Department Strives to Meet Demand for 21st-Century Engineers

The faculty and staff of the MSU Department of Mechanical Engineering (ME @MSU) understand the importance of offering a quality education to students for careers in the 21st century. Increasingly that means advanced degrees beyond the bachelor’s level. Recent postcard mailings to alumni and supporters of the department highlight current goals and show examples of students achieving those goals.

In addition, the postcards showcase artwork that is part of an art collaboration between ME@MSU and Okemos High School in Okemos, Mich., which was a program to allow high school students to use their creativity to produce artwork that was influenced by viewing a Jeep engine donated by Chrysler Corporation through the goodwill of alumnus Jack Withrow.

Advances in engineering are improving the quality of life for people around the world. Thus professional engineers need an understanding of a wide range of specialties as well as an in-depth knowledge of their own field. Increasingly this is acquired through graduate-level study for an MS or even a PhD. This trend is reflected in the expectation of many companies that their engineering leaders have at least MS-level qualifications. ME@MSU has a long tradition of providing both MS and PhD programs.

Basak Oguz, who received her BSME in 2007 and her MS this spring, is now employed at Whirlpool Corporation. Her research at MSU focused on multi-functional material for use as part of the thermal protection system for a space shuttle orbiter. Professor Patrick Kwon was her adviser for her master’s degree.

Professional engineers (PEs) are required to have at least a master’s degree in Europe but not in the United States. In a global economy this gives a potentially significant competitive advantage to European engineers and the companies that employ them. This is recognized by many U. S. employers who encourage and support engineers to pursue graduate-level education. This will need to become the norm in Michigan if we are to rebuild a thriving economy. ME@MSU offers MS and PhD programs in engineering mechanics and in mechanical engineering as part of its mission of education and outreach in support of the state.

Cody Squibb (BS ’06, MS ’09 mechanical engineering) has chosen to continue his education by going for a PhD in mechanical engineering. Squibb, working with Professor Harold Schock as his adviser, is researching ways to develop low-emission, high-efficiency engines. In the photo above he is using optical imaging inside a specially designed engine to visualize flow and combustion. Squibb would like to pursue a career in academia or industrial research after receiving his PhD.

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Okemos High School Art Collaboration with ME@MSU

Artwork by Christine Budd
Artwork by Ray Cloutier
Artwork by Ed Emmerich
David L. Joyce (BS ’78, MS ’80) received the 2009 Mechanical Engineering Distinguished Alumni Award at a College of Engineering banquet in May. Established in 2004, the award honors an alumnus of MSU’s Department of Mechanical Engineering who has a minimum of 15 years professional experience in engineering, provides leadership in engineering and engineering education, contributes to the department, college, or MSU, and is actively involved in the community.

Joyce is president and chief executive officer of GE Aviation, the world’s leading designer and producer of jet engines for commercial and military aircraft and a major provider of avionics, power management, and actuation systems. GE Aviation has more than 35,000 employees in operations worldwide, with revenues of $19.2 billion in 2008. Before assuming the top post, for three decades Joyce influenced the design and launch of GE’s most innovative and popular engines. His journey in aviation began after earning bachelor’s and master’s degrees in mechanical engineering at Michigan State University. He also received a master’s degree in business finance from Xavier University in 1992.

Joyce joined GE Aviation in 1980 at its Cincinnati, Ohio, headquarters and became immersed in advanced design and product development, contributing to nine jet engine families for 15 aircraft models. He expanded into Six Sigma quality leadership roles, and headed GE Aviation’s around-the-clock Customer & Product Support organization. Later, Joyce ran the regional and business jet commercial engine operations from 2000 through 2003, during the explosive growth in regional jet operations in the United States.

As GE Aviation’s president and CEO, Joyce is active in the industry and the community. He serves on the executive committee of the Aerospace Industries Association in Washington DC. At home, he serves on the Cincinnati Business Committee (co-chairing the group’s Education Task Force), on the boards of United Way of Greater Cincinnati and the Tri-State Warbird Museum, and the advisory board for the University of Cincinnati College of Engineering.

David and his wife, Pamela, live in Cincinnati, Ohio, with their two children, Leland and Maddie.

ME Students as Athletes

Football, swimming, diving, track, and softball — ME undergraduate students are conquering the tough task of majoring in engineering and participating in campus sports teams.

“She thinks today’s engineering students are becoming more diverse in who they are. “I think that makes the best engineer—having all these life experiences that teach you a lot of life skills,” says Ruhno. Her role as coxswain “has definitely helped me to be a leader.”

Sometimes, the correlation between a sport and engineering can be quite direct. At least that’s what Eric Tingwall, mechanical engineering major and Triathlon team member, has learned. “Triathlon is unique in that there’s a fair amount of engineering that goes into the sport,” Tingwall says. “A fairly large industry engineers bikes to optimize weight, aerodynamics, and stiffness. Compared to sports like soccer, basketball, and swimming, a triathlete’s success depends heavily on the gear—a well-engineered bike.”

Ross Weaver, of Southfield, Mich., is studying mechanical engineering. He plays cornerback for MSU’s football team. Weaver especially enjoys hands-on engineering projects and internships wherever he can get them. His experience in class has taught him the value of “working with other people and learning new ideas and different approaches to solving problems.”

Other MSU student athletes, who are majoring in mechanical engineering, include:

- Aaron Chamberlain, Men’s Track & Cross Country Outdoor
- Sean Costello, Men’s Swimming & Diving
- Ridge Hahn, Men’s Track & Cross Country Indoor
- Kenneth Hall, Football
- Samantha Hilk, Women’s Swimming & Diving
- Lauren Kramer, Women’s Softball
- Andrew Nuttall, Men’s Track & Cross Country
- Ashley Swartz, Women’s Soccer
- Quentin Williams, Football
- Aaron Winter, Men’s Track & Cross Country Outdoor
Department Strives to Meet Demand (continued from page 1)

The U. S. and Michigan economies need an injection of innovation and entrepreneurial spirit to create a new generation of competitive businesses with world-class engineering products. Research intensive universities, such as MSU, are engines of innovation and discovery powered by faculty and their graduate students. The constant flow of bright, free-thinking minds in the form of graduate students is essential for the process of discovery. After graduation from MS and PhD programs, they transfer the technology to the economy.

**Ryan Monroe**, ME doctoral student, is doing his research in non-linear dynamics. He is working on centrifugal pendulum vibration absorbers to dampen vibration in variable displacement automotive engines, which are designed to improve fuel economy. Monroe, who received his BS in 2006 and his MS in 2008, both from MSU, is advised by University Distinguished Professor Steven Shaw.

In a typical year, 350,000 engineers graduate in China as compared to 70,000 in the U.S., according to the National Academy of Sciences. That's approximately twice as many graduates per head of population in China compared to the US. In order to compete, the U. S. needs to ensure that its engineers are better educated with more of them achieving an MS or a PhD. MS@MSU offers almost 30 graduates courses as part of its MS and PhD programs. About 150 students are enrolled in these programs with two to three percent supported by graduate fellowships.

**Anoosheh Niavarani**, a PhD student in ME, is using molecular dynamics to study fluid motion at solid-liquid interfaces in support of bio-inspired design. Niavarani has won the prestigious Zonta Award for her work in mechanical engineering for two consecutive years. Her research is partially funded by an Amelia Earhart Fellowship. Professor Nikolai Priezjev is her adviser.

It’s difficult to persuade a student graduating with a BSME and a debt of more than $20,000 to pass up a job offer and continue studies for an MS or even a PhD. Yet to create a strong, competitive economy that’s exactly what we need to do in Michigan. ME@MSU is responding to this need by updating the MS and PhD programs to make them more attractive and relevant. In 2009-10 the department will introduce a new program in biomechanical engineering. We are also seeking to strengthen the resources available to support graduate students, particularly through graduate fellowships.

**Dan Isaac** received his master’s degree in engineering mechanics this spring. During his undergraduate work Isaac pursued graduate research on the long-term implications of acute cartilage trauma on the development of osteoarthritis. He is considering continuing research in orthopedics after medical school. University Distinguished Professor Roger Haut was his adviser.

**Casey Allen** has returned from industry to pursue research in laser diagnostics applied to the design of low-emission engines. Allen is in an accelerated PhD program that does not require a master’s degree. His PhD program is partially supported by a Colucci Graduate Fellowship. Professor Tonghun Lee is his adviser.

Tomorrow’s economic growth and quality of life are fueled by today’s research and invention. Many key indicators of research output show that the strength of U.S. research has declined in recent years. ME@MSU is striving to increase its research output both in terms of patents, published scientific papers, and MS/PhD students graduated. Graduate fellowships help, providing stipends and covering tuition costs to attract the best students to Michigan State University.

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Okemos High School Art Collaboration (continued from page 1)

Artwork by Katy Gibson

Artwork by April Miller

Artwork by Anna Pathak
Withrow Teaching Excellence Award

Tonghun Lee, assistant professor, received the Withrow Teaching Excellence Award at the college’s annual awards luncheon in March. Lee cares deeply about the quality of his teaching and invests substantial effort in providing the best experience possible for his students. He creates an environment where the material becomes understandable to the students and important for them to learn—qualities that are critical in the classroom. This engenders both respect and admiration from his students.

“He makes sure that students understand the theory behind the application,” says one student. Another student says: “We had heard all these horror stories about thermo . . . but it was not that bad, thanks to the teacher.” He is described as “a great and fair teacher!” and “an excellent teacher who has a bright mind and a good way of transferring knowledge to his students.” Simply put by another student, Dr. Tonghun Lee is a professor who “really is amazing!”

In addition, Lee is one of 39 engineers and scientists chosen for $12.1 million in grants as part of the Air Force Office of Scientific Research’s Young Investigator Research Program. This highly competitive process is intended to foster creative research in a wide range of areas. The AFOSR received 210 proposals in areas such as aerospace, chemical and material sciences; physics and electronics; and mathematics, information and life sciences. Lee’s research will focus on laser diagnostics of plasma-assisted combustion for scramjet applications.

Withrow Distinguished Scholar—Senior Award

Harold Schock, professor, received the Withrow Distinguished Scholar—Senior Award at the college’s annual awards luncheon in March. This award recognizes faculty members who have demonstrated excellence in scholarship, been in service to the university for more than five years, and hold the rank of professor.

Schock is responsible for the establishment of one of the most highly respected automotive research programs in the country. One of the world’s top researchers in internal combustion engines, his expertise centers on improving engine efficiency using novel design, the utilization of biofuels, and the conversion of waste heat to electricity. He also had a leading role in the development of pioneering measurement techniques like Molecular Tagging Velocimetry (MTV), high-speed combustion photography, and analytical tools for automotive engine modeling, and is now regarded as a leader in the materials processing of high ZT thermoelectric materials.

Shortly after arriving at MSU in 1987, Schock established the Engine Research Laboratory, which later became the Automotive Research Experiment Station.

A recent high point of his tenure at MSU was reached with the establishment in August 2007 of the $10 million, 29,000-square-foot Energy & Environment Research Station.

Withrow Student Service Award

This Withrow award is presented to an adviser, academic specialist, or non-tenure-track instructor for outstanding service to students in the college. This year it was awarded to Gaile Griffore. For more than 25 years, Griffore has served as academic adviser to students in mechanical engineering. She has touched the lives of thousands of students—likely more than any other adviser in the college’s history. Of particular note is her diligence in guiding students through the requirements of the program and its unwritten realities (what to take when, and what not to take concurrently). She double-checks everything and students who follow her guidance graduate on schedule, without complications. If she cannot directly assist a student, she will not give up until she finds the person or resource to assist.

As noted by a colleague, “Gaile constantly amazes me with the lengths to which she goes to make sure her students have every advantage, while still staying within the bounds of rules and procedures.” Said another, “When Gaile is on a quest for an answer to a pressing advising or policy question, she is reminiscent of Woodward and Bernstein . . .”

New Role for Professor

John R. Lloyd, University Distinguished Professor of mechanical engineering, has been named chief editor of the International Journal of Energy for a Clean Environment, published by Begell House Publishers. Under his leadership, the journal is expanding its scope to cover air-, water-, and earth-related studies of the influence of alternative energy technology and the impact on the environment. He was also recently appointed to the editorial board of the Web-based Thermopedia, an electronic encyclopedia of heat and mass transfer.
Craig J. Gunn, ME Communications Program director, received the Michigan State University Distinguished Academic Specialist Award this spring. Gunn fosters engineering students’ improvement of their oral and written communication skills. Beyond the classroom, he has influenced his field through work on university-wide committees and workshops, and through his work with the Cooperative and Experiential Education Division (CEED) of the American Society for Engineering Education.

**NSF CAREER Award**

Jongeun Choi, assistant professor of mechanical engineering and of electrical and computer engineering, received a National Science Foundation (NSF) Faculty Early Career Development (CAREER) Award. Choi received the award for his proposal, “Multi-Agent Systems and Gaussian Processes: Applications in Environmental Sciences.” He received a five-year $400,000 grant.

Choi’s work is in developing and analyzing distributed learning and cooperative control algorithms so that a network of mobile sensing vehicles can gather data and learn an unknown field of interest in order to perform specific tasks. Choi’s research has applications in the environmental sciences.

“Emerging technologies in robotic sensor networks and field prediction algorithms can offer great potential to deal with such issues,” he says. “The main purpose of my work is to develop control algorithms for a network of mobile sensing vehicles to explore and predict an unknown field of interest.”

His project offers training experiences for undergraduate and graduate students and provides opportunities to foster collaborative research with MSU’s Department of Civil and Environmental Engineering and Department of Fisheries and Wildlife. During summer residential programs sponsored by the College of Engineering’s Diversity Programs Office and the Office of Recruitment and K-12 Outreach, students will be able to try out some of the biologically inspired mobile robots—robots that mimic flocking birds or swimming fish—that have been developed in Choi’s lab.

**Article in Proceedings A of the Royal Society**

Thomas J. Pence, professor, and two co-authors recently had an article published in Proceedings A of The Royal Society. The article focused on dissolutions and reassembly of filamentary reinforcing networks in hyperelastic materials. The co-authors were Hasan Demirkoparan with Carnegie Mellon University in Qatar and Alan Wineman with the Department of Mechanical Engineering at the University of Michigan.

Proceedings A is a prestigious journal that publishes research papers, as well as short reviews containing original and interesting new ideas. The articles published are high-quality, original, fundamental articles of interest to a wide range of scientists, and often have long citation half-lives.

**New Faculty and Staff**

Viktor P. Astakhov, professor, has joined the department. He received a PhD (’83) in mechanical engineering from Tula Polytechnic University, Tula-Moscow, Russia. He was awarded a DSc in 1991 for his outstanding performance and profound impact on science and technology, and in 1994 he received a certificate of recognition as “State Professor of Ukraine.” He has published both fundamental and text books, book chapters, and many papers in professional journals and trade periodicals.

Astakhov is the editor in chief of a new publication—the International Journal of Advances in Machining and Forming Operations—and serves as special issue editor, board member, reviewer, and adviser for many international journals and professional societies. His main research and application interests include theory of metal cutting and its applications; cutting tool design, assessment, and optimization; and machinability of materials, new tool materials, and coatings.

Scott Kiefer recently joined the department as a teaching specialist. He came from the Tri-State University (now called Trine University). Kiefer teaches mechanics courses, including ME 222 “Mechanics of Deformable Solids” and ME 451 “Control Systems.” He has specialized in teaching and in undergraduate design projects for the last seven years. Kiefer obtain his BS from the University of Wisconsin—Platteville and his MS and PhD degrees from North Carolina State University.

**International Research**

ME Professor Ranjan Mukherjee, who received a prestigious Fulbright Scholarship in 2008, used the funding this spring by spending one semester in the Department of Mechano-Informatics at the University of Tokyo. He worked on the problems of mobile robotic solutions for wheelchair-bound residents of long-term care facilities, and impedance control of robotic manipulators. In addition, he gave seminars at various Japanese universities, including Kyoto University, Tohoku University, and of course the University of Tokyo.
Students @ ME

2009 Fitch Beach Award

Douglas Neal was the third-place recipient of the Fitch Beach Outstanding Graduate Research Award presented by the MSU College of Engineering Research and Graduate Studies Committee for outstanding research in a PhD program. Neal is an ME PhD student working on his dissertation. John Foss is Neal’s adviser.

2009 Academic Awards

Congratulations to the following students who were recognized at award ceremonies in spring 2009 for academic excellence and service to the community. Outstanding Graduate Student Award: Anoosheh Niavarani, Nikolai V. Priezjev; Outstanding Undergraduate Academic Achievement Awards: Charles Andrews, Nathan Geib, Kyle Kocarek, Jeffrey Laforge, Sara Murawa, Brian Rockwell, Amanda Ruhno, Eric Tingwall, Alexander Tollis, and Matthew Weir.

Service Award: Kenneth Maisonville and Eva Reiter.

2008-2009 Senior Student Ambassador: Amy Bittinger.

Diversity Programs Awards

Three ME students received Outstanding Diversity Programs Awards at a banquet in February.

Rickey Caldwell, ME graduate student, received an award sponsored by the Eaton Corporation. Caldwell is the graduate coordinator for the Guided Learning Center. He hires, trains, and maintains a staff of tutors for the college’s Diversity Programs Office. He also has run mentoring groups for the last three semesters. Caldwell received his master’s degree in mechanical engineering this spring. He had received his bachelor’s degree from MSU in 1999. This summer he has a research internship at MIT Lincoln Labs in Massachusetts. He will return to MSU this fall to pursue a PhD.

Christopher Gandy, an ME senior who graduated in May, also won an award for his involvement in the Diversity Programs Office and with the MSU chapter of the National Society for Black Engineers. Gandy has moved to Houston, Texas, where he is working for Dow Chemical as a technical services and development engineer.

Jarreau Jackson, ME junior, is the immediate past president of the MSU chapter of the National Society of Black Engineers and will serve as secretary and president emeritus for the 2009-2010 academic year. As a student research assistant, he worked with Professor Norbert Müller on woven wheel research in the turbo machinery lab. This fall will mark Jackson’s third year as a peer leader for the College of Engineering’s Residential Experience and he will mentor and aid first-year engineering students in Wilson Hall. This summer Jackson has worked for Chevron Corporation in New Orleans, La., working on- and offshore in the Gulf of Mexico in the facilities engineering department.

2009 SCC Award

Eric Tingwall was named an outstanding senior by the MSU Senior Class Council. He graduated in May 2009 with a double major in mechanical engineering and journalism. He balanced that academic heavy lifting with an equally rigorous life as a member of MSU’s Triathlon team. He was a leader on the team as president, a role that often required him to develop relationships with corporate sponsors. He received a General Motors scholarship and wrote for automotive publications during his college career. A native of Novi, Mich., Tingwall carried a 4.0 GPA in engineering and a 3.92 in journalism. He currently is working for Automobile magazine.

NSF Graduate Research Fellowship

Louis Flynn, an ME graduate student with Professor Ranjan Mukherjee, has been awarded a National Science Foundation Graduate Research Fellowship. This nationally competitive fellowship provides three years of funding toward a PhD in science, math, engineering, or social sciences. Flynn will pursue his PhD in robotics and controls in the MSU ME department, researching with Mukherjee.

2009 Zonta Award

Anoosheh Niavarani, an ME graduate student, has won the prestigious Zonta Award for her work in mechanical engineering for the second year in a row. Her research focuses on slip boundary condition of nano-fluids with molecular dynamics method in the Computational Fluid Dynamics (CFD) Lab. Nikolai Priezjev is her adviser.

The Zonta Award recognizes women of any nationality who demonstrate a superior academic record and provide evidence of a well-defined research program in the aerospace-related sciences or aerospace-related engineering field.

2009 SWE AWARDS

MSU Women in Computing (WIC) members Sara Murawa and Eva Reiter, both ME seniors, received outstanding student awards at the Society of Women Engineers (SWE) banquet in February. The purpose of the award is to honor exemplary students who have participated in SWE, Women in Engineering, and/or Women in Computing programs at Michigan State University.

Winners were selected on the basis of outstanding academic achievement and community involvement. Murawa received the award sponsored by Bosch, and Reiter received the award sponsored by Chrysler Corporation.

Murawa, who received her BS degree this spring, was the president of both Pi Tau Sigma and Tau Beta Pi, two honors engineering organizations. She also has been involved in the...
InterVarsity Christian Fellowship. “I encourage everyone to pick a student organization or two and get involved early,” says Murawa. “Don’t just pay the membership dues and write it on your resume. Instead, try running for an officer position or volunteering on committees. Being involved is a great learning experience.”

Murawa has had four internships with General Motors. She will pursue a master’s degree in mechanical engineering at MSU. She is from Hartland, Mich., and her parents are Lynn and Gary Murawa.

Reiter, who will graduate in December 2009, has won this award as a freshman and also as a junior. In addition to being SWE president this past year, she has also been the treasurer of SWE and of Pi Tau Sigma. She has worked as a career peer in The Center for Spartan Engineering and as an engineering aide to the mechanical engineering design program.

Reiter has completed several internships and is working for Shell Oil this summer. “One of the important parts of college is to make the experience your own,” say Reiter. “Find the things you enjoy doing by trying out new things, meeting new people, and taking yourself away from your comfort zone. This has really helped me figure out what I want to do with my life—and I have met some great people in the process.”

Reiter is from Haslett, Mich., and is the daughter of Bart and Marian Reiter.

Spring 2009 Design Day

The ME department has been at the forefront of Design Day, which is now a college-wide event every semester. The spring 2009 Design Day was held May 1 at the MSU Student Union. The event showcases graduating seniors with their capstone design projects and other design-oriented projects. “Design Day is a wonderful opportunity to see our future engineers in practice,” said ME capstone instructor Craig Somerton.

While all students participating in this contest are winners, the official awards for ME students were given to several teams.

**ME 371 Kids’ Choice** – Pre-college students select the best design by interviewing the ME 371 students. The winning team received the Sparty Plaque that was designed and built by students at Holt Junior High School. The first-place winner was The Bagel Mangler; team members are Mark Goldy, Mark Holmes, Nicholas Stuart, and Diana Toan. Brian Thompson is the instructor for ME 371.

**First Place ME 412, Heat Transfer Lab** – The design team includes Anthony Dellicolli, Jacob Haf, and John Sachs. Laura Genik was the faculty adviser.

**First Place ME 471, Leonardo da Vinci Scholars Award** – This design team developed a prototype appropriate to allow a quadriplegic to cast a fishing lure accurately and retrieve the lure and make additional casts without assistance. The members of the winning team are Stephanie Bonner, Kaitlin Donoughe, Steve Hukill, and Brandon Uhl. Dan Isaac is the instructor for this course.

**First Place ME 481, Oral Presentation** – Members of the Green Team, who developed an unmanned food demo system for Blue Sky Chicago, included Lisa Chapman, Zef Ivanovic, Christopher Miller, and Fadi Yousif. Tonghun Lee was the faculty adviser.

**First Place ME 481, Poster Presentation** – Team members, who developed a wind power demonstrator for Woodcreek Elementary School in Lansing as part of the Motorola Foundation Youth in Energy and Environment Humanitarian Project, included Brent Augustine, Christopher Gandy, Ryan Kelly, and Marcus Peters. Craig Somerton was the faculty adviser.

**First Place ME 481, Edison Undergraduate Design Award** – Team members who developed a vaccine refrigerator for remote regions of the world included Muhammad Nabeel Aslam, Kevin McPhail, Ryan McPhee, Brent Rowland, and Eric Tingwall. Craig Somerton was the faculty adviser.

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Professor Brian Thompson (left) has fun with the winning Kids’ Choice team. Instructor Dan Isaac (left) congratulates the winners of the Leonardo da Vinci Scholars Award.
When you receive this newsletter I will be concluding a five-year term as chair of the Department of Mechanical Engineering at Michigan State University. So by way of a very short report, here are 10 facts about the last five years in the department:

1. The faculty has grown from 35 to 44.
2. Journal papers published per faculty has increased by 64 percent.
3. Research space has approximately doubled.
4. Research contracts and grants received per annum have tripled.
5. The new $10 million Energy & Automotive Research Labs have been constructed.
6. The Composite Vehicle Research Center has been founded with initial grants of $6 million.
7. An undergraduate team won the ASME International Design Competition.
8. An undergraduate concentration in global engineering has been established with exchange agreements with The University of Edinburgh, Korea University, and National Tsinghua University.
9. A freshman engineering program was piloted and adopted by the College of Engineering as a component of the new Cornerstone Program.
10. Two members of the ME faculty (Gary Cloud and Roger Haut) became University Distinguished Professors, the highest honor that the university bestows on faculty.

Most of you know me only as an administrator; indeed I have served in that capacity for the last eight years, having completed a term as head of the Department of Mechanical Engineering at The University of Sheffield, England, prior to my role at MSU. However, I am also active in research and the picture at left below comes from some of my recent work on developing techniques to observe the mechanical interaction of nanoparticles with living cells in an optical microscope. Particles with diameters smaller than the wave length of visible light (400-700nm) are invisible when viewed in optical microscopes used in biology.

The picture shows the optical signatures in an optical microscope of individual 100nm nanoparticles on the right, which are self-assembling into a layer on the left. The optical signature is generated using Mie scattering; for more details see SMALL 4(10):1703-6, 2008. The research is part of a collaboration with Professor Maurice Whelan of the Nanotechnology and Molecular Imaging Unit in the Institute for Health and Consumer Protection at the European Commission DG Joint Research Centre.