Focus on the
College of Engineering and Applied Sciences

WMU’s Green Team

Industrial & Entrepreneurial Engineering
Aerospace Mechanical Computer Civil Electrical Computer Science Manufacturing

CONSTRUCTION

Engineers help shape the future

Engineering Management CHEMICAL

GRAPHIC AND PRINTING SCIENCE

PAPER

Engineering Design Technology
Dear Friends,

Over the last year—my first calendar year as associate provost—I have had the pleasure of visiting many of WMU’s international partners around the world. These meetings not only served to reaffirm our ties, they also resulted in new opportunities for expanded student and faculty exchange. My visits also allowed me to see many of our alumni—from members of the class of ’61 all the way to recent graduates. All of them share a deep affection for Western and gratitude for the education they received, setting them on track for successful careers in their home countries. My interactions during these trips have strengthened my appreciation of WMU’s extraordinary global reach and the tangible benefits that we receive from our international partnerships and alumni.

On campus, last year saw the launch of several exciting initiatives that will aid us in fulfilling our mission to be a learner centered, discovery driven, globally engaged university. The International Education Council (IEC) of the WMU Faculty Senate mounted a well-attended day-long workshop on curriculum internationalization. The College of Arts and Sciences International Committee developed a set of global learning outcomes, and the IEC is facilitating a campus-wide discussion on this topic. WMU has committed to a 50 percent increase in study abroad participation as part of the national Generation Study Abroad initiative, and a record number of faculty-led programs are planned for this year, including to areas of the world where we have not sent many students before. At Western, we believe that a high-quality education must prepare students to enter their careers with global awareness and cross-cultural understanding.

In this issue of WMU International News, we are featuring some of the international activity ongoing in the College of Engineering and Applied Sciences, including stories about:

- A sensor developed by a team of doctoral candidates chaired by Binu Narakathu of Kerala, India, that measures potentially dangerous head and body impacts for American football players and the military;

- Marylin Glass-Hedges, a doctoral candidate from the Dominican Republic, who is the student leader of WMU’s Green Manufacturing Industrial Consortium, which is developing “zero waste to landfill” manufacturing processes in collaboration with Kalamazoo area companies;

- Dr. Ala Al-Fuqaha, a WMU computer scientist, who is collaborating with researchers in Qatar and at Purdue University to develop Intelligent Transportation Systems to improve road safety via funding provided by the Qatar Foundation.

I hope you enjoy these accounts of WMU’s global impact and the pride we take in forging positive change in Kalamazoo and around the world.

We appreciate your interest in Western Michigan University and the Haenicke Institute and we welcome your comments about WMU International News. Please write us at: wmu-international@wmich.edu.

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Every day in Western Michigan University’s College of Engineering and Applied Sciences, faculty and students are hard at work applying principles of science and mathematics to turn imagined concepts and ideas into commercial applications that meet consumer and societal needs.

Developing a sensor for football helmets to monitor possible injury, identifying zero-waste-to-landfill manufacturing processes, improving aerodynamics on cars and trucks, growing super-thin crystals for semiconductors, and creating new gaming platforms, are just a few of the innovative research projects and ventures currently underway in the college. Faculty and graduate researchers are the recipients of about $3 million in grants each year, including significant awards from the National Science Foundation. Some of their stories are included in this issue of WMU International News.

Said AbuBakr, former chair and professor of the college’s Department of Chemical and Paper Engineering, heads up the CEAS International Education Committee. He said a primary goal of the college is to provide all of its graduates the opportunity to gain at least one international experience as part of their degree program. Some students complete internships or participate on research teams at local multinational companies; some students study abroad; and, all CEAS students will discover and learn with international students and faculty in the classroom and the lab.

“Even undergraduates participate in research,” said AbuBakr, who joined the CEAS faculty in 2001. “If undergraduates are interested in research, they can find a professor who will work with them. Our goal is to ensure our graduates are career ready—wherever they end up working they will be dealing with companies from other countries. Many graduates are immediately hired for jobs overseas.”

CEAS has an enrollment of about 2,500 students, including 470 master and 115 doctoral students. About 30 percent of the college’s 98 professors come from countries other than the United States, making the CEAS faculty one of the University’s most internationally diverse. Countries represented include: Bangladesh, China, Ghana, Hungary, India, Iran, Israel, Jordan, Nepal, Nigeria, Pakistan, Poland, Romania, Slovakia, South Korea, Sri Lanka, Tanzania and Turkey.

“Engineering is now a global enterprise,” said Dr. Edmund Tsang, CEAS interim dean, and professor of mechanical and aerospace engineering since 2001. “By being exposed to people from different cultures, our graduates are better equipped to collaborate with engineers from around the world, as well as gaining a better understanding of what drives customer demand for products or services.”

Located at the heart of the University’s Parkview Campus, the college is the University’s largest academic facility. Its $100 million high-tech building features 343,000 square feet (about 105,000 square meters) of state-of-the-art classrooms and laboratories.

Efforts to advance the college’s internationalization were focused in 2004 when the International Education Committee was formed, with each of the college’s seven departments represented by one member. Recent activity includes working with faculty to internationalize the curriculum, and aligning degree programs to allow a student to minor in global and international studies or to complete a dual degree coupling engineering and a foreign language.
Foreign language and international experience are very, very important to many employers,” AbuBakr said. “Studying abroad or having an overseas internship can give students an advantage when they are ready to enter the job market. Students also need to learn and understand that there are different specifications and constraints for engineering projects in other countries than they will encounter in the U.S.”

Dewei Qi, professor of chemical and paper engineering, has been leading a short-term study abroad program—Engineering in China—hosted at Sichuan University in Chengdu. The program introduces students to engineering and culture in contemporary China via lectures on a wide variety of engineering topics, tours of paper mills and manufacturing facilities, as well as visits to the Great Wall, Forbidden City, Summer Palace and other iconic landmarks.

Dr. Andrew Kline, CEAS professor and graduate advisor, is currently in the planning stages in collaboration with WMU’s Lee Honors College to take a group of freshman to Paderborn, Germany during a summer term and to take a pre-freshman group to Santo Domingo, Dominican Republic, during a spring break. AbuBakr is working on a green engineering and manufacturing program that will include cultural activities to be held in Valencia and Madrid, Spain.

“I have been an international student all of my life,” said AbuBakr, a native of Jordan. “I earned my undergraduate degree in Moscow, did some graduate study in Germany, and earned my Ph.D. from Michigan State. My experiences studying abroad gave me the idea that I would like all of our students to have a rich international experience. I know how beneficial that can be.”

Specialized engineering centers and laboratories include:
- Applied Aerodynamics Laboratory and advanced design wind tunnel
- Center for the Advancement of Printed Electronics
- Center for Ink and Printability
- Center for Paper Recycling
- Center for Advanced Vehicle Design and Simulation
- Human Performance Institute
- Manufacturing Research Center
- National Transportation Research Center for Livable Communities
- Center for Information Technology and Image Analysis
- Coating Center
- Computer-aided Engineering Center
- Interdisciplinary design studio
- Instructional laboratories in digital logic, microcomputers, circuits, energy conversion, and noise and vibration.

CEAS study abroad opportunities
WMU’s Office of Study Abroad offers many opportunities—long-term and short-term—for students to earn engineering credit in other countries. Since 2006, Dr.

www.wmich.edu/engineer
A team including a professor and doctoral candidates from India, Iran and Kalamazoo have teamed up at Western Michigan University to develop pressure sensing technology for use in American football helmets, by the military, and in other applications, to measure and help assess potentially damaging impacts.

It is no secret that tackle football can be a violent game, often resulting in players suffering major concussions from being pummeled on the gridiron. In its strongest acknowledgement of the potential risks, the National Football League in September 2014 released data from a commissioned report that shows nearly a third of retired players will likely develop long-term cognitive problems at “notably younger ages” than is common in the general population, as was reported by national media.

Using a revolutionary printing technology, the research team has developed a pressure sensor that can be used in a football helmet to record impacts and to send a message to a coach’s cell phone when a player has experienced a potentially dangerous head injury. The team’s members are Binu Baby Narakathu of Kerala, India; Ali Eshkeiti of Tehran, Iran; Michael Joyce of Kalamazoo, Mich.; Sai Avuthu, of Hyderabad, India; and their faculty mentor, Dr. Massood Atashbar, a professor in the College of Engineering and Applied Sciences’ Department of Electrical and Computer Engineering from Isfahann, Iran. They have also launched a startup company to bring their product to market—SafeSense Technologies LLC, which opened in February 2014.

“Our product will be especially helpful in the medical industry caring for patients with concussions caused by football injuries,” said Narakathu, the project leader, who is majoring in electrical and computer engineering. “We can use the same technology for a lot of other things, including touch pads and to detect bed sores and shoe sores. Another major industry we want to target in the future is the military to monitor explosive waves. A sensor can be integrated into a soldier’s uniform.”

Collegiate football offered a good example of when this type of sensor could come in handy in fall 2014 during a University of Michigan game. Michigan quarterback Shane Morris was visibly woozy and could not maintain balance after a hard tackle. He was removed from the game for a short time, was evaluated by medical personnel at the stadium, and was allowed to return the field, even though Morris had suffered a concussion. In news reports following the incident. Dave Brandon, former U of M athletic director, blamed the decision to put Morris back into the game on a lack of communication that caused confusion on the sideline.

“Cases like this are an example of what originally captured this research group’s interest,” said Atashbar, who is also the director of WMU’s Center for Advanced Smart Sensors and Structures. “The sensor the group has developed eliminates any inaccuracies or errors in communicating about injuries experienced on the field to coaches, who historically have had to rely on players to report their own injuries.”

The technology used to develop this “shock” sensor is new and offered a unique project for collaboration between the CEAS Chemical and Paper Engineering Department and the Electrical and Computer Engineering Department.
Using printed electronics technology, the sensor is embedded into a football helmet and works by collecting data and relaying that information via Bluetooth to a smartphone so that a coach can review the severity of the impact. A cloud server can also be used to save the data for future use.

Although the sensor was originally intended to be used in athletics, it also has many applications within the medical and military fields, such as registering the severity of a nearby explosion or in treatment and monitoring of hospital patients. “The material we are printing on is highly biocompatible and it is used in a lot of medical applications,” said Joyce, a doctoral student majoring in paper and printing science. “This type of sensor material is very new and has many natural characteristics that make it compatible with printing inks. This research is helping to advance the knowledge of the characterizations of the materials and interactions. Other colleges cannot offer that to their students all on one campus.”

In the near future, the research team is planning to conduct field testing of the sensors with a football team in preparation to put the sensors on the open market. The sensors will be available as an add-on to existing helmets, offering a cost-effective way for coaches to ensure the safety of their players.

Some of the obstacles the team faces in its final round of development are making the sensors flexible and durable enough to withstand extreme forces and finding the best materials to advance the printing technology.

“These students have created a product that will affect society for years to come,” Atashbar said. “They hope their work will inspire other engineering students to expand their education outside of the classroom.”

To move their project forward and prepare their product for commercial sale, Narakathu, Avuthu, Eshkeiti, Joyce, and Atashbar participated in a startup workshop on campus in June 2013 that attracted industry and business professionals interested in assisting the students in developing a business plan, and a business. Through a series of networking and brainstorming sessions, the team learned the necessary steps to launch their company through which they can further develop and sell their product—SafeSense Technologies LLC. They plan to complete product development and testing by mid-2015 and hope to see the sensor on the market—in a helmet or on the battlefield—within one year.

“WMU is also the only school in the country that offers a doctoral degree in paper and printing, which provided an uncommon opportunity to research the printing technology that we have used.”

Michael Joyce
A research assistantship segued into a lead position in the University’s Green Manufacturing Industrial Consortium for Marylin Glass-Hedges, a doctoral candidate in industrial engineering from the D.R.

Glass-Hedges is one of nearly 400 D.R. students who have enrolled at WMU since 2008 through a partnership the University forged with the D.R. Ministry of Higher Education. The WMU-D.R. agreement is based on an ongoing initiative called the Dominican Scholars Program, which was launched in 1996 by D.R. President Leonel Fernandez Reyna.

The consortium is comprised of companies engaged with the University in a non-competitive/pre-competitive environment on green manufacturing projects and programs. Four companies are currently participating: Fabri-Kal, Landscape Forms, Poly-Wood, and Steelcase. The efforts that the companies undertake to achieve “lean” manufacturing range from focused projects, such as material selection in product design and green manufacturing processes, to general activities, such as energy conservation and waste reduction/elimination.

“Marylin is the lead student for the GMIC,” said Dr. John Patten, chair of manufacturing engineering and director of the WMU Center for Manufacturing Research. “Her self-initiative and leadership skills are outstanding. She is very committed and regularly takes on additional work to make the GMIC better.”

Patten founded the manufacturing center with a grant worth close to $1 million from the United States Department of Energy. A primary mission of the center was to form a consortium and begin work on developing green manufacturing initiatives.

The GMIC was officially launched in January 2010; since then, nearly 100 companies, 17 faculty, and about 50 graduate and undergraduate students have participated in the consortium’s research and educational programs. Business members of the GMIC provide sustaining support through a $25,000 annual dues payment.

Glass-Hedges and WMU’s Green Manufacturing Team are currently working on 10 projects and have an additional handful of projects waiting to be launched. The team changes a bit each year and usually includes 10 to 15 undergraduate and graduate students majoring in various engineering areas.

“The first thing we do is sit down with the company and come up with a list of objectives,” Glass-Hedges said. “Then, we visit the manufacturing facility to make observations and to consider solutions. We come up with a game plan to tackle the project and a timeline, because that varies greatly based on what we are trying to do. I manage or provide consultation for all projects.”

A native of Santo Domingo, Glass-Hedges began working on a master’s degree at WMU in September 2008 and entered the Ph.D. program in September 2010. She gained a reputation as a hard-working, innovative student, which led to an offer in January 2012 to become a research assistant and work with Dr. David Meade, professor of manufacturing engineering and GMIC associate director.

“Marylin has been an essential member of the GMIC since she joined the team,” Meade said. “Our success is a direct reflection of her leadership and technical abilities. She is a driven individual who has the ability to break down a project into its components and efficiently manage the process to a successful completion. Marylin has been the primary architect behind our Zero Waste to Landfill process that we have used at numerous sponsor sites to substantially reduce operational costs by identifying opportunities for solid waste reduction through elimination or recycling. And, she has developed a great rapport with our member companies and industry sponsors, who appreciate her ‘get it done’ attitude.”

Glass-Hedges expected to conduct research during her graduate studies at WMU, but she said the depth and breadth of the knowledge and experience she is gaining on the GMIC team is much greater than she had anticipated.

“I had no idea that I would finish my master’s degree and go on for a Ph.D.,” she said. “I am accountable for everything in the GMIC, which has allowed me to work with several companies, attend conferences, and grow my network. I thank my country for the support and Dr. Meade for giving me the chance.”
By Linda Hanes

Holder of three degrees from Western Michigan University—bachelor’s, master’s, and doctorate—alumnus Sudesh Woodiga has achieved much success as an aerodynamics engineer at the Ford Motor Company in Dearborn, Mich.

Woodiga enrolled at WMU in fall 2002 after completing the first two years toward a WMU bachelor’s degree in Malaysia through the University’s twinning program at Sunway University. Founded in 1987, the 2 + 2 program between the two schools helped Malaysia emerge as a Southeast Asia regional center for education.

He stayed in Kalamazoo to earn his graduate degrees and was quickly hired by the Ford Motor Company after completing his Ph.D. in 2013. His current role is twofold: development of tools and methods to support the company’s aerodynamics team; and, the aerodynamics development of vehicle programs.

The main focus of aerodynamics development is delivering improved fuel economy and reduced greenhouse gas emissions, which is achieved by optimizing the exterior shape of a vehicle to reduce aerodynamic drag. Two major vehicle programs Woodiga has supported at Ford to this end are the 2015 F-150 truck and the Mustang car.

Woodiga’s doctoral research was in the area of fluid mechanics and aerodynamics measurements. With his faculty mentor, Dr. Tianshu Liu, a WMU professor of Mechanical and Aerospace Engineering from China, they developed an industry first: the Global Luminescent Oil Film Skin Friction Tool. The tool has received recognition from academic institutions and government agencies both within the United States and internationally for its contributions to the fluid mechanics and aerodynamics community.

Skin friction is a metric in fluid mechanics and aerodynamics that describes the interaction between a fluid and the medium with which it interacts. The characterization of this interaction—skin friction measurements—enables the fundamental understanding of flow in the respective systems, which in turn can be used as a design aid in flow control applications to improve the efficiency of these systems.

While at WMU, Woodiga led the Applied Aerodynamics laboratory from an operational perspective, supporting both research and academic instruction activities. Woodiga attributes that experience as a factor in securing a position within the aerodynamics group at Ford, which he said is engineering for a better, greener tomorrow, with more choices to drive energy efficient, environmentally friendly vehicles.

“I was originally interested in the aspect of engineering that focused on automotive design and aerodynamics,” said Woodiga, a native of Subang Jaya, Malaysia. “I felt that working at Ford Motor Company would be an interesting challenge, especially since energy management and fuel economy are important characteristics of a vehicle, aerodynamics being a critical subset of that. It has been rewarding to apply the knowledge and experience that I gained at WMU to tackle the issues that we are faced with in our world today, specifically improved energy consumption efficiency.”

The Ford Motor Company is multinational and the bedrock of Michigan’s economy. Since its founding in 1903, Ford has been on the cutting edge of engineering and manufacturing within the automobile industry, and its engineers must meet high benchmarks for strategic innovation. Woodiga said his deep interest in developing new and innovative forms of testing in research set him apart during the application process.

“During the course of my doctoral research, I learned how to adapt, use what resources I had available, and to work around roadblocks to achieve my final goal,” he said. “I was able to do a lot of hands on work at WMU that definitely helped me going into the industry because many of the things I learned were directly applicable skills and expertise highly acknowledged and appreciated by the management of my department within Ford Motor Company.”

Photo Courtesy of www.ford.com/cars/mustang/
For a researcher at a globally engaged university, international collaboration comes naturally. When Dr. Steve Durbin, professor and chair of the Department of Electrical and Computer Engineering, recently received a grant from the National Science Foundation to explore the synthesis and characterization of a new semiconductor (ZnSnN2) comprised solely of earth-abundant elements, he and his students embarked on this project with partners in the United Kingdom, Finland, and New Zealand, as well as Colorado, Michigan and Florida.

The material is formed using a sophisticated ultra-high vacuum technique known as molecular beam epitaxy (or “MBE”). MBE uses thermal evaporation to create what are called “thin films” – single crystals whose thickness may range from a few atoms to about 1/100th of the diameter of a human hair.

Durbin came to WMU in July 2013 with “several decades” of experience as an engineering professor and researcher. He initially planned to become a computer sciences engineer, but while working his way through school doing odd jobs he ended up working in an electrical engineering lab. His main responsibility was moving liquid nitrogen between two buildings for an MBE lab. “The MBE I brought to WMU turned out to be in that research lab,” Durbin said. He switched majors and became an undergraduate research assistance to the professor who was using the machine at that time.

Many compounds currently used for devices such as LEDs, solid state lighting elements, and lasers are based on indium and/or gallium, both of which are expensive, and whose long-term supply is a concern. Durbin is experimenting with ZnSnN2 as a potential alternative. Zinc (Zn) and tin (Sn) are much cheaper than either gallium or indium, are abundant in the earth’s crust, and approximately one-third of domestic consumption in the United States comes from reclamation sources, which is not the case with indium and gallium.

The MBE takes a week to achieve the appropriate level of vacuum to grow crystals. Durbin said the process starts with a substrate on which he attempts to grow a single crystal wafer in the pursuit of achieving a perfectly ordered lattice. “No one has achieved that yet,” he said. “Electrons don’t travel far in devices, so you don’t need a big crystal. We can grow layers that are just one atom thick, slowly, in a high purity environment.”

Graphic rendering of expected crystal structure of ZnSnN2. The small atoms are nitrogen. The atoms depicted with stripes are either tin or zinc, in equal numbers. The key issue is whether the zinc and tin atoms are randomly distributed on their lattice sites, or show a periodic arrangement among themselves.
Earlier in his research, Durbin was surprised to discover that growing perfect crystalline structures might not be necessary.

“It turns out that the “band gap energy” – the most critical parameter which characterizes any semiconductor – might be tunable in this material, not by adding other elements as done presently, but instead by “scrambling” the order of zinc and tin atoms in the crystal lattice in a controlled way,” Durbin said. “A perfect match for the sun which reaches earth’s surface is a band gap energy of 1.5 eV. “Randomized” ZnSnN2 has a predicted band gap energy of about 1 eV, whereas “perfectly ordered” ZnSnN2 should have a value of 2 eV. Half-way between, then, would be ideal for a solar cell. This is the main focus of our research at the moment.”

Collaborators on the project include researchers at Florida A&M University, the University of Liverpool (UK), the University of Michigan, University College London (UK), the National Renewable Energy Laboratory, and the University of Canterbury.

“The nature of our work leads to collaboration,” he said. “I am preparing materials other researchers are interested in looking at and measuring in other ways. It’s difficult to afford to have all pertinent research equipment and techniques in one institution. My collaborators are people looking at similar kinds of problems with different instruments.”

Dr. Steve Durbin and research assistants Nathaniel Feldburg (far left) and Brian Durant prepare to grow crystals in the molecular beam epitaxy machine.
A wide range of road safety and driver assistive applications—Intelligent Transport Systems—could result from a collaborative research project that Dr. Ala Al-Fuqaha, WMU professor of computer science, is working on with Dr. Elyes Hamida at the Qatar Mobility Innovation Center and Dr. Bharat Bhargava at Purdue University.

Funded through a $900,000 research grant from the Qatar Foundation—a private, non-profit education and research organization that leads the human, social, and economic development of Qatar—the team plans to design, deploy, and evaluate a framework for adaptation of security and performance features within a standard compliant ITS platform. Additionally, a set of active road safety applications will be demonstrated in Doha, Qatar through small-scale deployments.

Official launch of the project is planned for spring 2015. Al-Fuqaha and his WMU team will focus on developing new mathematical formulations and Trusted Platform Module-based software solutions to optimize the delivery time of sensitive data to vehicles.

Al-Fuqaha said there is a good possibility that by the year 2020 the United States government will mandate that cars and trucks include a wireless modem to connect to vehicular networks that could help alert drivers to potential crashes and other hazards and to communicate with “smart” roads. The research collaborators are developing software to provide the communication protocols.

“Deploying this technology means vehicles will be sharing data—the equipment that is currently available holds data, but does not share it,” he said. “Of course, that brings up security issues. We need to put security measures in place so hackers don’t have easy access to control vehicles. More security measures means it will take more time for the on-board computers to disseminate information. We need to find an intelligent balance between safety, security, and performance.”

Over the next three years, the research team plans to meet once each year in Qatar to compile, review and analyze road test data and at a conference in the United States to share results. Graduate and undergraduate students are also expected to participate.

“In the U.S., we are developing things more on the software side,” Al-Fuqaha said. “The software will be installed in Doha and will enable vehicles to autonomously communicate with other nearby vehicles or road infrastructures. It is still a futuristic technology.”

The project was spurred by Dr. Lotfi Ben Othmane, who earned his Ph.D. at WMU with Professor Leszek Lilien in computer science. Othmane worked with Bhargava (who served on Ben Othmane’s WMU dissertation committee) on several security and privacy issues, to develop the ideas for the project.

Before joining WMU and the CEAS faculty in 2004, Al-Fuqaha was active in research and development with Lambda Optical Systems and Sprint Telecommunications, where he contributed to the design and development of lambda’s optical routing protocol. He also played a key role in the design and development of Lambda’s Intelligent Network Management System for Dense Wavelength Division Multiplexing optical networks.

**Expanding communication frequency spectrum**

When Hurricane Katrina hit New Orleans in 2005, the emergency phone networks quickly experienced overload, while other parts of the communication frequency were wide open.

Tapping into those open frequencies could have expedited emergency calls and helped save lives, says Al-Fuqaha, WMU professor of computer science, who is also collaborating with Dr. B. Khan at City University of New York, as well as the University of Nebraska-Lincoln, to discover a solution.

“We hope to develop wireless devices able to intelligently hop from one frequency to another and not be stuck on a given channel,” said Al-Fuqaha. “Had this technology been available when Katrina hit, cognitive radio could have allowed for dynamic switching so these users would have been routed to the available part of the frequency spectrum; this could have saved lives.”

The project will be launched in spring 2015 and will include looking at animal behavior to guide the researchers in devising new technologies and algorithms to achieve dynamic spectrum access. “Animals forage and then consume,” Al-Fuqaha said. “We would like to be able to monitor channels of the frequency spectrum—forage—and then switch to open channels—consume.”

Al-Fuqaha is in charge of working on software and test-bed development to produce experimental results for the National Science Foundation-funded collaborative effort. Khan, at City University of New York, is working on simulation, creating the experimental study, and answering two key questions: What does it mean for cognitive radio networks?; and, What is the efficacy? University of Nebraska-Lincoln contributes data collected from field studies of animal behavior.

Graduate students are also expected to participate, and Al-Fuqaha welcomes undergraduates to approach him about research opportunities. “I am passionate about involving students in my research,” he said. “Conducting practical experiments is one of the most important and effective tools for students to learn.”

Learn more about Dr. Ala Al-Fuqaha on this [webpage](https://example.com).
Serial entrepreneur and angel investor are two labels that describe the significant contributions WMU alumnus Rajesh Voddiraju, a native of Hyderabad, India, has made to the computer science industry since completing his master’s degree at Western Michigan University in 1993. He was honored in October 2014 by WMU’s Department of Computer Science when he was selected as the recipient of the department’s annual Computer Science Alumni Excellence Award.

Voddiraju is the founder and CEO of HealthiPASS Inc, a healthcare patient-payment service provider in what is now a $5 billion per year industry. Another of his recent ventures is CVM Solutions, a software system that helps companies streamline supplier management processes. “CVM grew from a bootstrapped idea to being named as ‘Inc. Magazine’s’ 500/5000 fastest growing private companies in the United States,” Voddiraju said. “CVM has served over 300 Fortune 1000 firms nationally using its Software-as-a-Service and Supplier Intelligence data. It was acquired by a $2 billion firm in late 2011.” HealthiPASS and CVM Solutions are both located in the Chicago metropolitan area.

One of Voddiraju’s nominators for the distinguished alumni award was Dr. Ajay Gupta, a professor of computer science and CEAS graduate program director, who grew up in Jaipur, India. Gupta has always believed it inevitable that Voddiraju would be very successful. “Rajesh’s achievements have been one of our great success stories,” Gupta said. “He excelled at a very fast pace and climbed the ladder of the corporate and entrepreneurship world quickly. If I recall his student days, he stood out as one of the top. He showed out-of-the-box thinking on various ideas, class-work and research problems we discussed. In fact, during our discussion of the research problems, it was quite apparent that he was seeing them from a commercialization perspective instead of just the pure academic interest of the problems. His story should be a great inspiration to our current and future students.”

Voddiraju followed his best friend from India to Western in the early 1990s to earn a master’s degree, intent on pursuing every opportunity to maximize his time at WMU. He was taken under the wing of Dr. Donna Kaminski, professor of computer science, and Gupta. He said he was given many great opportunities, including working in a variety of labs, serving as a teaching assistant, and an internship with the Upjohn Company—now known as Pfizer, Inc.—focused on the manufacturing of pharmaceuticals. These experiences as a WMU student set the precedent for Rajesh’s future accomplishments.

For the last 22 years, Voddiraju has evolved from a hands-on techie, to executive management roles in management/IT consulting, and then on to his recent entrepreneurial successes. In addition to his work at HealthiPASS Inc., he is well known as a technology entrepreneur and as an angel investor in health care and technology ventures. He followed a passion for improving the health care industry when he founded HealthiPASS, Inc. “Healthcare is a large portion of the United States gross domestic product and it is an industry that is going through a major transformation,” he said “It was a couple of personal experiences that helped me decide to start HealthiPASS because I am passionate about simplifying the commerce between patients and their healthcare providers.”

As an angel investor, Voddiraju has invested in a new group of immediate care centers in the Chicago area and nearly a dozen technology startups. He has mentored many young entrepreneurs through his involvement with The Founders’ Institute, AngelPool, Cornerstone Angels, and other groups.

Voddiraju earned his master’s in computer science from WMU in 1993. He graduated at the top of his class with a bachelor’s degree in engineering from Nagpur University, Nagpur, India, and attended management programs at the University of California at Los Angeles and Tuck School of Business in Hanover, New Hampshire.

It is important to Voddiraju that other immigrants be able to experience the same opportunities for success he has enjoyed in the U.S. His advice for international students is simple. “Always be curious; always be hungry,” he said. “Colleges like Western provide a fantastic atmosphere for you to explore things. The current CEO of Microsoft was also an immigrant. The United States is a phenomenal environment for opportunity, there is no limit to what you can accomplish.”
Dr. Deepak Ravindra became a business owner at the same time he completed his Western Michigan University doctoral degree through a unique collaboration with a faculty researcher focused on developing methods to cut extremely hard and brittle materials. Ravindra worked with Dr. John Patten, former chair of WMU’s manufacturing engineering department, to launch Micro-Laser Assisted Machining Technologies LLC in July 2012. The new technology they have developed utilizes a diamond cutting tool capable of focusing gigawatts of laser power onto a concentrated surface to soften the material so a diamond can easily cut it. “People cut with diamonds, people cut with lasers—we merged the two into a hybrid device,” Patten said.

The researchers said the technology could replace the current method for making advanced engineered ceramics and semiconductors smooth—a lengthy and expensive polishing process.

“In the machining industry, materials are getting better, but the manufacturing of them is getting trickier,” said Ravindra, a native of Klang, Malaysia, who earned his bachelor’s, master’s and doctoral degrees at WMU. “When I entered the Ph.D. program, I was looking for a dissertation project in which I solved either a societal or industrial problem. Three to four companies that we were already working with had a grant for this kind of research, so we collaborated. John submitted an NSF proposal and was awarded close to $1 million, so I decided to do my Ph.D. along those lines.”

As part of the process to launch a business, in March 2012 Patten and Ravindra were selected to attend an Innovation Corps boot camp hosted by Stanford University and the National Science Foundation with their product, where they were required to interview a minimum of 100 potential customers. Acceptance into I-Corps came with a $50,000 grant and the NSF provided another $850,000 to get the company off the ground, which has already received state-level recognition as a semifinalist in the Accelerate Michigan business plan competition. The company now has a lab in WMU’s College of Engineering and Applied Sciences and a manufacturing facility at Battle Creek Unlimited, an economic development and business assistance resource in Battle Creek, Michigan.

Within two years of completing his Ph.D., Ravindra had engaged with about 160 prospective companies to identify 25 as strategic partners—a group that has a cumulative value of about $100 billion. “We have grown from a one-person company to a staff of nine, which includes WMU graduate and undergraduate students,” he said. “I am very proud of WMU, and almost everyone working with me has a WMU connection. It is a great sense of accomplishment to see things happen and to make an impact in such a short period of time.”

As a young man new to WMU’s campus, Ravindra said his goals were very lofty and he aspired to “solve every problem on the face of the earth.” He soon figured out how little he knew about the engineering world he intended to enter, but said he found plenty of chances to learn what he needed to become a successful researcher and business owner.

“In WMU’s engineering college, even as undergraduates, we were taught to engage very closely with industry,” Ravindra said. “Many students at other universities don’t get to do that, which can cause a huge disconnect between the academic and real worlds. Students need that engagement to become marketable. They need to have meaningful senior research projects and to go through the entire process to see how things work in a commercial setting. It is important to me that my company inspires a spirit of entrepreneurship in our employees.”
Incorporating a new style of roundabout—the turbo roundabout—into United States’ highway systems is the focus of research being conducted at Western Michigan University by Elisha Wankogere, a master’s candidate from Tanzania and recipient of the 2013 Dwight Eisenhower Graduate Fellowship award from the U.S. Department of Transportation’s Federal Highway Administration.

Wankogere entered a degree program at WMU before he received the fellowship in fall 2012 to work on his dream of becoming a civil engineer. He was attracted to WMU and the College of Engineering and Applied Sciences because he had been advised it offered a strong program in that discipline with a wide range of research opportunities. “I received a scholarship when I applied to Western, and although I had other options for my education I wanted to experience something different; that is why I decided to come to a school in Michigan,” Wankogere said.

One of his WMU professors, Dr. Valerian Kwigizile, assistant professor of civil and construction engineering and associate director of the Transportation Research Center for Livable Communities where Wankogere worked as a research assistant, suggested that he apply for a scholarship offered by the Dwight Eisenhower Graduate Fellowship program. Wankogere said he is very grateful for that advice because winning the award—beyond the monetary gain of $5,000—provided many opportunities to make connections with other students and engineers; the award could be used for travel, educational fees, or anything related to his research project. He wisely invested his funding to attend the Transportation Research Board annual meeting for students, which is held every January in Washington D.C. “The conference hugely increased my passion to study and conduct research on transportation,” said Wankogere, a native of Dar es Salaam, the largest city in Tanzania.

To answer some of his and other people’s important questions about the utilization and benefits of multilane roundabouts, especially the turbo roundabout, Wankogere prepared to conduct virtual driving tests of the new roundabouts that have been popping up in Europe, which he anticipates will soon make their way to the U.S. Turbo roundabouts work by forcefully spiraling traffic in a way that requires the driver to choose their direction before entering the roundabout. The rotor turbo is similar but allows for more turning options. Turbo roundabouts have raised dividers so cars do not deviate from their individual lane. Using the 3D modeling software, Creator Pro, he designed an animated driving simulator in which a participant drives through the different types of roundabouts—the regular and the turbo roundabout—while their actions are recorded by various sensors. The sensors make note of when the driver hits a divider or another car, speeds, or makes an illegal turn into another lane. The driving is done on a model car simulator made by RealTime Technologies, Inc. This “car” comes with a seat, wheel, pedals, and three screens in front of the driver to provide a more natural driving experience.

It took Wankogere five months to design the intricate road course, which required several individual virtual roadway tiles to be placed in specific and precise ways. It was important to Wankogere that the simulator experience be as authentic as possible so that his findings would be accurate. He believes the results of this research could change U.S. driving habits and potentially reduce the number of accidents occurring every year at roundabouts.

Testing officially ended on Oct. 25, 2014 after about 10 months of hard work, and the results indicate that lane keeping and speeding are still a problem in multi-lane roundabouts. The rotor turbo roundabout performs better in correctness of lane choice and navigation speed control. Yielding was not a significant problem in either kind of roundabout. Furthermore, it was found that roundabout signs and pavement markings used in the U.S. can be adapted for turbo roundabouts once the roundabouts are adopted.

Wankogere graduated from WMU in December 2014 and plans to travel for a while before he returns to school, or to Tanzania to help his country develop modern transportation systems. “After completing my undergraduate degree, I still had questions,” he said. “If I still have questions after I get my master’s degree, which is probably going to be the case, we will see if I go on to receive a doctorate sometime in the near future. Long term, I want to earn a living for myself and my family, and I would really like to make an impact on my country’s development as a civil engineer.”
Raspberry Pi focus of undergraduate research project

By Linda Hanes

Erivelton Gualter Dos Santos is an undergraduate exchange student studying at Western Michigan University for the 2014-15 academic year. At his home university in Brazil, Centro Universitário da FEI, he is majoring in automation and control engineering. At WMU, he has been working on creating a gaming platform and controller for the Raspberry Pi, a small computer.

**Anticipated graduation date:** December 2016
**Hometown:** Sao Paulo, Brazil

**Why did you choose WMU?**

When I entered college in Brazil, I heard a lot about the importance of study abroad and how it can help you become a better professional. Besides having the experience of studying in the United States, I knew that I wanted to go to a cold place; through some research I found WMU. At first glance, I could see how pretty the campus was and I knew about the convenient services available for students. But, I especially loved WMU when I saw the engineering campus and the projects that students were developing and working on.

**How long have you been at WMU?**

Since fall 2013. I took English classes for the first two semesters and started degree courses in engineering in summer 2014.

**What is a Raspberry Pi, and what inspired you to develop a game platform and controller for the Pi?**

Raspberry Pi is a small computer. It is the size of a credit-card and can do any activity that any other computer can do. For example, you can access the internet, play videos and songs, and do word processing. It also offers access to other digital I/O ports. Therefore, it can be used to create any project.

The main advantage of using a Raspberry Pi is that it is easy to use. It has a Linux operating system and can be programmed using two easy languages: Python or Scratch. If you know a basic language program it is possible to create any project, such as an air hockey table that I developed. It is similar to a normal air hockey table; however, I added automatic control scoring using the Raspberry Pi. That made it possible to offer two games with different end points: The first game has a determined finish time; the second game is limited to a certain number of goals. Utilizing the Raspberry Pi in the project made it possible to control all variables of the game, such as detection of a goal, counting the number goals and determining a winner.

**What are some challenges you encountered working on this project?**

The Raspberry Pi is a new computer and was developed to help students learn programming language on real projects at a low cost. I worked in Brazil on some programming projects, which helped me a lot in developing the software for the Raspberry Pi. I faced some challenges with the manufacturing of the electronic board. With the help of Dr. Steve Durbin and Mr. David Florida, I could finish the electronic assembly and upgrade the air hockey table with a screen and other tools to control the game.
What has been most beneficial?
The best part is that I learned how to try to find a solution for a problem before I ask for help. It made me more comfortable searching for information on a variety of subjects. Even though I am only working on a small project as an undergraduate student, I now feel that I could be a researcher and work on bigger projects.

Describe the new project that you are working on with Dr. Sawalha
I have been working with Dr. Sawalha on a project for the Ford Motor Company. The theme of the research is, “Towards Effective Multicore Processing in Automotive Powertrain Control Systems.” The research is really interesting, complex, and I am learning a lot of things that I did not learn in the classroom.

Did you also conduct research as an undergraduate in Brazil?
In Brazil, I used to work in a research group looking at robotic soccer. The main goal of this project was to develop robots to play soccer in a competition that happens every year between many countries. I used to work in the software development department, which improved my programming skills. That project gave me a lot of experience to build upon when working with the Raspberry Pi.

What are some of your long-term and short-term professional goals?
My short-term goal is to finish my undergraduate program and do an internship. When I go back to Brazil, I still want to join in some research groups to practice and learn more. Also, I want to begin a master’s degree program soon after my undergraduate degree is finished and I hope to do that at WMU.

How has WMU been beneficial to you in your research? What resources on campus have you used in your research?
I had 24-hour access to the laboratory I worked in, which made it easy for me to work anytime—day or night. The tools and materials supplied by the University are of the best quality and easy to obtain. The support of my advisors, Dr. Durbin and Mr. David Florida, was extremely important for the conclusion of this project. Dr. Durbin did not give the solution for the problems that I faced, but he gave me the path to find it out. In addition, Mr. David Florida helped with the necessary material and tools to develop the project.

What advice would you give to other students who want to start their own projects?
Never give up if you face a problem. It is natural to find it difficult to realize something because we as people do not know everything; even the instructors don’t always have the right answers. If you cannot find some solution, the best attitude is to try another way to fix your issue. For students interested in programming for a game platform and controller there is the Raspberry Pi Clun, which introduces the language programing, and the Raspberry Pi board.
A good deal of learning that takes place in WMU’s Engineering in China study abroad program comes from the exchanges that occur between students enrolled in the program and the WMU students from China, who serve as program assistants.

“Three WMU Chinese students—Zhengfan Yan, Yifu Rong and Qian Zhang—traveled with us, and that made things easier,” said Michael Moore, a senior from Farmington Hills, Mich., majoring in aviation flight science. “We could ask them what particular Chinese characters mean and then we would look for them on signs. They also assisted us with shopping and helped us haggle for lower prices. Four phrases I learned and still know are all thanks to them: Hello, how are you?; Thank you; You’re welcome; and ‘No, I don’t want ...’ for street vendors. I gained a tremendous amount of respect for the Chinese students because of how well they understood and spoke English.”

The two-week program that provides three credit hours of academic credit for successful completion was first offered by WMU’s engineering college in 2006. Participants live and study for most of the program at Sichuan University in Chengdu and visit major historical and industrial sites there and in Beijing and Shanghai. They also meet experienced Chinese engineers and faculty, who give lectures on special topics related to chemical, mechanical, electrical, computer and biological engineering. Dr. Dewei Qi, a professor in WMU’s Department of Chemical and Paper Engineering, serves as faculty director.

The program is designed to help students explore global engineering opportunities and to strengthen their working skills across engineering disciplines. It is a unique opportunity for engineering students to gain experience in their field in contemporary China, but it is also attractive to non-engineering students who can take it for general education credit. All students benefit from the comparative aspect of the curriculum in which Chinese engineering practices and methodologies are compared to those in the United States, as well as having the opportunity to participate in several cultural learning opportunities.

“The program is not just geared toward one aspect of the engineering world,” Moore said. “We got a little taste from the variety of businesses and schools we visited to see what they were doing. We had a few WMU paper engineering students with us on the trip and they were all excited about a visit we made to a paper mill. It was cool to see their take on what they were observing and how the Chinese ran the mill.”

Field trips for the 2014 group of five graduate and eight undergraduate students included visits to a large paper mill in Shanghai (Stora Enso Metso), a mechanics institute, a 2,000-year-old irrigation system, a pharmaceutical company, and the Department of Chemical Engineering at Sichuan University. In addition to academic topics, the students learned about Chinese culture through tours of the Great Wall, Forbidden City, Tiananmen Square as well as demonstrations featuring Chinese folk music, dancing and aerobatics.

Lauren Rockafellow, a senior majoring in chemical engineering from Traverse City, Mich., took the course for general education credit and graduated in December 2014. She bolstered her studies at WMU with an internship at Georgia Pacific, an American pulp and paper company, which led to an offer for a full-time paper engineering position that she accepted.
“I spoke about my study abroad experience in the interview and I think that helped me stand out in the pool of applicants,” Rockafellow said. “Alumni of the China engineering program had told me about it, and I realized going to China would be more fulfilling than taking a general education course on campus. It was very helpful because we were able to compare how we do things in the U.S. with engineering students and faculty in China. Paper processes are a lot different in China than in the U.S.—there are less safety restrictions, for one thing.”

Rockafellow admits that she had many preconceptions about China before traveling there that she discovered were completely off base. “I thought I would see old school China,” she said. “Shame on me for not realizing how well the country has grown and industrialized: I found there were many things that were done a lot like we do them in America and many of the road systems work like ours do. Chinese food is a lot better there than it is in the U.S. and everyone was really friendly—I have pictures of me that were taken with random strangers.”

It was the first trip outside North America for Moore, who plans to graduate in December 2015. “I was a little intimidated about traveling to China, but my grandparents and dad have been there and encouraged me to go,” he said. “It was great meeting people who were our age and getting to know them—people I still keep in touch with.”

Rockafellow said living on campus at Sichuan University provided opportunities for random interactions with Chinese students that were very enjoyable. “One day we were walking on campus and ran into three Chinese students,” she said. “They noticed we were Americans and asked if we spoke English—they were studying English and wanted to practice with us. While speaking with us, they even practiced using slang; they were afraid they weren’t competent, but they were!”

The 2014 Engineering in China group included eight additional WMU students: David Ajoku, Kendra Fein, Alexander Ferguson, Prashant Kotkar, Gina Noble, Gary Nola, Nolan Speer, and David Thomas. Funding that made it possible for three of the students to enroll in the program was generously provided by the WMU Paper Technology Foundation, Inc.
Glody Shaka Onya is a first-year student in WMU’s Center for English Language and English for International Students. He is from Democratic Republic of the Congo and he is planning on majoring in civil engineering.

How did you hear about WMU?
I found out about WMU through my cousin, Rachal Etshim, who helped me get admitted. He is studying at Western to obtain a graduate degree in education leadership.

Why did you decide to study in America/Western Michigan University?
America has the best programs in civil engineering and it is one of the best places in the world to study. I am hoping that when I finish my studies here I will be able to help my home country.

What are some exciting things that you have done since coming to WMU?
I went on the CELCIS field trip to Lake Michigan at the beginning of the year. It was actually my first time ever riding on a boat.

What are your long-term/short-term goals?
I want to stay in school and graduate with distinction. I also want to be able to speak English and understand spoken English. I can stay and work in America after I graduate, if I get a job.

When will you be graduating?
I am expecting to get my bachelor’s degree in 2018 and to finish a master’s degree in 2020.

What has been challenging about being an international student?
Listening and understanding to American people has been most challenging. In my CELCIS classroom, the teacher speaks slowly and it is easier for me to understand what is being said. But outside when American people speak, it is more difficult. So it takes many tries for me to perfect my English. But, I am more comfortable with speaking the English language now that I’ve been here for a couple of months.

What are some differences between school in the United States and school in the Congo?
America is a developed country; the Congo is undeveloped. In America, we can study in a good environment. When you have a diploma from America, wherever you are, you can know that you will be accepted in the world.

What attracted you to the engineering program?
The technology of engineering interested me. There is so much versatility: I can begin with civil engineering or I can begin with technology. But, I do know that someday I want to be a civil engineer.

What advice do you have for other students thinking about going abroad?
They can come here to study because Kalamazoo is a great city for students. Plus WMU is among one of the best universities in America.
Support WMU’s global engagement efforts through a donation to the Haenicke Institute for Global Education:
www.mywmu.com/haenickeinstitute

We welcome your inquiries!

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