibrating the multi-loop proton exchange membrane fuel cell system to optimize efficiency during transient load demands, typical of urban driving cycles. The research team uses physical principles and empirical relations to develop the dynamic model, and experimental vehicle data for the model validation whenever possible. Optimization and multivariable control analysis and synthesis techniques are also being used to define the system architecture and calibration.

"This type of lab doesn't even exist commonly in industry," said Stefanopoulou. "Most of the commercial labs test only one component of a fuel cell, but here we care about the interaction among the components. Our goal when we established the lab was to develop both diagnostic controls and software."

By design, the Fuel Cell Control Laboratory is an evolving place for fuel cell research. "We're using diagnostics actively," said



Members of the Fuel Cell Control Laboratory (left to right): Graduate student Don Lochner, Associate Professors Anna Stefanopoulou and Huei Peng, and graduate student Denise McKay, all of U-M, and Greg Chapman and Antonio Reis of Schatz Energy Research Center.

A closer look at the Fuel Cell Control Test Station.

Trends & Expenditures

Stefanopoulou. "When we detect a problem or anomaly, our hardware (valves, pumps, fans, etc.) immediately reacts to fix and isolate the problem emulating real world conditions."

One of the problems test centers like this one face is the relative lack of available accurate information. "Many companies that are engaged in this type of research are highly secretive about what they're doing," said Peng, "because of the potential profits that can be made when fuel cells become commercially viable – This is a potentially trillion dollar industry, and therefore many people are unwilling to share their research."

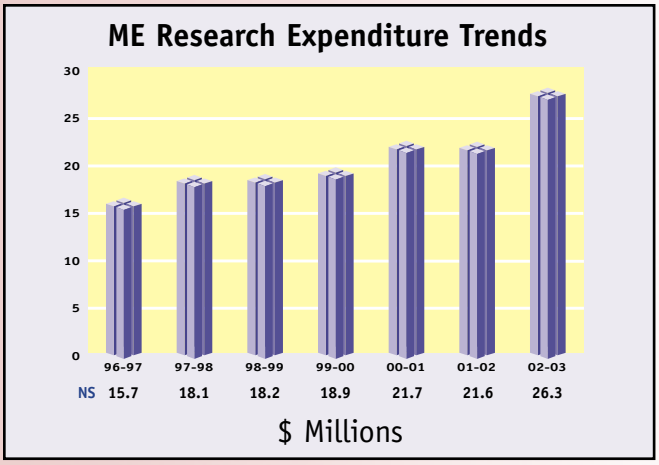
The field is so competitive that at one point, when Peng and Stefanopoulou tried to buy a fuel cell stack for testing, they could not find a vendor willing to sell them one. "We couldn't buy the fuel cell because commercial companies didn't want us to publish," said Stefanopoulou. "So we had SERC build one so we can put sensors all over it," she exclaimed with a big smile.

Fuel cells hold promise for a variety of future applications because they're scalable. It's possible that in the future, they'll power everything from wristwatches to airplanes. While some researchers may be looking into fuel cells of different sizes, the Fuel Cell Control Laboratory is working with a medium-size stack (twenty-four cells). "We're less interested in optimum stack size than we are in what happens when different variables are introduced," said Stefanopoulou.

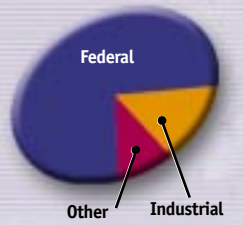
While Peng and Stefanopoulou direct the research, it's not a two-person effort. "I totally depend on my students to help us make this work," said Stefanopoulou. We couldn't do this without them." McKay's interest in the Laboratory's testing goes beyond the usual academic curiosity. She was one of the two lead engineers on the project at SERC. "I actually designed and programmed the software that controls and monitors the fuel cell," McKay said. "I joined the fuel cell team because I wanted to continue working with fuel cell and hydrogen technologies and help teach and train the next generation of fuel cell engineers. Working here also gave me a chance to work with the equipment I had helped create. It was an outstanding opportunity."

Above all, the team is excited about the possibilities of using renewable sources of energy for producing hydrogen fuel because the alternative (fossil fuels) is virtually unacceptable.

"Combining hydrogen and oxygen in a fuel cell is more efficient than combusting fossil fuels. Someday we will have depleted our fossil fuel resources," said McKay. "It may be five days, five generations or five hundred years. We can't wait until it happens. Fuel cell and electrolysis technology works, it's environmentally advantageous, and allows us to use an existing renewable source of power to produce our fuel domestically. I am confident that fuel cell technology will play a role in establishing a diversified energy infrastructure."



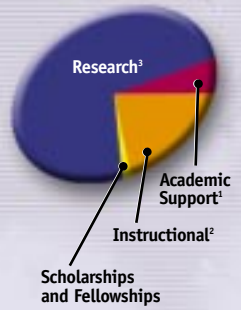
ME Research Expenditures



Distribution by Source
May 1, 2002–April 30, 2003

	%	$
Federal	77.60	20,426,229
Industrial	13.65	3,593,284
Other	8.75	2,303,368
	100.00%	**26,322,881**

ME Departmental Expenditures



Distribution by Source
May 1, 2002–April 30, 2003

	%	$
Academic Support[1]	6.46	2,312,216
Instructional[2]	18.77	6,720,273
Scholarship and Fellowships	1.25	446,631
Research[3]	73.52	26,322,881
	100.00%	**35,802,001**

[1] Funds used to support the academic mission of the department (infrastructure)
[2] Funds used to support teaching and classroom activities
[3] Funds from external (federal and industrial) and internal sources used for research support and generation

From the Laboratory to the Marketplace

In a highly research-oriented university like U-M, theoretical work and the acquisition of knowledge receive high billing, but the practical application of that knowledge for the benefit of society is also promoted.

More than fifty ME faculty have been actively working with the Office of Technology Transfer and Commercialization (OTTC) for Engineering to find commercial applications for their research. OTTC-Engineering, a division of the university-wide Office of Technology Transfer, is the university organization responsible for helping to introduce university research and technology to the marketplace. The process involves obtaining patents and identifying potential users and is a collaboration between the OTTC and the faculty or staff member. The OTTC maintains a list of all of the products available, and works with the inventor or team to seek potential customers. While every deal is different, university guidelines call for a split of any revenues that are generated among the inventor(s), the department, and the school associated with the invention.

"Our goal is to help faculty proliferate their discoveries through commercialization," said former OTTC-Engineering Director Tim Faley, who was recently named managing director of the Samuel Zell and Robert H. Lurie Institute for Entrepreneurial Studies. "This will ultimately benefit society by embedding U-M discoveries into products and services the public employs."

Several products developed by ME faculty are finding encouraging acceptance from a diverse range of commercial sources.

How can two surfaces best be joined without regard to orientation? That is the question **Associate Professor Diann E. Brei** has been working on, and her (tentatively named) "Active Velcro" allows two surfaces to be moved relative to each other without disconnecting the surfaces. The potential uses include possible applications for space station docking.

Professor Jyotirmoy (Jyoti) Mazumder is developing applications for laser materials processing. These applications include laser welding, melt flow measurements, and online, real-time quality measurements. He is working with the POM Group, Inc., one of the world's first companies to introduce reliable, laser-based direct metal fabrication of precision tools and dies for the plastics and the die casting markets. The firm is commercializing Mazumder's original work and patent on closed loop direct metal deposition technique. He also has received another patent on laser welding of galvanized steel, and is working with the OTTC to identify potential markets.

ME research does not always focus on hardware. **Professor Christophe Pierre** has created the "Turbo-Reduce" software, the result of research to develop tools predicting the vibratory response of bladed disks in environments such as jet engines. OTTC works with inventors to find licensees for software, usually in the form of software development organizations that can further develop the application prior to distribution. "Turbo-Reduce" has already found its way into commercial use through traditional licensing as well as through a consortium administered by Carnegie-Mellon University.

The casting analyzer which was developed by Professor Noel Perkins and his students. The tiny sensor in the plastic housing is a MEMS rate gyro, which provides an electronic signal that is acquired by the PDA. The PDA is installed with software that controls data acquisition. The resulting casting analyzer is used to measure and analyze fly casting technique.

OTTC-Engineering Licensing Specialist Doug Hockstad is working with Pierre, and recognizes the unique challenges in licensing software. "Software created in a university environment is often in a research stage," said Hockstad, "requiring further development prior to commercialization. Professor Pierre's software is different in that it's ready for the marketplace."

Given the renewed interest in biological organisms, the work of another ME faculty member is drawing interest for its commercial applications. **Assistant Professor Steven J. Skerlos** is collaborating with other CoE faculty to develop a micro-integrated flow cytometer. The potential uses of this portable, small-scale device include the detection and identification of biological agents, such as anthrax. While research is still continuing, Faley noted that several companies are evaluating the device for potential commercial use.

The research team at the **SM Wu Manufacturing Research Center** (WuMRC), internationally known for its advanced drilling research, is regularly involved in tech transfer activities. Over the years, it has accumulated a wealthy knowledge of advanced drill designs and drilling process improvement. Researchers not only work on the fundamental development of mathematical models for drilling process simulation, geometrical representation and analysis, and automatic generation of drill grinding methods, but also collaborate with industrial members to apply their theories and models to solve challenging problems. Many of

the research findings have found their way to industrial implementations, including the following examples.

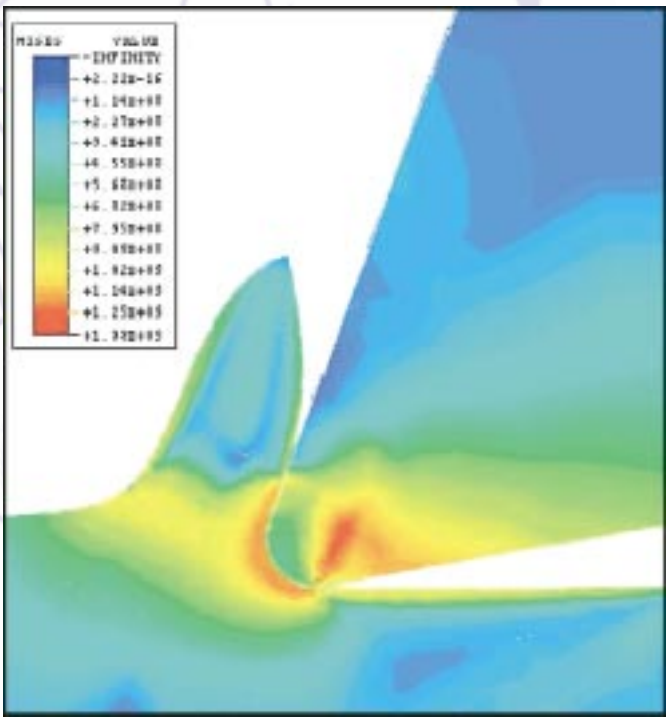
- Honda Motor Company approached WuMRC to develop an advanced gundrill design for its crankshaft production. Working with engineers from both Japan and Honda American Manufacturing in Ohio, WuMRC researchers developed a novel gundrill geometry that can significantly extend the life of the tool for deep hole drilling while maintaining very high drilling penetration rate. After laboratory demonstration as well as production validation, this design has been successfully implemented for production in Honda's Anna Engine Plant in Ohio.
- In another challenging application of small deep hole drilling, Delphi Corporation solicited the help of WuMRC researchers. The goal was to develop a high performance small twist drill design that can significantly increase the penetration rate and eliminate wasteful pecking operations required by the current design. Through careful modeling, analysis and optimization of the process, a new design was created. It greatly exceeded the expectations of the sponsor after numerous field tests and validation. This design is being transferred to a production line at Delphi's Ohio facility.
- Hole making has become a bottleneck in many of today's modern manufacturing systems. With a shared vision to develop future high-throughput hole making technologies, an industrial consortium was formed a few years ago by GM, Ford, DaimlerChrysler, Caterpillar and several leading cutting tool manufacturers. Again, this consortium approached the WuMRC team to help them to achieve their vision. Initially, a mini "Olympic" drill contest was conducted by the consortium to determine the best available commercial drills for high-throughput applications. WuMRC researchers were then asked to develop an advanced design to compete with the best commercially available drill designs. Through close collaboration with the consortium member companies, WuMRC researchers developed an advanced drill design with superior performance. For instance, drilling an 8.5 mm through-hole in a 25 mm thick Aluminum 319 plate, would normally take several seconds. Using the advanced drill developed by the WuMRC researchers, it only takes 0.15 second.

What does a backswing or landing a trout have to do with ME? The answer is found in the work of **Professor Noel C. Perkins**. He has translated his work in the classroom and the laboratory into the development of a miniature wireless instrumentation module that can be attached to a large variety of sports equipment, such as golf clubs, fly casting rods, and tennis rackets. The goal is to help identify optimum motion for maximum performance.

Perkins' module is similar to the hardware used in "strap-down inertial navigation systems" that employ rate gyros and accelerometers to determine position and orientation of a body. This new prototype will address two major weaknesses in a previous prototype: large/cumbersome size and an external wiring harness. "Creating a truly miniature and wireless prototype will provide a compelling proof-of-concept for companies interested in licensing the patent," said Perkins.

Perkins, Professor Khalil Najafi of the Electrical Engineering and Computer Science department, and their graduate students Sangwon Yoon and Kevin King recently completed a bread-board version of their six degree-of-freedom wireless module. This preliminary version included all components to be used in the final version, including three rate gyros, three accelerometers, a chip-based FM transmitter, and supporting receiver and circuitry. They are now constructing two final prototypes that package these components in a cube approximately 1.25 inches per side. To this end, they have machined the cubic surfaces and indexing edges to properly align the sensors and have made provisions to house all accompanying electronics (batteries, voltage regulator, buffers, multiplexor, transmitter) within the same volume. One of these two prototypes will be wireless and the other will have a compact external tether.

One of the applications for the MEMS device is in fly fishing, a particular passion for Perkins, and the product has been featured in a number of national publications. The publicity has been encouraging, and indicates the growing awareness by the commercial sector for products that come out of the OTTC.



Computer simulation model of a drill (developed by the SM Wu Manufacturing Research Center) engaged in cutting.

Life Sciences, NIH Grants Enable Valuable Research

Distinguished Senior Research Scientist James A. Ashton-Miller and colleagues have received funding for two major research areas that hold the promise of better health for women and the elderly.

The first grant is from the Michigan Life Science Corridor (MLSC) to conduct research on "Improving Muscle Power and Mobility of Elderly Men and Women." The second grant involves a Specialized Center of Research (SCOR) award from the National Institutes of Health to study "Improving the Prevention and Treatment of Incontinence in Women"

The MLSC grant is focused on the physical problems that accompany aging, and funds an innovative interdisciplinary approach. The team's proposal stressed using an "integrated style of research," in which a team of researchers from the applied and theoretical sciences and from the clinical area addresses the problem of muscular atrophy, weakness and reduced mobility in the elderly.

As the median age of the population age rises, it is increasingly important to find ways to help older individuals maintain a positive quality of life, said Ashton-Miller. Research demonstrates that after the age of fifty years, aging is accompanied by a steady loss of muscle mass, strength, and especially, power. These changes can make it increasingly difficult to make the quick movements necessary to prevent a loss of balance or to take a quick enough step to prevent a fall following a trip. The resultant muscular weakness can lead to a significant increase in the rate of falls and fall-associated injuries, especially among people over seventy years of age, creating significant economic and other societal issues. The good news is that at any age, weight training can improve muscle function. Although such training can never return elderly muscle to that of a young adult, improvements of 30 percent or more are feasible. These changes can be more than sufficient to maintain one's mobility when older.

The team's first goal is to develop better instrumentation for measuring maximum hip and knee power, as well as better methods to physically train to increase those attributes. Next, this instrumentation will be used to test the efficacy of those training regimens in forty-eight healthy young and forty-eight elderly men and women seventy years old and older. Finally, the effects of the training will be evaluated at the single muscle fiber level, at the whole muscle level, and on the ability to recover from standardized falls. The team hopes to improve the quality of life of older persons by finding better and more efficient ways to increase strength and mobility, thereby reducing the negative consequences of muscle atrophy and weakness.

An older volunteer smiles after having successfully completed a forward fall-arrest test. The rectangular shapes in the floor measure the ground reaction forces under each foot. Optoelectronic markers allow lower extremity kinematics to be measured during the arrest. Joint torques and powers are then calculated.

The team also hopes to use the findings as the basis for the formation of a Center for Aging Muscle and Mobility, to be based in the Institute of Gerontology at U-M. The research team is confident that their multidisciplinary and multilevel approach will enhance the visibility and productivity of already strong individual components in biogerontology and transfer technology from the University to local companies.

In addition to Ashton-Miller, the research team includes Associate Professor Neil Alexander (Geriatric Medicine), Institute of Gerontology Director Bruce Carlson, Assistant Professor Paul Cederna (Plastic Surgery), Professor John Faulkner (Biomedical Engineering), and Dr. Neil Cole of Bio Logic Engineering, Inc.

Ashton-Miller is also a principal investigator (PI) in two of the five components of the $5.6 million, five-year SCOR project, which seeks to improve care for women who suffer from urinary incontinence and pelvic organ prolapse. His colleagues and co-principal investigators are Obstetrics and Gynecology Professor John O.L. DeLancey, MD, and Assistant Research Scientist Janis M. Miller, RNC.

Primary study areas include:

- Pelvic floor biomechanics and birth injury
- Which pelvic floor defects cause stress incontinence
- Selection criteria for pelvic muscle therapy in stress urinary incontinence

Two cores will support these study areas:

- Core A, Administrative/Human Subjects/Biostatistics, provides project support by recruiting subjects, compiling and analyzing data, and protecting subject safety
- Core B, Measurement and Imaging, provides technical support for the three projects, together with integrated image analysis for 2D and 3D spatial data gathered across projects.

Ashton-Miller is the PI on Core B and the first study area, "Pelvic Floor Biomechanics and Birth Injury," which will ideally yield insights into how, when and why certain women are injured during birth. Such injuries are associated with genital prolapse (a kind of hernia) as well as incontinence later in life. Insights will help direct future research aimed at improving the prevention and treatment of these injuries.

Research Centers & Programs Maintain Excellent Performance

Engineering Research Center for Reconfigurable Manufacturing Systems

The Engineering Research Center for Reconfigurable Manufacturing Systems (ERC/RMS), now in its seventh year of operation, successfully passed an intense site visit in May 2003 by a review team from Washington, composed of industry and academic experts in manufacturing, and has been funded through 2007.

The center also gained a new Deputy Director, Professor Jun Ni, as former Deputy Director A. Galip Ulsoy took a leave from the department to serve as Director, Division of Civil and Mechanical Systems, with the National Science Foundation. Associate Professor Dawn Tilbury replaced Ni as Associate Director for Testbeds.

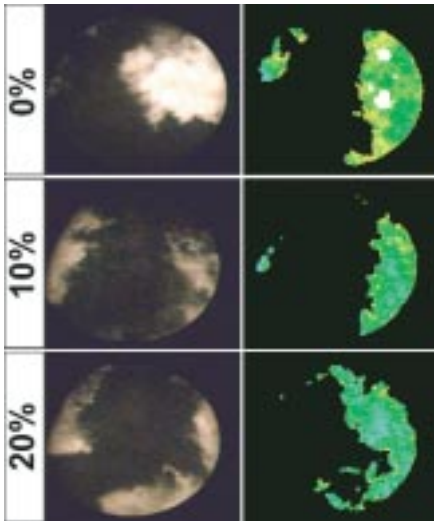
In other ERC/RMS news:

- The Reconfigurable Machining Tool was displayed at the International Technology Show, the largest manufacturing show in Chicago, for ten days. The university prototype made for a unique display, as most prototypes were being exhibited by commercial industry representatives.
- A new four-year partnership was formed with Morgan State University in Baltimore, with researchers from both universities to work in joint teams on four projects in the field of RMS. One of those projects is a new reconfigurable factory mini-testbed, being built and headed by Tilbury, which allows students from remote schools to program and monitor a mini-factory. The mini-testbed, which consists of several machines, a robotic arm, and conveyor, will "provide exposure to real-world systems," according to Project Manager John Korsakas. A major feature of the project is the study of networked control, which offers several advantages over traditional direct wiring, such as reducing the possibility of wiring being cut when it is accidentally run over by a fork truck.
- In August, the ERC/RMS hosted the second CIRP International RMS conference, with more than 100 participants from fourteen countries assembling to present the newest developments in reconfigurable manufacturing. The keynote presentation was delivered by Atsushi Niimi, President of Toyota Motor Manufacturing in North America. A second keynote presentation was given by Dr. John Brighton, head of NSF's Directorate for Engineering.

Automotive Research Center

The Automotive Research Center (ARC) is a unique research partnership founded in 1994 to advance state-of-the-art modeling and simulation of military and civilian vehicles, while providing both educational opportunities and a cooperative link among the military, academia and the automotive industry. Over the past eight years, the ARC, headquartered at U-M and including seven partner schools, has been funded by the Department of Defense, through its National Automotive Center (NAC) and U.S. Army Tank-Automotive and Armaments Command (TACOM) in Warren, Michigan.

The groundbreaking research work of the ARC was highlighted at the Ninth Annual ARC Conference on Modeling and Simulation of Ground Vehicles that took place in mid-May at the DaimlerChrysler Technology Center and at U-M North Campus facilities in front of a record number of participants. The conference showcased collective research efforts, through integrated, cross-cutting case studies, as well as contributions of individual researchers in parallel technical sessions. General Ross Thompson, Commanding General of U.S. Army TACOM, spoke concerning the growing importance of developing methodologies that will redesign future tactical and combat systems to make our armed forces more agile, while improving reliability and maintainability through the use of probabilistic simulation tools. Bernard Robertson, DaimlerChrysler's Senior Vice President for Engineering Technologies and Regulatory Affairs, described the challenges and opportunities in dual-use vehicle product development, especially regarding new hybrid propulsion technologies. Case studies spanned a range of automotive research topics and methodologies, such as simulation-based design and acquisition strategies, new structural simulations and methods for topology optimization and reliability-based optimal design, and driver/vehicle dynamic interactions. An integrative study of technology insertions for future trucks examined combining diesel-hybrid propulsion and fuel cell power for accessories.

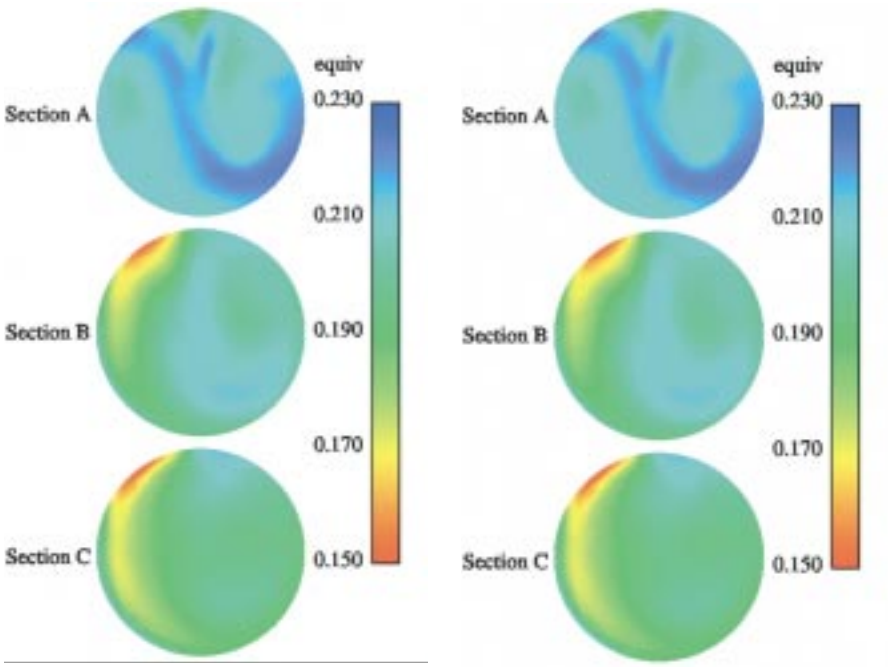


A sequence of images from the heavy-duty diesel engine obtained using the AVL Videoscope technology illustrates the effect of exhaust gas recirculation on flame temperatures.

Continued on page 14

Research Centers & Programs Maintain Excellent Performance (continued)

The third phase of the ARC, scheduled to start in 2004, will explore issues emerging in conjunction with systems engineering of advanced and alternative energy powered ground vehicles. Research efforts will be directed towards dramatically improving fuel economy and reducing visual signature and pollutant emissions, through the use of advanced diesel and hybrid powertrains, fuel cell auxiliary power units, and lightweight material structures. The new concepts, hybrid architectures, component designs and control strategies will be evaluated for duty cycles representing realistic missions of medium and large trucks, including off-road use of tactical trucks with the human in the loop. Research will continue to be organized around the core areas of the center, dynamics and controls of vehicles, digital human modeling, high performance structures and materials, advanced and hybrid powertrains, and integrated system design and simulation, while adding research projects related to robotic vehicles, mobility evaluation, and reliability and uncertainty in design optimization.



CFD predictions of in-cylinder equivalence ratio and temperature distributions for HCCI operation with negative valve overlap (-120 CAD) and high residual gas fraction (~42%) at 30 BTDC.

Multi-University Consortium on Homogeneous Charge Compression Ignition (HCCI) Engine Research

The Multi-University Consortium on Homogeneous Charge Compression Ignition (HCCI) Engine Research, now midway through its three-year effort, has made significant progress in answering the two main technical issues critical to developing HCCI technology: controlling combustion timing, which determines efficiency, and combustion rate, which determines smoothness of operation.

The HCCI concept holds a promise of delivering diesel-like fuel economy, while virtually eliminating emissions due to homogeneous, low-temperature burning

The U-M Rapid Compression Facility is being used to measure ignition delay times of ideal fuels under controlled conditions, for comparisons with chemical kinetic models being developed for HCCI combustion. At the same time, detailed heat transfer measurements made in a single cylinder HCCI engine in the W.E. Lay Automotive Laboratory are showing significant differences from conventional spark ignited engines. Heat transfer and reaction rate data are helping the validation of a new thermo-kinetic engine model which is being developed to investigate the effects of proposed control strategies for affecting the ignition timing in HCCI engines.

U-M researchers are also working with the KIVA-3V computational fluid dynamics code and a new U-M multizone HCCI combustion model to study the role of mixing in determining the rate of combustion. In partner schools, complementary work is underway on experimental engine control methods, and on fundamental chemical kinetics.

A three-year, $4 million endeavor, the HCCI consortium includes U-M, Massachusetts Institute of Technology, Stanford University, and the University of California at Berkeley

Dual Use Science and Technology Program DUST-GM

The second year of the Department of Defense Dual Use Science and Technology program (GM-DUST), a partnership among the DOD, General Motors, and U-M, was even more prolific than the first one, according to Professor Panos Papalambros, director of the program.

The participating research groups – manufacturing, powertrain, and systems – identified four engine subsystems, for which

the effects of manufacturing processes on engine performance and emissions are most significant: inlet manifold, injectors, valve train, and piston ring/cylinder liner assembly. The three teams, consisting of fourteen faculty/postdoctoral researchers, and sixteen graduate student research assistants, characterized surfaces of engine components using high-tech devices and novel techniques, developed analytical and computational models of manufacturing processes and engine performance and emissions, set up and performed experiments to validate computations, integrated simulation tools, and conducted deterministic and probabilistic optimization case studies. The success of the program was reflected during the last review meeting in April 2003, during which the sponsors expressed their strong interest to integrate and use the developed tools in their institutions.

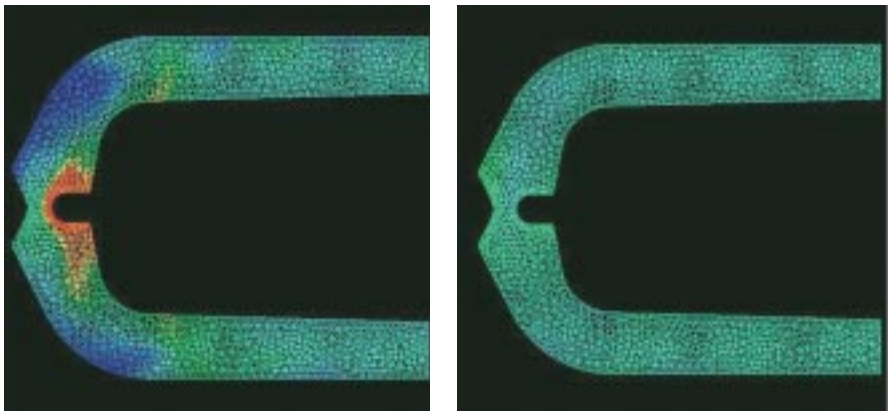
The work has verified the initial hypothesis that variations in engine components due to manufacturing imperfections have a significant impact on performance and emissions. Moreover, important trade-offs, e.g., between different types of emissions, have been identified and analyzed. The developed methodologies address the issues of optimal design under the presence of uncertainties and economic assessment of the use of advanced methods for improved manufacturing quality and therefore mechanical performance. In addition to articles submitted to scientific journals, a number of technical papers will be presented in a special session during the 2004 SAE World Congress and published in the associated proceedings.

Dual Use Science and Technology Program DUST-Ford

Another DUST Program on the "Simulation Based Design and Demonstration of Next-generation, Near-zero Emission Diesel Technology," is in its second year as well, delivering new simulation capabilities and solutions leading to attractive diesel options for light trucks and SUVs. The main motivating factor bringing together researchers from Ford Motor Co., International Truck and Engine Corp., and the U-M ME department is to make light diesel less polluting and quieter, so that the light truck market segment can benefit from the significantly higher fuel efficiency of diesels. Introducing the novel designs and systems will indirectly benefit the fourth partner and sponsor, U.S. Army TACOM, by accelerating the insertion of the new technologies into their future vehicles.

The team of U-M researchers has completed the model development, refinement of the simulation techniques and integration of component and sub-system models into virtual vehicle systems. The simulation tools have been configured for the specific geometries of Ford and International prototypes and validated based on the available experimental data from the highly dynamic test set-up at the W. E. Automotive Laboratory. The team is working on utilizing the simulation tools for systematic studies guiding the development of new designs and control strategies for advanced, near-zero diesels. Computational fluid dynamics (CFD) study has already provided a solution for eliminating a severe problem with the distribution of recirculated exhaust gas through a novel design of the intake manifold's mixing section. In addition, improved predictive capabilities of the CFD tools pertaining to spray break-up, impingement, mixing, combustion and formation of pollutants, such as soot and NOx, are clearing the path to optimum combination of combustion chamber design and injection strategies.

"The aggressive limits set by 2007-2010 EPA regulation will require the use of aftertreatment to clean up the exhaust, much like we did in the past with SI engines," says Program Director and ME Department Chair Professor Dennis Assanis. Hence, detailed models of components, such as the NOx absorber or the urea SCR, are integrated with the engine system simulation and used for development of strategies for maximizing efficiency and allowing regeneration of catalysts and filters.



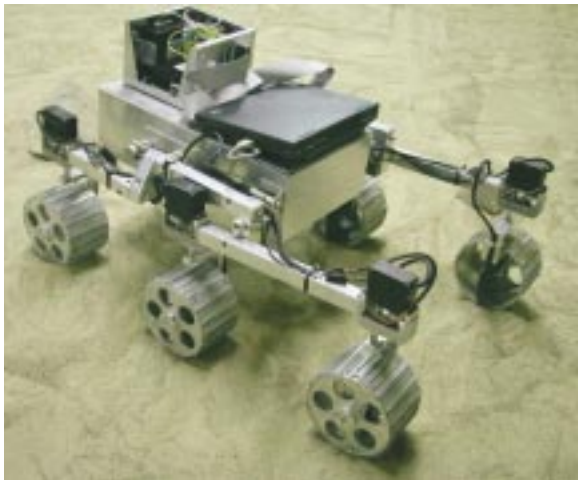
The CFD simulation guides a redesign of the intake manifold for an advanced diesel engine: the original configuration on the left shows very poor mixing of air (blue) and residual (red), while modified tangential EGR inlets produce very even distribution.

Research Notes

Dead-Reckoning Positioning Studied

Senior Research Scientist Johann Borenstein and Research Investigator Lauro Ojeda have been working on the "Proprioceptive Position Estimation (PPE) for Mobile Robots" project. "PPE," also known as "dead-reckoning," means that the system uses only internal sensors, such as gyros, accelerometers, and wheel encoders, but no external beacons or landmarks to determine the relative position of a vehicle. Funding for the project has been provided by The Department of Energy (DOE), NASA, and the Defense Advanced Research Projects Agency (DARPA).

Applications of their work include the development of a PPE system for the Mars Rover 2009 mission. Borenstein and Ojeda, together with Visiting Research Investigator Daniel Cruz, Visiting Graduate Student Giulio Reina, and a team of fifteen undergraduate students have built a clone of a Mars Rover, called "Rocky-8B," and are developing and testing their PPE system on Rocky-8B, roaming around in a Mars-like landscape.



FLEXnav PPE (Proprioceptive Position Estimation) system is shown mounted on the Rocky-8B Mars Rover clone. The system is under development by Senior Research Scientist Johann Borenstein and Research Investigator Lauro Ojeda.

Team Researches Rehabilitation through Haptic Interface

Thanks to a grant from the Midwest Research Network, Assistant Professor Brent Gillespie and Associate Professor Arthur D. Kuo are pursuing research into "Rehabilitation through Haptic Interface to Virtual Environments." The team's work had earlier been supported by an ME department grant established to support information technology initiatives within the department. The research centers around two ways in which haptic feedback can be used: to offer assistance or to enhance error feedback. The goal of the project is to harness a haptic interface and its controller to create manual tasks for stroke patients that function better as rehabilitation therapies than any task that can be performed on a non-motorized, non-programmable exercise device. The hope is to capitalize on the ability of a haptic interface to demonstrate motor interactions, to provide assistance, to encourage the adoption of certain coordination strategies, and to provide intuitive forms of error feedback that allow the patient to focus on and correct errors.

Rehabilitation experiments will focus on the simple task of turning a knob. The exercise will involve pronation and supination of the hand, and will especially encourage supination, which is difficult for many stroke patients. The task will require coordination in time: the objective for the patient will be more than to turn the knob; it will be to pump energy into a resonant mechanical system attached to the knob. A virtual disk that spins about the same axis as the knob will be coupled to the knob through a virtual spring.

In addition to the skill transfer measures, standard functional and strength measures will be used to assess recovery of strength and motor function. Other data available to analyze progress and the adoption of strategies will include the force and motion trajectories for each trial during training and transfer.

Key components include the relative simplicity of a single-axis haptic interface and the tight pairing of task performance with sensory-motor control loops. The single-axis device holds promise as a cost-effective rehabilitation aid that might someday enjoy wide distribution. The preservation of such a motor program through stroke or the role that such a motor program may play in a stroke rehabilitation therapy are important areas in which this project will generate many new hypotheses.

Exhibit will Educate About Product Development

Assistant Research Scientist Zbigniew J. Pasek has been working as the advisor to a student team in the Eng 477 Principles of Virtual Reality class, which teaches the fundamentals of virtual reality. The team's project, a virtual reality museum, was conceived with the idea of informing the public about the evolution of current manufacturing systems. The primary objective of this project, which was developed for display at the Ann Arbor Hands-On Museum, is to create a museum exhibit that will educate and increase awareness of the progress of manufacturing. The goal of the museum project is to educate and increase awareness of the progress of manufacturing in a classroom setting. Each visitor to the exhibit will be able to follow the progress of a pen as it is designed, manufactured, and finally marketed and sold. The project is based in using Virtual Reality Modeling Language, which is rapidly gaining acceptance as a mechanism to visualize geometric representations of a variety of manufacturing and architectural related entities. A model of the team's work is available at http://erc.engin.umich.edu/museum/index.html.

Pasek has also been actively involved in the "Development of a Manufacturing Exhibit for a Hands-On Museum," a project funded under the Education Program of the NSF Engineering Research Center for Reconfigurable Manufacturing. The project supports research in virtual reality educational tools.

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Life Sciences Class Reinforces Value of Interdisciplinary Approaches

The University of Michigan's initiative in life sciences studies is being felt all over campus. Thanks to the efforts of Associate Professor Karl Grosh and his colleagues, ME is among the leaders in bringing this initiative into the classroom via the new Life Sciences UC 264 class.

Grosh was invited to join Associate Professor Kate F. Barald of the Department of Cell and Developmental Biology and Professor John Middlebrooks of Otolaryngology in the development of a course in sound, hearing, and deafness. The course was a natural outgrowth of a university competition in 2000 to develop life sciences courses. Barald had been the chair of a university-wide committee appointed by the provost to draft curricula for new life sciences courses that were part of the general University Life Sciences Initiative. Barald, Middlebrooks, and Grosh developed the course plan, and in 2001, the plan received funding for three years.

According to Grosh, the course content, covering sound hearing and deafness, is in part simply an interesting vehicle for engaging students in the life sciences. Course developers wanted to emphasize the commonality of the scientific method among physics, biology, engineering, and medicine, as well as the fact that the lines between the various fields are blurred, with "significant cross-fertilization," said Grosh.

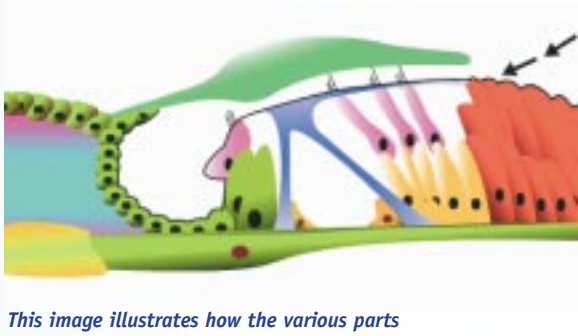
The course's objective is to introduce students to science problem-solving using the approaches of several scientific disciplines, including physics, biophysics, engineering, psychology, and molecular biology. According to Barald, the course is "designed to be cross-informative, in that each discipline's approach to the problems discussed in the course enriches and informs the others."

At the heart of the class is an examination of the auditory processing system, which offers significant opportunities for studies based in and crossing over into Grosh's, Barald's, and Middlebrooks' disciplines. The sensory cells of the ear can detect displacements on a scale of the diameter of a hydrogen molecule, discriminate sound levels across a range of six orders of magnitude of pressure, and distinguish frequencies that differ by one percent over a range of ten octaves. Given that level of sophistication, the ear is a fruitful area for interdisciplinary study. The course outline asks, "How are these feats accomplished with biological tissue?"

The answers, and the discussions that preceded them, have clearly involved and motivated students to a significant degree. Three students – an engineer, a cellular and molecular biology (CMB) student, and a psychology major – are currently working in Barald's laboratory on three completely different projects. The engineer is working on a stem cell project aimed at replacing sound- or disease-damaged nerve cells. The psychology major is working on a zebrafish inner-ear development project, and the CMB student is working on a chick inner-ear project implanting embryonic stem cells into the ear that change the course of inner ear development. The students learn many new skills, including cell culture, stem cell biology, antisense technology, molecular biology, cloning, surgical skills, and developmental biology, said Barald.

Key components of the course include the physics of sound propagation and its detection in fish, avians, and mammals, sensory cell regeneration, and the gene therapy studies that might someday benefit humans. Additional topics include pitch perception, speech perception, and topics in neuroethology, such as how various species have adapted their auditory systems for specialized tasks, including, for example, bat biosonar and sound localization by owls. Additional components include aspects of inner ear development, molecular and cellular development, the neurobiology of hearing and deafness, hair cell regeneration and why it does not happen in humans, deafness genes, and gene therapy approaches.

Based on student evaluations, the initial offering of the course met its objectives. One comment from the student evaluations was typical: "This is a class worth paying for. I can honestly say this was the single greatest course I have taken at this university. So often I find myself in classrooms being taught by a graduate student. In this course, with three doctors, a professor and two associate professors, I was the closest I had ever been to an intelligent environment that I could not help but learn from. I applaud the university for putting together this team whom I believe ran an extremely organized and successful semester."



This image illustrates how the various parts of the inner ear move to sense sound as it propagates through the cochlea. The image was originally developed as part of an animation by former GSI William Grenawitzke as a teaching aid for the Life Sciences course.

The three course developers are already working on improvements for the next time the course is offered. For example, the component dealing with ethical issues was so popular as a basis for discussion it will likely be expanded. The physico-acoustic lab component, devised by Grosh, Middlebrooks, and graduate student Bill Grenawitzke, also will be modified.

"The initial term was very successful," said Grosh. "With a small class, we had the chance to develop the labs and get real-time feedback. We spent a great deal of time on the lectures, honing delivery of complex material to a very general audience. It seems that we succeeded from the students' comments, and now we can further refine the class to improve on our initial efforts."

Shifting Gears in ME350

Students in the ME350 design class used to spend a good portion of their time learning failure theories and design components such as gears, bearings, and screws. For their class project, which constituted forty percent of their grade, instructors provided a list of standard components and all student teams worked on the same project (e.g. the design of an efficient elevator).

Now, under the leadership of Professor Sridhar Kota, the course has shifted gears. Today, students still learn how to select standard components, but also learn how to design non-standard components/sub-systems, and they are given the freedom to choose what kinds of projects they would like to work on.

"Starting from scratch, I teach them how to design a system for any mechanized motion," he explained. "And I let them have fun doing it."

After Kota provides examples of possible projects, students working in teams think of ideas for their own designs. They perform a patent search to ascertain that their idea has not already been implemented, and write a project proposal. Kota and his able teaching assistant, Charles Kim, whom he enthusiastically acknowledged for his contributions beyond the call of duty and his passion for engineering education, read the proposals to make sure that the scope and complexity are appropriate for the course.

Kota's guideline is straightforward. He asks, "Is it possible to frame this as a practical problem in terms of the theory I teach?" He stresses that all projects must deal with real-world constraints. If a team wants to design a tail-gate mechanism for a truck, for example, team members must be able to describe the truck or trucks on which their device will work, in order to meet real packaging constraints.

Once their proposals are accepted, teams create their unique system design using synthesis methods they learn in class (rather than tinkering by trial and error), model it in ADAMS (3D dynamic modeling software), and build a prototype in the student design lab. Students must also size each of the standard components such as gears, bearings, springs, and motors based on force analysis (using ADAMS). This adds realism to their component selection, rather than simply being a dry, end-of-the-chapter problem. The students' projects, along with projects from ME250 and ME450 design classes, are displayed during the ME Design Expo held each semester.

The underlying theory, Kota said, is to "capture the fundamentals needed to synthesize and analyze mechanized motions, be it a prosthetic knee mechanism or a manufacturing automation mechanism, and thereby offer the openness to create something unique that interests students."

Winter 2003 is the second semester Kota has taken this approach with his students. Previously, students in the fall 2003 class designed everything from an inchworm toy to a mechanized weight-lifting spotter, to an improved soccer ball kicker. Kota already feels the new approach has been very successful. Students are learning the basics of the entire design process, which prepares them for more advanced design projects down the road.

(Top) Many weight lifters prefer to bench press using free weights. The problem is that a human spotter is not always available. The "Pro Spotter 900" allows a weight lifter to safely bench press free weights (free standing) anytime he or she wants.

(Above) This redesigned soccer kicker offers a convenient, reliable, and tireless soccer companion that improves soccer lovers' skills and intuition. The goal was to produce a mechanism that could efficiently kick soccer balls at varied heights and speeds and that is not cumbersome or impractical.

Global Partnerships Continue to Grow and Flourish

Partnerships with other universities, particularly institutions in other countries, are an important educational opportunity for faculty and students, providing cultural insights and helping participants to have a global perspective. Among the many exchanges and partnerships in which ME has seen significant activity over the past year are those described below.

Shanghai Jiao Tong University, China

Cooperative programs with Shanghai Jiao Tong University have continued to provide valuable international cultural and educational experiences for students and faculty over the past academic year.

Formally established in 1999, ME's partnership with SJTU facilitates collaboration and sharing of knowledge between the two universities. Students from SJTU travel to U-M to attend classes and earn their degree here. At the same time, distance learning students live and work at Shanghai, attending U-M classes held on the SJTU campus and taught by U-M faculty.

During the past academic year, five SJTU faculty visited and performed joint research at U-M, and six U-M ME faculty taught at SJTU, said Program Coordinator Professor Jun Ni. At U-M, the first twelve SJTU students received their master's degrees in April. Seventeen distance learning students seeking a Master of Engineering in Manufacturing, through the Program in Manufacturing, attended U-M classes on the campus of SJTU.

"Without our partnership with SJTU, we would not have the opportunity to reach them," Ni said of these distance students, who are sponsored by industry leaders such as Delphi and GM.

Another cooperative venture with the Chinese university is a program of summer courses offered by U-M but taught by U-M faculty at SJTU. This allows U.S. students to attend U-M classes in an atmosphere where they are also immersed in another culture and language. As a complementary effort, SJTU designs several courses – art, history, culture, and language courses – especially for the U.S. students, offering greater cultural exposure.

Finally, undergraduates may participate in the Global Intercultural Experience for Undergraduate students program (GIEU), a university-wide program that offers exposure to global issues.

Global Product Development Course

Launched in Fall 2000 by Professor Deba Dutta, the award-winning Global Product Development Course continues to draw significant student interest and praise. Fall 2002 student Chris LaFleur wrote, "As a part time student and full time manager of Fire Prevention and Protection for General Motors Global Security, I can vouch for the impact this type of course will have by educating students and giving us real world experience in being a part of a global team."

Utilizing videoconferencing and other collaboration technologies, the course brings together students from England, Korea, and U-M to develop culturally sustainable products.

"The logistics of the GPD course was extremely challenging and the concept of the course provides many tools for overcoming these obstacles," LaFleur wrote. "The lectures were conducted using state of the art technology that allowed students from four universities across the world to attend class. The student teams were challenged with coordinating four different time zones in completing the course project. The cooperation required to overcome this obstacle will be invaluable in our future. The two face to face meetings of the student teams were instrumental in the success of the course projects, but provided significant challenges inherent to global travel."

Students have learned that success also depends upon overcoming cultural differences, LaFleur said. "Cultural obstacles had to be worked out and cultural advantages had to be gained from these differences. This concept could not be taught any more profoundly than through the structure of this course."

The first group of SJTU exchange students received their UM Master degrees in April 2003.

Dutta's PhD student Lalit Patil has developed an informational web site about the course at http://gpd.engin.umich.edu/

Korean Advanced Institute of Science and Technology, Korea

ME's partnership with the Korean Advanced Institute of Science and Technology (KAIST), officially established in 2001, continued to grow during the 2002-03 reporting year.

Ten U-M ME faculty visited KAIST to teach and attend seminars and workshops, and six KAIST faculty and five KAIST graduate students visited U-M ME. This included a July 2002 visit to KAIST by a large group of ME faculty to participate in a general steering meeting for the future of the program and to attend a technical workshop and collaboration organized by ME Assistant Professor Hong Im, who coordinates the cooperative program at U-M.

This August 20–22, the U-M ME department hosted a joint workshop with KAIST to exchange research interests between the two institutions. The two-day conference consisted of technical presentations by instructional faculty, research scientists, and graduates

KAIST-UM participants and accompanying family are pictured at the summer workshop and the general meeting held in 2002. The above photo was taken in front of the Department of Mechanical Engineering at KAIST, where the Joint Seminars on Reacting Flow Systems were held July 16–19, 2002.

students of KAIST and U-M in four areas: design and manufacturing; dynamics, systems and controls; materials and solid mechanics/MEMS/biosystems; and thermal and fluid sciences.

Two other departments – Electrical Engineering and Computer Science, and Nuclear Engineering and Radiological Sciences–also have cooperative programs with KAIST. The College of Engineering is working to integrate these individual efforts into a unified program, according to an activities assessment provided by Im.

Technical University of Berlin, Germany

The U-M Center for Intelligence Maintenance Systems and the Institute for Machine Tools and Factory Management (Technical University of Berlin) are cooperating on a product that combines two technologies that have already been under investigation by the institutions, according to an executive summary of the project, which was funded earlier this year by the National Science Foundation.

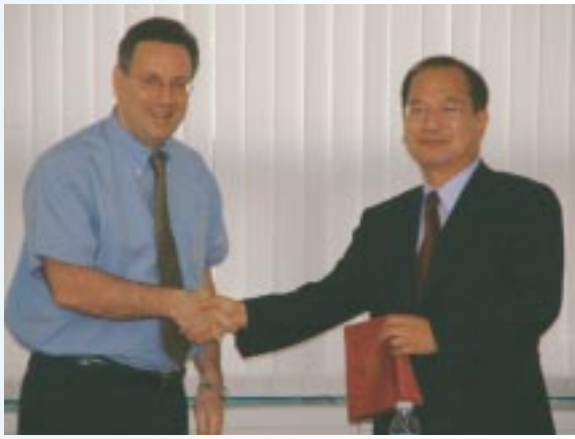
The goal is to develop an Embedded Watchdog Agent/Life Cycle Unit (LCU), which will assess and predict product performance, with information gathered being used to recommend proactive maintenance and to predict reusability of components. The IMS already performs research in the area of intelligent maintenance with information made available by a Watchdog Agent. The LCU was originally envisioned by TU-Berlin.

Practical uses for the technology include facilitating near-zero downtime by embedding it into manufacturing equipment reducing the logistical footprint associated with fleet maintenance in the transportation industry heavy industries, especially where equipment or installations are remote, such as mining equipment, ocean-going vessels, earth-moving equipment, and space exploration vehicles.

ME also partners with TU-Berlin on developing research and teaching material on eco-design and manufacturing with Assistant Professor Steve Skerlos, and students from that university have participated in the Global Product Development course (described on page 21) developed by Professor Deba Dutta.

ME Welcomes KAIST Colleagues

For the 2002-2003 academic year, ME welcomed two faculty members from the Korea Advanced Institute of Science and Technology (KAIST), Professors Chong-Won Lee and Sang Yong Lee, as a part of an academic exchange that was initiated only a few years ago.



Chairs of the ME Department of KAIST (Do Hyung Choi) and U-M (Dennis Assanis) exchange warm greetings at the general meeting held at KAIST on July 18, 2002.

The KAIST partnership also includes participation by the Kwangju Institute of Science and Technology (K-JIST). The primary activity of the program is the exchange of faculty and students to enhance both the teaching and learning processes. Program coordinators are Professor Yong-Taek Im at KAIST and ME Assistant Professor Hong G. Im.

To ease their entry into their new environment, the visiting professors are hosted by ME faculty. Professor Galip Ulsoy hosted Chong-Won Lee and Professor Arvind Atreya hosted Sang Yong Lee. "The host faculty member is someone who has common research interests with the visiting professor, so they can exchange some research collaboration during the visit," said Assistant Professor Hong G. Im. "The host faculty usually arranges most of the logistics of the visit, just as with any other visiting scholars coming to the campus."

"To promote this collaboration program, getting to know the research/teaching activities going on in each other department is essential," said Sang Yong Lee. "For this purpose, both departments arrange an annual KAIST/U-M Joint Workshop to update information on the research activities going on in each institute.

"The workshop is initiated by the program coordinators. The first workshop was held in July of the last year at KAIST, and the second workshop was held in August 2003 at the University of Michigan. Last year, a number of ME faculty went to KAIST to help plan the future of the program. They also took part in workshops and informal meetings with their counterparts in ME at KAIST."

continued on page 22

ME Welcomes KAIST Colleagues (continued from page 21)

At both universities, anyone who participates does so on a voluntary basis. "We have a coordinating professor at KAIST assigned to run this program, who works closely with the department chairman," said Chong-Won Lee. "As in ME here, there is also a committee for reviewing the program."

"The selection of the faculty members is based on the research/teaching plan submitted to the department for review," added Sang Yong Lee. "Of course, the relationship with the host faculty in U-M is very important."

Chong-Won Lee arrived in Ann Arbor at the beginning of the winter term 2003. His responsibilities include working on a research project sponsored by the NSF Engineering Research Center for Reconfigurable Manufacturing Systems (ERC/RMS) and teaching a graduate-level course on Random Data Analysis and Processing in fall term 2003.

Having had time to see how the ME department operates here, he finds little difference between the two. In addition, the campus and city were somewhat familiar to him, as Chong-Won Lee had visited Ann Arbor previously.

"I spent my one-year sabbatical leave here in 1985. Comparing the past and present of U-M, I see a noticeable change and improvement in research and educational activities by the faculty. Overall, the quality of the faculty is still excellent, and the facilities are excellent, as well," he said.

Chong-Won Lee's impressions of students are quite positive.

"I have attended several PhD defense meetings and student seminars. I was very much impressed by the excellent, well-organized, presentations of their work," he said.

Professor Chong-Won Lee received his doctorate in ME from the University of California, Berkeley, in 1980.

Professor Sang Yong Lee joined ME in September 2002, working primarily in research with his host, Professor Atreya. He also took advantage of the student exchange portion of the program.

"I brought three of my graduate students in KAIST to Ann Arbor so that they could feel the research atmosphere in a foreign university. Two of them have already gone back to KAIST after their six-month visit, and another one started his stay in last February and will be staying here until the end of August. It's been very valuable."

His initial impressions of ME have been positive and most of his expectations about the trip were both positive and accurate.

"I expected to build up a practical, two-way collaborative relationship with the faculty members working in the same field. And, of course, I looked forward to a change from my regular routine and everyday life in KAIST. I found exactly what I expected, a warm and talented faculty."

Top: Welcome dinner hosted by U-M ME Department during a visit by the KAIST ME department chair. Below, a visit by KAIST faculty and students to U-M later featured a presentation of student work by KAIST students.

Professor Sang Yong Lee earned his PhD in Mechanical Engineering from Northwestern University in 1982. He also holds a MS in Mechanical Engineering from KAIST (1976) and a BS in Mechanical Engineering from Seoul National University (1974).

PhD Degrees Conferred

FALL 2002

Jaime Camelio
Modeling and Diagnosis of Dimensional Variation for Assembly Systems with Compliant Parts

Co-chairs: S. Jack Hu, Dariusz Ceglarek

Karen (Lee) Fegelman
Modeling, Analysis, and Experimental Verification of a Multi-Mode Vibro-Impacting System

Chair: Karl Grosh

Menelaos Kafkalidis
Fracture Analysis of Plastically-Deforming Adhesive Joints via the Cohesive Zone Model

Chair: Michael Thouless

Raja Koutanya
Process Mechanics of Metal Cutting with Edge Radiused and Worn Tools

Co-chairs: Ken Ludema, William Endres

Ying Li
Optimal Design of Thermally Actuated Compliant Mechanisms and its Application to Product-Embedded Disassembly

Co-chairs: Noboru Kikuchi, Kazuhiro Saitou

Won-Joo Roh
Applications of Level Set Theory to Heat Transfer Problems and Automatic Mesh Generation

Chair: Noboru Kikuchi

WINTER 2003

Farshid Asl
Optimal Control of Reconfigurable Capacity in Manufacturing Systems

Chair: A. Galip Ulsoy

Stanislav Bohac
Reduction of Spark-Ignition Engine Hydrocarbon Emissions and the Associated Local Ozone Production Through Exhaust Variable Valve Timing

Chair: Dennis Assanis

Ryan Fellini
A Model-Based Methodology for Product Family Design

Chair: Panos Y. Papalambros

Theodor Freiheit
Reliability and Productivity of Reconfigurable Manufacturing Systems

Chair: S. Jack Hu

Shih-Huang (Shawn) Lin
Fracture and Fatigue Failure of Spot Welds Under General Combined Loading Conditions

Chair: Jwo Pan

Jay Pukrushpan
Modeling and Control of Fuel Cell Systems and Fuel Processors

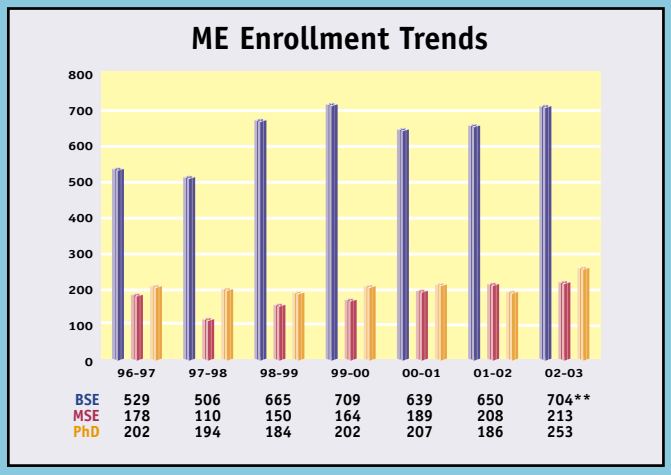
Co-chairs: Huei Peng, Anna Stefanopoulou

Robert Webbink
Generation and Performance Analysis of Assembly System Design Solutions for Single and Multiple Product Lines

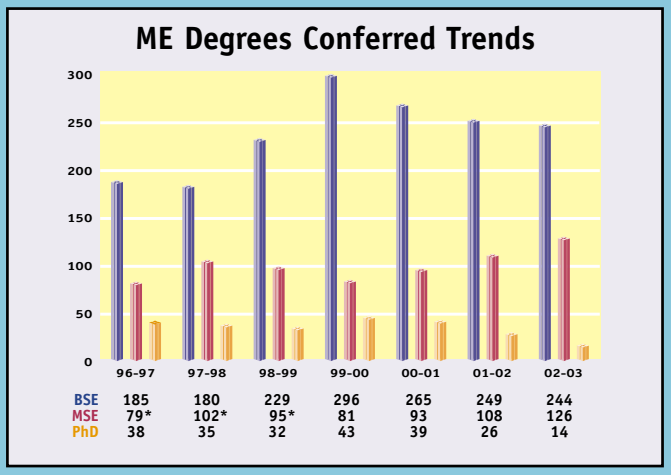
Chair: S. Jack Hu

Lin Zhang
Material Characterization for Finite Element Simulation of Orthogonal Cutting and Drilling

Chair: Jun Ni



**Includes dual and joint degree students and those enrolled in co-op/study abroad programs.



*Includes MSE, ME, and MEng AutoE.

Innovative Course and Teaching Projects Funded By CRLT

Assistant Professor Steven Skerlos

Two ME faculty members have received grants from the U-M Center for Research on Learning and Teaching (CRLT), enabling them to develop innovative courses and approaches to teaching.

The team of ME Assistant Professor Steven Skerlos and Associate Professor Kim Hayes of the Civil and Environmental Engineering Department, was among ten teams to receive a $10,000 Stage 1 grant through the U-M Gilbert Whitaker Fund for the Improvement of Teaching. The Fund provides grants for collaborative groups of faculty for the improvement of teaching and learning. Skerlos and Hayes received the award for their proposal, "Engineering Diffusion of Sustainable Engineering Principles into the College of Engineering Undergraduate Curriculum: Development of a Cornerstone Course."

As outlined in the proposal, Skerlos and Hayes plan to use the funds to help develop interdisciplinary teaching materials and methods for a new course, Introduction to Sustainable Systems Engineering. This would be a cornerstone course for development of undergraduate sustainability concentrations in both departments, with other departments expected to follow. Its implementation would also help satisfy the ABET (Accreditation Board of Engineering and Technology) environmental education outcome required of engineering undergraduates.

More so now than in the past, the development of this course is an important step. First, the increased awareness of and interest in the environment has become the impetus for acquainting today's engineers with designing for the environment. The next generation of engineers must not only consider product reliability and performance in design, but must also incorporate environmental costs and life cycle thinking into product/process development. It is also critical for this course to be taught at the undergraduate level, according to the proposal. Because many U-M graduates go into practice right after graduation and do not take graduate level courses, they could conceivably miss an in-depth introduction to sustainable engineering principles.

The importance of this field was a key component of Michigan Curriculum 2000. The project was the culmination of a five-year, College of Engineering-wide curriculum initiative that began in 1995, involving all undergraduate engineering departments. The primary goal was to reassess the way engineering education was being delivered and to improve the undergraduate engineering experience. The focal point of this component of the project was the expectation that all engineering undergraduate students would obtain environmental literacy by obtaining "the broad education necessary to understand the impact of engineering decisions in a global/societal/economic/environmental context."

Now, because each engineering undergraduate program is expected to teach students about the impact of its engineering discipline on the environment, the development of this class is even more critical. Skerlos and Hayes envision the course as being a cornerstone course which can link into a series of courses in a variety of departments, enabling these departments to develop related undergraduate concentrations in sustainable engineering systems.

Skerlos will oversee the development of web-based tools and the acquisition, development, and testing of computer software needed for design projects and effective delivery of the course. Hayes will be primarily responsible for preparing lecture material and course notes. The team will work together to design the course, homework problems, and integration of material for the course, which they expect to offer in either fall 2003 or winter 2004.

The primary focus of the course will be life-cycle decision making, and will stress the extensive interrelationship between the many and varied areas of engineering. Students will be expected to learn and understand where products come from (materials), how they are made (chemical, mechanical, electrical engineering), how they are transported within the societal infrastructure (industrial and operations engineering, civil engineering), how products are bought and used (economics, energy conversion, human factors), and how the products are disposed of (environmental engineering) or recycled (mechanical engineering and materials). As the proposal noted, it is anticipated that the proposed course will include "artifact-based education, intergenerational peer-to-peer teaching and learning, and open-ended design projects as primary teaching tools. These approaches intend to allow students to forget the engineering disciplines within specific lessons or projects, and permit them to focus on achieving a single creative or educational goal."

In addition, students will be encouraged to pursue their own sustainable engineering interests in the context of open-ended design projects. For example, one project might focus on designing a sustainable cell phone. Students will also be encouraged to create additional course material that will be posted on the Internet for use by future students.

"Skerlos and Hayes are breaking new ground to develop the next generation of teaching methods that are necessary to instill interdisciplinary thinking in our undergraduate students."

ME Chair Professor DENNIS ASSANIS

"Students can start any time, finish any time, and the pace is entirely up to them."

Assistant Professor ROBERT DENNIS

The course promises to be an exciting beginning. As ME Chair Professor Dennis Assanis noted, "Skerlos and Hayes are breaking new ground to develop the next generation of teaching methods that are necessary to instill interdisciplinary thinking in our undergraduate students. I am convinced that the proposed course will have a profound impact on the College of Engineering, and the Departments of Mechanical Engineering and Civil and Environmental Engineering in particular."

The course design is Stage 1 of the process. Stage 1 winners are eligible to apply later for Stage 2 grants, which provide an extra $15,000. More information on the Gilbert Whitaker Fund is available at http://www.crlt.umich.edu/whitakergrant.html.

Taking advantage of the power of the Internet, Assistant Professor Robert Dennis has developed an Internet-based electronics lab course. The objective of the self-paced ME499 Self-Paced Instrumentation Lab: Introduction to Research Instrumentation Laboratory with web-based tutorials (http://www-personal.umich.edu/~bobden/bob_me499.html) is to enable students with no prior experience to design, build, and test useful electronic circuits. The course was funded through a CRLT Faculty Development Fund grant.

A believer in the ability of students to be self-motivated, Dennis opens his syllabus with the exhortation, "Start when you're ready, stop when you're done, and enjoy the process along the way." He noted that the objective of the course is to enable students with no prior experience to design, build, and test useful electronic circuits. By the end of the course, students should be able to understand how most simple electronic circuits function, and they should be able to find resources and further information to improve their circuit design skills.

Assistant Professor Bob Dennis

He also challenges his students by announcing at the start of his syllabus: "Basic assumptions: You are interested in learning to build electronic circuits. You don't mind occasionally failing, and will continue to work until you succeed."

"I have felt very strongly that our department has needed a course in practical electronics for over twenty years, since I was here as an undergraduate student in 1982," said Dennis. "Why? Go to MIT and see what any of their undergraduate mechanical engineers know about electronics and electromechanical devices. I am not talking about just the theory of transistors; I mean a high level of practical knowledge as well as theory."

While several of the course modules are still under construction, Dennis noted that "Students can start any time, finish any time, and the pace is entirely up to them. Some students have trouble with this much freedom, but most actually get a lot out of the experience and start to work on their own projects at some point, just out of personal interest."

In addition to the twenty modules outlined in the on-line syllabus, students are also required to develop a significant project for inclusion in future modules for this course. The students must propose a circuit concept to the instructor, develop content for the web-based tutorial, design, build, and characterize the relevant circuit(s). The resulting material will be considered for inclusion in future modules. As Dennis noted, for many students, this will be their first opportunity to develop instructional material, so it will provide an interesting and unique experience for the student, as well as providing new material for inclusion in the course.

"We feel overall that this course, offered as technical elective to both undergraduate and graduate students, will provide a key element for many of the scholarly and professional activities of our students," said ME Chair Assanis.

In keeping with his penchant for developing innovative approaches to education, in Winter 2002, Dennis also introduced a graduate course, ME599 Biomechatronics. He describes the course as a "graduate survey course of current technologies which involve some sort of designed bio-hybrid system. It includes artificial hearts, cochlear implants, muscle-powered robots...basically anything new that incorporates both a living and a synthetic component into a functional system."

DAS Receives NSF CAREER Award

Continuing the tradition of outstanding academic and practical achievement at ME, Assistant Professor Suman Das has been selected by the National Science Foundation's Division of Design, Manufacture and Industrial Innovation (DMII) to receive a $400,000 CAREER award for 2003-2008. He received the honor for his proposal, "Solid Freeform Fabrication of Heterogeneous Multifunctional Devices."

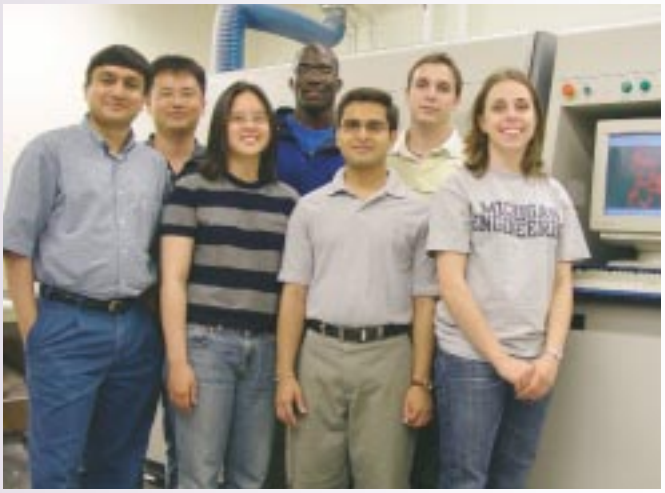
Solid freeform fabrication (SFF) refers to a group of technologies that have revolutionized product design and manufacturing. SFF processes rely on the concept of layer-by-layer material addition in selected regions. Their common feature is an ability to produce freeform, geometrically complex objects directly from a computer-generated 3D digital model. Such a model of an object is first mathematically sliced. Each 2D slice is then sequentially created in a desired material composition to build a complete 3D object.

Das' background and expertise is in a laser-based SFF technique known as selective laser sintering (SLS), in which he has conducted research for over a decade. In SLS, an object is built by fusing sequentially deposited layers of a powder using a computer-controlled laser that scans and sinters patterns onto the powder. SLS has the capability of processing a variety of polymer, metal, and ceramic powders directly into dense, functional forms.

Das' CAREER proposal outlines a research and an educational objective. The research objective focuses on creating a new SFF technology that enables the fabrication of heterogeneous devices with tailored multi-functionality spanning the macro- to nano-scale. This will be achieved by experimental and theoretical investigations in methods for patterned deposition of multiple powders and laser processing to construct such devices layer by layer. The educational objective addresses the development of a multi-disciplinary curriculum designed to foster a new generation of engineers endowed with a fundamental understanding and practical knowledge of solid freeform fabrication, computational design and Internet-enabled electronic collaboration methods.

Das expects future SFF research to significantly affect the way heterogeneous devices will be fabricated. He says, "In the future, major advances in SFF are expected to take place in the development of machines, materials, and techniques that enable the fabrication of heterogeneous, multifunctional components and devices. SFF methods are particularly well suited to building such structures because of the manner in which they construct objects, depositing materials where needed, volume element by volume element, layer by layer. If such SFF methods are successfully developed, they will facilitate entirely new ways of constructing advanced, multifunctional devices that cannot be fabricated by any other means."

He predicts that the primary impact of his research will be a next-generation SFF method based on multiple powder deposition and selective laser sintering with improved accuracy and feature resolution. A consequential impact will be the ability to fabricate novel, multifunctional devices efficiently in a single step. These devices hold the promise of great potential commercial, military, and social value. Specific devices envisaged in the near-term include functionally tailored bio-implants for surgical reconstruction, tissue regeneration, and drug delivery, and highly efficient, small-scale energy production, storage, and conversion devices such as micro-combustors, micro-reactors, or micro-fuel cells. Expected longer-term scientific and technical impacts include innovative approaches to multifunctional materials design and synthesis, and the integration of digital design and digital fabrication, enabling the physical prototyping of computationally optimized device designs derived from physics-based simulations.



Assistant Professor Suman Das (far left) with his research team (left to right), PhD student Haseung Chung, undergraduate Karlin Bark, undergraduate senior Adebisi Adewunmi, PhD student Pranav Kumar, undergraduate senior Tony Vittorini, and undergraduate Elizabeth Beck. Behind the team is the Solid Freeform Fabrication Laboratory's Sinterstation 2000 Selective Laser Sintering machine, which is being used to conduct research on fabrication of tissue engineering scaffolds using synthetic biodegradable polymers and polymer composites.

Typical of his collegial approach, Das was also quick to acknowledge his collaborators Scott Hollister (Biomedical Engineering), Rick Laine (Macromolecular Science and Engineering), Gerard Mourou (Electrical Engineering and Computer Science), John Howell (University of Texas-Austin), Louis Serafin (Signal Medical Corp.), Walt Garff (TAL Materials), and Tim Fuesting (Rolls-Royce Corp.) for writing supporting letters.

Das joined the ME faculty in September 2000. "I was attracted by the excellent national and international reputation enjoyed by the University's College of Engineering, as well as the interdisciplinary collaboration opportunities," he said.

Das received his PhD in Mechanical Engineering from the University of Texas at Austin in 1998. In addition to his CAREER award, Das has received the Outstanding Dissertation Award from the University of Texas at Austin (1999); the Michael Koczak Best Student Paper Award from TMS (1998); and Los Alamos National Laboratory Director's Post-Doctoral Fellowship (1997).

nsf awardees, past & present

NSF Awardees, Past & Present

NSF CAREER AWARDEES

Ellen Arruda	1997
Suman Das	2003
William Endres	1998
R. Brent Gillespie	2001
Karl Grosh	1999
Jack Hu	1996
Hong Im	2002
Katsuo Kurabayashi	2001
Jonathan Luntz	2001
Huei Peng	1998
Kazuhiro Saitou	2000
Ann Marie Sastry	1997
Albert Shih	2000
Steven J. Skerlos	2001
Anna Stefanopoulou	1998
Michael Thouless	1995
Dawn M. Tilbury	1999
Margaret Wooldridge	1998

PECASE AND PRESIDENTIAL FACULTY FELLOW (PFF) AWARD WINNERS

Jun Ni	1994
Ann Marie Sastry	1997
Brent Gillespie	2002

Albert Shih Joins Faculty

Associate Professor Albert Shih

Dr. Albert J. Shih has been named an associate professor on the ME faculty, starting in winter 2003. He comes to ME from a faculty position at North Carolina State University.

Before beginning his term at NCSU in 1998, Shih was a manufacturing process development engineer for seven years at Indiana-based Cummins Inc. Among his accomplishments was the development of grinding process for ceramic plungers in diesel fuel systems to meet EPA standards for diesel exhaust emissions.

After joining the NCSU faculty in 1998, he expanded his research to electrical discharge machining, elastomer machining, and scrap tire recycling. His research focus also included the infrared temperature measurement for grinding and diesel exhaust aftertreatment filters, the manufacturing and characterization of permanent magnets, diamond wire saw cutting of semiconductor wafers, and fuel cell manufacture.

For Shih, the decision to come to ME was an easy one. "The University of Michigan has a long tradition of excellence in manufacturing research," Shih said. "The University provides an excellent facility and infrastructure for research, and it's close to major manufacturing enterprises.

"I worked for many years as a manufacturing engineer before coming back to teaching, and my research interests will continue to be in design and manufacturing. For me, the most attractive part of being at ME is the opportunity to work with so many accomplished faculty, students, and research teams with whom I can collaborate."

Shih has taught ME 450 Design and Manufacturing III, in winter 2003. "It is a senior capstone project design course that I truly enjoyed teaching when I was at North Carolina State University. I will also be teaching ME 350, Design and Manufacturing II, in fall 2003."

Shih attended National Cheng Kung University in Taiwan, where he received a BS in 1984 and an MS in 1986. He received his doctorate in 1991 from Purdue University. He currently holds four patents and has published forty journal papers and twenty-six conference papers. Shih is also a recipient of a 2000 NSF CAREER Award.

Faculty Promotions

The following faculty members were promoted during the 2002-2003 reporting year:

Steven Ceccio, from Associate Professor with tenure to Professor with tenure

Kazuhiro Saitou, from Assistant Professor to Associate Professor with tenure

Anna Stefanopoulou, from Associate Professor without tenure to Associate Professor with tenure

David Everest, from Assistant Research Scientist to Associate Research Scientist

PRS On the Rise

Over the past decade, the number of Primary Research Scientists hired by ME has doubled, with a forty-one percent increase in just the past three years. They fill a unique and necessary role in the department, a role that is growing and being better-defined each year, according to ME Chair Dennis Assanis.

"Research issues are becoming increasingly complex, and they require a lot of multidisciplinary work. Research scientists in the ME centers are often on the forefront of the cross-cutting efforts, thus contributing to the removal of traditional boundaries," explained Associate Research Scientist Zoran Filipi, one of twenty-four PRS currently employed by ME.

This is where PRS are especially useful: They bring with them a solid understanding of multiple disciplines, the ability to work independently, and the ability to concentrate their energies on research, free of significant commitment to teaching responsibilities. This allows them to be more flexible and to quickly respond to new challenges in cases where the sponsor sets very aggressive deadlines, often incompatible with the regular pace of graduate research.

Each university has its own definition of a research scientist, but at the U-M College of Engineering, PRS are considered research faculty. There are four levels of research scientist: senior, associate and assistant research scientist, and research investigator. Prominent PRS, often leading their own labs like Dr. James Ashton-Miller, director of the Biomechanics Research Laboratory, are given the title Distinguished Senior Research Scientist (see also "Life Sciences, NIH Grants Enable Valuable Research," page 13).

Although not defined as "instructional" faculty, research scientists do participate in the educational process by extensively supervising and advising MS and PhD students on all types of projects. Assistant Research Scientist Zbigniew J. Pasek, for instance, is the advisor to a student team in the Eng 477 Principles of Virtual Reality class, which teaches the fundamentals of virtual reality (see "Research Notes," page 17).

ME welcomed eight new PRS this year. Following are brief descriptions of their education and interests.

Stani Bohac joined the department as an Assistant Research Scientist, researching internal combustion engines with special emphasis on emissions, combustion, exhaust gas aftertreatment, variable valve actuation, heat transfer, and friction. He received his BS and MS degrees from the University of Illinois, and earned his PhD from U-M.

Dohoy Jung earned his BS and MS degrees from Seoul National University, Korea, and he received his PhD in from U-M. He joined the department as an Assistant Research Scientist, conducting research in the areas of internal combustion engines; modeling and computer simulation of engine processes and systems; turbocharging, combustion, and pollutant emissions in engines; vehicle and engine system integration modeling; heat transfer; and humidification modeling of fuel cell.

Assistant Research Scientist Muammer Koc conducts research in the areas of manufacturing processes and systems, plastic deformation of materials, hydroforming, production of lightweight parts, application of CAE/FEA, design of tooling and products, e-manufacturing, machine infotronics, and predictive technologies. He is affiliated with the NSF Industry/University Cooperative Research Center for Intelligent Maintenance Systems, the NSF Engineering Research Center for Reconfigurable Manufacturing Systems, and the S.M. Wu Manufacturing Research Center. Dr. Koc received his BS from Middle East Technical University ('91), and earned his MS ('95) and PhD ('99) at Ohio State University.

Michael Kokkolaras, also an Assistant Research Scientist, received his Diploma in Aerospace Engineering in 1992 from Munich University of Technology, Munich, Germany, and his PhD ME from Rice University, Houston, Texas in 1998. His areas of research include optimal design, multidisciplinary optimization, design under uncertainty, systems engineering, product development, design of product platforms and families, surrogate modeling, and financial engineering.

Research Investigator Jianming Li conducts research in the areas of integrated design for reconfigurable manufacturing systems, PDM/PLM (product data management/product lifecycle management), enterprise application integration, and computer-aided design. He received his PhD in Mechanical Engineering ('00) and MS in Mechanical Engineering ('89), from Tsinghua University, Beijing, China, and his BS in Mechanical Engineering ('87) from Beijing University of Aeronautics and Astronautics.

Rhett Mayor joined the department as an Assistant Research Scientist and conducts research in the S.M. Wu Manufacturing Research Center. He received his PhD ('01), MS ('99), and BS ('96) from the University of Natal, Durban.

Assistant Research Scientist Chia Wei Wang's primary areas of research include analyzing porous structure materials for energy devices, and modeling micro mechanical and electrical systems. He received his BS ('92) from National Chiao-Tung University, Hsing-Chu, Taiwan, and his MS ('96) and PhD ('02) from U-M.

Wencai Wang joined the department as an Assistant Research Scientist, conducting research in the areas of computer-aided process planning, feature-based design, development of CAD tools for design of manufacturing systems, machining system dynamics, drill and drilling process. He received his BS ('86), MS ('89), and PhD ('97) from Jilin University, Changchun, China.

Assistant Research Scientist Yun-Bo Yi conducts research in the areas of nanoscale modeling of intracellular transport, percolation phenomena, porous nano/microscale materials, molecular dynamics, and thermomechanical systems. He is affiliated with the Heterogenous Multiscale Materials Lab. Dr. Yi received his BS ('94) from Tsinghua University, China; his MS ('97) from the University of Missouri-Rolla; and his PhD ('01) from U-M.

In Memoriam...

With the untimely death in December 2002 of Associate Research Scientist Nestor F. Michelena after a long illness, ME has lost one of its finest research faculty. Michelena, who worked in the Optimal Design Laboratory, had joined ME in 1995 as an Assistant Research Scientist. He was also an investigator for the Automotive Research Center for Modeling and Simulation of Ground Vehicles and for the GM Collaborative Research Laboratory.

Michelena, a native of Peru, had a diverse range of research interests, including computational tools for the design and optimization of complex engineering systems; theoretical properties of design coordination algorithms, multidisciplinary analysis and design; product platform design; design of non-conventional vehicles; and artificial intelligence in design.

Among his key research projects were System Partitioning and Optimization for Target Cascading; Coordination Strategies for Large-Scale Design Optimization; Model Decomposition for Large-Scale Optimization; Optimization-Based Calibration of Diesel Engine System Models; Optimal Design of Non-Conventional Vehicles; WWW Software Repository for Modeling, Design and Storage; and Distributed Cooperative Systems Design.

Prior to joining the staff, Michelena had been at ME as a Research Fellow from 1993-95. Earlier, he had been a post-doctoral fellow at the CADET (Case-based Design Tool) Project at the Center for Integrated Manufacturing Decision Systems at the Carnegie Mellon Robotics Institute. The project focused on a system that aids conceptual design of electro-mechanical devices and is based on the paradigm of Case-based Reasoning. He also held positions as a Research Engineer and Graduate Research Assistant at the University of California–Berkeley from 1986-1992.

While at ME, Michelena co-authored more than fifteen articles published in refereed journals, seventeen articles in refereed conference or symposium proceedings, and numerous articles and papers in other media and a wide range of conferences and other venues. In addition to his writing, Michelena also served as a technical article reviewer for leading publications, including the *Journal of Design Optimization*, the *Journal of Research in Engineering Design*, the *International Journal of Vehicle Design*, and for several ASME Design Technical Conferences. In recognition of his expertise, Michelena received the 1995 ASME Design Automation Best Paper Award.

Associate Research Scientist Nestor Michelena

Michelena received his PhD (1991), MS and MS Engineering degrees (1987) in Mechanical Engineering from University of California–Berkeley. He was also a member of the Berkeley Expert Systems Technology Laboratory. Earlier, Michelena attended the Catholic University of Peru, where he received his BS and Engineer degrees (1985) in Industrial and Mechanical Engineering. He was a member of American Society of Mechanical Engineers, Institute for Operations Research and the Management Sciences, Mathematical Programming Society, Society for Industrial and Applied Mathematics, American Institute of Aeronautics and Astronautics and International Society for Structural and Multidisciplinary Optimization professional societies.

As a member of the ME family and through his participation in several PhD and MS committees, Michelena was keenly aware of his valuable role in the educational process. He once wrote, "Although my principal function as a Research Scientist is to carry out research without required teaching duties, I consider I have played an important role in the education and training of graduate students at the Optimal Design Laboratory. Constant exchange of ideas and guidance and advising of students have evolved in innovative research topics that have been consolidated in case studies, masters' and doctoral theses."

Professors Dennis & Sick Receive ME Faculty Awards

In recognition of their achievements, Assistant Professor Robert Dennis and Associate Professor Volker Sick have been selected as the recipients of the 2003 ME Awards for Outstanding Faculty Achievement.

A long-time member of the Institute of Gerontology, Dennis joined the ME faculty in 2001 as an assistant professor. Since that time, he has become an inspiration to both his students and his colleagues, thanks to his energy and enthusiasm. In addition to his leading research in bio-systems, he is also focusing on research in muscle tissue engineering, cardiac tissue engineering, nerve tissue co-culture, tendon-muscle interfaces, implantable devices, biomechatronic devices, and cell culture instrumentation. He is currently a member of the ME Undergraduate Curriculum Committee and also an advisor for the Biomedical Engineering Society and the SAE Formula team.

His vision for education transcends the walls of the classroom. Dennis was instrumental in developing a self-paced Internet-based course, ME 499 Introduction to Electronic Instrumentation, for the fall term 2002 (see related story, page 24).

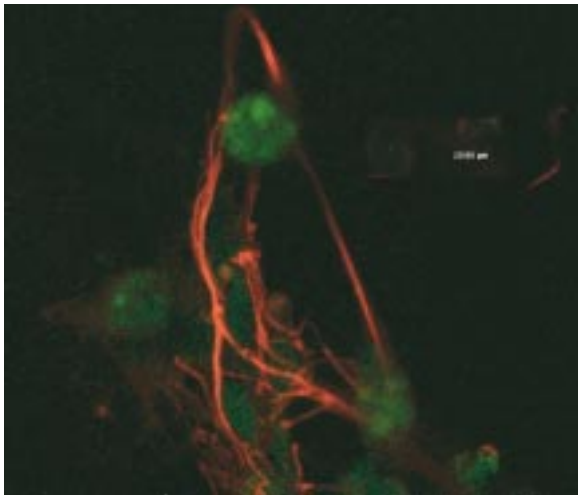
Dennis currently holds four patents based on interferometric force transducers, muscle tissue and peripheral nerves, and has published extensively in the field. He received his doctorate in Biomedical Engineering from the University of Michigan in 1996. He also earned MS degrees in Kinesiology (Human Motor Control) and Biological Engineering from U-M in 1992 and a BSE ME from U-M in 1987. Dennis was the recipient of the ME Teaching Incentive Fund Award for Core Undergraduate Course Instruction in 2001, and he was named Professor of the Term (Fall 2002) by Pi Tau Sigma, the U-M Mechanical Engineering Honor Society.

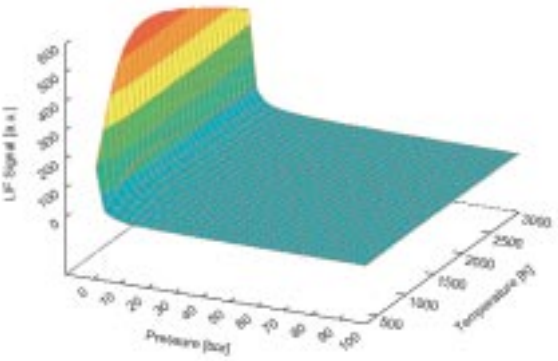
Additional honors have included the Whitaker Fellowship (Musculoskeletal Tissue Engineering) for 1995-96; the Clifford F. Snyder Past Chairman's Research Award from the Plastic Surgery Research Council in 1999, and an Outstanding Research Presentation Award (Acellular Nerve Grafts for Nerve Gap Repair) from St. Joseph Mercy Hospital in 2000.

In addition, Dennis has a joint appointment as assistant professor in Biomedical Engineering. He has also held visiting research scientist appointments at the Harvard-MIT Health Sciences and Technology facility and the MIT Artificial Intelligence Laboratory, Biomechatronics Group, since 2001.

"I really think this award indicates that our faculty recognize and appreciate the value of high-risk research in biomedical technology and biosystems," said Dennis. "This is a new area for Mechanical Engineering, and I am confident that we will assume a position of international leadership in these important emerging areas. This award includes teaching as well as research, so it is far more meaningful to me since I consider undergraduate instruction to be my primary responsibility."

A member of the ME faculty since 1997, Volker Sick has dedicated his time and energy to research in energy, pollutant formation, and engines. In one chief area of interest, engine research, he is focusing his research in quasi-3D imaging of fuel/air mixing and combustion; residual gas mixing; in-cylinder flows; nitric oxide formation in direct-injected gasoline engines; and fuel films. He is also actively involved in research into new imaging diagnostics, with a concentration in residual gas imaging; accuracy and precision of particle image velocimetry in engines; and spray diagnostics.





(Top) Fluorescent con-focal microscopy image of a neuromuscular junction formed between rat fetal spinal cord explant and 3D muscle construct. Red color is CY3 labeled neurofilament protein and green is FITC labeled alpha-bungarotoxin, which binds to ACh receptors. The combination of nerve and Ach receptors is indicative of a neuromuscular junction. (Bottom) Quantitative measurements with laser-induced fluorescence require a thorough understanding of the influence that pressure temperature, and gas composition have on the signal strength. In a collaboration of researchers at UM, Heidelberg and Boulder, CO, a web-based simulation tool was developed and is now released that allows, amongst other functions, the computation of correction factors for specific, user-defined measurement conditions. The tool is accessible via http://www.pci.uni-heidelberg.de/pci/lifsim/.

In addition, he is participating in the research and development of LIFSIM, an online software tool that enables the simulation of absorption and laser induced fluorescence (LIF) spectra (excitation and emission) for NO and O_2. Experimental spectra can be used as input to extract information on concentration and temperature. Correction factors for imaging diagnostics can also be evaluated. Sick is collaborating with Wolfgang Bessler and Christof Schulz of the University of Heidelberg and John W. Daily of the University of Colorado on the LIFSIM project.

To help carry out his teaching and research efforts, Sick has developed a state-of-the art Quantitative Laser Diagnostics Laboratory. There, he and his students pursue a variety of laser-based imaging measurements of fuel-air mixing and combustion studies. He has also been actively involved in the ongoing operation and success of the General Motor/U-M Collaborative Research Laboratory (see related story, page 4). This advanced facility continues to offer significant and unique research opportunities for ME students as a complement to their classroom learning.

The award also recognizes Sick's many contributions to the ME department, including his successes in revitalizing ME's laboratory courses in Thermal Fluid Sciences and his creation of a new class on Instrumentation. He has also served as the chair of the ME graduate program, and he is the incoming chair for the SAE International Fuels and Lubricants Conferences.

"Personally, I feel very honored by this award since it tells me that I have managed to become an integral part of the Department of Mechanical Engineering," said Sick. "Changing fields from the natural sciences (Chemistry) to engineering was and is an exciting journey that influences my teaching and research at the University of Michigan and all partnering institutions."

The current honor is but one of the several he has earned for his work. Sick has also received the ME Teaching Incentive Award for outstanding performance in education in both 1999 and 2001 and the 1999 Forest R. McFarland Award from the Society of Automotive Engineers.

Prior to joining ME, Sick was on the faculty at the University of Heidelberg and held visiting scientist positions at Sandia National Laboratory. He is a graduate of the University of Heidelberg, where he earned a Habilitation (Physical Chemistry, 1997), a Dr. rer. nat (Natural Sciences, 1992), and a Diplom (Chemistry, 1988).

awards

Epureanu Receives National Honor

Assistant Professor Bogdan Epureanu was named as the 2003 recipient of the Pi Tau Sigma Gold Medal, presented by the national mechanical engineering honor society and the American Society of Mechanical Engineers (ASME). The award is given annually to the engineering graduate who has demonstrated outstanding achievement in mechanical engineering within ten years following the receipt of his or her baccalaureate degree. He will receive the medal at the ASME International Mechanical Engineering Congress and RD&D Expo this fall.

Assistant Professor Bogdan Epureanu

Epureanu, who was nominated by ME Professor James R. Barber, credits his PhD advisor, Professor Earl H. Dowell from Duke University, as being a role model through the years. He also pays tribute to the three ME faculty, ME Professor Emeritus John A. Clark (1956), Department Chair Professor Dennis Assanis (1990), and Associate Professor Margaret S. Wooldridge (1999), who previously received this prestigious honor.

"It is an honor to be in their company," he said. "It is especially rewarding to have such a fine recognition of my accomplishments in the past ten years. I like to believe my work is noteworthy, but I am sure there are other researchers in our department and elsewhere who also have brilliant careers, and have accomplished a great deal."

Epureanu joined the ME faculty in January 2002, coming from McGill University in Montreal. He received his BS/MS degree from Galati University in Romania in 1993 and his PhD from Duke University in 1999. He also studied at Ecole Nationale Superieure des Mines de Paris (France) and Valladolid University (Spain).

In addition to the Pi Tau Sigma Gold Medal, he has received (with Professor Dowell and Professor Felipe Montoya of Valladolid, Spain) the A. M. Strickland Prize awarded by the Division of Manufacturing Industries of the Institution of Mechanical Engineers for the best paper (1998), the 2001 Petro-Canada Young Innovator Award, the 2001 Best Paper Finalist Award presented by the Society of Manufacturing Engineers, and the First Prize in the 1998 Eaton Mechanism Design Contest.

His research interests focus on nonlinear and chaotic phenomena, especially reduced order modeling, system identification and structural health monitoring, with applications to aeroelastic, manufacturing, and other nonlinear and complex systems. He is currently working on expanding the range of applicability of chaos and nonlinear phenomena to solving engineering problems.

Instructional and Research Faculty Awards and Honors

Thomas Asmus
- National Academy of Engineers.

Dennis Assanis
- 2002 SAE Award for Research on Automotive Lubricants.

Arvind Atreya
- Service Award, Department of Energy.
- Best Paper Award, 2001 ASME National Heat Transfer Conference, Anaheim, California.
- ASME Fellow.

Claus Borgnakke
- ME Teaching Incentive Fund Award, 2002.

Suman Das
- 2002 CAREER Award, National Science Foundation Division of Design, Manufacture and Industrial Innovation (see complete story, page 26).

Robert Dennis
- 2003 ME Award for Outstanding Faculty Achievement (see complete story, page 30).
- Pi Tau Sigma Professor of the Term, Fall 2002.
- Ruth & Joel Spira Outstanding Teaching Award, April 2003.
- Center for Research on Learning and Teaching Faculty Development Fund award for the development of ME499: Web-Based Electronics & Instrumentation Design (see complete story, page 24).

David R. Dowling
- Fellow, Acoustical Society of America.

Bogdan Epureanu
- ASME Pi Tau Sigma Gold Medal (see complete story, page 31).

Zoran Filipi
- U-M College of Engineering Outstanding Research Scientist Award.

Krishna Garikipati
- Pi Tau Sigma Professor of the Term, Winter 2003.
- ASME Fellow, March 2003.

Massoud Kaviany
- U-M College of Engineering Teaching Excellence Award.

Noboru Kikuchi
- Design and System Engineering Achievement Award, awarded by the Japan Society of Mechanical Engineers at its Annual Meeting, November 2002.

Sridhar Kota
- ASME Fellow.

Jyoti Mazumder
- 2003 Schawlow Award, Laser Institute of America.

Jun Ni
- SME Fellow.
- ASME Fellow.
- Board of Advisors, Chinese Ministry of Science and Technology.

Noel C. Perkins
- 2002 Amoco Undergraduate Teaching Award.

Christophe Pierre
- N.O. Mykelstad Award, ASME Design Division.

Jan Shi
- Excellence in Service Award, IIE Transactions, 2002.

Anna G. Stefanopoulou
- New Faces of Engineering, a feature of National Engineers Week.

Volker Sick
- 2003 ME Award for Outstanding Faculty Achievement (see complete story, page 30).

Steven J. Skerlos
- Gilbert Whitaker Award, Center for Research on Learning and Teaching, 2003.
- Ruth and Joel Spira Outstanding Teaching Award.
- Best Graduate Student Research Paper (2003), Environmental Chemistry Division of the American Chemical Society.
- U-M College of Engineering1938E Class Excellence Award.
- New Faces of Engineering, a feature of National Engineers Week.
- Robert Caddell Memorial Materials & Manufacturing Award (with Fu Zhao), 2002.

Michael Thouless
- ME Teaching Incentive Fund Award, 2002.

Dawn Tilbury
- Outstanding Young Leader Award, University of California-Berkeley Engineering Alumni Society.

A. Galip Ulsoy
- 2002 Leadership Award and Best Paper Award, Dynamic Systems and Control Division of ASME, November 2002.

Wen-Jei Yang
- Fellow of the World Innovation Foundation, Institute of National Enrichment and Development Leonardo da Vinci Award, 10th International Flow Visualization Conference, Kyoto, Japan Bicentennial Medal and Honorary Foreign Member, Societa' Medica Chirurgia di Bologna.

First Machine Shop Class for Staff Drills Success

Staff members of the ME department this summer participated in the first machine shop class for office staff. By all accounts, the class was a great opportunity for a fun and engaging learning experience.

A workshop in August 2002 was designed to help educate and familiarize staff with the equipment commonly used by students in learning (or building projects) in mechanical engineering and to have participants acquire a better sense of what students and faculty use on a daily basis. Following two training sessions, participants in the summer workshop project designed nameplates and learned how to use the various machines located in the department's Design and Manufacturing Laboratory. Aimed at the non-technical staff of the department, participants received training in using the machines, developed problem-solving skills, and garnered a "hands-on" feel for daily business in ME.

The nameplate projects were made using the machine shop's equipment under fairly close supervision. Staff members learned methods of measurement, layout and design implementation, and general machine safety. The staff members used band saws, milling machines, drill presses, laser cutters, files, tap holes, cut out, and plastic engraving tools. Bob Coury, Senior Engineering Technician and instructor of the class, demonstrated the materials and equipment for the project's participants. Some staff members had initial reservations about handling the machinery due to a lack of familiarity, but once they learned how to use the equipment, their fears were soon replaced with excitement.

"Bob was such a patient and encouraging teacher that I quickly became comfortable around equipment I had never used before," said ME graduate student recruiter and class participant Laura Elgas.

"Safety is the main concern and is the most important aspect of the facility," said Coury. All participants wore safety glasses and were instructed on proper machine shop procedures so that they would not be injured.

Planning for the class took a year. The idea originated in discussions Coury had with Administration Manager Marcy Brighton about offering a staff training.

"[The Department] saw the class as an opportunity for office staff to have a better understanding of what our students and technical staff experience in the machine shops," said Brighton, who suggested giving the staff a project to do as part of the training.

Both organizers and participants felt it was a wonderful experience.

"I received great feedback from other staff and faculty members," said Brighton. "From staff, it was 'when is the next class?' and from faculty, there was excitement about the staff being interested in the 'hands-on' side of ME."

The benefits of the class were wide reaching and touched everyone involved "[The class] was definitely worthwhile," said Coury, "I had a chance to get to know the people better and demonstrate what goes on in the machine shop."

The enthusiasm of the staff taking the class was the best part for Brighton. "They worked together, learned more about the department and were able to apply their knowledge in their jobs, like when talking to prospective students."

Staff members Susanne Davis, Laura Elgas, and Sue Gow (top to bottom), all of the Academic Services Office, demonstrate the correct use of machines in the department's Design and Manufacturing Laboratory.

ME Staff Excellence Recognized by CoE

Both an individual staff member and a team of staff received 2003 Excellence in Staff Service Awards from the College of Engineering. Business Manager Margie Lesser was the individual recipient, and the team award went to Warren Eaton, Bill Kirkpatrick, and Kent Pruss, senior engineering technicians in ME's Walter E. Lay Automotive Laboratory Instrument Shop.

The award program was established as part of a comprehensive initiative to recognize the vital contributions by staff to the CoE's success and prominence as one of the nation's premier engineering institutions. Awards, which are based on exemplary work and/or special achievements, serve as tangible evidence of the CoE's appreciation of its outstanding staff members.

This year's awards continue the tradition of excellence set by ME employees. Last year, ME Administrative Manager Marcy Brighton received the individual award.

Margie Lesser joined ME in July 2000 as business manager, but she has worked at the university since 1988. Her primary responsibilities include overseeing ME's finances and grant activities and helping in the planning, development, and implementation of department policies and programs. She also assists and advises Brighton regarding fiscal and operational issues, helps prepare the budget, monitors ME's financial status and activities for compliance, and approves expenditures. Equally important, she supervises the financial staff and makes sure they have the training and tools they need to perform their jobs.

In presenting the award, CoE Dean Stephen W. Director referred to Lesser's superior leadership skills. He acknowledged her work with both staff and faculty, while noting that by improving her team and operations, Lesser has met the critical needs of faculty and improved communication between faculty and staff. "Through her tremendous leadership skills," Director said, "Margie has had a significant impact on an important unit, a large department and the College's overall direction."

The dean also quoted from several of the many letters he received supporting Lesser's nomination. One supporter wrote, "I have observed her change the tone of a group from 'this can't be done' to 'this can work' just by her calm, logical approach to problem solving. No matter how pressured and hectic the environment might be, Margie has a positive attitude that is reflected in the way she interacts with those around her. This same demeanor has often changed a potentially volatile situation to a manageable one."

One of Lesser's staff members put it succinctly, saying, "With her 'can do' attitude, sharp focus and trademark upbeat personality, Margie is the type of leader that a hard working staff willingly follows."

Carole Groh, one of Lesser's staff and the person who coordinated the nomination, said her supervisor's tireless efforts and enthusiasm make ME more efficient and productive. "Margie is very proactive in her staff's professional development. She is very deserving of this award."

In acknowledging the honor, Lesser said: "I'm honored to receive this award. It is very rewarding to be recognized for my efforts and also very humbling. I am very big on staff development and teamwork, and I owe much of my success to my staff and co-workers both in Mechanical Engineering and the College. This award means my work is appreciated and that my staff appreciate me, and more importantly, it gives Mechanical Engineering the recognition it deserves."

Warren Eaton, Bill Kirkpatrick, and Kent Pruss were nominated for the team award by Supervisor of Technician Staff Lynn Buege. The award reflects, in part, a team or group that actively pooled its skills, talents, and knowledge, with evidence of each member's contributions and mutual support of each other.

Buege nominated the team because of their exemplary work in picking up the challenge of maintaining productivity while a key colleague was off on an extended sick leave. Buege also credited Jim Morgan, a retired machinist from Electrical Engineering and Computer Science, for his work supporting the team.

In nominating the three technicians, Buege pointed to their unreserved willingness to help out wherever and whenever needed to make sure that faculty and students receive assistance. For example, the team points with pride to their work constructing a nine-inch water tunnel for the department (see complete story about water tunnel on page 7). In addition, they often provide support to other departments, sharing facilities, manpower and resources, as they do in their ongoing support to the Solid State Electronics Computer Laboratory. It is precisely this spirit of collegiality and cooperation that the Excellence in Staff Service award was designed to recognize.

"These individuals demonstrated exceptional effort when a member of the staff had to be away," said Buege. "There were quite a few people who needed their assistance, and working as a team, they came through. We're proud of their work."

Housed in ME, the Instrument Shop's main charge is to support ME and college-wide research and students, and it was this responsibility that Director focused on in making the presentation. One faculty member's letter of support stated, "In the hundreds of encounters with this team, there has not been a single case where we, the staff, students, or faculty, have had anything but a professional and positive outcome to our requests. They do quality work with a short response time, which helps our research efforts greatly. Their constant attitude appears to be 'What is the right thing to do for the college, the department and the user of the facilities?'"

As might be expected from dedicated professionals, the recipients were modest about receiving the award. "I was amazed," said Pruss. "I don't think we did anything remarkable," a thought echoed by both Eaton and Kirkpatrick.

"We were just doing what we do," said Kirkpatrick.

Above, left to right, are team award winners Warren Eaton, Bill Kirkpatrick and Kent Pruss.

At right is Business Manager Margie Lesser (left) with Administrative Associate Carole Groh, who coordinated Lesser's awards nomination.

staff excellence

Two MEs Earn NSF Graduate Research Fellowships

Most new graduate students will rely on personal funds or loans to see them through graduate school – but a special few are fortunate to start their research with singular financial assistance. This is the case for graduate students Rachel Collino and Christine Vehar, who have been awarded highly-competitive and prestigious National Science Foundation (NSF) Graduate Research Fellowships.

Under this program, NSF provides up to three years of funding, including a $27,500 stipend and $10,500 cost-of-education allowance per year, in the form of a fellowship for students "in the early stages of graduate study in science, mathematics, or engineering." At U-M, Rackham Graduate School makes up the remainder of tuition. More than 6,500 applicants compete for fewer than 1,000 fellowships each year in 20 different disciplines.

In addition to standard information such as GRE scores and field of study, applicants must submit a Proposed Plan of Research and a Previous Research Experience Form. A panel of scientists, mathematicians, and engineers evaluates each application by answering two questions:

What is the intellectual merit of the applicant?

What are the broader impacts of supporting the individual's graduate study?

Collino's plan of research focuses on using functionally graded materials (FGMs) to improve artificial hip joints. At first, her proposal was going to focus on composite materials, but then she began learning about FGMs.

"I had been doing a lot of research for ME450 [Senior Capstone Design class], for which we had a biomedical project. This steered my thinking a bit more to how FGMs could be a much better material replacement for implants, etc.," she said. "I ended up scrapping my old proposal and giving myself a crash course in FGMs." She finished the new proposal just a few days before the application deadline.

"An application of functionally gradient materials that I find especially interesting is their use in various biomedical applications," she wrote in her proposal. "In joint implants, for example, FGM properties are useful in mimicking natural bone, a functionally graded composite itself."

One problem frequently encountered in implants is that the stiffer material of the implant tends to carry the majority of load on the bone. According to her proposal, this produces "a reduction in compressive stresses natural to the bone," leading to bone loss and the eventual loosening of the implant. In artificial hip joints, failure specifically relates to particles that are produced by the rubbing of the joint material. These particles are similar in size to bacteria that the immune system attacks, and, her proposal says, "Chemical processes due to the activity of the immune system then break down the surrounding bone, initiating failure of the artificial joint."

Collino proposed first to study wear behavior of biocompatible materials, such as hydroxyapatite or bioglass, to determine if these would serve as a suitable coating for hip implants to eliminate the offending particles; and second, to "compare the particle wear rate and size to those produced by the metals traditionally used." The research, she said, would apply not only to joint implants but also to implants connected directly to the bone, "exploiting the desirable properties of the biocompatible material while also prolonging the service life of the artificial joint."

Collino, currently in her first year of graduate studies, received her BSE from ME in April 2003 and is working toward a PhD. For the past two summers, she has held internships with Whirlpool Corporation Research and Engineering Center in Benton Harbor, Michigan. She credits her advisor, Professor Michael Thouless, and fellow PhD student Matt Cavalli for helping to prepare her to apply for graduate schools and fellowships.

Vehar's research plan begins by observing that humans typically construct mechanisms "as strong, rigid assembled bodies, while for millennia nature has constructed mechanisms as strong, flexible, integrated bio-components."

She proposed that, "medical applications, such as the cleverly intrinsic, multi-part prosthetic devices and artificial organs, can be astronomically improved if redesigned as biologically inspired compliant mechanisms."

(Left) Rachel Collino, (right) Christine Vehar

Specifically, her research plan aims to "unlock nature's design rules of thumb" by investigating the topology, torsionality, bending, rigidity, and compliance of bio-structures such as tree trunks and squid arms and tentacles; to capture these as mathematical design constraints; and to illustrate the new constraints by redesigning a prosthetic knee as a compliant mechanism. Using the knowledge gained from this research, a "new, automated optimization scheme for compliant mechanism creation" could be developed.

Vehar, currently in her second year of graduate studies, received her BS from the University of Dayton, Ohio, in May 2002 and is also working toward a PhD. As an undergraduate, she held a co-op with an aerospace company, as well as an internship in Washington, D.C. for engineers interested in policy. Her advisor is Professor Sridhar Kota.

Both women have expressed an interest in becoming educators, but Collino also has her eye on industrial research and development and Vehar's experiences have given her a desire to influence policy.

"I know I can't do everything," Vehar said. "But I know my talents, and I want to improve them as much as I can. I love problem-solving."

The Spirit Lives On...

Each year the University of Michigan holds a week-long celebration in memory of Dr. Martin Luther King Jr., leader of America's greatest nonviolent movement for racial equality and justice. The MLK Spirit Awards celebrate North Campus students whose leadership and service has exemplified the spirit of Dr. King. This year, two ME students, NJemile Vinson and Grant Weber, received this prestigious honor.

Vinson was nominated by Associate Professor Bruce H. Karnopp because of her outstanding energy in helping others both on and off campus.

In nominating Vinson, a third-year student in the Simultaneous Graduate/Undergraduate Study (SGUS) program in mechanical engineering and biomedical engineering, Karnopp wrote, "I have noticed NJemile out of class. She is supportive of other students. She helps them to understand material which she has mastered. In looking at NJemile's record of involvement in the university and in the community activities, I note that few students have shown this level of commitment.

"I have taught at the college level for four decades. I have not known many students who were so positively involved in the classes I have taught. I am extremely happy to give NJemile Vinson my enthusiastic recommendation." Karnopp added that Vinson is one of the finest students he has had in four decades of teaching.

Among her many on-campus activities, Vinson has worked with College of Engineering Distinguished Research Scientist James Ashton-Miller on his "loss of balance" research. In addition, she has been very committed to the U-M Chapter of the National Society of Black Engineers, the nation's largest student run organization, of which she is currently Vice President. Vinson is also involved in the residence hall community; she is a resident advisor at Bursley Residence Hall. Vinson is also the founder of dosomethingpositive Enterprises, a not-for-profit empowerment organization for African Americans.

Her many community activities include tutoring at the Ameritech Engineering Learning Resource Center. She is also a youth volunteer corps team leader at the Ann Arbor YMCA, where she recently received the 2003 Program Volunteer of the Year.

"It is an honor to be recognized by the University and the CoE," said Vinson. "It means that people recognize the way I try to contribute to the campus as a whole. It shows that the hard work that I try to do for myself and others on this campus does not go unnoticed."

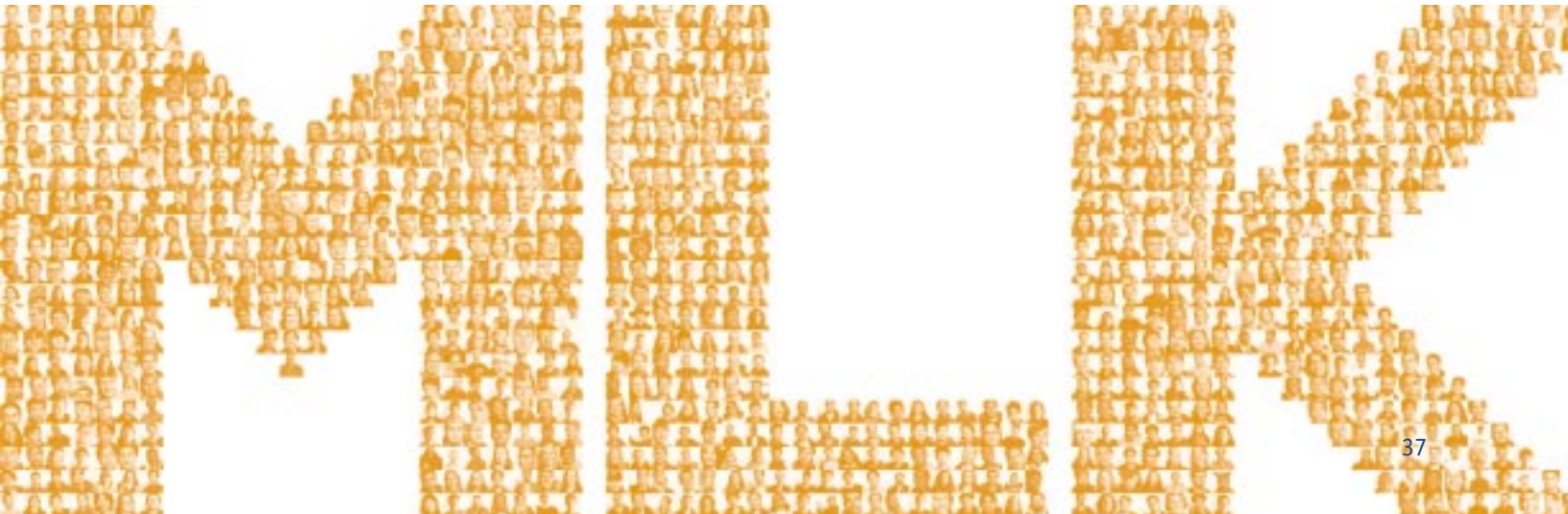
Grant Weber, a third-year mechanical engineering student, is equally busy with extra-curricular activities involving both students and the public. He was nominated by fellow engineering student Atul Manilal Porwal.

As president of Pi Tau Sigma, the mechanical engineering honor society, one of his chief responsibilities is to oversee the society's community-based efforts. To that end, society members regularly take part in numerous campus and community service events. These include participating in the fundraiser for the local Ronald McDonald House and helping to clean the Nichols Arboretum. The society also provides weekly tutoring sessions for first-year and second-year students at the Undergraduate Library. The U-M chapter of Pi Tau Sigma received Best Chapter and Best Service Chapter awards at the group's national convention earlier this year. (see complete story, page 38).

In addition to his role as a member of the Mechanical Engineering Student Leadership Board, Weber was also a coordinator of the student-run Dance Marathon. His efforts and those of his colleagues were tremendously successful; the 2003 event raised more than $197,000 for pediatric rehabilitation programs.

"I didn't know I was nominated until Atul sent me a copy of the essay he submitted," said Weber. "I was totally honored that someone else would take time out of his schedule to recognize some of my efforts here. I was fired up to continue my extracurricular commitments after knowing that my actions were not going unnoticed and that they did make a difference.

"The MLK Spirit Award is very special to me because I was nominated by someone from a Central Campus activity. He recognized my work not only with the Dance Marathon, but also saw my extensive involvement with Pi Tau Sigma and other engineering activities."



UM Chapter of Pi Tau Sigma Recognized for Excellence

Pi Rho Chapter, the U-M chapter of the Pi Tau Sigma national mechanical engineering honors society, received both Best Chapter and Best Service Chapter Awards during the PTS National Convention held February 21-23 in College Park, Maryland.

"There are 161 active PTS Chapters so these awards are major achievements by our Chapter, especially receiving both awards in the same year," said ME Professor Massoud Kaviany, who serves as chapter advisor and Central-Region vice-president of PTS National Council. "All PTS Officers have performed their responsibilities with excellence, particularly the current President Grant Weber and the immediate-past President Lauren Parkins. These students represent the best in the university, college, and department, and we are very proud of them."

Prior to the national convention, chapters complete an awards application where they discuss how their chapter has met the PTS goals of fostering high ideals in the engineering profession, stimulating and supporting departmental activities, promoting the professional welfare of members, and developing leadership and citizenship in members. The application also collected information about the level of involvement of its members, as well as the percentage of members who have served as officers. This document was presented to chapter delegates for voting at the convention.

The chapter award is given for overall activities, a high level of involvement by members, and a high degree of commitment by members and officers. The service award specifically recognizes the chapter's activities in the areas of community service and service to the engineering community.

"Part of the reason we attend this convention is so we can see what other schools are doing, so we can improve our own chapter," said Corresponding Secretary Rahul Sathe. "We came away with the feeling that we had one of the best-organized chapters."

Pi Rho is heavily involved in the department. The group is represented on both the Planning Committee and the ME Student Leader Board, coordinates a Tech Day design event, and co-hosts the student-faculty pancake breakfast with ASME. Pi Rho also maintains the popular ME Survival Guide, provides tutoring services, and volunteers at Ronald McDonald House.

"Our main fundraiser is grilling brats on the diag," said Secretary of Affairs Greg Braziunas, who previously served as the "Brat Chair" coordinating the cookouts and now continues to lend a hand at grilling just because he likes it.

"It gives us an opportunity for us to interact with the initiates," said Sathe, who also steps up to the grill regularly.

Both officers were grateful to the ME department, which funded the officers' trip to the convention. Attending this year's convention were Sathe and Braziunas, as well as Publicity Chair Heather Landis, Date Auction Chair Francesca Vitale, and Webmaster Tony Vittorini.

"We left the convention with the feeling that our chapter is not only one of the largest, but one of the best organized and motivated in the nation," wrote Sathe in a memo thanking Professor Greg Hulbert (who advocated for funding the trip) and the department. "We could not achieve such acclaim or such high standards without the fantastic help from yourself and the Mechanical Engineering Department."

Members of the Pi Rho Chapter of Pi Tau Sigma serve fresh-grilled bratwursts on the diag.

Crawford Wins National Award

Mark Crawford, Jr., a doctoral student in Mechanical Engineering and a Ford Motor Company product design engineer, has received the 2002 GEM/Black Engineer of the Year Student Leadership Award. The award was made for Crawford's demonstrable leadership in engineering and for his continued effort to educate young minorities. GEM, the National Consortium for Graduate Degrees for Minorities in Engineering and Science, presents the award annually to a current GEM fellow in a master's or doctoral program in engineering or science. Crawford formally received the award during the Black Engineer of the Year Conference held in February 2003 in Baltimore, Maryland.

Since joining Ford in 1998, Crawford has showed the company they were wise to hire him. To date, he has helped save several million dollars on the 2002 Ford Explorer, led product teams at the Kansas City Assembly Plant for the 2000 Ford Escape, and led a team that submitted a business plan for a new vehicle and convinced Ford's upper management to incorporate it into its product cycle plan.

While a member of Ford's Knowledge-Based Engineering Group, he created a software architecture that tremendously speeded up the development process of knowledge-based engineering software applications. His work was so impressive that Ford has encouraged him to apply for a patent. Currently, Crawford is part of Ford's Global Core Engineering Vehicle Dynamics Group, where he is working to integrate software to assist in the development of chassis control systems.

Beyond his clear and extensive professional commitments, Crawford has continued to be active in important community-based issues. He created Ford's mentoring program with the University of Missouri-Rolla's (UMR) Minority Engineer Program and serves as a Ford recruiter for UMR. In 2002, he was appointed by the UMR Chancellor to the African-American Recruitment and Retention Committee at UMR. He will now have direct input into the university's recruitment and retention of African-American engineering students.

He also established the Mark and La'Tonya Crawford Endowed Scholarship Fund to support underrepresented minority students pursuing engineering degrees. He participates in the Detroit Area Pre-College Engineering Program as a lecturer and corporate participant, and he serves as a mentor and counselor to the organization's teens.

"Receiving this award was an incredible experience," said Crawford. "My vice-president and chief engineer at Ford presented the award to me initially, and that recognition is truly the most memorable of my career thus far. This award is important because it acknowledges the hard work and commitment of those that strive to inspire others to pursue a technical education. This award encourages students to be mentors and to get involved in the community to promote engineering as a career choice to minority students."

Crawford chose to attend the University of Michigan because of its strong mechanical engineering academic program and research opportunities. "The university's ties to the automotive industry, especially the Automotive Research Center, persuaded me that this was the best place for me to continue my education," he said.

Since entering the doctoral program in 2002, Crawford has already felt the benefits of his decision. "My work at ME has already generated real-world results in my job at Ford," Crawford said. "I believe that my education here is truly preparing me to be a technology leader, and I'm very excited about my future opportunities."

Mark Crawford, Jr.

Crawford graduated from the University of Missouri-Rolla, with honors, with a BS in mechanical engineering in 1996. While there, he was honored by Who's Who Among American College and University Students. After completing his undergraduate program, Crawford won both an MS GEM Fellowship and an NSF Fellowship to pursue his masters' degree in mechanical engineering, which he received in 1998.

A native of Kansas City, Missouri, Crawford currently resides in Belleville, Michigan with his wife, La'Tonya Crawford, and their twin boys, Jordan and Jamal. In his free time, he enjoys camping and traveling.

Distinguished Leadership Awards Recognize Commitment, Contributions

Doctoral students Haitham Mahmoud and Tershia Pinder are the recipients of the U-M College of Engineering's Distinguished Leadership Award, which is presented to "a student who has demonstrated outstanding leadership through his/her contributions to the college and/or the community." Dean Stephen W. Director made the presentation at the annual Leadership Recognition Dinner in March.

Top to bottom: Tershia Pinder, Haitham Mahmoud

"It was great to receive this award," said Mahmoud. "On the one hand, I felt joy and pride to be recognized and honored, but on the other I had some anxiety because I know that now more needs to be done."

In keeping with the criteria for the award, Mahmoud has made numerous contributions both on and off campus. He was one of the organizers of the 2002 ME Graduate Student Symposium and is the president of the Ann Arbor Egyptian Student Association (ESA). The group organizes activities related to Egypt and the Egyptian community in Ann Arbor, including hosting social gatherings. The ESA also runs a campaign to collect professional books and sends them to selected universities in Egypt.

Mahmoud's advisor, Professor A. Galip Ulsoy was enthusiastic about the recognition. Ulsoy noted that in Mahmoud's role as one of the organizers of the 2002 graduate student symposium in Mechanical Engineering, he did an excellent job in organizing the seminar that year. The symposium is a chance for incoming graduate students to learn about the research going on in the department, and for experienced doctoral students to present the work they have been doing.

Coming to Ann Arbor was an easy decision for Mahmoud. "The ME department at the University of Michigan is one of the best in the world, so it wasn't a difficult choice. I also knew a few people studying here, and they told me Ann Arbor is a beautiful city. I also found some surveys placing Ann Arbor as one of the top ten 'livable' cities in the United States."

Mahmoud also noted that the diverse ME student body makes studying here a really exciting experience because students meet people from all over the world and are exposed to differing cultures and backgrounds. "Besides," he added, "the excellent body of faculty means that students here always get to interact with the best people in each field. I think it is this combination of academic excellence on the part of faculty and students and the cultural diversity of the place that makes it worthwhile to do what it takes to go through the program."

Mahmoud's doctoral research is focused on the design of dynamic systems and the use of concepts from systems theory and control in that process. The idea is to try to decompose a large system into smaller subsystems and design these separately. The robustness of the subsystem designs to changes in other subsystems can be analyzed using some of the tools in the systems theory literature. The goal is to enable the design of the subsystems to proceed in parallel, yet achieve good performance once the system is assembled. Mahmoud is also working toward a master's degree in financial engineering.

Mahmoud previously received the Best Presentation in Session Award at the 2002 American Control Conference in Anchorage, Alaska. A native of Cairo, he earned a BS in mechanical engineering (1999) and a MS in mechanical engineering (2001) from the American University in Cairo.

"The ME department at the University of Michigan is one of the best in the world, so it wasn't a difficult choice."

HAITHAM MAHMOUD

For Tershia Pinder, being involved with student organizations has been an integral part of her education at ME. "I think it has improved my leadership abilities, and it has also increased my sense of responsibility for the needs of the community," she said.

A quick look at her schedule is proof she puts her beliefs into practice. Among her on-campus activities, Pinder has held several offices, including the presidency in 2001-02, of the Society of Minority Engineering Students-Graduate Component. Working within this organization, she also was the student chairperson of the IMPACT Recruitment Weekend and a mentor in the Summer Engineering Academy's Bridge Program. Pinder was also a member of the ME Graduate Student Council, where she was the Chairperson of the Graduate Student Symposium in 2001 and the Prospective Student Weekend. She has also been a member of the Movement of Underrepresented Sisters in Engineering and Sciences and the Students of Color of Rackham.

Her activities extend to the classroom as well, holding graduate student instructor positions in Thermal Fluid Sciences I and CAD/CAM/CAE Systems. In addition, she has been a teaching assistant in the Mechanical Engineering Division of the College of Engineering's Detroit Area Pre-College Engineering Program, "The Making of the Automobile." She has also honored her commitment to helping other students, working as a tutor for Thermal Fluid Sciences II.

As befits a recipient of the Distinguished Leadership Award, her commitment to service extends well beyond the campus. Since 2000, she has made time to be a co-founder and choreographer of the Brown Chapel AME Church's Liturgical Dance Ministry in Detroit, and has served the church as the chairperson of the Young Adult Worship Service and mentor participant at the Young Adult Bible Study.

Born in Baltimore and raised in Glen Burnie, Maryland, Pinder was attracted by the academic opportunities at ME. "Once I visited the university and the department," said Pinder, "the choice was easy. I was really impressed with the resources and facilities. The ME department has so many wonderful faculty members with great research projects. I felt that I would grow so much within this environment and I truly believe I have!"

Working under the direction of her advisor, Professor Arvind Atreya, Pinder's research focus is in the thermal fluid sciences. She seeks to determine techniques to control the combustion process by reducing pollutant emissions and increasing combustion efficiency. This work examines the effect of transient changes in inlet conditions on nonpremixed flames by using a computer-controlled burner and numerical simulations.

Prior to entering the doctoral program in ME, Pinder received her MS in mechanical engineering (2002) from the University of Michigan and her BS in fire protection engineering (1999) from the University of Maryland in College Park. In addition to her academic work, Pinder also held positions as an Engineering Trainee at the National Institute of Standards and Technology in Gaithersburg, Maryland, and as a Quality Education for Minorities Fellow at the NASA Goddard Space Flight Center in Silver Spring, Maryland.

"All of my activities have helped me to improve my time management, delegation, and team building skills," Pinder said. "Beyond that, I feel extremely honored to be recognized by the College of Engineering."

U-M Head Football Coach Lloyd Carr and ME Chair Dennis Assanis (third from left and far right) greet ME graduate students Ron Grover and Tershia Pinder (from left) at the College of Engineering's Leadership Recognition Dinner in March 2003.

hed leadership

ME Student Helps "Deliver" Improved Fuel Economy

In order to diminish their reliance on fossil fuels, many companies who depend on truck-based services have made supporting the development of hybrid engines a top priority. One of these firms, FedEx Express, selected three companies to participate in its search for a hybrid electric Class 4 step-van to become its delivery truck in 2004. The goal was to design a vehicle that would increase fuel efficiency by 50% and reduce emissions by 90%.

The company eventually chosen for the job was Eaton Corporation, and that's where ME student Chan-Chiao (Joe) Lin comes into the picture.

Lin's relationship with Eaton began when Jason Liu, an Eaton engineer, attended the annual Automotive Research Center (ARC) conference last May, where Lin presented his research on control strategy development of hybrid vehicles. Liu realized that Lin's research fit their requirement for the FedEx project and offered Lin a summer internship with Eaton.

As an intern at Eaton from July to September 2002, Lin was actively involved in the company's hybrid electric truck project. The company's plan was to leverage its significant experience in automated mechanical transmissions to develop a parallel-type, "Direct Hybrid" system, incorporating an electric motor/generator located between the output of an automated clutch and the input to an Eaton® Fuller® AutoShift® transmission.

This architecture makes it possible to recover energy normally lost during braking and store the energy in batteries or other energy storage devices. Electric torque can be blended with engine torque to improve vehicle performance and to operate the engine in its most fuel-efficient range for a given speed, or to operate the vehicle with electric power only.

Lin's primary responsibility was to help design an advanced algorithm for the control strategy of the prototype hybrid truck for further fuel economy improvement. The control strategy in hybrid vehicles is responsible for the power management and coordination of overall vehicle systems, including the internal combustion engine, electric motor, transmission, and battery.

"Since we have developed a methodology at the Automotive Research Center to design the control strategy for hybrid vehicles," said Lin, "the basic job for me at Eaton was to apply this design methodology to their prototype hybrid truck to see if the fuel economy could be further improved. This also offered a good opportunity to validate my approach on a real hybrid truck."

Lin was also involved with developing the hybrid electric truck simulation tool, testing/modifying the control algorithm, and analyzing the real-time data collected from the truck. He credits his mentor Jason Liu, manager Richard Nellums, and colleague Matt Busdiecker, for providing outstanding support.

Naturally, the key question is: did the team's work achieve their goal? The improved prototype truck was delivered to FedEx Express for final testing in September 2002. The fuel economy of the new truck achieved 45% improvement (compared to the 50% target) over the baseline FedEx truck. The particulate matter (PM) and NOx emissions were reduced by 93% and 54%, respectively (compared to the targeted 90% reduction).

As a result, FedEx has formally announced its intention to use the technology developed by Eaton in its fleet. According to a May 20 press release, "FedEx Express has agreed to purchase twenty hybrid electric diesel delivery trucks using Eaton's innovative hybrid electric technology. Later this year and into early 2004, these twenty vehicles will begin operation in four yet-to-be-named U.S. cities.... This program has the potential to replace the company's 30,000 medium duty trucks over the next ten years."

Chan-Chiao (Joe) Lin

Lin is a PhD student under the supervision of ME Professor Huei Peng and Electrical Engineering and Computer Science Professor Jessy W. Grizzle. He is also a graduate student research assistant in the ARC, where he researches power management in hybrid vehicles. Lin received his BS ME from National Tsing Hua University, Taiwan in 1995, and an MS ME from National Taiwan University, Taiwan in 1997.

Graduate Student Fellowships and Awards

Fall 2002 and Winter 2003

FELLOWSHIPS AWARDED BY ME

Departmental Fellowships
Brenton Bergkoetter
Lei Cheng
Hao Du
Zhijiang He
Zhenhua Huang
Alexander Knafl
Pranav Kumar
Jingjing Li
Tao Li
Andreas Malikopoulos
Chang Qi
Xiulin Ruan
Jing Zhou

Rackham Engineering Award
Deanna Capobiano
Colleen Doyle
Claudia Fajardo
Christina Frost
Elizabeth Ivy
Ivelysse Lebron-Duran
Adrianne Prysock
Christine Vehar

Dean's Fellowship
Lisa Case
Brock Partee
Handa Xi
Min Zhang
Bradley Zigler

Regent's Fellowship
Steven Collins
Paul Griffiths
Alex Hsu

Recruitment Fellowship
Kari Danek
Rui Li

Block Grant Fellowship
Aaron Weaver

FELLOWSHIPS AWARDED BY RACKHAM

Predoctoral Fellowship
Dong Ying Jiang

Committee on Institutional Cooperation Fellowship
Jay Mitchell

FELLOWSHIPS AWARDED BY THE COLLEGE OF ENGINEERING

Tuition Fellowship/Shanghai Jiaotong University International Exchange Program
Jianbo Liu

Tuition Fellowship
Hui Wang
Lijun Zhang

EXTERNAL FELLOWSHIPS

American Welding Society Scholarship
Matthew Cavalli

The National Consortium for Graduate Degrees for Minorities in Engineering and Science Fellowship
Mark Crawford
Nia Harrison
Josha Martinez
Jose Rico III
Deandre Thompson

National Science Foundation Fellowship
Daniel Georgiev
Sneha Madhavan-Reese
Vinod Natarajan

National Defense Science & Engineering Graduate Fellowship
Brian Jensen

Shanghai Jiaotong University International Exchange Program
Xin Cheng
Xiaoming Shen
Lei Zhang
Peizhi Zhang

DEPARTMENT AWARDS

Graduate Student Symposium

Posters:
1st: Karim Hamza
2nd: Chang-Ju Kim
3rd: Essam Al-Bahkali

Presentations:
Dynamics, Systems and Controls
1st: Hosam Fathy
2nd: Farshid Maghami Asl
3rd: Szabolcs Sovenyi

Fluid Mechanics, Heat Transfer and Combustion:
1st: Alan McGaughey
2nd: Aristotelis Babajimopoulos
3rd: Charles Funk

Design and Manufacturing:
1st: Kerr-Jia Lu
2nd: Charles Kim
3rd: Karim Hamza

Bio-Engineering:
1st: Sarah Calve
2nd (tie): Alaa Ahmed, Kathleen DeSantis Klinich

Solid Mechanics and Materials:
1st: Essam Al-Bahkali
2nd: Parag Dixit
3rd: Shawn Lin

Ivor K. McIvor Award
Shih-Huang (Shawn) Lin

Robert Caddell Memorial Award
Fu Zhao

RACKHAM AWARDS

Susan Lipschutz Award
Melissa Chernovsky

COLLEGE OF ENGINEERING AWARDS

Distinguished Achievement Award
Alan McGaughey

Distinguished Leadership Award
Haithan Mahmoud
Tershia Pinder

Graduate Student Awards
Patrick Hunt
Haitham Mahmoud
Tershia Pinder

MINORITY ENGINEERING PROGRAM OFFICE AWARDS

Master Student Achievement
Ibrahim Badiru
Claudia Fajardo
Christina Frost
Adrianne Prysock
Jose Rico III
Rocio Saracho
Lara Sherefkin
Brett Thompson

PhD Student Achievement
Jaime Camelio
Melida Chin
Ronald Grover
Charles Hoffler II
Tershia Pinder

Undergraduate Student Fellowships and Awards

Fall 2002 and Winter 2003

DEPARTMENT AWARDS:

A. D. Moore Award
Zachary Kreiner

Andrew A. Kucher Award
Veronica H.T. Chin

Arlen R. Hellwarth Award
Aimee Constantine

BP Award - Minority Scholarship
Evan Lowe
Idaresit Usoro

BP Award - Outstanding Sophomore
Katherine Bach
Steven Kren

Caddell Memorial Award
Brian Walby

Charles Barth J. Prize
Veronica H.T. Chin

GEM Award
Vernon Newhouse

Graebel
Matthew Leach

Henry Ford II Prize
Kevin Donovan

Hugh Rumler Prize
Lauren Parkins

J. A. Bursley Prize (Endowment)
Rachel Collino

Lubrizol Scholarship
Dannielle Sita
Laura Stojan

Marian Sarah Parker Prize
Karlin Bark

ME Distinguished Achievement Award
Kiran Douza

Mildred & Steele Bailey Prize
Kiran D'Souza

R & B Tool Scholar
Carolyn Wineland

Spirit Award
Brian Rhodes II

William H. Mack Memorial Engineering Prize
Brian Krieger

COLLEGE OF ENGINEERING AWARDS:

Continuing Excellence Award
Evita Nedelkoska

Elaine Harden Award
Lauren Parkins
Brian Walby

Roger M. Jones Poetry Prize
Adam Dick

Undergraduate Student Award
Rebecca Kramer

MINORITY ENGINEERING PROGRAM OFFICE AWARDS:

Rising Student Achievement
Adebisi Adewunmi
Sean Whitney

New Student Achievement
James Forehand
Alberto Lopez

Undergraduate Achievement
Elliot Alvarez
Miguel Bahena
Manuel Chavez
Lander Coronado-Ga
Marietsa Edje
Alexandre Evrard
Christopher Gold
Chad Goldstein
Danya King
Adrien Lazzaro
Jose Llamas Vidales
Evan Lowe
Daniela Marquez
Michael Michaud
Vernon Newhouse
Portia Peters
Marcus Russell
Ariel Schuger
Vera Simms
Alexander Smith
Arthur Tyson
NJemile Vinson
Matthew Walker
John Wieland

General Paul J. Kern Receives 2002 Alumni Society Medal

U.S. Army General Paul J. Kern received the 2002 Alumni Society Medal at the annual College of Engineering Awards Night presentation last fall. The honor was in recognition of his outstanding contributions to both the military and to ME.

"I'm honored to be recognized by a university which has shaped my life," said General Kern. "I was married and my first son was born in Ann Arbor. The professors and friends I made there have been a part of my career ever since."

In making the presentation, Dean Stephen W. Director noted that the award was being made because of Kern's "outstanding accomplishments; his remarkable ability to adapt, in the face of dangerous, complex and changing circumstances; and his tremendous leadership in service to his country."

General Kern, who earned master's degrees in both mechanical and civil engineering from University of Michigan 1973 and who has served as the U.S. Army Material Command Liaison to the ME External Advisory Board since 2001, assumed the duties of Commanding General, U.S. Army Materiel Command on October 30, 2001. As Dean Director noted, "The Army Materiel Command's responsibility is 'If a soldier shoots it, drives it, flies it, wears it, or eats it,' they provide it.

"General Kern is not just responding to change, but is leading the Army to move in strategic directions it's never gone before. It is a huge task. General Kern is directing supply-chain improvement efforts throughout the Army. His challenges include maintaining field readiness while modernizing weapons systems and controlling costs."

The clear thinking demanded of ME graduates is evident in General Kern's approach to his responsibilities. As he told those under his command, "Change is not easy. Making that change happen is like building a bridge, a bridge into a new century, without knowing exactly what's ahead. I ask you to always keep in mind that there is some young soldier somewhere, on a mountain top in Afghanistan today, in some other far off place tomorrow. That's why we do what we do."

Prior to this assignment, he served as the military deputy to the Assistant Secretary of the Army for Acquisition, Logistics and Technology and was the senior military advisor to the Army Acquisition Executive and the Army Chief of Staff on all research, development, and acquisition programs and related issues. He supervised the Program Executive Officer system, and served as the director of the Army Acquisition Corps.

Earlier in his career, General Kern was attached to both field units and the Secretary of Defense office in Washington. He has also taught weapon systems and automotive engineering at the U.S. Military Academy and was the department's research officer.

General Kern has served three combat tours with the U.S. Army. Most recently, he served as the Brigade Commander of the Second Brigade, Twenty-Fourth Infantry Division at Fort Stewart during Desert Shield/Desert Storm. The Second Brigade played a pivotal role in the historic attack on the Jalibah Airfield allowing the Twenty-Fourth Infantry Division to secure key objectives deep inside of Iraq. He also served as the Assistant Division Commander of the division after its redeployment to Fort Stewart. As a junior officer he began his career with two combat tours in Vietnam with the Eleventh Armored Cavalry as a platoon leader and troop commander.

General Kern's memories of Ann Arbor remain vivid. "After two tours in Vietnam, the university was a challenging experience," he said, "but the students and the faculty made my adjustment easy and the education was superb.

U.S. Army General Paul J. Kern

"I still return to the university for advice, and the high academic standards have helped me in all my endeavors."

General Kern was commissioned as an Armor lieutenant following graduation from the U.S. Military Academy at West Point in 1967. During his career, he has received the Defense and Army Distinguished Service Medals, Silver Star, Defense Superior Service Medal, Legion of Merit (with Oak Leaf Cluster), Bronze Star Medal with "V" Device (with Oak Leaf Cluster), Bronze Star Medal (with two Oak Leaf Clusters), and Purple Heart (with two Oak Leaf Clusters). He also received the SAE Ralph R. Teetor Educational Award in 1976.

Fuher Helps Set EPA Standards

Michael J. Fuher ('91 BSE ME) was awarded the 2002 SAE/InterRegs Standards and Regulations Award for Young Engineers for his work at Ford Motor Company in authoring several published reports and technical papers regarding automotive emissions.

In making the announcement of the award, the organization noted that Fuher's standards will be felt on a national level, saying, "His recommendations have been adopted by the EPA and the California Air Resources Board, which have resulted in the establishment of standardized protocol for future evaporative emissions testing."

Fuher was hired at Ford ten years ago in what is known today as Vehicle Environmental Engineering. He credits the company with giving him many opportunities to grow and to learn about automotive engineering, emissions testing, and environmental responsibility. He's currently a technical standards engineer at the company.

His special interest and involvement in standards enabled him to participate in a variety of projects dealing with exhaust emissions and evaporative emissions of motor vehicles. In one of his first projects, he conducted experiments to study the impact of humidity and moisture on the performance of carbon canisters.

"Concern had been raised that higher levels of moisture may reduce the purge performance and working capacity of canisters, which are used to control fuel evaporative emissions of vehicles," noted Fuher. "The data did not support such concerns, and as a result, the California Air Resources Board (ARB) used these findings in developing their evaporative emissions test requirements. I authored a report on these studies, which was published in 1994 as SAE Technical Paper 940299."

Fuher then became involved with the SAE's Light Duty Vehicle Performance and Economy Measurement Standards Committee, participating in the task force to develop exhaust emissions and fuel economy measurement standards for hybrid-electric vehicles (HEVs). The group developed the basic framework of HEV testing including the four-phase urban test, battery state-of-charge tolerances, and the appropriate weighting of test results based on consumer charging and driving habits.

ME staff member Janet Lyons, who works in the Automotive Research Center, fills up her new Ford Focus, which is equipped with the latest evaporative emissions control to trap refueling vapors. Since 2000, all passenger cars are equipped with onboard absorbing carbon canisters to trap gasoline vapors produced during refueling.

Fuher encapsulated the recommendations made by this task force and authored SAE Technical Standard J1711, "Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles," published in 1999. SAE J1711 offers a broadly applicable and widely accepted procedure for measuring HEV emissions and fuel economy. Since the publication of J1711, the California ARB published HEV testing requirements, which are mainly based on the standard's recommendations and introduced the optional zero evaporative standard, which is a compliance requirement for partial zero-emission vehicles.

Fuher and his colleagues played a leadership role in developing a standardized protocol to demonstrate zero fuel evaporative emissions capability. They worked with engineers across the automotive industry and with the California ARB to develop the fuel system test rig concept, the dry rig subtraction concept, and the protocol to measure representative permeation of engine compartment components. After agreements were reached between industry and the ARB, Fuher wrote the standardized test protocol, published by ARB in November 2001 as "Manufacturers Advisory Correspondence #2001-03."

The SAE/InterRegs Standards and Regulations Award for Young Engineers was established two years ago as a way to reward and encourage the participation of engineers under the age of thirty-five in developing standards that reduce emissions or improve safety of automobiles.

"While public activism is often seen as the driving force behind environmental improvement, I am gratified that SAE and InterRegs, Ltd. co-sponsor this award to endorse the engineering side of environmentalism, which I feel is where the real work is being done. The groundbreaking efforts of the HEV task force and the publication of a clear and universal standard have helped to pave the way to the development and production of HEVs, which hold the promise of reduced emissions and improved fuel economy over conventional vehicles."

Fuher is quick to credit his years at ME for the education he received.

"On North Campus, I was surrounded with highly motivated students, renowned faculty, and state-of-the-art resources. I gained a solid engineering base at Michigan, which provided me with confidence and skills for my years ahead at Ford. Spending four years in Ann Arbor also fostered in me a deeper appreciation for human diversity, which I feel is an essential leadership value in today's corporate world."

With a thirty-year history in the global automotive industry, InterRegs Ltd., are publishers of international regulatory and standards information for the automotive, mobile construction equipment and non-road engine manufacturing industries.

Newest EAB Member Brings Extensive Automotive Experience

The newest member of the ME External Advisory Board is Dr. Gerhard Schmidt, Vice President-Research and Advanced Engineering at Ford Motor Company. Schmidt, who joined the EAB in 2002, leads Ford's worldwide research organization.

The approximately 1,300 scientists, engineers, and technicians who comprise the Ford research staff concentrate on anticipating the technical needs of Ford customers, providing innovative solutions to technical challenges, and incorporating those solutions into products and processes. As head of Research and Advanced Engineering, Schmidt also oversees the planning, development and implementation of Ford's top global technology objectives.

Prior to his arrival at Ford, Schmidt served as Senior Vice President Vehicle Integration at BMW AG and spent ten years as Senior Vice President Powertrain Development for the German automaker. During his twenty-one years at BMW, Schmidt held a wide range of leadership roles in engine research and development.

Schmidt's first association with ME came shortly after he joined Ford in April 2001. He visited the Department of Mechanical Engineering and also hosted a delegation of ME professors at the Ford Scientific Research Lab last year. In May 2001, a group of powertrain technical specialists led by Graham Hoare, Director of Powertrain Research and Advanced Engineering, visited ME Chair Dennis Assanis and other ME faculty members. The purpose of this visit was to consider U-M for inclusion as one of the three to five "elite" university powertrain research and development partner universities that Ford was considering.

Accepting the invitation to join the EAB was an easy decision for Schmidt. He was aware that, historically, Ford viewed the University of Michigan as a preferred partner in recruiting, continuing education, and collaborative research. He also recognized that U-M is the largest provider of engineering talent to Ford.

"Our reasons for partnering with the University of Michigan are as strong as ever," said Schmidt, "and furthering our awareness of one another can only help strengthen this mutually beneficial relationship."

Schmidt also expressed his admiration for what he sees as the good balance between academic and industry orientations in the ME department, remarking on the strong work ongoing in basic science alongside very practical application-oriented development. "The university research needs of Ford Motor Company span a continuum from fairly basic fundamental science in some areas to very practical development in others," he said. "The University of Michigan Mechanical Engineering department can meet many of our needs across this spectrum."

In keeping with his commitment to maintaining the close ties to ME, Schmidt noted that he has already met with a number of ME faculty members, including Professors A. Galip Ulsoy, Panos Papalambros, and Yoram Koren. He also noted the many ME alumni working within Research and Advanced Engineering.

"Ford Motor Company will continue to have a strong preferred relationship with the University of Michigan," said Schmidt, "and there is an opportunity to expand this relationship as we select partner universities at which we will conduct the majority of our university-based power train research and development work."

Schmidt's primary goal as member of the EAB focuses on greater communication and mutual awareness between U-M and Ford, which he believes can have a positive benefit on student education. He feels that if history is a guide, a greater number of Michigan engineers will go to work at Ford than any other corporation. Helping the students understand what is important and what will help them succeed in industry is an important endeavor to which he believes Ford should contribute.

Dr. Gerhard Schmidt

Above all, he said, "I look forward to my participation on the EAB, and the continued fruitful relationship between the University of Michigan and Ford Research and Advanced Engineering."

Schmidt received his degree in mechanical engineering in 1971 from the University of Aachen in Germany, and his PhD in investigations on stratified charge – internal combustion engines in 1979 from the Faculty of Mechanical Engineering at the University of Aachen. He is a native of Garmisch-Partenkirchen, Germany.

Collins Honored with Alumni Merit Award

John W. Collins III, former Alcoa executive vice president, Science and Technology, has been named the recipient of the 2003 Alumni Society Merit Award for the Department of Mechanical Engineering. This award, established in 1992, is presented annually to recognize an alumnus whose achievements have been extraordinary in his field of specialization and who has brought distinction to himself and the College.

Collins' most recent position at Alcoa, which he assumed in 2001, showcased the exceptional achievement that earned him the award. In that role, he led Alcoa's corporate technology programs, strategic product and process developments as well as breakthrough technology projects. He is also a member of Alcoa's Executive Council, the senior leadership group that provides strategic direction for the company. Earlier this year, he was named the Chairman's Counsel.

"I feel truly honored by this recognition," Collins said. "In many respects I been associated with Michigan all of my life. My mother and father graduated from the University of Michigan, as did my sister and a number of my aunts, uncles and cousins. I guess I'd call myself a U-M family brat," he added with a chuckle. "In one of our first family photos, I was sporting a maize and blue U-M sweater."

The family tradition of attending Michigan is mirrored by a family tradition of working for Alcoa. Collins' father was also an Alcoa officer, and not so coincidentally, was a long time member of the CoE Industry Advisory Board and the Alcoa ambassador to U-M, a role also filled by Collins since the early 1990's.

"Alcoa has close ties with U-M, and I'm pleased to be part of that. When my father worked with the college, he said it was very important to help develop the next generation of leaders for our company, and I saw that as my responsibility as well. The college is uncommonly responsive to input from industry. The CoE has consistently turned out excellent graduates who are solidly grounded in scientific first principles and engineering concepts. This insures a life long ability to solve complex problems with a proper blend of know-how and know why. This was the approach I was taught, and it has helped me at every stage of my career."

Collins noted that one of his proudest achievements was being elected a corporate officer of Alcoa in 1995. Unlike a promotion, it's an honor reserved for those who have made a significant contribution to the company. He placed receiving the Alumni Society Merit Award a close second. "When I received word that I was to receive this award, I felt the same thrill as I did at Alcoa. It's an honor to have one's work recognized," he said.

Collins joined Alcoa in 1969 at the Alcoa Technical Center near Pittsburgh. His first position was as a development engineer in product and process development; he later became section head of engineering and equipment there. From 1978 through 1986 he held a series of sales and marketing assignments. Since that time, Collins has been president of a number of Alcoa's major business units, including Engineered Products and Mill Products.

In addition to being a member of the ME External Advisory Board since 2001, Collins is a member of the advisory board for the Tauber Manufacturing Institute at the University of Michigan, as well as several other commercial and academic industry advisory boards. He currently holds five U.S. patents and is the recipient of three Alcoa Technical Awards. Collins received a BS ME in 1969 from the University of Michigan. Collins plans to retire next January. He and his wife, Karen, reside in Austin, Texas, and have three children, daughters Paige and Lanie, and a son, John W. Collins IV.

John W. Collins III

Recipients of the Alumni Society Merit Awards from each academic department are selected by departmental committees, whose members are chosen and headed by the department chair. The list of recent recipients of the ME Alumni Society Award indicates the breadth of interests of ME graduates. A complete list accompanies this story on page 49.

ME Alumni Society Merit Award Past Winners

2002-2003
Michael Korybalski
BSME 1969, MSEME 1972, MBA 1980
Consultant to the CEO
MSC Software Corporation

2001-2002
Wen-Ying Tsai
BSEME 1953
Artist

2000-2001
Charles M. Vest
MSE 1964, PhD 1967
President
Massachusetts Institute of Technology

1999-2000
Robert Transou, Jr.
MSE 1967
Retired

1998-1999
Ward Winer
BSEME 1958, MSE 1959, PhD 1962
Regents' Professor and Director
Woodruff School of
Mechanical Engineering
Georgia Institute of Technology

1997-1998
William Sommers
BSEME 1955, MSE 1956, PhD 1961
Retired

1996-1997
Charles Hutchins
BSEME 1957
Co-Founder
Manufacturing Data Systems, Inc.

1995-1996
Carroll J. Haas, Senior
BSEME 1947
Chairman of the Board
Colonial Engineering, Inc.

1994-1995
Roger McCarthy
BSEME 1972
Chairman of the Board
Exponent, Inc. & Exponent Failure
Analysis Associates Inc.

1993-1994
Robert J. Buckler
BSEME 1971, MSE 1973
President & COO
DTE Energy Distribution, DTE Energy

1992-1993
D. Roger Heimbuch
MSE 1967, PhD 1970
Executive Eng. of Power Train Systems
General Motors

EAB Spring Meeting

Members of the ME External Advisory Board during their spring 2003 meeting: (seated, from left) ME Department Chair Dennis Assanis, Robert Transou, Carroll Haas, Mike Korybalski; and (standing, from left) John Collins, Ward Winer, Roger McCarthy, Marshall Jones, Richard Heglin, Chuck Hutchins, Roberta Zald, Gerhard Schmidt, and Walt Bryzik.

M-Racing, the U-M SAE Formula racing team, won two design awards in the 2003 FormulaSAE Competition and placed 32 out of 130 participating teams.

The Year in Photos

Associate Professor Dawn Tilbury in a research research factory built in Ozzero, Italy by the Institute of Industrial Technologies and Automation of the Italian National Research Council. The factory is being used for a European project called "EuroShoe," which studies "mass customization"—flexible and reconfigurable manufacturing applied to shoes, so that customers can order a pair of shoes in the style and color they want, custom fit to their feet. During her sabbatical, she worked on extending the logic control methodologies she helped to develop at U-M to this flexible system.

ME Department Chair Professor Dennis Assanis (right) with Shanghai Jiao Tong University Professor Liguang Li, during a visit to SJTU.

Above: M-Pulse, the U-M Solar Car, on exhibit at the Detroit Auto Show. At right: U-M Chemical Engineering Professor Levi Thompson, ME Department Chair Professor Dennis Assanis, ME undergraduate student Ahmir Rashid, and Aerospace Engineering undergraduate student Joseph Lambert, beside the M-Pulse exhibit.

High school students participating in the NASA Summer High School Apprenticeship Research Program completed training in the ME Design and Manufacturing Laboratory.

ME Design Expo Winter '03

Clockwise from upper right are a few of the many projects exhibited by students at the Winter 2003 Design Expo: Human Powered Hydraulic Launch Assist Vehicle, Nozzle Design for a Fan Shaped Dishwasher Spray, Body Jacket Hip Joint Redesign, Fuel Cell Powered Army Robotic System, Stair Climbing Wheelchair, and Autonomously Guided Vehicle.

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MichiganEngineering