2005

ME-EM 2005 Annual Report

Department of Mechanical Engineering-Engineering Mechanics, Michigan Technological University

DEPARTMENT OF MECHANICAL ENGINEERING

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ENGINEERING MECHANICS

2005 ANNUAL REPORT

MichiganTech

MECHANICAL ENGINEERING - ENGINEERING MECHANICS

2005 ANNUAL REPORT

A MESSAGE FROM THE CHAIR

2005 has been another successful year, with an abundance of novel research and educational activities taking place in the department of Mechanical Engineering-Engineering Mechanics. To stay on the cutting edge of education, research, and technology, we continually strive to improve our curriculum, our facilities, and our approach to education.

As engineering processes become accelerated through market pressures, our graduates must enter the workplace ready to perform well in complex, global environments. Our creative Enterprise organizations mirror business with similar structures, pressures, and opportunities for innovation. Our industry-sponsored senior design projects provide our graduates with the real-world project experience needed for success in the business world. The achievements of our alumni are a source of enormous pride to our faculty and staff. Our research innovations, coupled with entrepreneurship among our faculty, staff, and students have led to the creation of many successful businesses around the globe.

I invite you to peruse the pages of this annual report. You will find inspiring stories of faculty, students, and alumni who are leaders in their fields. Exploring topics from human factors to sustainable solutions to creativity in engineering, you will discover the emerging faces behind technology, and view engineering ideas that have, and will, change the world.

The exciting transformations of exemplary, experiential education are revealed in the engineering work of our faculty and students. I commend them for their steadfast belief in infinite possibilities and their commitment to building worldwide partnerships with people and companies in diverse fields.

And, as always, I invite your feedback and comments. By working together, we will find superior methods and resourceful solutions to any advancing challenge. We welcome your thoughts and your support.

William W. Predebon

William W. Predebon
Professor and Department Chair

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ME-EM: A LEADER IN INNOVATION

OVERVIEW OF ME-EM DEPARTMENT

In the January 2006 State of the Union Address, President George W. Bush acknowledged the importance of American competitiveness in the global economy, and the leading US resources in human talent and creativity. He announced his *American Competitive Initiative*, designed to "encourage innovation throughout our economy, and to give our nation's children a firm grounding in math and science." He made the commitment to fund research programs in the physical sciences, especially in the fields of nanotechnology, supercomputing, and alternative energy sources.

The ME-EM Department continues to be a leader in these areas, and will be a responsive participant in President Bush's plan to make America an ongoing, competitive leader in the world economy. We are already gaining recognition as one of the premier centers of education, research, and innovation by academia, industry, and government. Our solid ME-EM reputation for innovation will only expand as we continue our diligent work in creating exceptional educational opportunities for young people seeking engineering degrees in the future.

MISSION

Prepare engineering students for successful careers.

VISION

Be a department of choice nationally.

EXECUTIVE COMMITTEE

Dr. Gordon G. Parker
Design and Dynamics Systems Area Director

Dr. Lyon Brad King
Energy Thermofluids Area Director

Dr. Michele H. Miller
Manufacturing and Industrial Area Director

Dr. Gopal Jayaraman
Solid Mechanics Area Director

Dr. Ghatu Subhash
Associate Chair and Director of Graduate Studies

Dr. Harold E. Evensen
Associate Chair and Director of Undergraduate Studies

Dr. William W. Predebon
Department Chair

COMMENTS ON THE STRATEGIC PLAN

The ME-EM Department continues to make progress on the goals set forth in its strategic plan. I am pleased to report that our graduate and research programs are again nationally ranked. This year, the *2006 US News and World Report: America's Best Graduate Schools* ranked our graduate program 52nd (top 32%) nationally and 2nd in Michigan, among 164 doctoral-granting mechanical engineering departments. We have achieved our strategic goal for the second year in a row—being ranked in the top 50 nationwide.

Research Expenditures Soar

In recognition of our research productivity, the National Science Foundation (NSF) ranked the ME-EM Department 29th in Research Expenditures for the fiscal year 2003— with a total of $6.127 million in expenditures—among all Mechanical Engineering Departments in the US. This placement was accomplished with one of the largest undergraduate mechanical engineering programs in the nation. Our undergraduate program is currently 3rd in the US and 1st in Michigan in BSME degrees granted. We have been in the top five in this category for the past 22 consecutive years.

Faculty and Student Contributions

In addition to receiving numerous awards that recognize the quality of their work, our accomplished faculty continue to receive extensive external support for their cutting-edge research. They also continue to publish the significant results of their research in prestigious journals in the field. In addition, many of our graduates go on to start their own companies, demonstrating they have the entrepreneurial spirit, expertise, and confidence to become successful company leaders. And, our alumni continue to make major technological contributions, creating innovative solutions that further advancements in technology across the globe.

Clean Snowmobile Challenge

Finally, the ME-EM Department continues to host important challenges and events that impact the development of technologies for the real world, like the Clean Snowmobile Challenge. For the 4th consecutive year, the ME-EM Department and the Keweenaw Research Center hosted the *Society of Automotive Engineers (SAE) Clean Snowmobile Challenge* on March 13-15, 2006. This event promotes new technologies for quieter recreational vehicles, while also addressing their environmental impacts.

Universities from all over competed in the event, including schools from Michigan, Wisconsin, Minnesota, New York, Maine, Utah, and Montreal, Canada. Michigan Tech received a *Society of Automotive Engineers Award* for Best Design. If you missed this year's Clean Snowmobile Challenge, you will have the opportunity to join us next year. With the huge success of this past year's Challenge, we plan to continue hosting this event for several more years to come.

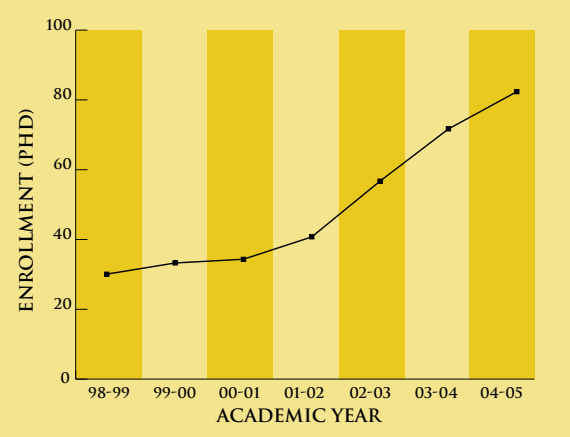
2005 ANNUAL REPORT

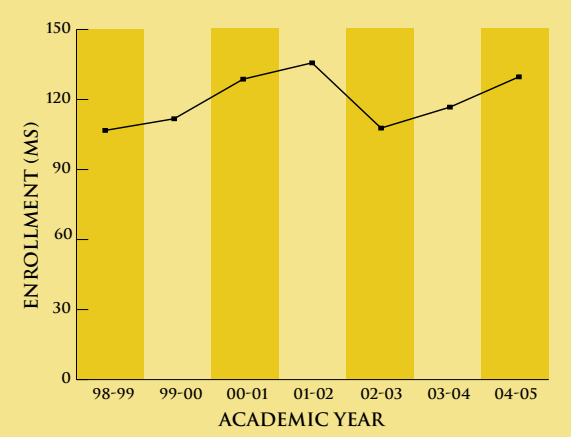
ME-EM DEPARTMENT DATA AND EXPERTISE

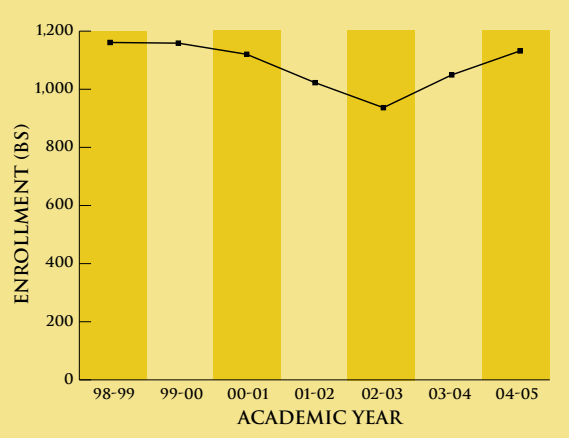
ENROLLMENT AND EXPENDITURES

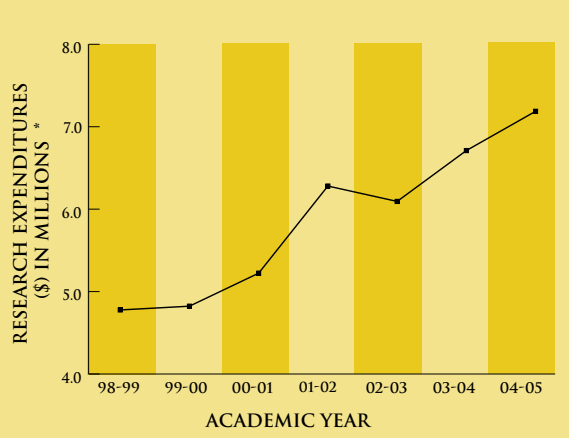
With one of the largest undergraduate programs in the US, the ME-EM Department also continues to build its PhD and Graduate student enrollments. In 2004-2005, ME-EM awarded 201 Bachelor's, 31 Master's, and 16 Doctoral degrees. In addition, ME-EM research expenditures have dramatically increased, from just under $5 million in the 1998-99 academic year to over $7 million in 2004-2005. These statistics, represented in the graphs below, reflect ME-EM's Vision for educational excellence and its commitment to the goals outlined in the ME-EM Strategic Plan.

ME-EM DEGREES GRANTED			
	BS	MS	PHD
98-99	238	24	8
99-00	254	20	9
00-01	237	31	2
01-02	238	37	3
02-03	219	45	6
03-04	215	41	10
04-05	201	31	16









**Reported expenditures will differ from last year's annual report due to an accounting change.*

PROFESSIONAL ADVISORY COMMITTEE

The *Professional Advisory Committee* (formerly the *Industrial Advisory Committee*) is a select group of corporate, academic and professional leaders, many Michigan Tech alumni, who advise the ME-EM department, sharing their expertise and providing assistance with curriculum direction, research topics, education-and-industry partnerships, and resource development. The primary role of the *PAC* is to keep the department in step with current industry, ensuring the best possible education for ME-EM students. *PAC* members offer their professional insight and provide valuable input that shapes the state-of-the-art engineering education taking place in the ME-EM department.

Fall Meeting—from left to right: Michael Smaby, Leigh Otterlei, Jeffrey Zawisza, Allen Frank, Peter Sandretto, Thomas Clark, Timothy Thomas, Roger DeWitt, Geoffrey Weller, Michael Hofman, and John Leinonen

Spring Meeting—left to right—*Front Row*: John Leinonen, Peter Sandretto, Geoffrey Weller, and Kirby Baumgard *Back Row*: Dr. Glenn Mroz (MTU President), Dr. David R. Reed (Provost & VP for Research), Thomas Clark, Alan Frank, Dr. William W. Predebon (ME-EM Department Chair), and Kurt Person

PAC 2005-2006 MEMBERS

Kirby J. Baumgard
John Deere Power Systems

Thomas Clark
Caterpillar, Incorporated

William Cooper
Visteon Corporation

Alan Frank
Whirlpool Corporation

Michael Hofman
Ford Motor Company

Paul Jones
American Axle and Manufacturing

John Leinonen
Ford Motor Co/Exponent, Inc.

Brenda Moyer-Kochen
Dana Corporation

Leigh Otterlei
3M Corporation

Kurt Person
Bosch

Peter Sandretto
DaimlerChrysler Corporation

Kevin Schlueter
Skilled Manufacturing, Inc.

John Schwekert
General Motors Powertrain Group

Adil Shafi
Shafi, Incorporated

Sandra Skinner
Ford Motor Company

Michael Smaby
Kimberly-Clark Corporation

Timothy Thomas
PARTsolutions, LLC

Geoffrey Weller
General Motors Corporation

Jeff Zawisza
Dow Chemical Company

FACULTY & STAFF

SURPASSING HEAT TRANSFER BOUNDARIES

CARL ANDERSON

TELEMETRY TECHNOLOGIES

Performance under pressure, strain, and acceleration. This dynamic approach exemplifies the leading work of Dr. Carl Anderson who has been solving heat transfer problems for research and industry since the 70's. Together with his students and colleagues, Dr. Anderson has created the "eyes" with which to see invisible thermal systems inside engines. An experimentalist for most of his career, Anderson has developed innovative techniques and tools that deliver measurements from inside engines that no one else has been able to. A wireless telemetry technique, originally based on infrared technology and now microwave-based, provides data from internal reciprocating and rotating components in harsh operating environments. This technology has optimized designs and improved durability in pistons, connecting rods, crankshafts, and bearings.

The Heat Transfer Quest

Exploring possibilities that are well beyond the horizon, Anderson has capitalized on his never-ending desire for new data. While working on his undergraduate degree at Michigan Tech, he worked for IBM in Vermont and after graduation, at Bell Labs in Denver. From there, his quest in heat transfer research led to Stanford University, where he received his Masters degree. Recognizing the balance that teaching would bring to his research, he completed his doctorate at UW-Madison and returned full-circle to Michigan Tech as a professor in 1980. Anderson recounts the serendipitous turn of events that generated the development of his telemetry technology.

First, there was Anderson's curiosity in finding a way to measure in-cylinder heat transfer in a running engine. He explains: "I wanted to characterize the thermodynamic state of the end gas in the combustion chamber. I could measure the heat transfer from the approaching flame front and heat transfer to the combustion chamber wall, but heat transfer to the piston was much more challenging to measure because of its rapid movement and acceleration. I started asking people if there was a good way to measure piston temperatures, and no one knew of any way to do this. So, we did what any imaginative researcher might do—we invented a way."

An Adept Graduate Student

Next in the order of events came an extremely talented graduate student named Glen Barna, who attended Michigan Tech from 1985 to 1989, and worked with Anderson in this new research area. Originally a certified steamfitter, "Glen could weld titanium under water." Barna had that unique blend of theoretical and practical abilities that enabled him to carry out complex design work. "When those skills come together, it is magic," Anderson notes, and continues, "Glen was a special student who could make things happen—he understood the core principles and he was able to build whatever we wanted."

The other pieces of this fortuitous mix included collaborations with numerous researchers, and several partners in electrical engineering. *Anderson, Barna, et al* began their work by placing a small radio transmitter in the engine, but quickly found that it was not very effective. They needed the signal to modulate at a high frequency, so they experimented with transmission via infrared LED's. At this point in time, the word had gotten out about Anderson's research, and people were calling from around the automotive industry to inquire about his progress. Skeptics were everywhere—few believed that this approach could ultimately deliver results.

Perfecting the Method

Anderson and his team persisted in creating a successful measurement transmission technique, pushing past the limitations of standard components by custom designing and building many of them. Anderson delineates, "We knew that the average integrated circuit chip would not survive the high temperatures but a few of them would. In many cases, it was a stochastic process. Since we were building it by hand, if the part failed, we replaced it with a new one until we found a 'high performer.' We innovated through many approaches and we kept going until the method was perfected."

The success of Anderson's research and design approach is revealed today with his company IR Telemetrics, Inc. (IRT) leading the way, providing patented technology in infrared and microwave telemetry systems. Co-founder Glen Barna is at the helm of this vital business and has been since its inception in 1991, transitioning from graduate student to full-time President and CEO.

Anderson actively utilizes the telemetry instruments that Barna manufactures in his ongoing research with engines and torque converters. Examining thermal loading issues in high-speed direct-injection diesels, he has identified the spray impingement signature and the resulting heat transfer enhancement on the piston crown. In torque converters, with the aid of Michigan Tech's unique torque converter test cell, he is measuring static pressure fields throughout the converter—quite a challenge since the converter has rotating elements inside of rotating elements, but not a problem with the microwave telemetry technique.

The Latest Data

Reflecting on the impact of his technology, Dr. Anderson pronounces, "The teaching and research tools are better than ever. That's what makes it exciting. Whenever a graduate student walks in the office with data, I just love it! I love learning something new about whatever device we are working on." *The new discovery for this week?* They collected their first pressure field measurements on the tip of the turbine blade, and the pressure on the suction side was higher than on the pressure side indicating a negative incidence angle. These are preliminary results; nonetheless, Anderson is thrilled: "This kind of data, when it turns out counter to what you expect, makes the research much more interesting. There are always new questions to explore!"

Distinguished Service Award

Dr. Carl Anderson received the first Michigan Tech Faculty Distinguished Service Award in 2000 for his exceptional contributions as an advisor to student vehicle design teams. Under Anderson's direction, new challenges were initiated in the Baja—all women and FormulaCar design teams. He also led the proposal efforts that successfully brought the Clean Snowmobile Challenge design program and FutureCar design program to Michigan Tech.

A Michigan Tech Family

The Anderson family is a testament to the outstanding education at Michigan Tech: Christine, Anderson's wife, has an MS in Biology and daughters Jesse and Olivia both have a BS in Biology, all from Michigan Tech.




COMMUNICATING THROUGH SILENCE

HAROLD EVENSEN

THE NVH REVOLUTION

Modern consumer goods are often so well-engineered that their operation has become imperceptible. Washing machines run with a quiet, gentle hum. Virtual symphonies give concerts in cars free of background engine noise. Dr. Harold Evensen, who has studied noise control, vibration, and signal analysis for the past 35 years, affirms, "The marvel of today will be the commonplace tomorrow. The kids will take much of it for granted, absolutely."

Observing these marvels as a professor at Michigan Tech since 1970, Dr. Evensen was also a student at the Sault Ste. Marie branch of Michigan Tech, which is now Lake Superior State University. There he experienced his first taste of teaching, presenting information to a class of his peers, which he never forgot: "I really loved it! You get up there and see them reacting to what you are saying, and it really pumps you up. It's almost like being a comedian—you feed off the audience. You need the feedback because you can see when someone is not 'getting it.' You can see it in their faces and so you want to change how you are saying it. Understanding it and explaining it are two different things. It's a nice challenge and still the best part of teaching."

Facets of Noise Control

Knowing that engineering and education were his passion, Evensen set off into the world to get some experience. After spending time in the Army, at NASA, and finally in a composites research laboratory at Whitaker Corporation in San Diego, he made his way back to the Upper Peninsula and Michigan Tech in 1970. At that time, Michigan Tech had no capacity for making composite materials, so he delved into his second love—NVH—noise, vibration, and harshness. Signal analysis is a natural component in this

area, since noise and vibration require the analysis of signals and the interpretation of their meaning, as well as their sources. Evensen explains, "Noise control is part of a larger system known as NVH. You are controlling noise but you are also controlling the vibration that creates the noise, which is very important in vehicles and appliances. In fact, NVH permeates almost all of the consumer industry today."

Sound Quality Research

Evensen has seen enormous movement in the noise and vibration business to bring the sound levels down and improve the quality of our environments. There has been significant research to locate the source itself to make products run smoother. He describes current issues in NVH: "They've come a long way in the automotive industry, to the point where they are attempting to quiet things you wouldn't have even dreamed of quieting years ago. Now they want it so you can play symphonies—they don't want to hear the wind noise—it wasn't long ago, you couldn't hear the wind noise anyway," he pauses to chuckle, "because there was too much banging and clanging going on from the vehicle itself. We are experimenting with sound not just to reduce it but to make it sound the way you want it to."

Take car doors, for example; they need to sound just right, not too quiet, or users will think they aren't closing properly. And, different cultures react differently to varying sounds, making it necessary to tailor the sound to the people in the target market. Evensen continues, "Some

people prefer the Lexus over the Town Car, and it's not just the interior, it's the *way* it sounds. We are getting into sound quality, assessing what the sound communicates and what it means to the listener, almost like evaluating music. It's getting very sophisticated."

A Practical Curriculum

As Director of Undergraduate Studies for the past five years, Evensen has also seen changes in the curriculum, changes that he feels distinguish Michigan Tech from other schools. "We still like to get our hands on things; we haven't lost that. There was a move to make the curriculum more theoretical, but Michigan Tech didn't go overboard in that direction; it has kept its practical bent." A man who knows how to get things done, Evensen has served on the Senior Design Committee, helping to shape the program. Students are now designing actual products for industrial sponsors. They don't simply create a virtual design; they have to build the product that meets the needs of their sponsor. "We have had over 100 different sponsors, both large and small, and many students have been hired through contacts made with their sponsors," states Evensen. This kind of involvement gives students a competitive edge in the job market.

Dr. Evensen hopes to remain involved with Michigan Tech, even after his retirement, perhaps as a part-time instructor. After all, "working with the students" is what he will miss most. He points out that they have taught him many things, the greatest lesson being that one cannot judge students by their performance in class. "One thing I have observed is that you can't trust your observations." Laughing heartily, he adds, "In research, you control the condition; you can relate the response to the things you control. In the classroom, you only have a very limited window of observation into student lives, and there are so many other factors. Sometimes the very feature that made them different is what made them successful. If you encounter a student who has a bizarre approach to the solution which ultimately may not work, you could be looking at someone quite innovative who has the guts to try it, not take the safe way, which is often the one you taught them."

Envisioning Nano Futures

As for the future of technology, Evensen predicts exciting discoveries in the nano and micro fields and the miniaturization of products. "When I was younger, I dreamed of having a tape recorder that had—this is silly because it is so primitive now—," he interjects, "the oscilloscope display built into the lid, quite impossible in the 70's, of course. Now you can have it on this (pulling his palm pilot out of his pocket), and not only that, you can transfer the data instantaneously all over the world." Size will no longer be a limitation in the future with these new technologies. He says, laughing loudly, "You could even imbed it in your toenail if you could figure out how to communicate with it."

THE ART OF ACCURATE MEASUREMENT

JOHN LIGON

EXPERIMENTAL MECHANICS

Dr. John Ligon gets out a piece of paper, picks up a pencil, and begins drawing. He sketches a simple model of the resistant strain gage, the one invention that has played a significant role in his career over his years in the field of Experimental Mechanics. Ligon takes great delight in pointing out to his students that an engineering graduate student invented the resistance strain gage at California Tech in 1936.

Dr. Ligon explains: "Of course, the computer has been an enormous benefit to the experimental mechanics field. Telemetry, being able to send the signal wireless, has also made a significant improvement in the way we can collect data. But the basic experimental tool that I have used the most is the resistance strain gage. It's a printed circuit that is bonded to the surface of a structural component. When the component is deformed, the resistance changes which can then be related to strain and stress in the component."

Drawing the Answer

Despite the technological changes over the years, the resistant strain gage still remains basically the same as it was when it was developed in the 30's, because it was developed in the simplest form from the beginning. Ligon continues, "Even though there has been a significant shift to computational experiments—a natural outcome of the growing sophistication of computers—there still remains the importance of being able to take an actual measurement to determine a boundary condition, verify a numerical result, or adjust a program." He feels that despite the evolving level of sophistication in experimental and computational mechanics, engineers will still need to be able to stand back, make some simplifying assumptions, and calculate an approximate solution to the problem—"drawing on the back of a napkin to check their results."

This *hands-on* approach seems to be key for Ligon as he describes his most memorable research over the years. A native of Texas, Ligon continued north after receiving his BS and MS at Texas Tech and his doctorate at Iowa State University. When he came to Michigan Tech in 1972, Ligon's initial research focused on hard rock mining. The work he completed for the Bureau of Mines was a challenging series of projects, which required laboratory experiments using dynamic photoelasticity in addition to the on-site testing in Michigan Tech's experimental mine, doing blasting and taking stress wave measurements. Those projects, however, ended in the mid 80's when much of hard rock mining was significantly downsized across the country.

Since then, Ligon has focused on research involving fastener design for composite components for the automotive industry, as well as the development of the field of Phytomechanics. With colleagues from Michigan Tech, the University of South Africa, Iowa State University, and Pacific Northwest Laboratory, Ligon has applied the analytical and experimental mechanics to the study of plants in order to understand their physiological responses to

the environment. Ligon describes the application of phytomechanics: "If we bond strain gages to the stem of a tree, for example, and the tree goes into some type of physiological stress, like a lack of water or nutrients, the tree responds with a change in strain of the stem. We can also monitor events such as how a tree reacts to different fertilizers and air-borne pollutants, as well as any kind of contaminants such as a pipeline leaking near the tree."

Environmental Variables

Phytomechanics was launched in the mid 70's when the team won an award for a paper on the subject, published in the *Journal for Experimental Stress Analysis*. Yet, they have not been able to obtain any major funding to move the research forward. It would take a lot of testing, both in the laboratory and in the field, to move from the calibration stage to an end product used in the field. There are myriad variables when dealing with plant monitoring in the field. One must separate the instrument from the environmental factors. Ligon notes, "You would need to know that you are reading the plant's responses to its environment and not just how the temperature affects the gage or how the wind bends the tree." This kind of research would take not only time, but significant external financial support.

Most recently, Ligon led a Michigan Tech Team presentation at the US Forest Service, which proposed to monitor the health of trees across the nation. Instrumentation connected to thousands of trees would retrieve data that would be uplinked to satellites. The health of the US Forest Reserve would be monitored through technology rather than sending people out into the field to take those measurements, as is currently done. Ever a looming possibility, funding for this proposal would be an exciting retirement gift for Ligon, who is retiring at the end of this year. Of course, he would immediately return to Michigan Tech in a research professorship role to participate in the project!

Expanding Interests

Retirement for Ligon will not necessarily mean retirement from his field, no matter the outcome of the Forest Service proposal. He may pursue one of his entrepreneurial interests, consult in experimental mechanics, or assist in developing some new technology. He is also considering traveling to other universities to teach fundamental Solid Mechanics courses as a visiting professor. And, then there are his hobbies of fishing, hunting, photography and woodworking—noble pastimes to pursue in Houghton or to take on the road.

Of course, it goes without saying that Ligon will continue his membership in the *Society for Experimental Mechanics (SEM)*, an organization in which his past leadership role sums up his commitment to his field, his enthusiasm for working with students, and his ongoing collaboration with other engineers around the world.

President of SEM

Although he was President of the organization in 1984, Ligon feels his most rewarding accomplishment was starting the *Student Paper Competition* back in the 80's, which he organized and chaired at the international level from 1990 through June 2005. Students from universities around the world compete with each other by making presentations of their research. There have been entrants from as far away as England, Scotland, Russia, India, and New Zealand; places Ligon may visit after his "retirement" from Michigan Tech. Dr. Ligon will certainly be at future annual *SEM* meetings, one of the best locations to find colleagues who share the same passion for the field of Experimental Mechanics—he'll be the one drawing on the back of his napkin.

A COMPELLING VISION FOR INNOVATION

EDWARD LUMSDAINE

CREATIVE ENGINEERING

Creativity and entrepreneurship have been the lifelong passions of Dr. Edward Lumsdaine, a Mechanical Engineering faculty member and Management Consultant for Ford Motor Company. The following excerpt, taken from one of Lumsdaine's published books, *Entrepreneurship, Creativity, and Effective Problem Solving: Keep on Moving!* (with Martin Binks) reflects the crux of his belief system and approach in engineering, as well as in life. And, *Keep on moving* is a phrase that Dr. Lumsdaine has taken to heart—he has lived, taught, and worked all over the world, consistently keeping his finger on the pulse of industry throughout his educational career.

"The word creativity is derived from the Latin ***creare*** *to make and the Greek* ***kreinein*** *to fulfill…. In the context of entrepreneurship, it is creativity that leads to the development of new products and processes which when innovated replace the traditional and previous version. Creativity leads to greater fulfillment on an individual basis as we use our imagination to create new horizons in terms of what we do in our lives…. Creativity therefore has a novelty and also relevance in terms of changing what we do and what we believe about our potential, which is yet to be realized."*

Lumsdaine has also co-authored a textbook called *Creative Problem Solving and Engineering Design*, which delineates the process of using whole-brain thinking, a model that Ned Herrmann invented along with a tool

for its measurement. A physicist who became Manager of Management Education for General Electric, Herrmann greatly influenced Lumsdaine both personally and professionally—much of Lumsdaine's work revolves around Herrmann's theories on four-quadrant brain functioning and the importance in integrating the use of all these quadrants in order to tap creativity and realize true innovation. Most engineering students predominately use the left brain and leave out the right brain modes. What is particularly compelling about Lumsdaine's book is that it presents not only the theory but also a wide variety of practical exercises to learn how to effectively use all the quadrants of the brain.

"It is true that people are naturally creative, but I believe that we have set up mental blocks; we have taught students how not to be creative throughout their entire school curriculum. By the time they come to college, they are numb. I don't teach creativity, per se. What I teach is how to knock down all those barriers that have been put there. I teach engineering design in stages. The first stage is teaching the foundation, the second is learning how to be creative, then comes problem solving, and finally teaching the actual design. I also encourage creativity at every step in the process, and I require that my students come up with at least three different ideas for each one of their designs."

Technopreneurship

In addition to using creative approaches to design, Lumsdaine promotes the connection between engineering and business. Dubbing it "technopreneurship," he focuses on

teaching technical students about entrepreneurship. He brings the purpose behind design to the forefront—why patent products if they will never be used? As a result of his work, all first-year engineering students at the University of Pretoria, South Africa, are required to take a course in entrepreneurship and innovation, with his book being the academic foundation to guide their inventive team projects. As Special Professor of Business at the University of Nottingham, England, Lumsdaine and his colleague, Professor Martin Binks, co-teach MBA students each fall in a one-week intensive entrepreneurship class in Singapore, and their book has just been adopted for teaching entrepreneurship to engineering students at the University of Nottingham.

"I believe that the role of engineers is to design and create products for the benefit of society. I've always felt that when we design something, we ought to have a market for it. There needs to be much more emphasis on the marketing part in engineering education. We should teach our students enough about entrepreneurship so they can communicate with business people or be able to market the product themselves. In fact, I insist that our Michigan Tech design teams have at least one marketing or business student per team."

Broadening Horizons

Lumsdaine has created exceptional experiences in business and management which he applies directly to his theories. He was a research engineer for Boeing, a director for the New Mexico Solar Energy Institute, and Dean for both the University of Michigan-Dearborn and the University of Toledo in Ohio. He came to Michigan Tech in 1993 as the Dean of Engineering and left this position in 1995 to become the head consultant of the C3P Program at Ford Motor Company. Lumsdaine spent two years developing and running Ford's own "technical university" which trained 8,000 people in the new technology of solid modeling. Lumsdaine and a Ford manager built this program from the ground up in record time, organizing the entire structure of the project—securing a building, developing a curriculum, recruiting faculty, designing a catalogue, registering students, collecting tuition, and teaching 35 to 40 different courses. Since returning to Michigan Tech in 1997, Lumsdaine has maintained this Ford partnership, bringing significant financial support and educational excellence to programs at Michigan Tech.

"I grew up in Shanghai and came to the United States when I was sixteen. I have been in academia for many years, but I have left often and done other things. I never seem to stay in one place for more than five or six years. I have been around, and I ***know*** *the value of creativity, innovation, and technopreneurship. I've always been involved in things that are a few years ahead, and I also know that people need to catch up. Somehow it is human nature to resist things that are new. Change is uncomfortable for a lot of people—I have a illustration that says: 'Only a wet baby likes a change!'*

His Legacy Continues

A professional engineer who likes to take risks, Lumsdaine remains a visionary who challenges the status quo, continuing to write about and share his evolving theories. A man of incredible foresight, he is obviously someone who thrives on change. His creative spirit comes through in the stories he tells about the inspirational journeys of cutting-edge inventors—people like Chester Carlson. It took Carlson, who invented Xerox, seven years to find a company to back his product! In fact, Lumsdaine was awarded the *Chester F. Carlson Award*—his most prized possession—in 1994 for his innovations in engineering education. Whatever the future holds for Dr. Lumsdaine, his greatest contributions will be his commitment to creativity in engineering education and his dedication to technopreneurship, bringing innovation to technical education and industry through collaborative partnerships. Certainly, Michigan Tech will be informed and changed by Lumsdaine's purposeful approach to "seeing [and doing] things differently."

TRANSFORMING THE ENGINEERING EQUATION

MICHELE MILLER

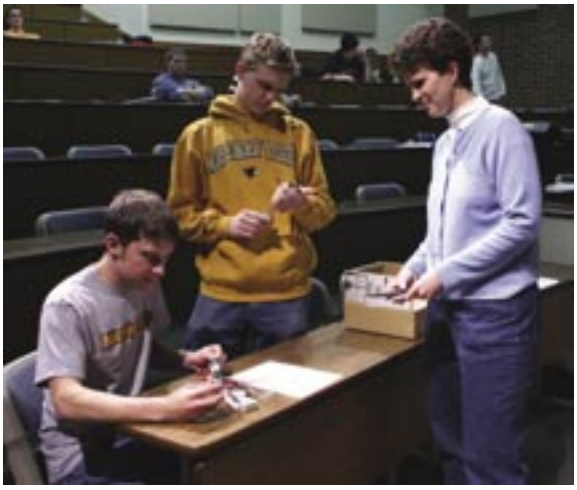
CONTEMPORARY EDUCATION

I don't think my story is unusual. I liked the legos and erector sets, I liked math and science in school, and because my dad was an engineer, I saw firsthand that engineering was a good career.

Some recognize their calling in a flash, but Dr. Michele Miller formed her career choice from her myriad experiences in life. Her father's influence along with her childhood activities predetermined her path to the field of Precision Engineering. From childhood on, she actively engaged her environment with the powers of observation and analysis— watching how others repaired equipment, questioning product designs by disassembling the devices, and experimenting with her own ingenious solutions to problems.

Human Factors

Today, Dr. Miller is sharing that ingenuity, bringing change to much more than the faces of engineers. The exponential speed of technological development has brought with it specific human challenges, which Miller believes need to be addressed. And she is doing just that, in the new course she is teaching entitled *Human Factors*. She explains, "*Human Factors* is about



figuring out how to design things in ways that are easier for people to use—technology is all around us yet it's not always easy to operate. These complications arise because engineers implicitly understand the design and operation, but people with limited engineering knowledge do not have this same comprehension and when they try to use these products, they may run into problems."

Miller cites the example of the healthcare industry. Currently, hospitals have a lot of complex equipment which has enabled them to make much more accurate diagnoses and perform highly evolved procedures. Some of this technology, however, increases the opportunities for making mistakes, sometimes mistakes with disastrous consequences. By bringing the *human factor* back into this engineering equation, Miller hopes to improve the ultimate designs and better prepare up-and-coming engineers to work with contemporary challenges.

Designing Complex Systems

Another important issue that she will be addressing through this class is the information overload that often happens to people who work in complicated environments. *Human Factors* will examine how the person fits into that system and take into account the human capabilities when designing these complex systems. Miller adds, "A complex system could be a nuclear power plant, an automobile, an office, anything with some complexity. This is a fairly new field but there has been a lot of activity in the area since the 1950's, mostly in the military. I think this

issue is becoming a lot more relevant as the world gets more complicated and technology is more pervasive." Changing technologies and evolving issues also significantly affect the research funding landscape, as Miller is discovering with the dwindling funding for traditional manufacturing research. Miller came to Michigan Tech in 1994 and has been an Associate Professor since 2000. She originally studied the machining of glass and ceramics in her graduate work, receiving her PhD from North Carolina State University. Since then, she has also done work in the field of MEMS—micro electro mechanical systems—designing optical chips. Today, however, she is modifying her focus to match the movement of the funding agencies as well as the interests of the world at large: "To have to re-tool is a difficult thing, but on the other hand, there are a lot of people who have to do this. Certainly, our students will have to change directions at some point in their careers; so it is a valuable thing to learn. The nice thing about an academic environment is that there is opportunity to discover new interests. I really like that part of it, that freedom to intellectually explore other areas."

Evolving Research

Beyond her primary academic research, Miller defines two distinct interests which she has been investigating over the past year: graduate education specific to problem-solving skills, and expanding public exposure to engineering and technology. She is actively pursuing funding for both topics and hopes to develop some creative partnerships in the process. Obviously enthusiastic about the possibilities, Miller especially likes the idea of educating elementary children, and the public, about engineering and technology. Believing that universities need to play a major role in educating their communities, she also notes, "Our technological literacy is pretty low in the general public. One of the reasons is that engineers don't really communicate what they are doing very well. They don't communicate it at a level that the average person can understand."

Science Museum Exhibits

Miller stresses the importance of bringing this technological education into the region around Michigan Tech. Describing her vision, she says, "I really want science and engineering to be something that the public bumps into more often, so what I want to do is to have a kind of science museum that is exhibited around the community." Elaborating on this project, she describes rotating displays at the library, mall, and other locations around town that would feature some kind of simple demonstration of an engineering principle or technological device. An accompanying computer kiosk would also have a story or a quiz about science and technology, and data could be collected about public knowledge or interest areas.

These *museums* could have tie-ins with public school programs already happening. For instance, Family Science Nights taking place around the western Upper Peninsula would be a natural starting point. In addition, the local school districts could participate in the training of Michigan Tech students, whose educational presentations would be geared to the age of their audiences. Miller concludes, "The way that I want to implement this is to start an engineering enterprise program that is basically informal science education, where students are creating the content of these exhibits and analyzing the data, and at the same time, they are becoming informal science educators." The final outcome would yield engineers who have better communication skills and community members with advanced technological literacy.

Solving Societal Issues

Innovative thinking, innovative programs—Dr. Miller represents the future of engineering education. Chuckling, she adds that "the old guys with horned rimmed glasses" is an outdated image that doesn't do justice to the changing field of engineering, and she stresses the importance of promoting this choice as a viable career for young women, especially if they like math, science, and problem solving. Opportunities abound to work on a wide variety of current issues including energy, healthcare, and the environment. Pausing to look out her office window at the bird's eye view of the Michigan Tech grounds, she asserts, "Engineers are critical to solving some of the most important modern societal problems."

DISCOVERING THE ADVENTURE OF INQUIRY

MICHAEL LACOURT

LABORATORY RESEARCH

I try to keep an open door policy. I hope that students feel comfortable enough to ask questions and to come to my office if they need assistance. I like to stay involved with the students' activities, and I especially enjoy the vast variety of experiences in my work.

Michael LaCourt's dedication to his work is obvious when a student knocks on his door requesting help with his current lab project. He is having some trouble with his CAD program in generating a design; the difficulty lies within the computer code needed to make the product he has created. Although LaCourt cannot meet with the student immediately, he makes time to meet with him an hour later so that they can examine the details of his design project together. LaCourt's demeanor is cordial and encouraging; his pragmatic nature makes him approachable, easily engaged by his students and their ideas.

Uncovering the Path

It is obvious that LaCourt's flexibility and openness have served him well—he has certainly capitalized on the educational opportunities and diverse experiences that have come his way at Michigan Tech. Returning to his alma mater and home town 28 years ago, he followed a unique path to his current position as a laboratory instructor in Manufacturing and Mechanics of Materials. Originally hired to teach electronics to mining engineering students, he soon discovered that to adequately address the needs of these students, he had to know what was happening in the mining industry. He describes his journey: "Most of the research at that time was in rock mechanics. I had to learn about strength and mechanics of materials, statics, and chemistry. I started taking more courses, myself, and then taught those topics in mining engineering."

That progression in mining education advanced into other areas of study, as LaCourt explains, "Then, I had to learn about manufacturing. We were designing our own test fixtures because they couldn't be bought commercially at that time. Ultimately, we designed and manufactured the parts ourselves. Shortly after that, I began teaching manufacturing lab classes here, and now, I work with both Materials and Manufacturing." LaCourt has continually challenged himself in the pursuit of lifelong learning, exploring various fields from electrical to mechanical to metallurgical engineering.

Student Impact

LaCourt's students have also been an integral part of his ever-evolving path at Michigan Tech. He calculated that he has worked with over 5,000 students from freshmen to doctoral candidates—he has touched a lot of lives! His students have also made a significant impact on his teaching, as he describes: "A lot of times when you are trying to teach something, students will show you a different way of looking at it. I have found that what they bring into class helps with my instruction in subsequent classes." Student interaction and involvement enrich the laboratory experiences for everyone. LaCourt acknowledges that adding their contributions to his knowledge base enables him to assist the next class in new ways.

The support and work atmosphere of the Mechanical Engineering department has also shaped LaCourt's long career at Michigan Tech. Approximately 75 faculty and staff in the

ME-EM department have created a cohesiveness not found in many other places. LaCourt values the camaraderie and the leadership of this group. He notes, "I don't know of anyone here who hasn't become part of the group. We all work very well together, and I believe this has come from how the system is structured, which is actually determined by the group itself, not exclusively by one individual." Many decisions are based upon group participation and feedback, creating an environment that sustains the faculty and staff, as well as providing an exemplary educational environment for the students.

Building Relationships

In addition, LaCourt feels that the design groups and research projects have offered extensive opportunities for people and students in the department to get to know one another. Changes in the curriculum now dictate that all undergraduates participate in design groups. From the get-go, they are also encouraged to participate in research projects to get as much hands-on experience during their time at Michigan Tech as possible. LaCourt's specialty is exactly that—the experiential component of their education. Most of his work in materials revolves around student research, from experimenting with metals to metal forming to composites, ceramics, and components.

Diverse Cultures

This practical groundwork, LaCourt believes, makes ME-EM students some of the best-equipped graduates, resourceful and ready for the real-world challenges in engineering. He has every confidence that many of them will play valuable roles in the future, especially as energy requirements shift dramatically. As we move even closer towards a world economy, LaCourt emphasizes the necessity for student diversity on campus so that people get to know one another well, and come to understand each other's customs and cultures. His work with the growing number of international students at Michigan Tech has given him great hope for the challenges that lie ahead—socially, politically, and technically. It is also no surprise that he and his family have hosted several international exchange students. The unique deer racks protruding from his office wall—a gift from one student—are from a small deer native to Germany. They are tiny, but loom largely as evidence that this student's stay with the LaCourt family was a notable time.

Questioning Minds

Displayed beneath the deer racks, his 2004 *Employee Excellence Award* is a visible reminder that Michael LaCourt has made a professional commitment to quality education at Michigan Tech. Summing up his approach in teaching, he relates this story about his oldest grandson who is eight years old: "Last year when he was in second grade, he would never ask questions in class. Never. He had somehow derived the impression, perhaps from the other kids, that asking questions was stupid. I explained to him that teachers actually like it when students ask questions, because it tells them that they are paying attention, they are thinking about what the teacher is talking about, and there is something that they don't understand, so the teacher needs to fix that, before they can go on to the next topic. My grandson said to me, in amazement, 'Really?! You don't mind when we ask you questions?' I assured him that it is important to ask questions and told him that we all have questions from time to time." Contemplating this heartfelt memory, LaCourt smiles broadly, adding, "And hopefully, sometimes, I even know the answer!"

ACCOMPLISHED NEW FACULTY

NEW HIRES 2004-2006

One of the top goals of the ME-EM Strategic Plan is to attract and retain high quality and diverse faculty, staff, and students. The new faculty for 2004-2006 are experts in a variety of research areas, and bring with them extraordinary practical experience from their fields. Adding new inspiration and innovative ideas to our engineering curriculum, these accomplished educators join our ever-evolving group of outstanding faculty members.

Dr. Spandan Maiti
PhD, University of Illinois at Urbana-Champaign

2.5 years post-doc experience at the University of Illinois

Research Areas: *Modeling and Simulation of Failure and Deformation of Multifunctional Materials, Biomimetics, Multiscale Analysis, Dynamic Fracture*

Dr. Jeffrey S. Allen
PhD, University of Dayton

12 years experience at NASA Glenn Research Center

Research Areas: *Microfluidics and Fuel Cells*

Dr. Jeffrey D. Naber
PhD, University of Wisconsin-Madison

9 years experience at Motorola Automotive and Industrial Electronics Group and 3 years at Sandia National Laboratory

Research Areas: *Engines and Powertrains*

Dr. Jaime A. Camelio
PhD, University of Michigan

1 year A.T. Kearny, and 3 years post-doc experience at the University of Michigan

Research Areas: *Assembly Systems, Manufacturing Process Modeling, Design Optimization, Systems Diagnosis, Manufacturing Complexity Management*

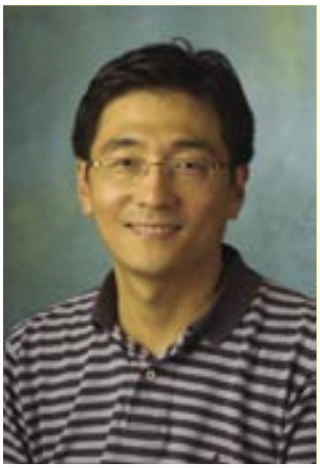
Dr. Gregory M. Odegard
PhD, University of Denver

4 years experience at NASA Langley Research Center

Research Areas: *Nanomechanics and Nanotechnology*

Dr. Henry Sodano
PhD, Virginia Polytech Institute and State University

Research Areas: *Power Harvesting, Vibration Control, Smart Structures, Structural Health Monitoring, Non-Contact Damping*



Dr. Byeng Dong Youn
PhD, University of Iowa

8 months at the University of Detroit Mercy as an assistant professor and 3 years experience at the University of Iowa as a post-doc, Research engineer, and Adjunct Professor

Research Areas: *Engineering Design, Reliability and Quality Engineering, Durability (fatigue) Analysis, Statistical Information Technology, Design Sensitivity Analysis*

FACULTY AND STAFF AWARDS

Our commitment to excellence is reflected through this year's faculty and staff awards, recognitions, and promotions. The Mechanical Engineering-Engineering Mechanics Department honors the following faculty and staff for their achievements and success.

Dr. John K. Gershenson
SAE Ralph R. Teetor Education Award
Society of Automotive Engineers, 2005

Dr. L. Brad King
SAE Ralph R. Teetor Education Award
Society of Automotive Engineers, 2006
Distinguished Alumni Award
Calumet/Laurium/Keweenaw School District Reunion Association, 2005

Dr. William R. Shapton
(Professor Emeritus)
SEM 2006 DeMichele Award recognizing "exemplary service and support in promoting the science and educational aspects of modal analysis technology"
Society of Experimental Mechanics, 2006

Dr. Ghatu Subhash
MTU Annual Research Award
Michigan Technological University, 2005

Dr. John W. Sutherland
Fellow of SME
Society of Manufacturing Engineers, 2005

Dr. Virgil W. Snyder
(Professor Emeritus)
Honored with a plaque for his outstanding contributions to the field of modal analysis
Society of Experimental Mechanics, 2006

Dr. L. Brad King
Promoted to Associate Professor with tenure, 2005

Dr. Craig R. Friedrich
Promoted to Professor, 2005

Dr. Donna J. Michalek
Dr. Donna J. Michalek has accepted the position of Director of Faculty Success and Diversity in the College of Engineering. The appointment is part time. Dr. Michalek will retain her full time position in the department.

Dr. Henry A. Sodano
Dr. Henry Sodano, an assistant professor in the Department of Mechanical Engineering, was quoted in the prestigious journal *Nature* about windmills powering wireless networks.

STUDENTS

CREATING GLOBAL CONNECTIONS

GRACE EATON

UNDERGRADUATE

Grace Eaton—poised, articulate, confident—is a Senior with a mission. A mission that began as Eaton motored through the scenic waterways of the Hudson River Valley with her family in upstate New York. Her mechanical interest in boat engines combined with her concern for the pollution issues facing the Hudson River directed her passage into Mechanical Engineering at Michigan Tech. She discloses her future goals: "I want to be a part of changing how we view energy, how the world uses energy, and how we take care of the environment with the technology we have."

An Internship in China

Interviewing with large engine companies like Cummins Inc., Eaton is well on her way to bringing her vision to fruition. She shares with her future employers the practical experiences she has gained at Michigan Tech, the most recent being a three-month internship for a metal stamping factory in Dongguan, China. In this position, she communicated the progress of the project to the invested partners—a German company located in China overseeing a Japanese project with headquarters in the US. Eaton rose above the challenge of language and cultural differences, learning much in the process. Describing this profound experience, she notes, "The world seems so much bigger now. Every preconception that I had about Asia was wiped away. I would like to go everywhere. I'd love to see India and Africa, and make some comparisons with my trip to China."

Eaton is already leading the way as President of the *Society of Women Engineers (SWE)* and a member of the *ME-EM Student Advisory Committee*. She understands the importance of taking an active role in creating the world one desires. Eaton explains, "One thing I have learned about myself since I have been at Michigan Tech is that anything I put my mind to, one way or another, I am going to get it done, and I am going to do it well." She is exceptionally talented in her studies as well as in her recreation—as a boater, skier, field hockey player, and broom ball extraordinaire.

Following Their Footsteps

Although she is the first in her family to get an engineering degree, Eaton has followed the footsteps of strong, fearless individuals like her mother, father, and especially her grandmother who is 83 years old and about to be ordained. Her grandmother lives in nearby Calumet and is part of the reason that Eaton chose Michigan Tech. Eaton is also considering the Michigan Tech graduate program since she is drawn to the active research taking place in Emissions and Computational Fluid Dynamics. Whatever her course, Grace Eaton will be a preeminent force in the world of Engineering.





MARGOT HUTCHINS
PHD STUDENT

Passionate. Driven. Gifted. These traits have shaped the life of Margot Hutchins. She is *passionate* about her vision to create social equity through industry practices and is finding her niche in the newly formed *Sustainable Futures Institute (SFI)* at Michigan Tech. Hutchins is *driven* to work long hours and excel in both her studies and her cross-country running adventures. She recently completed the Whistlestop Marathon in Ashland, Wisconsin—a 26.2 mile run on an old railroad grade—in two hours and 57 minutes! And, Hutchins is particularly *gifted* in Engineering. Graduating from Michigan Tech with a BS in Mechanical Engineering, she knows how to speak the technical language and she wants to use this skill to address critical social issues.

Social Responsibility

Combining social issues and engineering is a daunting task; however, Hutchins is exploring this path through an individualized program within the *SFI*. Social responsibility in industry is an absolute necessity, as she

explains, "Humans need to change their behaviors on many different levels if we are going to maintain the quality of life that we currently enjoy. There is a big push in industry toward social responsibility, and many companies are establishing corporate social responsibility statements. These statements often declare that companies value things like equity and education, but operationally, they struggle with determining how to promote improvement on social issues and measure their progress."

With the multidisciplinary approach and support of the *SFI*, Hutchins is developing the tools, metrics, and underlying science to measure and improve the decisions and practices that affect social sustainability. She describes the purpose of this *social equity tool* for decision making: "Business leaders need tools and quantitative measures, and my work is ultimately focused on addressing these needs, and linking engineering and business decisions to social issues."

Economists have developed techniques to determine how monetary flows cascade through an economy and impact the activity in various industry sectors. Environmental engineers built upon this idea to describe the effect of monetary flows on economy-wide resource consumption and pollution measures (e.g., greenhouse gas emissions and solid waste). Hutchins continues, "Our idea is to use a similar approach to characterize the effect of monetary flows on social indicators such as education, health care availability, and poverty level. Scale is a challenge; we want the tool to be able to describe global behaviors and regional effects in the US. Many developing nations supply the industrialized world with raw materials, and we want to help companies make decisions about how they spend their money. Purchasing wisely is one way to bring about positive

Integrating Sustainability

social change around the world." Hutchins' goals do not end here; she is also interested in integrating sustainability concepts into engineering curricula. She believes sustainability will become increasingly important in the 21st century. Since her long-term vision includes a career as a faculty member, Margot Hutchins will have abundant opportunities to apply her gifts and drive in the pursuit of her

The Sustainable Futures Institute

The *Sustainable Futures Institute (SFI)* was established at Michigan Tech on April 1, 2003, and is headed by Co-Directors Dr. John Sutherland (ME-EM) and Dr. James Mihelcic (CEE). The mission of the *SFI* is to create and disseminate new tools, methods, knowledge, and technologies that promote and support societal sustainability principles. The vision of the *Sustainable Futures IGERT Project* is to develop an integrated scientific and social basis for decision-making on sustainability issues. *IGERT* is supported by a grant from the National Science Foundation.





STUDENTS

BUILDING GLOBAL COMMUNICATION

JULIO RIVERA

PHD STUDENT

I believe the biggest world issues we will face are communication and values. Communication is the key to our success. I see that we are not communicating well—locally, nationally, and globally. I think that we are losing our values, and the world is becoming too materialistic. But, there is always hope; maybe that is why I am here, to make a difference.

Julio Rivera, a native of Puerto Rico and a graduate from the University of Puerto Rico at Mayagüez, is making a difference wherever he goes. A PhD student and member of the *Sustainable Futures Institute*, Rivera takes sustainability to heart, making certain to give back as much as he has received. He has taken on the task of promoting Michigan Tech in his homeland, and has met with representatives from four universities there in an effort to recruit students and create educational partnerships with Michigan Tech.

Inspiring Puerto Ricans

Giving his best, he is also a member of *NOSOTROS*, the *Society of Hispanic Professional Engineers (SHPE)*, and has helped organize numerous Hispanic cultural events, including the first live salsa band performance in Houghton. In addition, he is on the *ME-EM Graduate Student Advisory Board* which addresses issues for Hispanic students at a national level; and as the *Graduate Student Council Health Insurance Manager*, his service extends far beyond the classroom.

Rivera is part of the *Sustainable Futures IGERT (Integrative Graduate Education and Research Traineeship)*, a National Science Foundation Project. His long term goal is to become a faculty member and return to Puerto Rico. He explains, "We need to have more Puerto Ricans educated at the doctorate level. Faculty members have the responsibility to mentor students and interact with them. In order to attract more students to science and engineering, we have to *inspire* them."

Rivera describes his smaller goals along the way, an ever-expanding list which includes an internship in Australia. Integrating the social, economic, and environmental aspects into his program, he is specifically interested in manufacturing and air quality. He plans on investigating the mechanisms that affect the behavior of nano particles in the air, linking them to the impacts on human health.

Engineering Public Policy

From there, Rivera would like to explore the process for determining better air quality standards, and finally, public policy at a national level. He explains, "I think it is important to increase the number of scientists and engineers in Congress. Since we are facing more complex problems, Congress will be making many technical decisions. We need to have people with engineering backgrounds there so that benefits to society are maximized."

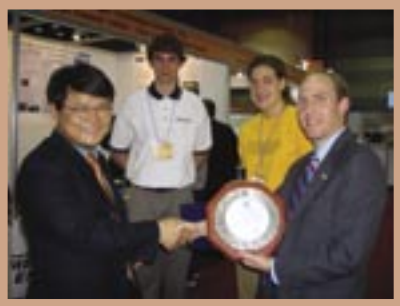
There is some irony in the fact that the largest challenge for Rivera at Michigan Tech has been the English language. In Spanish, he says, "Tienes que estar adentro para saber lo que está pasando." (*You have to be inside to know what is happening.*) Julio Rivera has immersed himself completely, and his conversations, whether in English or Spanish, are thought-provoking interactions that articulate his zeal for building relationships across the world.

STATE-OF-THE-ART TECHNOLOGIES

The Michigan and Superior rooms—two ME-EM Department Labs—were recently renovated and engineered with new teaching technologies. In addition to paint and new carpeting, the Michigan Lab received 25 new computers, a digital projector, and a large presentation screen designed by SmartTechnologies. By writing directly onto this screen with a special stylus and software, presenters can annotate animated and PowerPoint slides or other presentation software.

The *Sympodium Interactive Pen Display* from SmartTechnologies is also being used in the Graduate Student Lab on the ME-EM 5th floor. Funded by a grant from the SMARTer Kids Foundation of Canada, this new technology is becoming quite popular with faculty and students. Lecture notes, formulas, and answers can be written and saved directly onto software applications like PowerPoint, Word, Excel, and AutoCAD.

HPV Honors at 2005 Competition



At the 2005 ASME Human Powered Vehicle (HPV) Competition held in Alabama, the Michigan Tech team garnered first place awards in: Overall Engineering, Design and Innovation, Analysis, and Aesthetics. The ME-EM capstone senior design project provides this innovative HPV design and fabrication experience. Dr. John Gershenson and Dr. Ibrahim Miskioglu were the faculty advisors.

Hitting the Streets of Seoul

In fall of 2005, Dr. Gershenson and two senior design project groups—a Volvo-sponsored Muffler Design team and the Human Powered Vehicle team—traveled to Seoul to take part in an Engineering Exposition featuring design projects by students from various universities across South Korea. Industry executives and government leaders attended the Expo. Michigan Tech students also accompanied Dr. Gershenson and Dr. Peck Cho, who is in Korea on sabbatical, to meetings with engineering faculty from several Korean universities. Promoting the capstone design program at Michigan Tech, they shared their perspectives on the program.

Tony Schwenn (BSME 2005), a current graduate student in Business Entrepreneurship at Michigan Tech, found the trip educational and multifaceted. Schwenn especially appreciated the Korean hospitality: "We were able to learn about a whole new culture. Our hosts were amazing—they were college students who served as our translators and guides. Together, we wandered the streets, visited the shops, rode a bullet train, and explored one of the ancient cities. They made the whole experience remarkable in so many ways."

STUDENTS

BROADENING ME-EM EXPERIENCES

STUDENT ADVISORY COMMITTEE

The *ME-EM Department Student Advisory Committee* is composed of student representatives from departmental organizations and professional societies. The ME-EM Chair and the Associate Chair and Director of Undergraduate Studies also sit on this committee. Working directly with Dr. Predebon and Dr. Evensen, these students inform the ME-EM Department and Faculty about curriculum ideas, special concerns, and student issues. *Student Advisory Committee* members also coordinate the department activities and calendar of events for their prospective organizations.

Grace Eaton, who represents the *Society of Women Engineers*, notes that this committee is a direct line to the top, proclaiming, "Every topic we bring up is attended to and dealt with appropriately. The *Student Advisory Committee* has been an awesome vehicle for making change."

2004-2005 SAC MEMBERS

Steve Anton
Pi Tau Sigma, President

David Dame
Aerospace Enterprise Committee Chair

Joal Derbas
American Society of Mechanical Engineers, Chair

Grace Eaton
Society of Women Engineers, President

Kiran Khadke
Graduate Student Council Representative and Challenge X Leader

Chad Morrison
Society of Automotive Engineers, President

Akshay Patil
Graduate Student Council Representative and Freshman Advisory Board Chair

Harold Evensen
Associate Chair and Director of Undergraduate Studies

William Predebon
ME-EM Department Chair

Michigan Space Grant Consortium Awards
The Michigan Space Grant Consortium (MSGC) is a group dedicated to promoting education and research in space-related science and technology in Michigan. In 2004-2005, the MSGC awarded grants to two ME-EM students for their aerospace research topics.

Adam Moore
Senior
An Investigation of Model Characteristics of an Inflatable Space Structure
$2,500 Award

Emily Fossum
Graduate Student
Electron Dynamics in a Hall Thruster
$5,000 Award

GRADUATE SEMINAR SERIES 2004-2005

A committee of Michigan Tech faculty members put together the dynamic ME-EM Graduate Seminar Series every year. Dr. William Endres is the Chair of the committee, which creates an agenda of compelling topics for both students and faculty. The seminars offer graduate students and faculty opportunities to expand their knowledge base to areas of study outside of their specific research. Composed of a diverse mix of renowned leaders representing academia, industry, and government; this year's Seminar Series featured leaders from Purdue University to Honeywell to the EPA.

Prof. Ibrahim Karaman
Texas A&M
Use of Severe Plastic Deformation in Microstructural Engineering of Structural and Smart Materials

Dr. Vladimir Segal
Honeywell
Material Processing by Simple Shear

Prof. Ravichandran
Cal Tech
Large Electrostrictive Actuation of Ferroelectric Perovskite Single Crystals

Dr. Enrique Ramé
National Center for Microgravity Research
Modeling Liquid Spreading: A Fluid Mechanical Approach

Prof. Jeffrey Allen
Michigan Tech
The Role of Capillarity on Effective Water Management in PEM Fuel Cells

Prof. Jeffrey Naber
Michigan Tech
Individual Cylinder Torque Deficit Measurement via Physically Based Signal Processing of Crankshaft Dynamics for IC Engines

Prof. Ravi-Chandar
University of Texas, Austin
Mechanical Behavior of Stents and Stented Arteries

Prof. Anil Bajaj
Purdue
Issues in Modeling Seat-Occupant Dynamics for All-Foam Seats

Prof. Gregory Odegard
Michigan Tech
Modeling and Simulation of Nanostructured Materials

Prof. Steven Collicott
Purdue
Capillary Fluids Topics in Zero and Finite Gravity

Dr. Harvard Vold
ATA Engineering
Spatiotemporal Filtering for Continuum Interplotation of Test Data—How I Became a Rocket Scientist

Dr. Jim Redmond
Sandia NL
Recent Advances in Structural Dynamics Modeling and Validation at Sandia

Dr. Burhan Altan
Michigan Tech
Severe Plastic Deformations: Towards Bulk Production of Materials with Nanostructure

Dr. Mark Shephard
Rensselaer Polytechnic Institute
Automated Adaptive Analysis of Simulation-Based Design

Dr. Julie Zimmerman
EPA
Formulation and Evaluation of Green Metalworking Fluids

Dr. Spandan Maiti
UIUC
Cohesive Modeling of Material Failure at Different Time and Length Scales

Prof. Nemat-Nasser
UCSD
A New Horizon in Engineering Sciences: Biomimetic Multifunctional Materials

Dr. Susan Zhou
UC Irvine
Merging of Active DNA Arrays with Micro- and Nano- Fabrication

Prof. Jonathan Kofman
University of Waterloo
Application of Computer Vision in Intelligent Systems and Human-Machine Interfaces for Range-Sensing and Robot Teleoperation

Dr. Kishore K. Pochampally
MIT
Crucial Issues in Strategic Planning of Reverse and Closed-Loop Supply Chains

Dr. George Muntean
PNNL
Energy, the Environment, and the Particulate Challenge

Prof. William King
Georgia Tech
Thermal Processing and Thermal Measurements at Extremely Small Scales: 10 Nanometers to 50 Micrometers

Dr. Song-Charng Kong
University of Wisconsin
Low Temperature Engine Combustion Study Using Detailed Chemistry with Experimental Validations

Prof. Ryan Vallance
George Washington University
Research Towards Nano Machining with Field-Emitted Electron Beams from Carbon Nanotubes

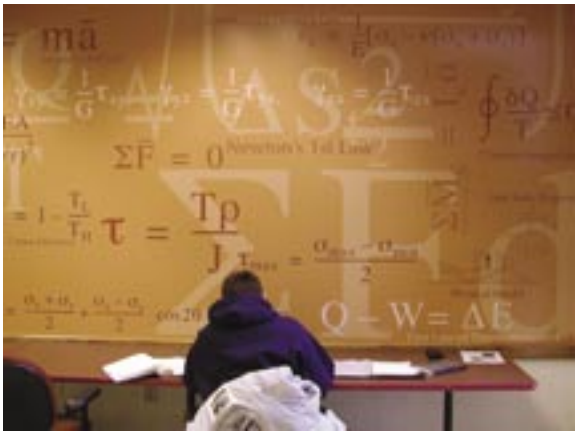
Dr. Tom Letowski
U. S. Army Research Lab
Speech Communication Through Bone Conduction

Prof. Philippe H. Geubelle
University Illinois at Urbana-Champaign
Failure of a Self-Healing Composite Under Monotonic and Fatigue Loading: Experiments and Cohesive Modeling

ME-EM DEPARTMENT SCHOLARSHIPS

STUDENTS

UNDERGRADUATE SCHOLARSHIP RECIPIENTS



Michigan Technological University has established a resounding reputation for outstanding students. The ME-EM Department strives to make engineering education opportunities available to qualified students from diverse backgrounds. Financial Aid scholarships are awarded to students on the basis of high academics, outstanding leadership, financial need, and underrepresentation. Following are the ME-EM undergraduate scholarship recipients for the 2004-2005 academic year.

Abdoullahzadeh, Navid
Ackerman, Heather A
Adams, Brooke A
Adler, Daniel P
Aguila, Jorge L
Ahlem, Eric D
Aho, Heather N
Albers, Neil R
Alt, Matthew M
Amlotte, Sarah M
Anderson, Beau L
Anderson, Christian T
Anderson, Gabriel B
Anderson, Greg A
Anderson, Kelly S
Anderson, Matthew P
Anderson, Nathan C
Andrews, Jacob W
Anton, Steven R
Arens, Gregory D
Aschinger, Michael J
Atherton, Brandi M
Auge, Jessica L
Austin, Gregory T
Awannegbe, Edohamen P
Azarovitz, Daniel E
Bagley, John T
Bair, Tyler M
Balfour, Juan J
Barkley, Matthew D
Bassindale, Joseph J
Baxter, Bryan J
Beckman, Justin L
Beilke, Jonathan R
Bejcek, Brian C
Bekkala, Wesley H
Belling, David A
Bendick, Kathleen M
Benes, Philip M
Bengry, Matthew E
Bennett, Timothy A
Benson, Michael S
Berry, Kevin J
Besonen, Thomas P
Biery, Cameron J
Billiu, Christopher S
Billmeier, Michael K
Black, Eric C
Blake, Justin A
Blecke, Jill C
Bobchik, Joseph P
Boes, Steven T
Bojanowski, Brenton E
Borns, Christopher W
Bosscher, Nathan L
Botero, Derek R
Bouman, Jeffery A
Bourgo, Kevin M
Bowron, Micah J
Bracy, Cory L
Bradley, Brett B
Bradley, Sarah M
Brady, Jason A
Brandt, Colin M
Bray, Farah J
Breining, Elizabeth K
Brewster, Michael R
Brinks, Andrew J
Brouwers, Andrew J
Brown, Stephanie J
Bruce, Andrew D
Bryson, Peter A
Buckingham, Scott A
Buckner, Erin R
Buono, Joseph R
Burt, Fritz N
Burwell, Alan C
Cafmeyer, Sean M
Caldwell, Ryan E
Campbell, Alan W
Canepa, Rachel E
Capello, Kyle J
Carl, Brian A
Carlson, Melissa M
Caudill, Cole J
Caverly, Jacob A
Ceterski, Kenneth N
Chamberlain, Matthew L
Chao, Darald E
Chaphalkar, Nikhil S
Christian, Kevin J
Cieslinski, Andrew J
Cohrs, Angela S
Conner, Chris R
Cook, Eric R
Cook, Ryan B
Coolich, Casey K
Cox, John A
Coyne, Jonathan C
Crandell, Beau E
Cross, Jason R
Crouch, Molly S
Daavettila, Andrew R
Daavettila, David C
Dame, David M
Davis, Andrew
Davis, Christopher M
Davis, Gregory A
Dayton, Richard A
Dean, Catherine A
Deaner, Justin M
Debo, Matthew
Deffendall, Sean A
Dehlin, William J
Dehn, Lucas S
DeLand, Seth B
Dennison, James W
DeVormer, David D
Dewey, Timothy J
DeWitt, Robert M
Deyo, Benjamin E
Dillon, Jacob C
Dion, Jeremy J
Donlin, Paul R
Donovan, Luke R
Downer, Andrew M
Duarte, Joseph A
Dubiel, Matthew J
Duesing, Peter E
Dye, Nicholas J
Ehlers, Jonathan A
Ehlert, Gregory J
Ellis, Katrina M
Enck, Carolyn M
Erickson, Brigham R
Esser, Scott M
Essex, Ryan W
Evans, Brent I
Eziyi, Ifegwu L
Farrell, Nathan C
Farrelly, Grant A
Faulkner, Andrew L
Faussett, Thomas W
Fecteau, Blake J
Feenstra, Joel R
Feider, Justin M
Fenton, Andrew C
Feustle, John L
Fields, Tom H
Figliomeni, Jonathan M
Fitzgerald, Edmund W
Folson, Stephen W
Fors, Kelsey L
Fossen, Jens E
Foster, Michael E
Fox, Ryan E
Francis, Ray A
Frantti, Neal V
Freed, Bryan G
Fry-Schallhorn, Lindsay D
Fultz, Derek W
Gardner, Jacob J
Garlock, Kevin D
Garver, Scott W
Gentry, Nathaniel J
Gerbers, Bryant J
Gerondale, Adam P
Gibbs, Christopher A
Gibbs, Timothy L
Gifford, Jonathon L
Gillespie, Jason E
Gillespie, Justin W
Gilmer, Matthew C
Goffard, Gregory D
Golda, Fred N
Gomez, Andre L
Gonzalez, Juan C
Granstrom, Jonathan M
Graziano, Michael T
Green, Jacob T
Green, Patrick A
Greene, Kyle P
Greenwald, Jonathan R
Gulewich, Brian C
Haack, Robert M
Habegger, Adam D

Hadden, Cameron M
Hagner, Charles A
Hahn, Joshua W
Hall, Bryon J
Hall, Christina J
Hallesy, Susan A
Halonen, Levi J
Halt, Thomas M
Hanes, David C
Hanna, David J
Hannah, James M
Harjer, Jennifer L
Harrington, Kristopher A
Harris, Kathryn L
Harvala, Lance J
Harvey, Paul M
Hasslen, Eric J
Hatch, Tenasia E
Hauch, Karen N
Hauswirth, Kyle A
Hawkins, Brett T
Hawley, Justin R
Heering, Jason R
Heichelbech, Benjamin S
Heins, Ryan D
Hemenger, Alicia G
Herman, Adam J
Hernandez, Joseph E
Herrington, Jacob R
Heubel, Eric V
Hocking, Joel M
Holbrook, Matthew T
Holland, Daniel P
Holmes, Matthew A
Holt, Georgio M
Honkala, Carl A
Horn, Jacob T
Houlmont, Michael L
Huesman, Wade M
Huggard, Jacob D
Hughbanks, Zachary J
Iduma, Godwin C
Igboanugo, Chukwuemeka P
Jacobsen, Eric J
Jeannot, Phillip A
Johnson, Amanda J
Johnson, Christie L
Johnson, David L
Jones, Andrew P
Jordan, Kari L
Joseph, Elmo
Joseph, Eric D
Jungnitsch, Russell P
Kalafut, Kalvin W
Kalenauskas, Eric W
Kangas, Greg A
Kanitz, Steven M
Karner, Steven M
Karnes, Matthew R
Kartes, Trevor J
Kastamo, Adam P
Kauppila, Carl J
Kempeinen, Matthew P
Kempke, Daniel J
Kennedy, David J
Kern, Shaughn
Kero, Christopher J
Kero, Matthew P
Kiel, Haijo A
Killeen, Matthew
Kivela, Erik L
Kivisalu, Michael T
Klobucher, JoAnn M
Kloss, Jacob P
Klug, Solomon C
Kluskens, Laura J
Kneeland, Philip D
Knepfler, Carl M
Knoebel, Ronald W
Kolhagen, Benjamin J
Koning, Laura A
Kooiker, Seth C
Kortenhoven, Keith A
Korth, Hans G
Koskey, Louis W
Kostner, Timothy R
Kostrzewski, Thomas J
Krieger, Brandon W
Kroll, Ryan R
Kroodsma, Nathan D
Krueger, Jason S
LaBar, Ryan D
LaFountain, Andrew L
Lange, Robert A
LaPeer, Jeremy K
Larson, Jonathan M
Larusson, Birkir
Lass, Amber B
Latsch, Joseph R
Lauman, Jeffrey W
Lautner, Andrew K
Lechnyr, Joseph W
Lee, Kevin M
Lehmann, Erik W
Lennon, Michael T
Leonard, Cody M
Leonard, Edgar J
Lepinski, Joshua J
Lepley, Brian K
Lewis, Stephen J
Lievens, Charisse M
Lindenberg, Jason R
Linford, Aaron M
Little, Adrian M
Littlepage, Steven M
Loiselle, Jacob A
Longstreet, Aaron J
Losiewicz, Eric P
Loukus, Roy H
Love, Richard W
Loveland, Dustin P
Lowe, Dustin K
Lowe, Nicholas C
Ludy, Andrew J
Luskin, Casey M
Lyngstad, Kyle D
Lyons, Trevor P
MacDonald, Brad M
MacNeill, Chelsey A
Maloney, Christine A
Maloney, Kevin J
Manchik, Kari A
Mann, Craig A
Manninen, Paul J
Manninen, Todd A
Manthei, Jesse P
Marion, Joshua M
Marks, Amanda K
Marsh, Kyle J
Martell, Peter A
Martin, Jennifer L
Martin, Michael A
Martin, Nicholas T
Mason, Blake J
Mathues, Ryan J
Mayville, Samantha A
Mazure, Ryan J
McCubbin, Nicholas E
McDonald, Mitchell A
McElmurry, Scott M
McHale, Brian C
McNally-Carolan, Christopher J
Merkel, Laura K
Messenger, Aaron S
Messenger, Jacob C
Meyer, Edmond J
Meyers, Amy L
Miller, Christopher F
Miller, Samuel J
Miller, Timothy J
Mittag, Matthew D
Mleziva, Brian T
Monick, Kassie I
Moore, Christopher L
Moore, Christopher W
Moran, Jonathan W
Morello, Andrew J
Morgan, Dan C
Morris, Daniel H
Morris, Ryan L
Morris, Sean M
Morrison, Chad H
Mott, Jerod C
Motz, Julie A
Mullins, Bradley M
Murtland, Frank C
Nagy, William H
Neece, Joshua A
Nelson, Matthew T
Niemela, Carrie S
Nordstrom, Ryan M
Noreen, Trenton B
Nummerdor, Brock D
Olearnick, Joshua D
Olson, Christopher L
Osborn, Matthew J
Osborne, Jonathan J
O'Sullivan, Christopher M
Otis, Amanda M
Ovist, Grant J
Owen, Kristina M
Palm, Karl H
Palmer, Leann M
Panczenko, Jason A
Pantke, Andrew W
Parenteau, Alan R
Parker, Seth R
Pasquali, Dean A
Passehl, Abbey M
Paul, Jeremiah D
Pearson, Sarah J
Pederson, Mark D
Peketi, Ravi
Peplinski, Andrew J
Peterson, Kyle I
Pierce, Carl P
Pipkorn, Casey J
Piro, Anthony R
Plegue, Michael J
Plott, Christopher A
Plummer, Bradley R
Pohlman, Benjamin N
Pollum, Christopher A
Polonowski, Christopher J
Polzien, Stephen J
Prenkert, Christopher J
Prohaska, Robert S
Pruehs, William N
Pruetz, Jeffrey E
Pullen, Kyle S
Putnam, Douglas C
Quade, Brekke E
Quade, Rachel L
Racklyeft, Adam C
Rajala, Andrew M
Rajnauth, Rodney J
Rankin, Victoria L
Rautiola, Niikolas A
Reevs, Timothy C
Reinhardt, Timothy R
Reno, Tyler M
Rhode, Joshua L
Rhome, Brandon P
Richards, Andrew W
Rickli, Jeremy L
Riedel, Christian T
Riffe, Jessica A
Riley, Timothy P
Riutta, Benjamin J
Robinson, Rosalyn H
Rochowiak, Dain S
Rohr, Andrew P
Rokke, Christopher J
Ronning, Kiel E
Rosalez, Javier
Rose, Stephanie M
Rosenberger, Amanda L
Rosinski, Ryan D
Rothe, Jillian J
Rottier, Catherine T
Rouse, Brandon T
Ruth, Jessica A
Rutterbush, Scott A
Sams, Steven K
Sarsen, Douglas C
Scallon, Sean T
Scarth, Caleb P
Schechter, Ryan E
Scherwinski, Aaron D
Schmidt, Joshua S
Schneider, Danielle M
Schoo, Dusty J
Schuster, Noah D
Schut, Jeffrey D
Scott, John H
Sebastian, Christopher M
Sebeck, Bryan J
Sechler, William F
Sesselmann, Kristen R
Shah, Amit
Shaner, Benjamin J
Sherrington, Matthew R
Sherzer, Rachel A
Shissler, Ryan P
Sikkema, Brian J
Silhavy, Matthew J
Silva, Steven D
Simula, Nate T
Skauge, Sandy M
Smith, Nicholas J
Smith, Richard G
Smith, Zachariah P
Snyder, Kevin H
Soderlund, Justin J
Soliz, Steven C
Sommerfeldt, Nelson I
Sorensen, Philip H
Soule, Ian B
Spalding, Stephen W
St Germain, Ryan P
Stanaway, Benjamin C
Stanczuk, Grant A
Stasa, Korinne M
Steslicki, David M
Stewart, Kyle B
Stickels, Daniel W
Stock, Jacob L
Stone, Raymond T
Strebel, Christopher J
Streberger, Daniel S
Strickland, Jessica A
Sturgis, Brandon D
Sturos, Chase P
Sturtevant, William W
Sturza, John D
Sutton, David C
Swanson, Tara E
Swathell, Joshua J
Talbot, Kiel E
Tan, Alan W
Tan, Soon Siong
Taylor, Gustan J
Taylor, Jeffrey D
Temple, Kevin P
Thomas, Nathaniel R
Thomasini, David M
Thoms, Christopher G
Thut, Ryan R
Toohy, Charles W
Toutant, Daniel P
Traczyk, Timothy
Trewartha, Michael D
Trierweiler, Rebecca M
Tuinstra, Kimberly A
Turner, Travis D
Ulstad, Melissa A
VanAntwerp, Jack C
VanAppledorn, Craig
Vanderhoof, Daniel E
VanDrese, Glenn J
VanHeusden, Elizabeth M
VanHoek, Theodore E
Velthouse, Evan R
Verhey, Ian R
Vettel, Drew M
Vincenz, Jason M
Vine, Cody J
Volmering, Andrew D
Voshol, David B
Wackerle, Christopher K
Walber, Chad M
Walsh, Matthew W
Walsworth, Jordon M
Walter, Jon A
Walton, Stephanie J
Ward, Ryan L
Warmack, Adam M
Watkins, Steven G
Way, Kyle E
Weber, James C
Wellnitz, Casey C
Wells, Lee J
Westrope, Benjamin E
White, Keith B
White, Raymond A
Whitehead, James A
Whitney, Evan M
Wieman, Kyle L
Wilkie, Nathan E
Wilkins, Christopher J
Wilkins, Matthew L
Willemsen, Andrew M
Willett, Kelly L
Wimalasena, Lakmini M
Winer, Evan T
Wingard, David R
Winter, Richard L
Woelmer, Lee N
Wolk, Kimberly A
Zambon, Nathan D
Zblewski, Matthew J
Zettel, Thomas A
Ziesemer, Chad D
Zink, Brian S

ILLUMINATING OUR FUTURE

ALUMNI

"We prepare students to create the future."
—Mission of Michigan Tech

"We prepare engineering students for successful careers."
—Mission of ME-EM

The Mechanical Engineering-Engineering Mechanics Department proudly recognizes the following alumni who have made revolutionary contributions to the field of engineering and the world. These leaders and entrepreneurs have been lighting the way for our future generations—shining examples of innovative problem-solving and resourceful action. As Michigan Tech graduates, these lifelong learners also reflect the integral foundation of their experiences in the ME-EM Department where engineering education embraces principles of teamwork, leadership, active research, discovery-based learning, and entrepreneurship.

The ME-EM Department honors the extraordinary life accomplishments of these distinguished alumni, and values their ongoing commitment to excellence and education at Michigan Technological University.

JACK REAL '39
Aviation Industry

Pioneering Aviation Designs With Howard Hughes

After graduating from Michigan Tech in 1939, Jack Real worked as a design engineer, and later Vice President, at what is now Lockheed Martin Corporation. "*The Lockheed Legend,*" Real developed the Cheyenne combat helicopter. During this time, Real met Howard Hughes and served as his personal aviation advisor from 1957 until Hughes' death in 1976. In 1979, Real became President of the Hughes Helicopter Company, developing the AH-64 Apache helicopter, financially turning the company around. In 1983, the *Robert J. Collier Trophy*—the nation's highest honor for aeronautics achievement—was bestowed upon Secretary of the Army Jack Marsh, and Hughes Helicopter, which was under Real's leadership. Real facilitated the sale of Hughes Helicopter to McDonnell Douglas, remaining as President and CEO until his retirement in 1986. Real, along with Bill Yenne, wrote *The Asylum of Howard Hughes*, a book about his longtime friendship

with Hughes. Recognizing his extraordinary contributions in the field, Real received an honorary Doctorate from Michigan Tech in 1968 and the *Howard Hughes Memorial Award* in 1990. A life trustee of the Michigan Tech Fund, Real also garnered the Michigan Tech *Distinguished Alumnus Award* in 1995. Jack Real passed away in Mission Hills, CA, on September 6, 2005—a great loss for many, since Real is known worldwide for his outstanding aviation contributions.

CRAIG LAZZARI '42
Energy Industry

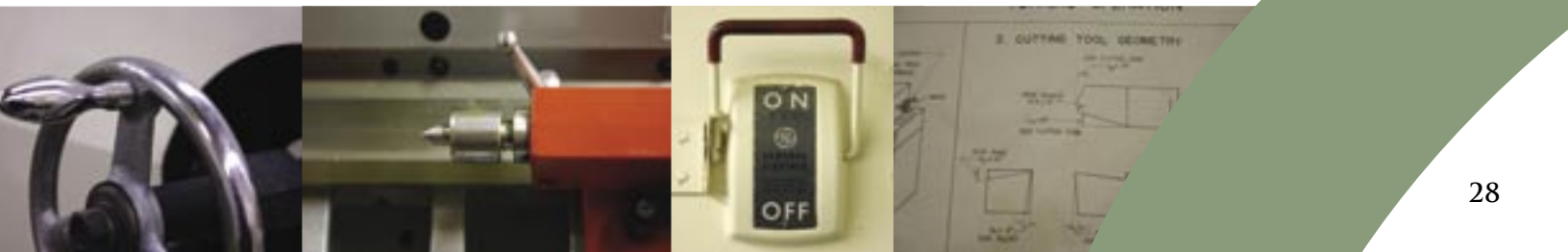
International Development of Diversified Projects in the Oil and Natural Gas Fields

After graduating with honors from Michigan Tech in 1942, Craig Lazzari served in the U.S. Navy in WW II. In 1946, he joined Fish Engineering Corporation and became a Project and Sales Engineer of refinery, petrochemical, and pipeline projects. After executing many projects nationally, he moved to Argentina as Vice President of Fish Engineering International to head the Sargo, S.A. project—an integrated pipeline, refinery, and industrial gas project extending from the Bolivian border to Buenos Aires. In 1960, Lazzari formed the Bolivian Oil Company along with his own company. He moved his operations back to the US in 1964 where today, he remains as President of The Interfinancial Corporation. In addition to being instrumental in the operation of several other worldwide projects, Lazzari has assisted with the development of two oil fields in Kazakhstan during the last 12 years. Acknowledging his gratitude to Michigan Tech "for giving him the knowledge and confidence to participate in such diverse projects," Lazzari has served on the Michigan Tech Board of Trustees. In recognition of his long and meritorious service to society and the Engineering profession, Craig Lazzari received the Michigan Tech *Board of Control Silver Medal* and was awarded lifetime membership in the *National* and the *Texas Society of Professional Engineers*.

ALBERT MAKI '48
Areospace Industry

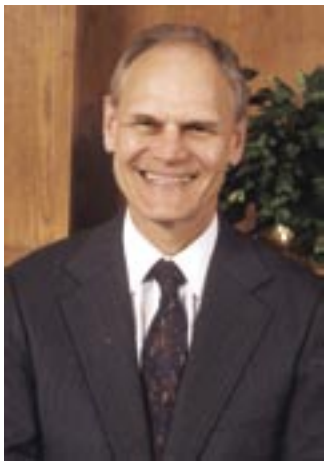
Innovational Aerospace Technologies

"I don't believe in having a capability which is geared to doing just what we know about today. You have to look ahead." These words, spoken by Albert Maki, sum up the brilliance of his career in Aerospace Engineering. Contributing to technological breakthroughs wherever he went, Maki served on submarine duty during WW II, working on the first jet engines. Graduating from Michigan Tech in 1948, Maki became a project engineer for General Electric. In 1955, he joined AVCO, a contractor that built many components for rockets in the US Space Program. As manager for the Titan and Atlas reentry vehicle program, Maki and his team invented the ablative heat protection for space capsule heat shields, making atmospheric reentry a reality—a first in aerospace technology. In 1975, he moved to the Brunswick Corporation and later became Vice President, overseeing countless programs that required cutting-edge research and technologies. Maki received the *Board of Control Silver Medal* from Michigan Tech. "Abbie" Maki currently lives in Arizona and is documenting his visionary work in a book he hopes to publish entitled, *Submarines to Space: An Eyewitness to American Technology.*



SHINING ALUMNI LEAD THE WAY

RICHARD ROBBINS '56
Excavation Equipment



Preeminent Tunneling Machine Technology

Richard Robbins is an international leader in tunneling machine technology. After graduating from Michigan Tech in 1956, Robbins joined his father's company, producing state-of-the-art mechanical excavation equipment for tunnels, mines, and shafts. Boring three large tunnels in the Chunnel, a railway tunnel under the English Channel, he has continued to set records in tunnel boring technology. President, CEO, and Chairman of The Robbins Company from 1958-1993, he was granted 11 US and 54 foreign patents. He also served as Vice President of the International Tunneling Association, addressing Health and Safety in Works, a critical issue in underground construction. In 1993, Robbins sold his company and established The Robbins Group in 1995, which implements the research and product development for The Robbins Company. Always a visionary, Robbins chaired the Michigan Tech *Leaders for Innovation Capital Campaign* from 1997-2002. He is the recipient of numerous awards including an honorary Doctorate and the *Melvin Calvin Medal of Distinction* from Michigan Tech. In 1999, the *Engineering News-Record* featured Robbins as one of the "Top People of the Past 125 Years," an equipment innovator who "helped shape this nation and the world." In 2002, Richard Robbins received one of the oldest and most prestigious awards from the *Western Society of Engineers*, the *Washington Award,* which recognizes engineers "whose professional attainment have preeminently advanced the welfare of humankind."

DANIEL RIVARD '59
Automobile Industry

Leading Corporate Visions and Change

Daniel Rivard has been committed to finding the best solutions in today's complex world, both in his career and in his retirement. Graduating from Michigan Tech in 1959, Rivard joined the Ford Motor Company where he served as Chief Engineer for Passenger Car Development and Manager of Light Truck Product Development. He also became Director of Product Quality and Process Improvement, creating fundamental changes in Ford's North American product development processes. After his "first" retirement in 1992, Rivard was asked to return as Consultant to Ford of Europe, overseeing its Product Development Process. In 1993, he was asked to serve as Special Vehicle Director for Ford's worldwide racing and total performance road vehicles (SVT) program until his "second" retirement in 1997. During these three years, Ford won the F-1 World Championship, Cart Championship, the Indy and Daytona 500's, and the Trans Am and Off-Road Championships.

ALUMNI

Rivard has received countless awards from Michigan Tech including an honorary Doctorate, the *Distinguished Alumnus Award*, and *Outstanding Service Award* for his ongoing leadership in engineering, as well as in the ME-EM Department. He has served as a Board of Control member, a life trustee of the Michigan Tech Fund, and Chair of the ME-EM Phase I Fund Raising Campaign. "In recognition of the importance of hands-on product creation in the educational experience," Daniel Rivard and his wife Carol also funded and established the *ME-EM Product Realization Center*. Rivard continues to work with ME-EM in making innovative changes, which furthers "our goal of being the best ME-EM epartment in the world."

CARL AVERS '62
Energy Industry

Creative Solutions for Energy Systems

After earning his BSME from Michigan Tech in 1962, Avers went on to Stanford University where he completed courses in Special Finance, Economics, Accounting, and Engineering Economy. He began his career in 1962 at the San Diego Gas & Electric Company as a Junior Engineer. Advancing to Project Manager, Avers then launched his entrepreneurial career with the creation of Applied Energy, Incorporated in 1970. From 1980-1989, he was Chairman and President of Catalyst Thermal Energy Corp., a New-York based company which has been one of the nation's largest operators of district energy systems. During this time under Avers' management, revenues for this company went from under $3 million to $125 million. In 1989, Avers co-founded Thermal Ventures, Inc., a company which develops and manages district heating and cooling systems. He is currently CEO and Chairman of this company and co-founded Thermal Ventures II, LLC, which was formed in 2000—for the purpose of developing district heating, cooling, and electricity generating business with units throughout the country. He served two terms as a board member and former President of the *International District Energy Association (IDEA)*. In 1986, Avers received *IDEA's* highest honor, the *Norman R. Taylor Award*. Carl Avers was honored by Michigan Tech by being recognized as one of the 38 alumni of 8,500 alumni candidates as a standout within his industry as an entrepreneur that helped restore a troubled industry—district steam systems.

DAVID HILL '65
Automobile Industry

Premier Performance Automobile Designs

In 1964, David Hill joined the Cadillac Motor Car Division of General Motors; he graduated from Michigan Tech shortly after that, in 1965. Hill completed his Masters in Mechanical Engineering through the University of Michigan. He continued working for General Motors within various engineering positions and in 1979, was named an executive in the company. In 1982, Hill became Chief Engineer of the *Cadillac Allante*. In 1992, he assumed these responsibilities for the *Cadillac Deville* and *Concours*. Hill ultimately became Chief Engineer for the *Chevrolet Corvette* and Vehicle Line Executive of performance cars in 1993 and 1995 respectively, leading the development of the fifth-generation *Corvette* and the introduction of the *Cadillac XLR*. Excelling in these roles, he launched the sixth-generation *Corvette* with the new *505 bhp Corvette Z06* for 2006.

Hill has shared his expertise, returning to Michigan Tech to give seminars and workshops to students in the ME-EM Department. After more than 41 years of dedicated service to the General Motors Corporation, Hill retired on Jan. 1, 2006. In his prestigious career, he was only the third chief engineer in the 53-year history of the *Corvette*. David Hill brought this premier sports car to new heights, significantly increasing its performance, refinement, and value.

ALUMNI LEAVE THEIR MARK

HAROLD WIENS '68
Manufacturing Industry

Stimulating Growth for Worldwide Industrial Businesses

Harold Wiens has left his dynamic mark on businesses across the world—fostering significant, profitable growth—in Japan, China, India, Brazil, Russia, and Eastern Europe. Wiens' successful career began in 1968, after he received his BSME degree from Michigan Tech. Serving in a variety of capacities and later as Plant Manager of 3M, Wiens then became Manufacturing Manager for Memory Technologies Group in 3M Europe in 1983. In 1991, he joined 3M's Executive Conference as General Manager of the Data Storage Tape Division. In 1995, Wiens moved to Executive Vice President of Sumitomo 3M in Japan, a business that had no growth since 1990; and by 1997, under his expert management, this company increased its revenue by over 10%. Wiens moved to St. Paul in 1998 as Industrial Markets Group Vice President and in 2001, became Executive Vice President of Industrial Business. Continuing in this role until mid-2005, he implemented global organizational restructuring which resulted in the business going from an operating income of 13% in 2003 to over 20% by 2005. In addition to his international connections, Wiens has maintained strong ties to Michigan Tech, serving on its *National Advisory Board Blue Ribbon Committee* and *National Advisory Board*. Harold Wiens became Transportation Business Executive Vice President in mid-2005 and retired on February 1, 2006.

ALUMNI

SABINA JENNY HOULE
PCA Inductee 2005

Sabina Jenny Houle is the most recent alumna to be inducted into the Presidential Council of Alumnae (PCA) at Michigan Technological University. The PCA recognizes successful Michigan Tech women for their educational excellence, past student service, professional accomplishments, community contributions, and University support.

Sabina Jenny Houle is a three-time graduate of Michigan Tech. She received her BS in Chemical Engineering in 1985, and then two Master's degrees, in Chemical Engineering and Mechanical Engineering in 1987. She also received a German translating certificate from the Goethe Institute. In addition, Houle studied Polymer Physics through a graduate student exchange program at the Swiss Federal Institute of Technology.

In 1987, Houle began her career with the Dow Chemical Company as an Engineer; in 1989 she was promoted to the position of Senior Research Engineer. During her five-year tenure at Dow, she developed novel processes and equipment for new polymeric materials, BCB's and PBD's.

In 1992, she joined the Donnelly Corporation as a Senior Materials Engineer. There she was responsible for the development of an adhesive process—and subsequent patent—that bonds PVC to glass for production of single-sided encapsulation. This development was used on Chrysler minivans and won *Design of the Year* at the North American Auto Show in Detroit.

Leading Innovative Development

From the Donnelly Corporation, Houle moved to FKI Automotive as a Materials Engineer for Samsonite. She was lead for a team of engineers and suppliers responsible for developing the thermoplastic/thermoset resins to meet the next generation of luggage design requirements.

Houle is currently a Module Engineering Group Leader with Intel Corporation. She began at Intel in 1997 as Senior Material Quality Engineer, became Senior Packaging Engineer in 1999, and Staff Engineer in 2001. She has led development teams in Japan, Germany, and across the US, working with suppliers to meet the company's packaging requirements and timelines. In her current position, she manages a staff of engineers and technicians responsible for chip attach assembly technology for all Intel's Packaging Development programs. Houle has received 11 divisional awards in the past eight years.

Diverse Contributions

Houle is a member of the *Society of Plastic Engineers*, *Society of Manufacturing Engineers*, *Society for the Advancement of Material and Process Engineering*, and the *Institute of Electrical and Electronics Engineers*. She has authored 25 publications and papers, and presented at numerous conferences. Currently, she has eight patents issued and 19 pending.

Houle is active within her community volunteering for a homeless shelter, St. Mary's Food Bank, and the Intel Kid's Club. She also mentors several Intel Jr. Engineers on career growth.

At Michigan Tech, she was a member of *AICHE*, *Tau Beta Pi*, Vice President of the *Society for Women Engineers*, and historian for *Theta Chi Epsilon Sorority*.

Sabina Jenny Houle currently resides in Phoenix, Arizona.

Presidential Council of Alumnae

The PCA Mission is to "encourage and support Michigan Tech female students and alumnae in accomplishing their career and life choice goals." The PCA acts as an advisory board to the University President and the Department of Educational Opportunity. PCA members assist with programs and activities that benefit all students, and the development of leadership and professional skills, especially for women.

BLAZING NEW PATHS: ME-EM VISIONARIES

ENTREPRENEURS

Webster's New World College Dictionary defines an entrepreneur as "a person who organizes and manages a business undertaking, assuming the risk for the sake of the profit."

Much more complex than this definition, entrepreneurs are problem solvers—visionaries—who are enterprising, imaginative, and driven. In their minds, problems are never roadblocks but instead exciting challenges to be overcome. They dare to reach beyond boundaries, continually redefining views of the world.

The Mechanical Engineering-Engineering Mechanics Department at Michigan Tech has created an environment rich with opportunities for faculty and students to explore their talents, foster their ideas, and develop their inventions. Education that encompasses the philosophical, theoretical, and practical realms serves to produce innovative entrepreneurs who are making quantum leaps into future technologies.

The following ME-EM alumni and faculty have used these dynamic experiences at Michigan Tech to build reputable companies that are leading the way in many fields. Above all else, these entrepreneurs are fed by the fires of passion for their work.

GLEN BARNA

IR TELEMETRICS, INC.

"One of the best things about creating my own business has been watching it 'grow.' It is very much like creating a living thing, like planting a tree. It really feels good to know that this entity that you created is providing a useful product and meaningful employment for a number of people."

Glen Barna discovered his destiny while attending Michigan Tech. He completed his first BS in Forestry and Land Surveying in 1976 and went on to work as a Journeyman Steamfitter in the power, process, and energy industries all around the US. Like so many students who attend Michigan Tech, Barna returned in 1985 to get his BS and Master's degree in Mechanical Engineering, which he completed in 1989. His Master's thesis focused on the creation of an infrared telemetry technique to measure piston temperatures in internal combustion engines.

Together with his advisor Dr. Carl Anderson, Barna continued work in this area as a Research Engineer at Michigan Tech until 1995, managing one million dollars in funded research from GM and Ford. They perfected two new measurement

techniques using infrared and microwave telemetry, and patented both methods. In 1991, Barna and Anderson launched IR Telemetrics, Inc. (IRT) to commercialize this technology.

"IR Telemetrics is the industry leader in providing wireless transfer of data from internal reciprocating and rotating components," states Barna, President and CEO since its beginning. Furnished with a dynamometer laboratory and data acquisition equipment, IRT is able to provide data from inside harsh operating environments—which was previously unavailable—for a wide variety of industries. Applications of IRT's technology include transmission of signals from pistons, connecting rods, bearings, crankshafts, turbines, rotary kiln ovens, and locomotive drive axles.

In 1996, Michigan Tech alum Paul Lavigne (MSME '85), joined IRT as Vice President and in 2003, alum Steve Bethel (MSME '85), started as IRT's Director of Engineering Services. Currently, IRT has a staff of 12, almost entirely Michigan Tech alumni, who have contributed to the success of the company. In 2005, IRT received the *University Commercialization Excellence Award* from Governor Jennifer Granholm for successful commercialization of technology developed at Michigan's public universities. **www.irtelemetrics.com**

ALLEN CURRAN
THERMOANALYTICS, INC.

"One of the best things about creating this company has been the control we have over the work we pursue. We are able to spend most of our time tackling problems that are interesting and challenging to our engineers, and that have solutions that are put into immediate use by our customers."

Dr. Allen Curran holds a PhD in Mechanical Engineering from Stanford University, and has over 15 years experience in modeling thermal systems. Curran was a ME-EM faculty member from 1986 - 1989, and continues to serve on graduate student advisory committees for the department. He joined the Applied Research Group at Michigan Tech's Keweenaw Research Center in 1989 and headed the Center from 1992 - 1996. Dr. Curran is also the co-founder and Chief Technical Officer of ThermoAnalytics, Inc. (TAI), established in 1996.

TAI is a leading infrared modeling and software development company headquartered in Houghton County, near Michigan Tech. TAI's research is focused on modeling thermal systems including thermoregulation and thermal comfort. Previous research produced the techniques used in the development of RadTherm® software, the thermal analysis program developed for Ford Motor Company, and MuSES™ software, the US Army's standard infrared signature prediction code. Both programs are in use worldwide, and RadTherm is award-winning software that demonstrates TAI's creative force in both analysis technology and user interaction, with a recently released, updated version. According to Curran, "Version 8.0 will allow engineers to simulate a wide range of heat transfer issues from brakes to passenger thermal comfort."

TAI provides software, training, and services to government and commercial customers. They have pioneered technology transfer programs that have produced effective thermal analysis tools for automotive, aerospace, electronics, manufacturing, and other industries. RadTherm®, WinTherm®, and MuSES™ software programs have become powerful tools in global product innovation. TAI has also capitalized on additional resources for solving engineering problems through collaboration with the faculty at Michigan Tech.

In 2005, TAI garnered the *Coolest Workplace Award* presented by Michigan Governor Granholm for businesses located in the Upper Peninsula. TAI was also recognized as one of Michigan's 50 Companies to Watch. *See article on page 40.* Creating a workplace environment "where staff can thrive and deliver groundbreaking innovations" has been the foundation for TAI's success. **www.thermoanalytics.com**



ENTREPRENEURS

VIGOROUS TECHNOLOGIES

WILLIAM ENDRES

ENDRES MACHINING INNOVATIONS, LLC

"Though this venture is outside the university, the experience brings a new flavor to the design and manufacturing courses I teach. It is also exciting to become a student again, learning about IP protection, business entities, accounting, taxes, and insurance through extensive reading and discussions with my advisory team. However, most rewarding by far is being able to create some jobs in the local economy."

Currently an Associate Professor in the ME-EM Department at Michigan Tech, Dr. William Endres received his PhD in Mechanical Engineering from the University of Illinois at Urbana-Champaign in 1992. His primary research interests include fundamental cutting mechanics, machine-tool system dynamics, and mechanistic modeling techniques. He has contributed greatly to the fundamental understanding and analysis of the effects of the blunt edge and wear-land found on most cutting tools.

In addition to teaching and academic research, Dr. Endres is working to transform his research knowledge to commercial products. In 2004, he founded Endres Machining Innovations, LLC (EMI), and recently established an office and research-and-development lab in the Michigan Tech Enterprise SmartZone in Houghton. EMI currently employs four engineers and technicians, providing testing and training services to compliment its technology activities. According to Endres, "EMI is a leader in process and tooling research and development. Through our engineering services relationships, we seek to identify and understand needs for new broad- and niche-market technologies related to machining processes, cutting tools, and associated equipment."

Five technology projects are underway to develop cutting tools and processes that can operate at dramatically higher productivity rates (e.g., higher cutting speeds, longer tool lives, and/or lower tool change time). One technology has many potential applications outside machining—any that can benefit from an unusually thick, hard coating that will not delaminate from the substrate. Industries of application include automotive and truck, off-road vehicles, military ground vehicles, and aerospace.

Dr. Endres has been honored with various awards, including an *NSF Career Award* in 1998, and the *Outstanding Young Manufacturing Engineer Award* in 1999 from the *Society of Manufacturing Engineers (SME)*. He also received the *Blackall Machine Tool and Gauge Award* from the *American Society of Mechanical Engineers (ASME)* in 1997, recognizing his PhD work as a best paper published in the *ASME Journal of Manufacturing Science and Engineering*. **www.endresmachining.com**

MAHESH GUPTA

PLASTIC FLOW, LLC

Dr. Mahesh Gupta, an Associate Professor of Mechanical Engineering, joined the faculty of Michigan Tech in 1994. Prior to that time, he worked as a research associate at the Cornell Injection Molding Program and as a private consultant

for C-Mold. Gupta's research is focused on computer simulation of the flow and heat transfer in polymer extrusion and injection molding. He is also the President of Plastic Flow, LLC, which he founded in 2002.

Since its beginning, Plastic Flow has provided consulting services to plastics manufacturers across the US. The company is currently marketing PELDOM software for simulation of polymer extrusion—"the only software that can simulate a polymeric flow with completely independent shear and elongation viscosities for the polymer," adds Gupta. This novel software is a result of the innovative research of Gupta and Michigan Tech graduate students.

With PELDOM, manufacturers can simulate how a given polymer will flow through a die, streamlining the research and development process, and considerably reducing the product time to market. Gupta explains, "Goods ranging from PVC pipe to garbage bags are extruded. During extrusion, a polymer is forced through a die to form sheets or tubes. As new polymers are developed, manufacturers design new dies, and much time can be lost in this trial-and-error approach." Plastic Flow is focused on refining PELDOM software, making it increasingly accurate and versatile by incorporating leading-edge polymer research, which is supported through the Plastic Design and Manufacturing Laboratory at Michigan Tech.

Leadership through Innovative Research best reflects Plastic Flow, LLC, and the approach of Dr. Gupta, who has published more than 60 papers in the field of polymer processing. He also served on the Board of Directors of the Electrical and Electronic Division of the *Society of Plastics Engineers*. Gupta is an ongoing technical reviewer for a large number of international journals and federal funding agencies. **www.plasticflow.com**

GORDON KUIVANEN
DURNELL ENGINEERING, INC.

"One of the best things about owning my own business has been FREEDOM."

Gordon Kuivanen attended Michigan Tech on a scholarship and graduated with honors in Mechanical Engineering in 1952. His abilities and motivation granted him many opportunities, and successes, in life. He earned his pilot's license at the age of 16—a skill he used frequently in later years for his company business trips. He joined GM Research in Detroit after graduation and then served as a lieutenant in the Air Force. After completing his Masters at Wayne State University, Kuivanen returned to GM Research. In 1961, he began working for the White Motor Corporation in Minneapolis, progressing to Chief Engineer of the White Industrial Division.

With a growing interest in managing his own company, Kuivanen became General Manager and part owner of a construction equipment manufacturing firm in Denver, Colorado. Despite hard work and a great product, this company did not succeed, largely because Kuivanen notes, "Effective financial management was not a tool in my experience bag at that time. This experience was perhaps my most valuable."

In 1979, undeterred by this "failure," Kuivanen became Co-owner and President of another manufacturer of construction equipment, this time in Iowa. His most satisfying accomplishment of his career—this company maintained strong gross profit levels and controlled other expenses, resulting in excellent profits and a debt-free operation.

After selling the company, Kuivanen was active as a small business consultant and volunteered in numerous local, regional, and state economic development programs. As a consultant for the Veterans Administration, he worked with disabled veterans across Iowa, assisting them with self-employment. He has garnered the *Governor's Volunteer Award* twice and in 1996, received the state, regional, and national Small Business Administration awards for *Veteran Advocate of the Year*.

Also sharing his success with Michigan Tech, Gordon Kuivanen believes strongly in "giving something back to help other young students achieve some of their dreams." He and his wife Betty have established a charitable gift annuity for scholarships for ME-EM students from the Baraga area, where Kuivanen grew up and they have both retired.

ENTREPRENEURS

IMAGINATIVE ENTERPRISES

JOSH LOUKUS

REL MACHINE

"The best part about starting your own business is the flexibility to work any 16 to 20 hours of the day that you want."

Josh Loukus has never shied away from long days or challenging work. He received his BSME in 1997 and in 2000, earned his PhD in Mechanical Engineering, both from Michigan Tech. His current research interests lie in the area of advanced lightweight composite materials including metal matrix composites, ceramics, and metallic foams for 'tailored' material performance. These performance metrics include selective stiffening, selective strengthening, and machining characteristics. Other active interests involve automation of existing processing technologies that are labor intensive using robotic and mechanical solutions.

REL Machine, Inc. was established in 1990 by Robert and Josh Loukus, both Michigan Tech graduates. The company began with two pieces of equipment—an engine lathe and a knee mill. Initially, REL was a small machine shop, completing repairs and job shop work for local customers. The job shop work continued until 2000.

In 2000, REL's experience in machining and assembly work culminated in their first automated part inspection line, which was designed for and sold to Alcoa. Since then, REL has moved into many different areas of automation: robotic machining cells; totally automated inspection for fluorescent penetrant inspection (FPI); and automated thermal processing furnaces, presses, filtration systems, shape-ceramic shape-forming equipment, and material handling systems.

In the last three years, REL has grown to 18 employees and has added over 10,000 square feet of manufacturing space. REL's advanced materials research lab in Calumet, Michigan, has equipment to produce parts on an *industrial-size* scale as opposed to a *laboratory* scale to ensure that technology that is developed can readily be commercialized and deployed to industry. The lab also has a state-of-the-art machine shop under the same roof to assist in the assessment of current machining technology, as well as advanced *tailored* machining processes for the developed materials.

Building customized automated systems with quality components has given REL the competitive edge. Josh Loukus adds, "Our commitment is to provide a system that provides minimal maintenance and downtime. And, we guarantee our customer satisfaction." That strategy has paid off—REL Machine, Inc. is currently designing its next expansion. **www.relmachine.com**

MATTHEW MONTE

MONTE CONSULTING COMPANY

"For me, the best thing about starting a small business in marketing communications is the opportunity to blend knowledge with imagination and deliver text and images with truly meaningful content. It's a dream job with endless challenge."

A gifted communicator who expertly blends technical fields with creative media, Matthew Monte began his career in technical communication while working as an engineering intern at Saturn Corporation in 1988.

Monte graduated with honors from Michigan Tech with a BSME in 1993. As an undergraduate, he took modern language studies in German and later studied Japanese at the Japan Center for Michigan Universities in Shiga Prefecture, Japan. As a graduate student in Environmental Engineering, he continued to merge his interests in technology and communication by attending the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland. He then joined Michigan Tech's Rhetoric and Technical Communication program. Later experience in technical sales, marketing, and management at the Cuda Corporation and Nautilus Processing Systems, Inc. led Monte to the creation of his own communications and marketing firm, Monte Consulting Company (MCC) in 2001.

MCC specializes in creating high-tech media for professional audiences, connecting clients to their customers through effective writing, graphic design, video, and 3-D animation. Monte adds, "Our media is a lens, focusing our clients' technology into the eye of the audience. We cross the gap between engineering and marketing, making technology visible, accessible, and appealing." MCC has developed animations and rich media for presentation to diverse audiences including leaders of Fortune 500 companies, research team members, and technical litigation professionals. MCC also designs distinctive Annual Reports, lending its marketing expertise to organizations like the ME-EM Department.

In 2005, MCC moved from the Michigan Tech Enterprise SmartZone into a larger office in downtown Houghton. An expanding client base and diversifying operations, along with the hiring of additional staff, precipitated this propitious move. **www.monte.cc**

GLEN SIMULA

GS ENGINEERING, INC.

"By far, one of the best things about creating my own business has been the ability to pursue projects we believe in without waiting for approval."

Glen Simula has always strived for the top and achieved outstanding results in his life. Graduating from Michigan Tech with high honors and a BS in Mechanical Engineering in 1981, Simula continued with his position as a Research Scientist at MTU's Keweenaw Research Center (KRC). He completed his Master's degree in Mechanical Engineering, also with high honors, at the University of Michigan in 1984. As the program manager of the Systems Development Group at KRC, Simula was the principal investigator on over 25 structural component development programs for the US Army, Marine Corps, and military prime contractors. Nineteen years of experience in this area catapulted him into the presidency of his own company, GS Engineering, Inc. (GSE) in 2001.

GSE delivers advanced engineering solutions to military and commercial transportation markets through high value research, design, development, and correlated testing services. The company focuses on engineering services in research and development, lightweight component structural design, vehicle-based testing and measurement, reverse engineering, noise vibration harshness analysis, and more. Using advanced computer modeling tools such as ProE Wildfire, finite element analysis (FEA), and dynamic analysis, GSE brings ideas from virtual concepts to full-size prototypes that are tested in the laboratory and in the field.

GSE is a Michigan Tech Enterprise SmartZone company, a program in the Houghton-Hancock area aimed at the development of high-tech businesses. Starting with three employees, GSE has quickly grown to 33 employees, including four Michigan Tech interns. Growth has been consistently at greater than 40% per year. To date, GSE's customers include US Army TACOM, US Marine Corps, General Dynamics, Stewart & Stevenson, Oshkosh Truck, Boeing, and many others. In August of 2005, GSE named Chris Coxon (BSME 1994), another Michigan Tech alum, as its Chief Engineer. GSE opened a metro Detroit branch in Oakland University's SmartZone incubator in January 2006. GS Engineering, Inc. recently garnered Michigan's *50 Companies to Watch Award* from Governor Jennifer Granholm. *See article on page 39.*
www.gsengineering.com

ENTREPRENEURS

MICHIGAN AWARDS ME-EM LEADERS

COMPANIES TO WATCH

ME-EM HONOREES

Second-stage companies are often overlooked as driving forces in statewide economies. The initiative *Michigan Celebrates Small Business* is changing that omission by recognizing and honoring Michigan companies for their achievements and important contributions to the marketplace. The *50 Companies to Watch in Michigan Awards,* sponsored by the Edward Lowe Foundation, are conferred upon companies that "exhibit one or more special strengths in the marketplace and create a solid basis for economic growth and community development. Special strengths may relate not only to company growth factors but also to other areas of achievement and operation, such as innovative products, innovative business practices, or special work in the community."

Second-stage companies are defined as "past the startup phase and facing growth issues rather than survival issues, employing 6 to 99 full-time employees, and having between $750,000 and $50 million in annual revenue or working capital from investors or grants." Five of the 50 companies chosen in 2005 were started by Michigan Tech graduates. The following companies, with ME-EM alumni or faculty at their helms, are honorees of the *50 Companies to Watch in Michigan*: GS Engineering, Inc.; Testing Services Group, LLC; ThermoAnalytics, Inc.; Twisthink; and Van Aire, Inc. Following are highlights from four of these companies.

GS ENGINEERING, INC.

HOUGHTON, MI

"GS Engineering began with sweat equity, financed through a home equity loan, and has grown by delivering a quality product to the customer. Risk is managed through conservative projections, a diverse customer base, and many long hours to ensure a secure business for the employees." —Glen Simula

Founded in 2001 by Glen Simula (BSME 1981), GS Engineering is an agile company providing advanced engineering solutions to military and commercial transportation markets. GSE went from 10 to 22 full-time engineers in 2005, and now employs 33 engineers and support staff. Valuing the dedication and talents of employees, GSE promotes ongoing education and collaborative teamwork in creating innovative solutions to engineering problems. GSE is expanding into new areas including metal matrix composite material research and development, and vehicle testing that will complement the testing available at Michigan Tech's Keweenaw Research Center. The superior quality work of GSE is evidenced by their satisfied clients, repeat customers, and new-business referrals.

GS Engineering employs a growing number of Michigan Tech graduates and students: 19 alumni and four interns.

TESTING SERVICES GROUP
LAPEER, MI

*"Some of the best advice I ever got was to surround myself with the best people I could find—that includes engineers, accountants, lawyers, business people, and bankers—and then **listen** to them… It's hard to learn much of anything when you're doing all of the talking."*
—Mark Lockwood

Founded in 1998 by Mark Lockwood (BSME 1982), Testing Services Group, LLC is an independent laboratory providing testing and evaluation services for manufacturers of fuel components, emission control systems, and total fuel systems for automotive, small engine, and marine markets. TSG has "pioneered the science of measuring minute levels of evaporative emissions, and established the benchmark in leadership, innovation, and service excellence." The company employs 25 people from the local community and makes significant contributions to charitable causes each year. An organizational commitment to open communication has brought valuable insights to TSG operations. This management practice, along with a judicious application of technology and delivering world-class quality service has brought TSG to the forefront of this field.

Testing Services Group employs another Michigan Tech graduate, Jason Rae, who was recently promoted to Supervisor of their Evaporative Emissions Laboratory.

THERMOANALYTICS, INC.
CALUMET, MI

"We have mitigated risk by developing and marketing internationally a commercial software product that has a diverse set of applications. Not only does this complement the engineering services that we provide, but it also minimizes the impact of downturns in any one market sector or economy." —Allen Curran

Founded in 1996 by co-owners Allen Curran (pictured above in an 8-12 micron band infrared portrait), Keith Johnson, and six others, ThermoAnalytics, Inc. is an employee-owned company that develops thermal and infrared signature prediction software. A global leader in radiation analysis, TAI employs 32 people, and is an original spin-off company from research initiated at Michigan Tech. A sound business plan and continued technological innovations have propelled TAI into global markets. TAI maintains a commitment to the local community, contributing to arts, cultural, and economic development organizations. A highly skilled and productive staff, in combination with the weekly *All Hands Meeting* where together, employees examine revenues and expenses, have created the solid foundation for cutting-edge, advanced software tools and services, and worldwide success.

ThermoAnalytics, Inc. employs 15 Michigan Tech graduates and two Michigan Tech students. Among these graduates, 11 hold degrees in Mechanical Engineering.

VANAIRE, INC.
GLADSTONE, MI

"VanAire has minimized risk through diversification, and by identifying niche markets that are not likely to be influenced by foreign competition."
—Richard Vandevusse

VanAire, Inc. was founded in 1987 by Richard Vandevusse (BSME 1977). VanAire manufactures advanced Dissolved Air Flotation technology for the pretreatment of food processing wastewater; valve automation hardware for the actuation of ball, butterfly, and other rotary valves; and chutes and other components for the concrete truck industry. VanAire has pioneered the use of automated (CNC) machining, laser processing, robot welding, and advanced design capabilities (CAD) normally used in high production manufacturing, for short-run production of its components, and those of other UP-based manufacturers. The company is currently building Michigan's first refinery for the production of biodiesel. With over 60 employees, VanAire emphasizes a team approach to problem-solving and decision making.

Dan Spreitzer and Mary Anne Colucci, pictured above with Richard Vandevusse, are also Michigan Tech graduates who work for VanAire, Inc.

RESOURCES

BUILDING FOR THE FUTURE

ME-EM DONATIONS 2005

Our donors are critical to the success of the Mechanical Engineering-Engineering Mechanics Department. Their contributions assist ME-EM in *Building for the Future*, a campaign that promotes the development and expansion of our education and research.

Phase I of this campaign was exceeded and has been completed. Phase II, entitled *Endowing Excellence,* is well on its way to the goal of raising $54 million by 2010. With these monies, the ME-EM Department will focus its efforts on attracting, rewarding, and retaining high quality faculty, students, and staff. This fund will establish endowments for faculty chairs, fellowships, scholarships, and student programs.

The following list encompasses the many people who have generously shared their resources to create an outstanding ME-EM Department. ME-EM is extremely grateful for their ongoing support.

INDUSTRY AND CORPORATE SUPPORT

3M Company
Anchor Coupling, Inc
Andersen Corporation
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Buick Factory 9
Canariis Corp
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Eluci Tech
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Ford Motor Company Fund
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Gougeon Brothers, Inc
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Society for Experimental Mech
Sounds and Motion
Terex Handlers
The Engineering Group, Inc
Trinity Turbine Technology, LP
US Filter
Visteon Corporation
Volvo Constr Equip Korea, Ltd.

ALUMNI AND FRIENDS SUPPORT

$50,000 AND ABOVE

Arthur & Dolores Heim
Richard & Elizabeth Henes (1948)
Harvey & Sharon Dewey (1965)

$10,000 - 49,999

Prof. Aubrey W. Gibson
Jane C. Hardwicke
Robert & Dorothy Monica (1950)
John & Joan Calder (1967)

$5,000 - $9,999

Mary J. McKie
Norman & Ruth Pratt (1942)
Larry & Robin Deaton (2006)

$1,000 - $4,999

Karrie L. Gatza
William & Mary Ann Predebon
Gerald & Patricia Schroeder
Jack G. Real (1937)
Richard & Georgia Crosby (1955)
Paul V. De Baeke (1955)
Charles & Marilyn Knauer (1955)
Arthur J. Koski (1955)
Eugene & Nancy Suppelsa (1955)
Frank & Leslee Agosti (1958)
Daniel & Eleanor Rivard (1959)
Gerald & Verla Hill (1960)
Earl & Sylvia Seppala (1961)
Peter & Anita Sandretto (1964)
Terrence & Rosalie Maki (1965)
Dale & Sarah Roberto (1968)
Rex D. Stone P.E. (1969)
Larry & Deborah Vojtech (1969)
Camiel & Anne Marie Thorrez (1970)
Mary Janet & Robert Knapp (1971)
Gerald & Patricia Schroeder (1971)
Michael & Carol Paradis (1975)
Thomas J. Tanciar (1975)
Geoffrey & Terri Weller (1975)
Stuart & Gail Koford (1976)
Craig & Becky Tester (1977)
Dean & Suzi Waldie (1979)
Gerald & Kathleen Philo (1980)
James & Carolyn Luyckx (1982)
Jeffrey & Melissa Zawisza (1983)
Donald R. Elzinga, Jr (1984)
Mark & Michelle Gauthier (1985)
Mark & Kerri Musculus (1992)
David M. Ryan (1995)

UP TO $999

Eleanor M. Adams
John & Ethel Baldwin
Barb & Dale Bash
Jacqueline I. Bender
John Jay Blanck
Tim & Beth Boutell
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Michael & Yvonne Carl
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Adam & Laura Kirklin
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Eugene & Delores Kopec
Lloyd & Loretta Kramer
Thomas & Loretta Krempasky
Terry & Cathryn Lautner
Walter & Cheryl Leesch
James & Rosemary Lehner
John & Brenda Lich
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Narasipur & Pramila Suryanarayana
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Ellen J. Wallis
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Gilbert & Joan Wirkner
Lynn R. Wolgast
James & Diane Wolverton
Timothy S. Woycik
Sue & Larry Yager
Doris B. Yax
Judith A. Zielinski
Forest C. Randall (1931)
Paul W. Swift (1933)
Janus R. DeHamer (1935)
Ferdinand J. Remondino (1936)
William & Elsie Herrmann (1937)
John & Mary Ann West (1941)
Jorma & Patricia Aho (1942)
Robert M. Stuckey (1942)
Chester & Elenora Taylor (1943)
Adrian & Elizabeth Dykema (1944)
Warren & Mary Furbeck (1946)
John & Ila Reeves (1946)
Wallace & Kathleen Thomas (1947)
Robert & Dorothea Fricke (1948)
Kenneth & Lois Harder (1948)
Walter & Ruth Jennings (1948)
Roscoe & Nell Marah (1948)
William & Elaine McHugh (1948)
Henry J. Pellikka (1948)
Clinton & Mary Phalen (1948)
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Harold & Joan Barber (1949)
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Wesley & Marielle Bush (1949)
Thomas M. Franey (1949)
William & Thursa Kargela (1949)
James & Shirley Keir (1949)
John & Barbara Lawrey (1949)
James & Dorothy Mills (1949)
Robert & Ruth Nelson (1949)
George & Betty Otto (1949)
Paul & Gladys Roberts (1949)
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Virginia & James Wishart (1949)
Robert J. Woelk (1949)
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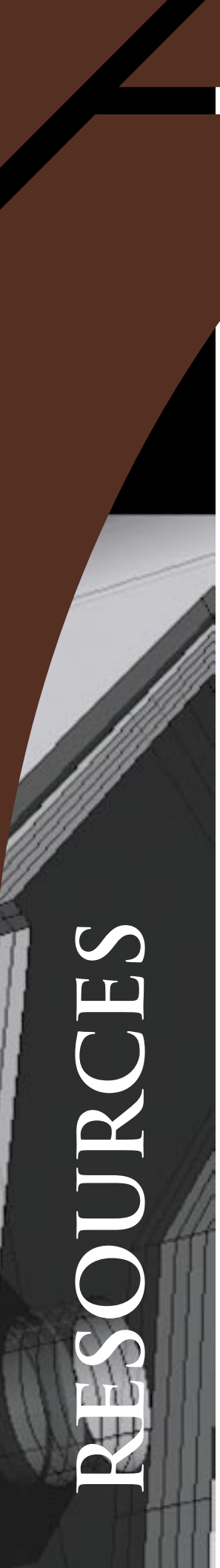

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Kim & Susan Keith (1978)
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John & Joi Beck (1980)
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& Carey McCaffree Pellerin (1987)
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CONTRACTS AND GRANTS

ME-EM research is supported and sponsored by an expanding number of industrial partners. These partnerships strengthen and sustain the superior quality engineering research taking place at Michigan Tech. During the fiscal year 2005, 45% of all ME-EM research was supported by industry with the following active contracts and grants.

DESIGN & DYNAMIC SYSTEMS

SPONSOR	TITLE	PRINCIPAL INVESTIGATOR	TOTAL AWARD
National Science Foundation	Senior Engineering Design Projects to Assist Disabled Persons in Michigan's Copper Country	Charlesworth, Debra *Co-PI: Beard, John E.*	$116,851
ThermoAnalyitics, Inc.	RadTherm/iSIGHT Integration - Installation and User Applications	Bettig, Bernhard P.	$25,829
Polaris Industries, Inc.	Snowmobile Powertrain Transfer Path Analysis	Blough, Jason	$10,000
PCB Piezotronics	Larson Davis DSS Labview VI & NVH Course Development	Blough, Jason	$43,000
Polaris Industries, Inc.	Characterization of Seat & Handlebar Vibration of ATV's & Snowmobiles	Blough, Jason	$60,000
Ford Motor Company	Optimization of P/T Mounting System for Steady State Driving Conditions	Blough, Jason *Co-PI: Rao, Mohan D.*	$105,264
Ford Motor Company	Systematic Design of Product Platform Achitectures	Gershenson, John K.	$70,300
General Motors Corp	Application of GM-GMS to the Manufacturing Systems Design	Gershenson, John K.	$175,125
National Science Foundation	Product Modularity - The Link Between Product Architecture and Product Life-Cycle Costs	Gershenson, John K.	$372,715
Ford Motor Company	2005 Support of C3P Power Training	Lumsdaine, Edward	$7,400
Ford Motor Company	2005 C3P Technical Administrative Support	Lumsdaine, Edward	$134,421
Ford Motor Company	2005 Support of C3P 200 Level Training	Lumsdaine, Edward	$279,779
Ford Motor Company	2005 Support of C3P Powertrain Training	Lumsdaine, Edward	$356,292
BMT Designers & Planners, Inc.	Crane Test Bed Development	Parker, Gordon G.	$85,158
National Science Foundation	Graduate Research Fellowship Program	Parker, Gordon G.	$87,800
BMT Designers & Planners, Inc.	System Identification of Hydrostatic Transmission for Pendulation Control System Implementation and Simulation	Parker, Gordon G.	$192,861
Ford Motor Company	Senior Design: Design, Testing and Construction of a Hemi-Anechoic Chamber for the Chasis-Roll Dynamometer Test Faculty at MTU	Rao, Mohan D.	$20,349
John Deere & Company	Measurement of Acoustic Absorption of Grass Surfaces Using the In-Situ Method	Rao, Mohan D.	$25,600
Volvo Construction Equipment Korea	Enterprise: Study & Reduction of Interior Noise in Volvo Excavators	Rao, Mohan D.	$54,261
Caterpillar, Inc.	Development & Validation of Sound Package Treatments to Reduce Noise from Caterpillar Engines	Rao, Mohan D. *Co-PI: Blough, Jason*	$54,452
University of Massachusetts Lowell	Multi-Semester Interwoven Project for Teaching Basic Core Stem Material Critical to Solving Dynamic Systems Problems	Van Karsen, Charles D.	$33,294
Whirlpool Corporation	Development of a Compliant Floor Test Stand	Van Karsen, Charles D. *Co-PI: Parker, Gordon G.; Rao, Mohan D.*	$50,000

MANUFACTURING/INDUSTRIAL

SPONSOR	TITLE	PRINCIPAL INVESTIGATOR	TOTAL AWARD
Machining Process Technologies, LLC	Preliminary Investigation of Modular Molding	D'Souza, Roshan	$2,872
National Science Foundation	SGER: Preliminary Investigation of Selective Volumetric Sintering of Powder Metallurgy Parts	D'Souza, Roshan	$83,112
M.K. Morse Co, The	Mechanics-Based Design of Metal Cutting Circular Saws	Endres, William J.	$83,639
University of Michigan	An Engineering Research Center in Wireless Integrated Microsystems	Warrington, Robert O. *Co-PI: Friedrich, Craig R.*	$4,017,293
US Department of Defense	Research and Infrastructure Development Center for Nanomaterials Research	Friedrich, Craig R.	$5,806,939
National Science Foundation	GOALI: Optimum Design of Extrusion Dies Using the Estimated Elongational Viscosity of Polymers	Gupta, Mahesh	$405,047
National Science Foundation	NUE: Undergraduate Exploration of Nano-Science, Applications, and Societal Implications at Michigan Tech	Jaszczak, John *Co-PI: Miller, Michele H.*	$134,396
National Science Foundation	BE/MUSES: Renewable Energy from Forest Resources: Investigating the Complex Interrelated Issues Associated with Generating Automotive Fuels from Lignocellulosic Biomass	Maclean, Ann *Co-PI: Sutherland, John W.*	$1,911,901
Kimberly-Clark Corporation	Data Dependent Systems Joint Engineering Project	Pandit, Sudhakar M.	$195,236
National Science Foundation	Defining a Curriculum for Service Sector Engineering	Sorby, Sheryl A. *Co-PI: Sutherland, John W.*	$99,976
Boston Scientific Corporation	P2A2 Membership	Sutherland, John W. *Co-PI: Endres, William J.; Gershenson, John K.*	$60,000
National Science Foundation	IGERT: Achieving Environmental, Industrial, and Societal Sustainability via the Sustainable Futures Model	Sutherland, John W. *Co-PI: Gershenson, John K.; Michalek, Donna J.*	$6,519,800
Ford Motor Company	Ford - MTU Off-Campus Ph.D. Program: A Proposal for Advising Support Development of Hybrid Forming Dies for Super Plastic Forming in Aluminum Sheet	Weinmann, Klaus J.	$59,120

SOLID MECHANICS

University of Michigan-Michigan Space Grant Consortium	Exploring the Meniscal Tissue of the Knee Joint	Haut Donahue, Tammy L.	$2,500
Pennsylvania State University	Finite Element Analysis of Small Blood Pumps	Haut Donahue, Tammy L.	$9,951
Champion Marine, Inc.	Senior Design: Side-Lift Tandem Boat Hoist	Haut Donahue, Tammy L.	$23,400
National Institutes of Health, National Institute of Arthritis & Musculoskeletal & Skin Diseases	Structure and Function of Meniscal Horn Attachments	Haut Donahue, Tammy L.	$244,550
Whitaker Foundation, The	Mechanotransduction in the Meniscus	Haut Donahue, Tammy L.	$390,449
State of Michigan	REF: Multiscale Modeling of Fracture Toughness of Nanostructured Viscoelastic Foam Materials	Odegard, Gregory	$29,815
National Aeronautics and Space Administration	Equivalent-Continuum Modeling of Nanostructured Polymer Composites	Odegard, Gregory	$279,900
State of Michigan	Nationally Visible Infrastructure: The MTU Machining Education & Research Laboratories (MERL)	Predebon, William W. *Co-PI: D'Souza, Roshan; Endres, William J.; Friedrich, Craig R.; Michalek, Donna J.; Miller, Michele H.; Sutherland, John W.*	$34,700

SOLID MECHANICS (CONTINUED)

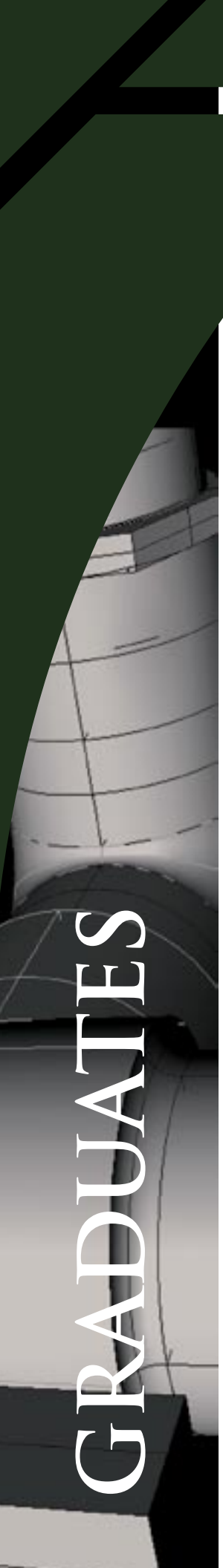
SPONSOR	TITLE	PRINCIPAL INVESTIGATOR	TOTAL AWARD
State of Michigan	REF: Biotechnology Research Center Technician Support to Enhance Interdisciplinary Molecular Research	Predebon, William W.	$42,300
Henry Luce Foundation, The	Clare Boothe Luce Scholar Program	Anderson, Christine S. *Co-PI: Predebon, William W.*	$295,611
Oak Ridge National Laboratory	Plasticity Limits for Structural Ceramics Under Instrumented Single-Grit Scratch Testing	Subhash, Ghatu	$188,844
National Science Foundation	GOALI-Ultrafine Grained and Nanostructured Ceramics: Influence of Processing Grain Size and Strain Rate on Fracture Characteristics	Subhash, Ghatu	$451,318

ENERGY THERMOFLUIDS

SPONSOR	TITLE	PRINCIPAL INVESTIGATOR	TOTAL AWARD
National Aeronautics and Space Administration	Dynamics and Heat Transfer of Evaporating Films in Reduced Gravity	Allen, Jeffrey	$64,138
State of Michigan	REF: Technique for Non-Instrusive Pressure Measurements in Microfluidic-Based MEMS Devices - A Feasibility Study	Allen, Jeffrey	$28,176
National Aeronautics and Space Administration	Microscale Investigation of the Thermo-Fluid Transport in the Transition Film Region of an Evaporating Capillary Meniscus	Allen, Jeffrey	$50,334
Ford Motor Company	Ford Distance Learning Program - PhD in Mechanical Engineering (MEEM)	Anderson, Carl L. *Co-PI: Naber, Jeffrey*	$45,000
US Department of Energy	Direct Injection Compression Ignition Diesel Automotive Technology Education (GATE) Program	Anderson, Carl L. *Co-PI: Cho, Peck; Johnson, John; Michalek, Donna J.; Yang, Song-Lin*	$497,199
General Motors Corp	The Effect of Torque converter Design Parameters on Noise & Cavitation Characteristics	Anderson, Carl L. *Co-PI: Blough, Jason*	$201,194
General Motors Corp	Experimental Determination of Turbine Blade Inlet Tip Loading	Anderson, Carl L. *Co-PI: Blough, Jason*	$96,510
US Department of Education	GAANN: Enhancing the Position of the United States Through Interdisciplinary Development of Fuel Efficient Hybrid Compatible Internal Combustion Engines	Anderson, Carl L. *Co-PI: Cho, Peck; Johnson, J.; Michalek, Donna J.; Yang, Song-Lin*	$451,800
Visteon Corporation	Electronically Controlled Powertrain Cooling	Anderson, Carl L. *Co-PI: Yang, Song-Lin*	$393,193
Seoul Metropolitan Office of Education	Short-Term Professional Development Program for Korean Teachers	Cho, Peck	$213,389
John Deere & Company	Modeling of a Continuously Regenerating Particulate Trap in a Heavy-Duty Diesel Engine with Cooled Low Pressure EGR	Johnson, John H. *Co-PI: Yang, Song-Lin*	$77,965
University of Michigan-Michigan Space Grant Consortium	An Investigation of Model Characteristics of an Inflatable Space Structure	King, L. Bradley	$2,500
University of Michigan-Michigan Space Grant Consortium	High Power Vacuum Arc Thruster	King, L. Bradley	$2,500
University of Michigan-Michigan Space Grant Consortium	Procurement of an Inflatable Boom for a Nanosatellite	King, L. Bradley	$2,500

ENERGY THERMOFLUIDS (CONTINUED)

SPONSOR	TITLE	PRINCIPAL INVESTIGATOR	TOTAL AWARD
University of Michigan-Michigan Space Grant Consortium	Procurement of an Inflatable Boom for a Nanosatellite	King, L. Bradley	$2,500
University of Michigan-Michigan Space Grant Consortium	Small Satellite Deployment Dynamics	King, L. Bradley	$2,500
University of Michigan-Michigan Space Grant Consortium	Electron Dynamics in Hall Thrusters	King, L. Bradley	$5,000
University of Michigan-Michigan Space Grant Consortium	Probe Studies of Bismuth Plasma as a Hall Thruster Diagnostic	King, L. Bradley	$5,000
National Science Foundation	CAREER: Electron Fluid Dynamics in a Hall-effect Accelerator: Using Fundamental Research to Enhance Education and Technology	King, L. Bradley	$602,344
US Department of Defense	A Vaporizing Liquid-Metal Anode for High-Power Hall Thrusters	King, L. Bradley	$353,320
US Department of Defense	PECASE: Spacecraft Interaction Studies of a 20-kW Bismuth-Fueled Hall Thruster	King, L. Bradley	$652,586
State of Michigan	REF-RS: The Development of Hydrogen & Hydrogen Duel Fuelled Internal Combustion Engine Research Programs	Naber, Jeffrey	$36,865
Ford Motor Company	Auto-Calibration: Cold Start & Warm-Up	Burl, Jeffrey B. *Co-PI: Naber, Jeffrey*	$58,893
Ford Motor Company	TI-VCT Engine Optimization	Naber, Jeffrey *Co-PI: Parker, Gordon G.*	$94,690
Motorola, Inc.	Experimental Measure & Analysis for Determination of IC Engine Performance Interactions	Naber, Jeffrey	$147,646
R.W. Fernstrum & Co	Investigation of Flow & Heat Exchange Capabilities for FERNCOOL Box Cooler Heat Exchangers - Continuation	Narain, Amitabh	$76,653
Engineered Machined Products, Inc.	Flow Simulations for Optimized Performance of EMP (Engineered Machined Products, Inc.) Made Displacement Pumps	Narain, Amitabh	$67,748
National Aeronautics and Space Administration	Direct Computational Simulations and Experiments for Internal Condensing Flows' System-Instabilities/Dynamics in Micro-Gravity and Terrestrial Environments	Narain, Amitabh *Co-PI: Evensen, Harold A.; Van Karsen, Charles D.*	$436,763
National Science Foundation	Prediction and Attainment Capability for Quasi-Steady Internal Condensing Flows: An Integrated Computational/Experimental Approach	Narain, Amitabh *Co-PI: Evensen, Harold A.*	$340,975
University of Michigan-Michigan Space Grant Consortium	Analytical Study of Drop Breakup in Combustion Engines	Post, Scott L.	$15,600
John Deere & Company	CFD Study of Flow within Injector & Spray Formation in Cylinder	Post, Scott L.	$23,186
National Science Foundation	Acquisition of High Speed Digital Imaging System for Multidisciplinary Research at MTU	Post, Scott L. *Co-PI: Endres, William J.; Miskioglu, Ibrahim*	$214,230
National Aeronautics and Space Administration	Numerical Study of Low Emission Gas Turbine Combustor	Yang, Song-Lin	$558,913



2004-2005 PHD AND MS GRADUATE DEGREES

PHD GRADUATES AND ADVISORS

Arcand, Benjamin (2005)
Advisor: Friedrich, Craig R
An Active Surgical Positioning Device for a Cochlear Implant Electrode Array

Chen, Wei (2004)
Advisor: Parker, Gordon G
Simultaneous Optimization of Smart Structures

Cheng, Huojin (2005)
Advisor: Beard, John E
Model Based Experimental Investigation on Powered Gait Orthosis (PGO)

Fan, Xiaorui (2005)
Advisor: Miller, Michele H
Force Modeling for Intermittent Grinding Processes

Gandhi, Anand (2005)
Advisor: Anderson, Carl L
Spray Characterization in a Direct Injection Spark Ignition Engine During Cold Start

Guo, Fang (2005)
Advisor: Gershenson, John K
Defining Relationships Among Product Architecture, Product Life-Cycle Modularity, and Product Life-Cycle Cost

Hao, Min (2005)
Advisor: Rao, Mohan D
Vibraton Analysis of Constrained Layered Beams with Multiple Damping Layers

Hii, Wei (Wilson) (2005)
Advisor: Michalek, Donna J
Transient CFD Study of Machining Mist Removal through Kinematic Coagulation

Inal, Mehmet (2005)
Advisor: Anderson, Carl L
Thermal Loading and Surface Temperature Analysis of the Piston of a Small HSDI Diesel Engine

Ling, Di (2005)
Advisor: Gupta, Mahesh
Simulation of Fluid-Solid Interaction in Powder Injection Molding

Loukus, Adam (2004)
Advisor: Subhash, Ghatu
Evolution of Material Properties and Optimization of Process Parameters During Hydroforming of Aluminum Extrusions

Miers, Scott (2004)
Advisor: Anderson, Carl L
Identification and Characterization of Impingement Signatures in a High Speed Diesel Engine Using Piston Surface Temperature Measurements

Padilla, Antonio (2004)
Advisor: Johnson, John H
Development of Models to Study the Emissions, Flow, and Kinetic Characteristics from Diesel Oxidation Catalysts and Particulate Filters

Pavnaskar, Sandeep (2004)
Advisor: Gershenson, John K
A Systematic Method for Leaning Engineering Processes

Qu, Rong (2005)
Advisor: Rao, Mohan D
Health Monitoring, Diagnostics and Prognostics of Mechanical Systems

Rogers, Paul (2004)
Advisor: Nelson, David A
Evaluation of Loop Heat Pipe Performance for Ground Vehicle Applications

MS GRADUATES AND ADVISORS

Andrus, Benjamin (2005)
Advisor: Post, Scott L.
CFD Simulations of a Full-Scale, Blunt-Based Vehicle at High Reynolds Numbers

Bagwe, Sangram (2005)
Advisor: Vilmann, Carl R.
Design of Bolted Joints for Sandwich Composites

Biswas, Abhishek (2005)
Advisor: Nelson, David A.
A Computational Method to Predict Human Thermal Comfort

Calder, Patrick (2005)
Advisor: Jayaraman, Gopal
Studies to Determine Ideal Use and Positioning of an Airdam and Simulations to Predict Pedestrian Trajectories During Automotive Collisions

Case, Steven (2004)
Advisor: Gershenson, John K.
The Validation of a Classification Scheme for Lean Manufacturing Tools

Chandan, Pratik (2005)
Advisor: Gupta, Mahesh
Meshing Algorithm for Two Dimensional and Three Dimensional Moving Boundary Problems

Etapa, Jeffrey (2005)
Advisor: Van Karsen, Charles D.
High Frequency - Low Amplitude Dynamic Characterization of Elastomers through Experimental Techniques

Gami, Rahul (2004)
Advisor: Endres, William J.
Effect of Corner Radius on Tool Temperature

Godin, Lindsay (2005)
Advisor: Donahue, Seth W.
A Mechanotransduction Pathway in Bone - The Role of Calcium-Calmodulin Dependent Protein Kinase 2(CaMKII) and Calcineurin in Bone Adaptation

Gorsalitz, Gary (2005)
Advisor: Allen, Jeffrey
A Feasibility Analysis on Utilizing an Exisiting Environmental Chamber Laboratory for Freezing Studies Relating to Water Management in PEM Fuel Cells

Grattan, Patrick (2005)
Advisor: Jayaraman, Gopal
Finite Element Study to Interpret the Fracture Pattern on the Patella Resulting from Knee Impact Due to an Automobile Crash

Gugale, Shaileshkumar (2005)
Advisor: Friedrich, Craig R.
A Monolithic Actuated Cochlear Prosthesis Insertion Tool

Hales, Adam (2005)
Advisor: Post, Scott L.
Binary Droplet Collisions with Droplets of Greatly Unequal Size

Hasan, Mohammed (2005)
Advisor: Johnson, John H.
The Filtration and Oxidation Characteristics of a Diesel Oxidation Catalyst and a Catalyzed Particulate Filter: Development of a 1-D 2-Layer Model

Jimenez, Hugo (2005)
Advisor: Parker, Gordon G.
Unattended Ground Sensor Application Using Consumer-of-the-Shelf (COTS) Hardware and Software

Joshi, Shantanu (2005)
Advisor: Jayaraman, Gopal
Control Over Projection Using Head Tracking for a Desktop Virtual Reality System

Jost, Britta (2004)
Advisor: Parker, Gordon G.
Application of the Approximation and Model Management Optimization (AMMO) Framework to Parameter Identification Problems

King, Kevin (2004)
Advisor: Subhash, Ghatu
Course work only

Lakkireddy, Venkata (2004)
Advisor: Johnson, John H.
The Effect of an Advanced Oxidation Catalytic Converter and a Catalyzed Particulate Filter on Emissions from a Heavy Duty Diesel Engine

Leep, Daniel (2005)
Advisor: Gershenson, John K.
Course work only

Londhe, Niranjan (2005)
Advisor: Rao, Mohan D.
Development of an In-Situ Measurement Technique for the Measurement of Acousitc Absorption Coefficient of Grass and Artificial Turf Surfaces

Lonkar, Satyajit (2005)
Advisor: Vilmann, Carl R.
Design and Optimization of In-Plane Adhesively Bonded Joints of Sandwich Panels

Maes, Jason (2004)
Advisor: Haut Donahue, Tammy L.
The Time Dependent and Failure Properties of Bovine Meniscal Attachments

Piaget, Thomas (2005)
Advisor: Jayaraman, Gopal
Finite Element Method Analysis of a Tie Rod BumperSystem for Improved Automotive Crash Energy Management

Rawal, Abhay (2005)
Advisor: Van Karsen, Charles D.
Compliant Floor Test Stand

Rosso, Paul (2005)
Advisors: Beard, John E., Blough Jason R.
A Variable Displacement Engine with Independently Controllable Stroke Length and Compression Ratio

Sandretto, Peter (2004)
Advisor: Gershenson, John K
Application of Next Generation Technologies to Competition Human Powered Vehicles

Shah, Amit (2004)
Advisor: Gupta, Mahesh
Simulation of Polymeric Flow in an Twin-ScrewExtruder: An Analysis of Elongational Viscosity Effects

Thomas, Sudip (2005)
Advisor: Friedrich, Craig R.
Focused Ion Beam System Characterization for Rates of Material Removal in Silicon

Vaze, Ajit (2005)
Advisor: D'Souza, Roshan
Octree Decomposition - Recomposition Based Rapid Manufacturing Process

Zhou, Liang (2005)
Advisor: Arici, Oner
Calculate Cooling Load of a Vehicle by Radiant Time Series Method

GRADUATES

2004-2005 BS GRADUATES

FALL 2005 BS GRADUATES

Adler, Daniel P
Badenschier, Shanon M
Balchik, Andy J
Baldwin, Scott N -Summa Cum Laude
Berger, Joseph D -Magna Cum Laude
Bilyeu, Jordan D
Blochwitz, Andrew S
Buck, Steven J
Burt, Nikolas R
Carpenter, Jeffrey J
Clevenstine, Jacob A
Cozad, Julianne M
Donnelly, Arthur J
Dow, Brian R
Eddy, Eric B
Ehlers, Joseph R -Cum Laude
Evon, Matthew J
Fabian, Robert S
Ferguson, Derek R
Fowler, Robert J
Gay, Zackery B -Cum Laude
Grumm, Dennis M
Haas, Thomas R -Cum Laude
Hahnenberg, Frank A
Herman, Luke J -Magna Cum Laude
Higgins, Zachary J
Himes, Matthew D -Cum Laude
Holmes, Charles A
Hooper, Adam C
Johnson, Nicholas C
Johnson, Adam S -Magna Cum Laude
Johnson, Robert S
Kangas, Scott R
Kayser, Mark R -Cum Laude
Kiley, Joseph E
Kim, Hwa Y -Cum Laude
Klawitter, Joel M -Cum Laude
Klein, Mark D -Magna Cum Laude
Krcmarik, Andrew J -Cum Laude
Liedke, Brent J -Summa Cum Laude
Loch, Kelly A
Lundquist, Bryon J
Manyen, Randall A
Marchlewicz, Derek S
Markel, Timothy D
Mitteer, Elizabeth A
Mulzer, Michael D
Mursch, Steven R
Naik, Pramod
Nerat, Benjamin J
Nguyen, Andy V
Pairolero, Nicholas T
-Summa Cum Laude
Parenteau, Adam S
Peabody, Daiyouga E
Pekrul, Neil R
Pikka, Matthew J
Plamp, Benjamin C
Renn, Bryant C
-Magna Cum Laude
Rickert, Frederick, II C
Shanks, Rodney F
Skiera, Jason R
Smith, Stacey L
Smith, Michael S
Soetaert, Michael J -Cum Laude
Sommerfeldt, Nelson I
Stivaletti, Matheus R
Ustishen, Jeffrey R
VanDenHeuvel, Joshua D
VandenBush, Matthew T -Cum Laude
Verhagen, Nichole M
Westra, Christopher D
Wingert, Carl, II F
Wolanin, Michael A
Yap, Fei C

SPRING 2005 BS GRADUATES

Addy, Mark J
Aymen, Justin C
Baker, Matthew R
Baker, Jordan W
Barens, Matthew J
Bassindale, Joseph J
Bekkala, Wesley H
Biery, Michael J
Bischoff, Jeffrey D
Blake, Justin A
Bouman, David J
Boyer, Matthew L
Brady, Jason A -Magna Cum Laude
Bray, Farah J
Brewster, Michael R
Buckingham, Scott A -Cum Laude
Carlson, Melissa M
Cercone, Ben M
Clements, Michael R
Cohrs, Angela S
Cook, Craig W
Coyne, Jonathan C
-Magna Cum Laude
Creisher, Jonathan C
Dean, Diana C
Deto, James R
Dowker, Jessica M
Earl, Gavin M
Erickson, Brigham R
-Summa Cum Laude
Faulkner, Traci A
Gentry, Nathaniel J
Gerbers, Bryant J
Gibbs, Christopher A
Gillespie, Jason E -Summa Cum Laude
Goffard, Gregory D
Greenlee, Andrew C
Heichelbech, Benjamin S -Cum Laude
Hicks, Robert J
Hockers, Shaun J -Cum Laude
Humphreys, Gregory A
Igboanugo, Chukwuemeka (Peter)
-Cum Laude
Inman, Richard G
Jerz, Andrew D
Johnsen, Matthew P
Johnson, Christie L -Cum Laude
Johnson, Jeffrey W
Kapelanski, Timothy J
Koehler, Christopher M
Kohlwey, Kevin M
LaFountain, Andrew L
Larson, Jonathan M
Larusson, Birkir
Liew, Choon J
Lillesve, Peter J
Linford, Aaron M -Summa Cum Laude
Litts, Andrew T
Liu, Sin (Sabrina) M
Lubinski, Jacob R
Martin, Michael A -Cum Laude
Mathur, Saurabh -Summa Cum Laude
Mayer, Andrew W -Cum Laude
Mayville, Samantha A -Cum Laude
Medford, Katherine S
Merkel, Laura K -Magna Cum Laude
Morgan, Bradley L
Murphy, William N
Murphy, Roger P
Nancarrow, John P
Newport, Jason D
Northrup, Todd M
O'Marro, Kelly M
Oleszkiewicz, William R
Osborne, Jonathan J
-Magna Cum Laude
Pederson, Mark D
-Magna Cum Laude
Pollum, Christopher A -Cum Laude
Polonowski, Christopher J
-Magna Cum Laude
Raines, Austin C
Rajnauth, Rodney J
Richards, Andrew W
-Summa Cum Laude
Richmond, Micah C
Roby, Shay A
Saari, Dale R
Scherwinski, Aaron D
-Magna Cum Laude

Schimke, David M
Schmit, Michael P
Schwedler, David L
Schwenn, Anthony J
Skauge, Sandy M -Cum Laude
Soliz, Steven C
Stasa, Korinne M -Magna Cum Laude
Stewart, Kyle B
Sturos, Karl A
TenEyck, Jonathan S
Thut, Ryan R -Cum Laude
Tice, Dietrich W
Tjernlund, Jason D
Traczyk, Timothy -Cum Laude
Trierweiler, Rebecca M -Cum Laude
Unterbrink, Ian R
Varda, Hayley M
Vettel, Drew M -Magna Cum Laude
Walber, Chad M -Cum Laude
Wells, Lee J -Magna Cum Laude
Whitney, Evan M
Zakerski, James M
Zellner, Christopher A
Zink, Brian S -Summa Cum Laude

SUMMER 2005 BS GRADUATES

Anderson, Kelly S -Cum Laude
Andrzejewski, Jason M
Carlson, Trevor T
Gidcumb, Daniel B
Gonsowski, Mark J
Herz, Eric E
Martyka, James P
McNett, William D
McQueen, Matthew T
Shah, Amit
Strebel, Christopher J
Warmack, Adam M

ORDER OF THE ENGINEER

All graduating seniors from the ME-EM Department are invited to the *Order of the Engineer* Ceremony, a public induction where they accept the responsibilities and duties outlined in the formal statement, *Obligation of the Engineer*. These Michigan Tech graduates, along with engineers nationwide, acknowledge the primary purpose of engineering as being a service to the public.

FALL 2004

Dr. Kathryn Clark, President, Docere
Keynote address and Inductee

SPRING 2005

Roger DeWitt, ME–EM Alumnus, Manager Engineering – New Engine Programs, John Deere Power Systems
Keynote address

Alan Frank, Whirlpool
Inductee

William J. Endres, MTU
Inductee

Ghatu Subhash, MTU
Inductee

FELLOWSHIPS 2004-2005

Alumni Fellowship
Tumul Gupta

Cummins Fellowship
Mohammed Hasan
Paramjot Singh

Damler-Chrysler Fellowship
Erin Burns

Doe-Gate Fellowship
Nirav Acharya
Kirtan Bhandary
Brian Eggart
Luke Luskin
Saurabh Mathur
Kiran Premchand
Anand Shende
Paramjot Singh
Abishek Thalagavara

Fulbright Fellowship
Jorge Kurita

Gaann Fellowship
Brian Eggart
Luke Luskin
Scott Miers
Paul Rosso
Robert Stocker

Henes Fellowship
Vishesh Kumar

ICAP Fellowship
Mehmet Inal
Robert Stocker

IGERT Fellowship
Karl Haapala
Margot Hutchins
Julio Rivera

2004-2005 JOURNAL ARTICLES

PUBLICATIONS

The ME-EM Department continually works to engage all of our students in the integration and creation of knowledge through teamwork, instruction, and research in an active, discovery-based learning environment. The following published articles reflect the expertise of our faculty and students, our ongoing research, and the exciting developments in the field of Mechanical Engineering.

Please Note: **Bold text** indicates ME-EM faculty members and *italicized text* indicates ME-EM students.

Purcek, G., **Altan, B. S., Miskioglu, I.,** and *Ooi, P. H,* 2004, "Processing of Eutectic Zn-5%Al Alloy by Equal-Channel Angular Pressing," Journal of Materials Processing Technology, 148(3), pp. 279-287.

Summers, J., **Bettig, B.**, and Shah, J., 2004, "The Design Exemplar: A New Data Structure for Embodiment Design Automation," ASME Journal of Mechanical Design, 126(5), pp. 775-787.

Singh, P., and **Bettig, B.,** 2004, "Port-Compatibility and Connectability-Based Assembly Design," ASME Journal of Computers and Information Science in Engineering, 4(3), pp. 197-205.

Bühler, M., **Bettig, B.,** and **Parker, G.,** 2004, "Topology Optimization of Smart Structures Using a Homogenization Approach," Journal of Intelligent Material Systems and Structures, 15(8), pp. 655-667.

Chen, W., *Bühler, M*., **Parker, G.**, and **Bettig, B.,** 2004, "Optimal Sensor Design and Control of Piezoelectric Laminate Beams," *IEEE* Transactions on Control Systems Technology, 12(1), pp.148-155.

Dhaliwal, A., **Parker, G. G**., and **Blough, J. R.,** 2004, "Active Structural Acoustic Control of Road Noise in a Passenger Vehicle," International Journal of Vehicle Autonomous Systems, 2(3/4), pp.168-188.

D'Souza, R. M., Séquin, C. H., and Wright, P. K., 2004, "Automated Tool Sequence Selection for 3-Axis Machining of Free-Form Pockets," Computer Aided Design, 36(7), pp. 595-605.

Corpus, W. T., and **Endres, W. J.,** 2004, "Added Stability Lobes for Machining Processes That Exhibit Periodic Time Variation—Part 1: An Analytical Solution," ASME Journal of Manufacturing Science and Engineering, pp. 467-474.

Corpus, W. T., and **Endres, W. J.,** 2004, "Added Stability Lobes for Machining Processes That Exhibit Periodic Time Variation—Part 2: Experimental Validation," ASME Journal of Manufacturing Science and Engineering, pp. 475-480.

Kountanya, R. K., and **Endres, W. J.,** 2004, "Flank Wear of Edge-Radiused Cutting Tools Under Ideal Straight-Edged Orthogonal Conditions*,"* ASME Journal of Manufacturing Science and Engineering, pp. 496-505.

Friedrich, C., and *Kulkarni,V.*, 2004, "Effect of Springback on Micromilling Forces," Microsystems Technology Journal, 10(6/7), pp. 472-477.

Arcand, B., Butala, N., and **Friedrich, C.,** 2004, "Design and Modeling of an Active Positioning Device for a Perimodular Cochlear Electrode Array," Microsystems Technology Journal, 10(6/7), pp. 478-483.

Friedrich, C., *Avula, R.*, and Gugale, S., 2005, "A Fluid Microconnector Seal for Packaging Applications," Journal of Micromechanics and Microengineering, 15, pp. 1115-1124.

Gershenson, J. K., Prasad, G. J., and Zhang, Y., 2004, "Product Modularity: Measures and Methods," Journal of Engineering Design, 15(1), pp. 33-51.

Zhang, Y., and **Gershenson, J. K.,** 2004, "Questioning the Direct Relationship Between Product Modularity and Retirement Cost," Journal of Sustainable Product Design, 2(3), pp. 55-70.

Haut Donahue, T.L., Hull, M.L., Rashid, M. M., and Jacobs, C. R., 2004, "The Sensitivity of Tibio-Femoral Contact to Parameters Describing the Geometry of the Lateral and Medial Menisci," Journal of Orthopaedic Research, 22, pp. 807-814.

Haut Donahue, T. L., Donahue, H.J., Jacobs, C. R., and Yellowley, C. E., 2004, "A Role for Annexin V in Bone Cell Mechanotransduction," Bone, 35, pp. 656-663.

Jayaraman, **G.,** and Struthers, A., 2005, "Divergence and Flutter Instability of Elastic Specially Orthotropic Plates Subject to Follower Forces," Journal of Sound and Vibration, 281, pp. 357-378.

Meyer, E. G., Sinnott, M. I., Haut, R. C., **Jayaraman, G**., and Smith, W. E., 2004, "The Effect of Axial Load in the Tibia on the Response of the 90° Flexed Knee to Blunt Impacts With a Deformable Interface," Stapp Car Crash Journal, 48, pp. 1-20.

Kladopoulou, E. A., **Yang, S. L**., **Johnson, J. H., Parker, G. G.,** and Konstandopoulos, A. G., 2003, "A Study Describing the Performance of Diesel Particulate Filters During Loading and Regeneration: A Lumped Parameter Model for Control Applications," SAE Transactions Journal of Fuels and Lubricants, pp. 647-668.

Schaub, H., **Parker, G. G.,** and **King, L. B.,** 2004, "Challenges and Prospects of Coulomb Spacecraft Formation Control," Journal of the Astronautical Sciences, 52(1/2), pp. 169-193.

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Sun, J., Ju, C., Yue, Y., Gunter, K. L., **Michalek**, **D. J.,** and **Sutherland, J. W.,** 2004, "Character and Behavior of Mist Generated by Application of Cutting Fluid to a Rotating Cylindrical Workpiece—Part 2: Experimental Validation," ASME Journal of Manufacturing Science and Engineering, 126(3), pp. 426-434.

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Kucuk, H., **Parker, G**., and Baumgartner, E., 2004, "Robot Positioning of Flexible-Link Manipulator Using Vision," Robotica, 22, pp. 301-307.

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Hao, M., and **Rao, M. D.,** 2004, "Optimum Design of Multiple-Constraint-Layered Systems for Vibration Control," AIAA Journal, 42(12), pp. 2448-2461.

Wirkner, K. J., **Rao, M. D.,** and Gruenberg, S., 2004, "Dynamic Characterization of Automotive Exhaust Isolators," Journal of Automobile Engineering, 218, pp. 891-900.

Spruit, M., **Rao, M. D.,** et al, 2004, "Study of Noise Transmission From a Table Saw," Sound and Vibration, June Issue, pp. 20-26.

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Imaninejad, M., **Subhash, G.,** and *Loukus, A.,* 2004, "Experimental and Numerical Investigation of Free-Bulge Formation During Hydroforming of Aluminum Extrusions," Journal of Materials Processing Technology, 147(2), pp. 247-254.

Loukus, A.R., **Subhash, G.,** and *Imaninejad, M.,* 2004, "Mechanical Properties and Microstructural Characterization of Extrusion Welds in AA6082-T4," Journal of Material Science, 39, pp. 6561-6569.

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Sutherland, J., *Gunter, K.,* Allen, D., Bauer, D., Bras, B., Gutowski, T., Murphy, C., Piwonka, T., Sheng, P., Thurston, D., and Wolff, E., 2004, "A Global Perspective on the Environmental Challenges Facing the Automotive Industry: State-of-the-Art and Directions for the Future," International Journal of Vehicle Design, 35(1/2), pp. 86-110.

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Department of Mechanical Engineering-Engineering Mechanics
Michigan Technological University
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Houghton, MI 49931-1295

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