

Lawrence
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INNOVATION

SPRING 2015

Johnson Controls
Vehicle Engineering
Systems Laboratory



Corporate partnerships Research and education benefit from industry interaction

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On the cover: Assistant Professor Selin Arslan of LTU's A. Leon Linton Department of Mechanical Engineering talks to students John Marnon and Shashank Rai about an upcoming test in the recently updated Johnson Controls Vehicle Engineering Systems Laboratory. LTU students learn automotive engineering as they work on research projects for industry partners.
(Cover photo by Glenn Triest)

From the Dean

This is a very exciting time for the College of Engineering at Lawrence Technological University. In recent years we have seen a dramatic surge in enrollment, especially at the graduate level.

In anticipation of continued growth, we have broken ground for the Taubman Complex, a new academic building that will open in fall 2016 with advanced facilities for robotics engineering, biomedical engineering, life sciences, and several related programs. It will also be the home of the Marburger STEM Center (see page 27).

Four years ago we launched the first bachelor's degree program in robotics engineering in Michigan – and one of the first in the nation – and in May we will award the first degrees in this program, which continues to expand to meet the needs of a thriving sector (see page 21). Our biomedical engineering bachelor's degree program is also maturing and expanding under a new director (see page 15).

We have opened several labs in the past year and have completed major upgrades on the chassis dynamometer in our Johnson Controls Vehicle Engineering Systems Laboratory (see page 2), a great example of the strong support that LTU receives from industry.


Lawrence Tech continues to benefit from a wonderful long-term relationship with the Kern Family Foundation and the Kern Entrepreneurial Engineering Network. That relationship moved to a new phase in 2014 with a three-year \$697,000 grant (see page 16). We continue to build out the curriculum to bring the entrepreneurial mindset to all engineering students in all four undergraduate years.

Civil engineering continues to be a major strength at Lawrence Tech, whether it is research done in the Center for Innovative Materials Research (see back cover) or the community outreach provided by LTU's Great Lakes Stormwater Management Institute to promote low-impact development and preserve water resources in the Great Lakes region (see page 12).

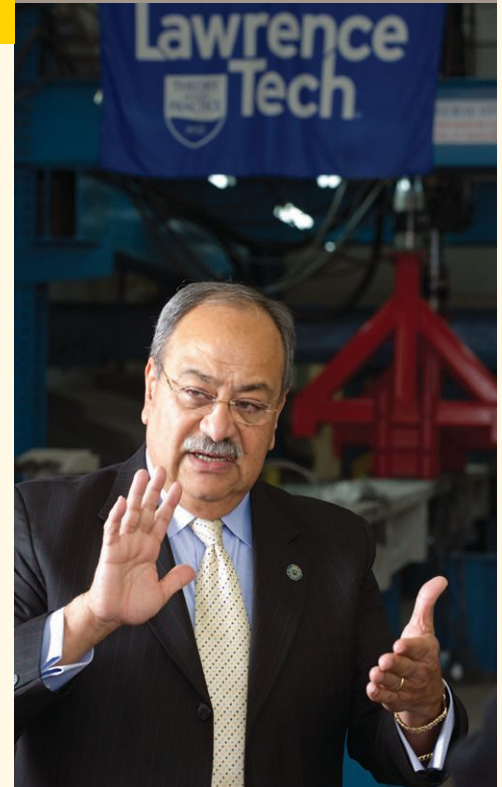
For all of these reasons and many more, LTU maintains its place in the top tier of its region and class. In particular, we were very pleased to see that LTU's College of Engineering moved up from 41st to 23rd on the list of best undergraduate programs in the country in the 2015 edition of the *U.S. News & World Report Best Colleges*.

Lawrence Tech is also among the top 100 colleges and universities nationwide in the 2015 Payscale College Salary Report, which measures the earning power of college graduates. LTU graduates who pursued advanced degrees also placed in the top 100 nationwide (see page 27).

We are proud that LTU President Virinder Moudgil has been named chair-elect for 2017 of the Association of Independent Technological Universities, a group of 22 institutions. LTU works with these nationally recognized universities in promoting innovation in engineering and science education.



Nabil F. Grace, PhD, PE
Dean, College of Engineering
University Distinguished Professor



CORPORATE PARTNERSHIP

JOHNSON CONTROLS EXPANDS LTU'S



Updating the chassis dynamometer at LTU's Applied Research Center was a complex operation that took many months to complete.

“The partnership with Johnson Controls is part of a broader effort by Lawrence Tech to respond proactively to the needs of our corporate partners with innovative academic and research programs.”



MaryAnn Wright

data-acquisition equipment and software for vehicle systems modeling and simulation. An additional gift from Johnson Controls funded the acquisition of hardware-in-the-loop equipment that tests vehicle system components for the purpose of characterization and modeling.

These expanded lab capabilities position LTU as a leading research facility in the Detroit area for automotive systems testing and development, in addition to expanding the University's fundamental research capabilities.

The upgraded facility has been named the Johnson Controls Vehicle Engineering Systems Laboratory. Milwaukee, Wisconsin-based Johnson Controls is the world's largest manufacturer of automotive batteries. The company's full range of lead-acid and Lithium-ion battery technology powers nearly every type of vehicle, including conventional, Start-Stop, Advanced Start-Stop, Micro Hybrid, hybrid, and electric. Johnson Controls supplies Lithium-ion batteries to Mercedes-Benz and BMW from a plant in Holland, Michigan. The international company has numerous automotive and energy-storage engineering technical centers and production plants in Michigan.

The expanded relationship with Lawrence Tech has been spearheaded by MaryAnn Wright, vice president of engineering and product development for Johnson Controls Power Solutions, who joined LTU's Board of Trustees in 2013.

Talent pipeline

“Building the talent pipeline for the next generation of technical leaders through academic partnerships is a top priority for Johnson Controls,” Wright said. “These relationships are critical to drive leading-edge research and technology discovery as well as create an environment to develop the next generation of engineers and scientists.”

Lawrence Technological University's four-wheel-drive chassis dynamometer had some unique capabilities when it was installed 13 years ago, but a lot has happened in the automotive industry since then. Thanks to generous support from research partner Johnson Controls, LTU's dyno once again offers cutting-edge technology to researchers, students, and corporate partners.

During the past year, multiple grants from Johnson Controls have funded the addition of independent motors that can simulate going downhill and also test hybrid vehicles, which use regenerative braking to feed power back to a high-voltage hybrid battery. Another addition is a robotic driver that provides more consistent and reliable data.

The investment also included modular

RESEARCH CAPABILITIES

As a result, LTU is leveraging its faculty expertise and research facilities in energy storage systems, electrification applications, modeling and simulation, and vehicle testing to work with Johnson Controls to identify and commercialize next-generation energy storage technologies.

“The partnership with Johnson Controls is part of a broader effort by Lawrence Tech to respond proactively to the needs of our corporate partners with innovative academic and research programs. We are helping these corporate partners develop market-based solutions while providing students with real-world experiences and skills,” LTU President Virinder Moudgil explained.

After supporting the upgrades in the lab, Johnson Controls was the first in line to utilize the testing equipment with three research projects. Two of the projects involve testing novel Micro Hybrid systems, and the third is investigating sensor reduction for production Lithium batteries.

Associate Professor Giscard Kfoury and Assistant Professor Selin Arslan of LTU’s A. Leon Linton Department of Mechanical Engineering are leading a team of both undergraduate and graduate students in investigating the effect of a novel 48-volt Micro Hybrid system on fuel economy and vehicle performance. Various controls strategies are being developed and tested using a prototype vehicle on the upgraded chassis dynamometer. Kfoury and Arslan are also conducting

LTU graduate student Shashank Rai (R) checks the chassis dynamometer monitoring systems with lab technician Mark Schmidt in the Johnson Controls Vehicle Engineering Systems Laboratory.



testing on a Johnson Controls prototype vehicle equipped with an advanced 12-volt Start-Stop system that can provide significant improvement in fuel consumption. The vehicle will be tested under various standard and custom-drive cycles, and the tests will be repeated with different battery configurations.

“These two projects bring together students from both mechanical engineering and robotics engineering. They study hybrid vehicles and get a chance to work as a team with a state-of-the-art chassis dynamometer and robot driver,” Arslan said. “These projects offer an amazing opportunity for both professors and students.”

The third research project, which is being conducted by Kfoury and Associate Professor Rob Fletcher, focuses on devising optimization algorithms that can determine the ideal placement and number of sensors on a production model battery. Data from these sensors is used by the battery management system to assess the thermal state and health of the battery.

Kfoury said the dynamometer upgrades enable Lawrence Tech to meet industry testing needs, while also providing students with experience with technology

that is currently in use in the auto industry.

“Johnson Controls realized the significance of having this dynamometer,”

Assistant Professor Selin Arslan and robotics engineering student John Marnon discuss how to set up the robotic driver for LTU’s updated chassis dynamometer.



capability at LTU for research and vehicle systems engineering,” We are extremely pleased with their investment.”

Four large electric motors were added to the dynamometer, one at each set of wheel rolls. Each has a capacity of 75 hp of continuous power, with peaks available of up to 125 hp.

Robotic driver

The second major improvement to the LTU dynamometer is a robotic driver. Basically, it’s a box that is set on the driver’s seat with two leg-like actuators to press down the accelerator and the brake. That makes it possible to do very precise tests of speed and braking effort.

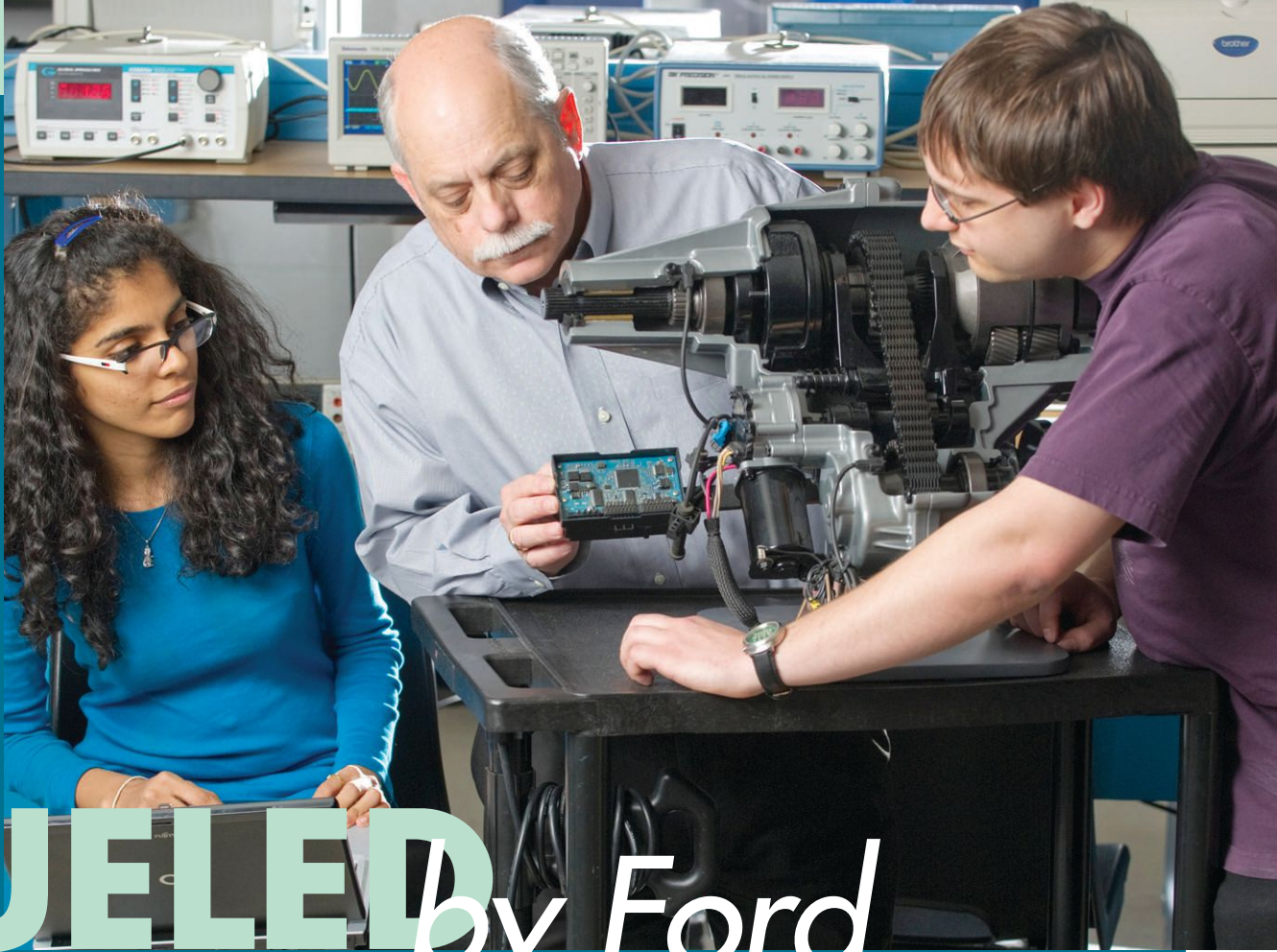
“If you want to run fuel efficiency tests on the dynamometer, you have to have repeatability and very accurate testing. That is not always possible with a human driver,” Kfoury said.

Test drivers are sometimes prone to boredom and inconsistent performance during a long testing period. The robot driver, however, will happily drive 5 mph – or whatever speed you want – for 40 minutes, or however long you want. “It’s no longer a source of error,” Kfoury said.

Eventually, Lawrence Tech will add a hand-like actuator to the robot driver to test manual transmissions for trucks and specialty vehicles.

With all of these expanded capabilities, LTU will be able to provide testing services for engine efficiency, thermal management, hybrid powertrain analysis, regenerative braking systems, wheel lock and slip, and engine control strategies, among others. □ EP

Philip Olivier, chair of LTU's Department of Electrical and Computer Engineering, has enlisted the help of students Sahana Thanabalan and Christopher Horton on a research project for Ford Motor Company.



FUELED by Ford

D AUTOMAKER TURNS TO LTU FOR RESEARCH ON EMBEDDED SOFTWARE

Developing new uses for embedded software is an important role played by university researchers across the country and around the world, and that's especially true at Lawrence Tech with its proximity to the automotive industry.

The demand for electrical engineers is growing, and LTU has more than 120 candidates for master's degrees in the field – a dramatic increase from just a few years ago. LTU also added a Bachelor of Science in Embedded Software Engineering in 2014 based on industry input and support.

LTU's Department of Electrical and Computer Engineering received a \$25,000 Red Poling grant from the Ford Motor Company last year, and is currently working with Ford on an additional research project valued at nearly \$50,000. The department is also managing two \$5,000 Ford College Alliance Mini Grants.

The Poling grant will fund research projects by LTU faculty and students on

two embedded software systems for automobiles, AUTOSAR and controller area network (CAN). The two systems are needed to coordinate the growing number of computers in a vehicle and to maximize usage of their combined computing power.

Now that the auto companies rely on suppliers for major sections of the vehicle, such as the axle assembly, a vehicle can have more than 20 computers on board that must interact with each other. The CAN bus that performs this role was introduced more than 30 years ago, but its role keeps changing and expanding as more minicomputers are added and vehicle systems become more complex.

New testing protocols must be introduced to keep pace with additional embedded software applications, and LTU research teams can help Ford get the most functionality out of all the computers in the automobile.

A second research project involves AUTOSAR, which stands for automo-

tive open system architecture. Originally developed in Europe, AUTOSAR standardizes basic system functions, making it possible to introduce innovative electronic systems and protocols that can improve performance, safety, efficiency, and environmental friendliness.

“For example, if more computing power is needed to introduce a new function, AUTOSAR can direct an underutilized computer to take over the task,” Olivier said. “As AUTOSAR becomes more accepted in the U.S. market, companies like Ford will need to conduct more tests on this embedded software system.”

One mini grant will be used to design and build a vehicle-to-infrastructure testing module in the DENSO Autonomous Vehicle Navigation Lab, which was built last year with a grant from the Japanese auto supplier with manufacturing facilities in the Detroit region. The lab provides a virtual “road” and “GPS” system in LTU's Engineering Building, and model vehicles equipped with GPS-

like receivers can be guided to navigate a specific route.

The mini grant will be used to add more sensors to the roadway and the test infrastructure, as well as additional communications capabilities to and from the vehicles so that different modes of vehicle-infrastructure-vehicle communi-

cation can be established and tested.

A second Ford mini grant will be used to put on the Midwest Symposium on Model Predictive Control at Lawrence Tech this spring. Model predictive controls are widely used in the automotive industry to reduce gas consumption and attain other efficiencies.

Taking advantage of its location at the center of the U.S. auto industry, LTU will call on industry experts to give plenary presentations and lead tutorials on model predictive control and other current applications. The Ford grant will provide \$500 prizes for the best PhD, master's and undergraduate presentations. □ EP

Students salvage old-growth lumber for future structures

Architectural engineering student Mike Paciero is learning some valuable lessons about construction outside the classroom, thanks to a \$25,000 Ford Community Challenge (Ford C3) grant from the Ford Motor Company Fund.

"Pioneer Material Renewal" is an extracurricular project to deconstruct a dilapidated Detroit building, assess the salvaged material, conduct tests for viable re-use, and design a new building to be constructed with the salvaged materials.

A team of six Lawrence Tech students is partnering with RecoveryPark on Detroit's east side and Architectural Salvage Warehouse Detroit (ASWD), and also interacting with other community organizations. The student team is responsible for stripping the house down to the structural elements. With help from student and community volunteers, deconstruction subcontractors will then take down the house, backfill and grade the site, and transport and store the salvaged materials.

Paciero, who will graduate with a master's degree in architectural engineering in May, is the team leader for the Ford grant. The other team members are Andrew Bradford, Charlie Harris, Meaghan Markiewicz, Brandon Olsen, and James Sharp.

The house at 4820 Dubois Street on Detroit's east side was built in 1888. Historical research shows that the pine lumber came from first-harvest timber cut in Michigan. The trees were hundreds of years old when harvested. At that time 2x4s were actually two inches by four inches, whereas today's 2x4s are slightly smaller.

Paciero is leading the assessment of the salvaged building materials – primarily 2x4s and 2x6s – coming out of the vacant residence. Since there aren't universally recognized standards for recertifying reclaimed wood for construction, the strength of the old lumber must be verified. He used testing equipment in LTU's Center for Innovative Materials Research to determine that the old lumber has maintained its structural integrity despite years of service and remains at least as strong as contemporary 2x4 lumber.

Paciero found himself referring back to the civil engineering courses in structures that are part of the architectural engineering curriculum at LTU. "Taking what I learned in those classes and applying it to actual materials has given me a better understanding of structures and how they work," he said.

The team aimed to reach an 80 percent yield of salvageable lumber. Since the original structure was 1,200 square feet on the first floor with a full attic, this would allow them to end up with at least enough lumber for a structure of 1,000 square feet. The structure that other team members will design could be a residence, a community building supporting activities such as an



LTU students (L-R) Meaghan Markiewicz, Mike Paciero, Brandon Olsen, and James Sharp visit the house in Detroit that was later deconstructed to provide the lumber for a new structure.

adjacent urban-farming operation, or a combination of the two.

Paciero said he has gained valuable leadership experience through the process of coordinating with ASWD, the subcontractors, and the city officials reviewing the project and issuing the necessary permits.

"When you're working with people, organizations, and government outside the University and in the real world, you see how important it is to be timely and to follow through on what you say you are going to do," he said.

The stated purpose of the Ford C3 grants is to promote sustainability and innovation.

"Educating the next generation of leaders is at the center of the Ford Fund's commitment to a better world," said Jim Vella, president of the Ford Motor Company Fund and Community Services. "Education, innovation, and sustainable solutions is a powerful formula for success in our communities and will help future engineers, managers, and entrepreneurs build a solid foundation for the careers of tomorrow."

□ EP



Architectural engineering student Mike Paciero went to LTU's Center for Innovative Materials Research to test the strength of lumber that is more than 125 years old.

DENSO Foundation funds research on nanofluids as engine coolants

Lawrence Tech graduate students Elankathiravan Mathivanan (L) and Anand Chaudhari (R) prepare to run an experiment to measure the effectiveness of nanofluids as engine coolants with guidance from LTU Assistant Professors Liping Liu and Selin Arslan.



IMPROVING EFFICIENCY

When Assistant Professor of Mechanical Engineering Liping Liu heard that the DENSO North America Foundation was looking for student projects to fund at local universities, she remembered some research she conducted when she was working on her PhD.

“I was involved in research in which we dispersed small amounts of nanoparticles – sizes on the order of tens of nanometers – into fluids and caused a significant increase in convective heat-transfer performance. At the time, the research centered around air conditioning and refrigerants, but I realized we could explore the same benefits in engine cooling systems.”

Liu is now working with two LTU graduate students to explore the benefits of using nanofluids to improve the efficiency of automobile engine cooling systems, and also to provide opportunities for students to gain hands-on experience with the applications of automotive technologies and on the topic of nanotechnology. The project supports student in-class activities, design exercises, and research opportunities both in nanotechnology and the broader automotive field.

The \$50,000 grant will underwrite experiments that Liu’s research team is conducting with assistance from other LTU

professors in mechanical engineering, biomedical engineering, and chemistry. They include testing a variety of nanofluids with varying types and amounts of nanoparticles to determine their effect on heat transferring capabilities.

“We’re running the engine on the engine dynamometer made possible by an earlier grant from the DENSO Foundation, and we are working to build the experimental setup and capture all the data we need,” she added.

“... the research centered around air conditioning and refrigerants, but I realized we could explore the same benefits in engine cooling systems.”

The interdisciplinary project that started in August 2014 involves five faculty from three LTU departments. Liu is the principal investigator (PI), and two of the co-PIs, Professor Badih Jawad and Assistant Professor Selin Arslan, are also with the A. Leon Linton Department of Mechanical Engineering. The other co-PIs are Associate Professor Yawen Li of the biomedical engineering program and Chemistry Lecturer Nicole Villeneuve of LTU’s Department of Natural Sciences.

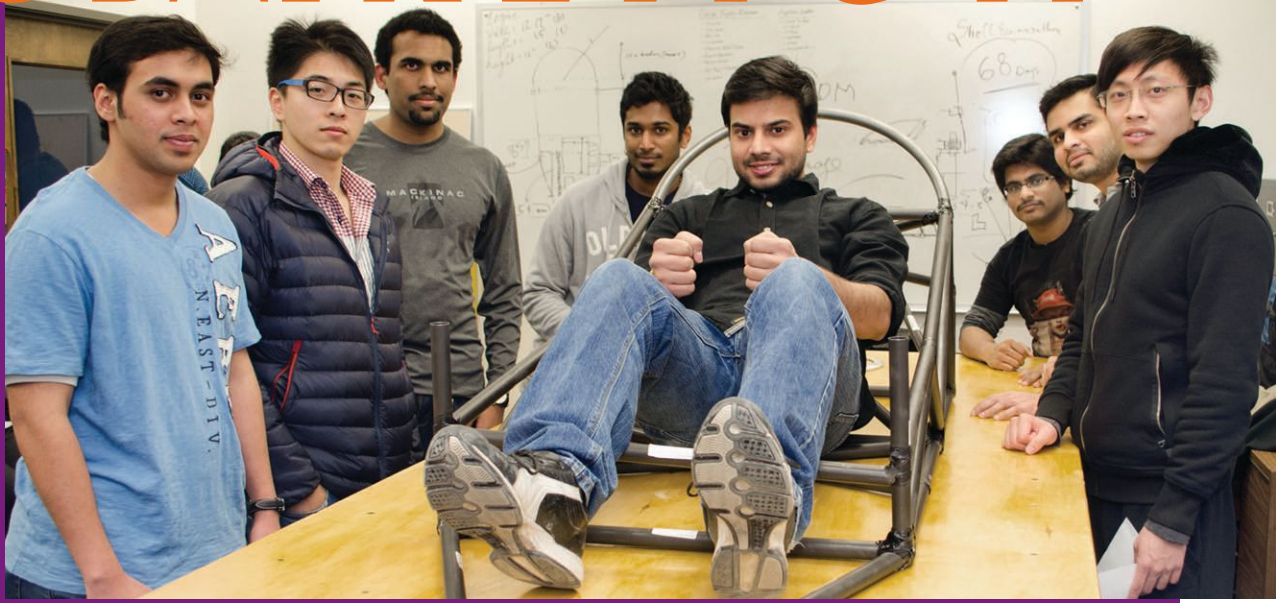
The two graduate students, Elankathiravan Mathivanan and Anand Chaudhari, are using this project to support their master’s theses, one focusing on numerical simulation and the other on experimental investigation with LTU’s DENSO Engine Dynamometer.

This project also provides activities for the nanotechnology summer camp that Lawrence Tech offers to high school students.

As a bonus, the engine being tested is the same model as the LTU Formula SAE competitors are currently using in their vehicle. “Maybe what we learn in our experiments will help our Formula team, too,” Liu added. “And we’re going to see if the nanofluids affect exhaust emissions. This could be a win-win-win.” □ EP

GLOBAL REACH

Bhavik Chauhan demonstrates where the driver will sit in LTU's new supermileage vehicle. Some of his teammates are (L-R) Samruddh Kulkarni, Lei Cao, Varun Reddy, Shashank Rai, Kishan Balan, Desai Ameya, and Xiaodong Chen.



A Automotive engineering has an international flavor at LTU

A large cohort of Indian and Chinese graduate students has had a major impact on the master's degree programs in automotive engineering and mechanical engineering at Lawrence Tech in the 2014–15 academic year. Thanks to strong interest from these international students, enrollment in the two programs has grown to more than 220.

Many of these students were attracted to LTU by specific courses in automotive engineering. As an added bonus, some of them have been able to practice what they learn in the classroom by participating on the SAE Supermileage team.

Led by team captain Shashank Rai, the Indian contingent is playing a big part in Lawrence Tech's return to the SAE Supermileage competition after an absence of several years. Several other team members are from China.

Demand for automobiles is expected to be very strong in both India and China in the coming years as the middle class in both countries continues to grow dramatically. Ambitious students are preparing themselves for good careers in the auto industry by getting an advanced degree in the United States.

These students found less than a dozen automotive engineering programs in the United States that had the curriculum they

were looking for. They chose Lawrence Tech because of its proximity to the major automakers and suppliers located in the Detroit region, which remains the heart of the American automotive industry. Some were attracted by the degree program's core courses, Applied Thermodynamics, Mechanical Vibrations, Advanced Mechanics of Materials, and Engineering Analysis.

Many students were attracted to LTU by specific courses in automotive engineering.

The faculty members who teach graduate students have doctoral degrees and are involved in applied research and consulting. Many engineers currently working in the auto industry serve as adjunct faculty, and they bring their knowledge of the latest practices into the classroom.

The automotive program also benefits from having access to both a chassis dynamometer and an engine dynamometer, which have been established and updated by Johnson Controls, Inc. and DENSO North America, respectively.

The instruction in finite element analysis in the Engineering Analysis course has already paid off for members of the Su-

permileage team. After creating a model for their racing vehicle using SolidWorks software, the students used the Ansys software that they learned about in class to run simulation tests to determine if their vehicle design is stable.

The annual collegiate competition takes place at Eaton Corporation's proving grounds in Marshall, Michigan, and Eaton helped LTU get back in with a \$5,000 corporate contribution.

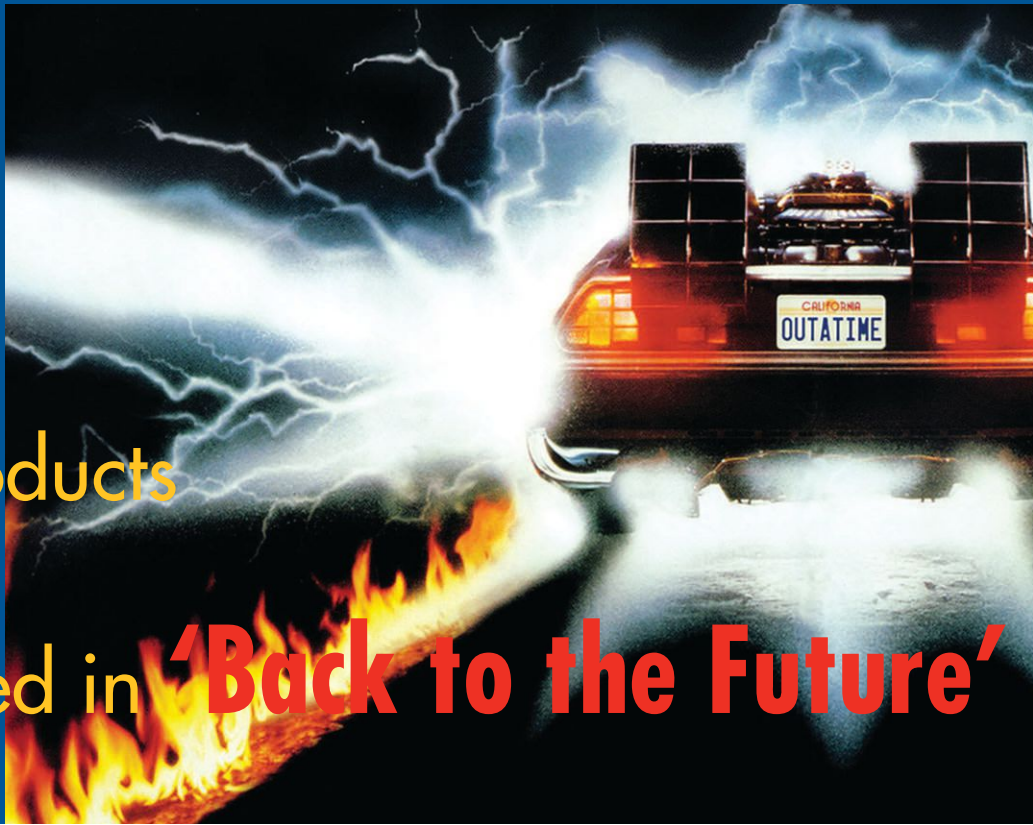
Rai said he plans to complete his master's degree in two years and then stay another two years to gain some experience in the auto industry and perhaps add to his education. Some of the other students have similar plans because global experience will be an asset when they return home to India.

So far they have been impressed by the number of automotive engineering jobs available in the United States, and they look forward to working in the industry after they complete their second semester at LTU.

"We've been going to career fairs and talking to a lot of companies," said Bhavik Chauhan, who is pursuing a master's degree in mechanical engineering. "We've found a lot of opportunities to work in the automotive industry around here." □ EP

When Marty McFly and “Doc” did their time traveling in the “Back to the Future” movies, they got there in a DeLorean, the car that was designed and then manufactured by Lawrence Tech alumnus John DeLorean, BSIE’48.

Consumer products look better than envisioned in ‘Back to the Future’



2

2015 was the far-off year in the future that Marty McFly and “Doc” visited in the 1989 sci-fi movie, “Back to the Future Part II.” So whatever happened to that future? Where’s my hoverboard? Where’s my hydrating instant oven?

According to Kun Hua, Umasankar Kandaswamy, and Nabih Jaber, three assistant professors in LTU’s Department of Electrical and Computer Engineering, the consumer technology that has developed since “Back to the Future” is actually better than envisioned by the movie screenwriters. And while we may have to wait a long time to get flying cars or hoverboards that apparently work on antigravity, there are more promising developments on the horizon.

We already have high-speed and mobile access to the Internet and smartphones that put the world in our pockets.

We’re getting closer to cars that drive themselves, or are at least smart enough to avoid horrible accidents like that 193-vehicle chain reaction crash this winter on I-94 near Kalamazoo.

“The future is a different but better ‘wow’ than the movie,” Jaber said.

Jaber’s research centers on wireless communications and smart grid applica-

tions. He got interested in smart cars as a child, when the family Nissan used recordings to talk to its occupants about doors ajar and other problems.

Kandaswamy is involved in research on image processing, computer vision, and vision learning – making computers see and learn just like humans do.

And Hua is working on wireless communications, signal processing, and vehicle communications – creating what is in essence a moving network that can warn cars of trouble ahead. The technology can also be used for unmanned robotic applications like search and rescue.

These rising stars of LTU’s electrical

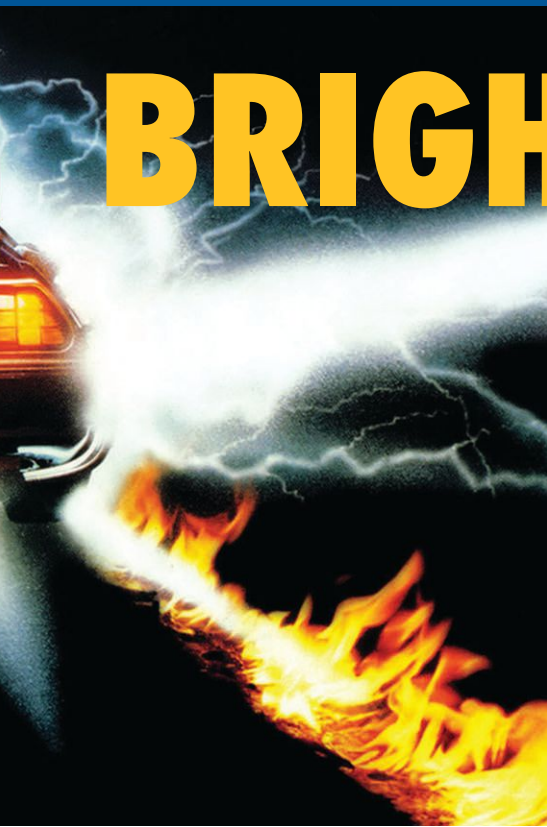
engineering faculty are working to get these technological breakthroughs out of the lab and into consumer products. Hua works in LTU’s Wireless Communication and Networking Laboratory, Kandaswamy in the Digital Signal Image Processing Laboratory, and Jaber in the Innovative Smart Wireless Networking Laboratory.

Smart grid and smartphones

For the last seven years, Jaber has been working on a wireless technology called DSRC (dedicated short-range communications) and studying what has been up until now a largely dead-end data

● ● ●
These rising stars of LTU’s electrical engineering faculty are working to get these technological breakthroughs out of the lab and into consumer products.
● ● ●

BRIGHTER FUTURE



© Universal Studios

transmission technology called WiMAX that can send and receive data over a large area.

Jaber started working with other graduate students on networking and the smart grid after the infamous blackout spread over many states in the Northeast in 2003 when he was in graduate school. His version of the smart grid uses sensors to detect potential faults before they happen and alert engineers to take steps to fix them before the circuit breakers begin flipping, even pinpointing the location of faults so utilities don't have to waste time searching for the problems in trucks. He's also working on an app to educate consumers about energy efficiency and electricity usage.

Hua is working on a network of wireless body sensors that communicate with a smartphone – for example, monitoring people with heart disease or other chronic conditions and communicating automatically in real time with health professionals and family members before there's a crisis.

Hua has also been working with Ford, DENSO, and Delphi on three projects related to a mobile wireless sensor network for road safety in intelligent

transportation systems. "Traveling safety can be improved by forming vehicles into groups for mutual interaction with each other," Hua said. "Vehicles of the future will communicate both with each other and with the infrastructure to better serve drivers with autonomous maneuvering."

Traffic data for such a system would provide improved navigation, route optimization, analytics for increased traffic flow and safety, and automatic accident reporting that would reduce emergency response times.

Kandaswamy and two of his graduate students spent part of the summer of 2014 helping Delphi Corp. to showcase the advantages of DSRC that makes cars more aware of their surroundings by monitoring nearby vehicle and pedestrian traffic.

Biometric applications

Kandaswamy has also done work on compressing images and recognizing content in compressed domain. Recently he has been investigating the application of this technology to biometric data. His research in this area is focused on fusing face data with iris biometric data in the compressed domain to create a multi-modal biometric login for smartphones, computers, and smart homes.

Kandaswamy is also working on a biomedical app to compress medical data

for mobile devices and have it available on tablets and smartphones. He has filed a patent application on a novel image compression algorithm and has established a startup business called Texsar Inc. to work on it.

As for their favorite modern technologies? None were really envisioned in "Back to the Future."

Said Kandaswamy: "If you told me even ten years ago that I would be watching live TV on an iPad or an iPhone, I wouldn't have believed you, but here we are."

Jaber mentioned direct human-computer interface.

Also, all three said smartphone video has made everybody a TV reporter, since anyone can post music or write on the Web for the entire world to see. The only question, they said, is how that content gets monetized.

Kandaswamy said he can see a future in which people will get some kind of payment for whatever they contribute to a website – video, music, even comments – using a form of online signature that can't be removed from the content. □MNR

Nabih Jaber, Umasankar Kandaswamy, and Kun Hua (L-R) discuss how research in their labs at Lawrence Tech could lead to new consumer products in the future.



LEARNING by doing

Undergraduate research provides productive educational experience

Associate Professor Yawen Li in LTU's biomedical engineering program has found that original scientific research provides undergraduate students with a unique educational experience that prepares them well for the next step in their academic or professional careers.

Research-based learning is an emerging national trend in collegiate education. Li has taken the approach of having engineering students actively participate in her research as part of their senior design projects. The students each logged in approximately 10 hours per week during a two-semester period. They received five course credits for completing their senior design project.

Li is seeking an alternative approach for treating painful and potentially debilitating anterior cruciate ligament (ACL) tears – injuries that are particularly common among athletes and the elderly. Surgery to replace a torn ligament can lead to long-term complications, and a process known as tissue engineering may

be a better option, according to Li.

Her research has focused on developing a method for regenerating ligament tissues using a combination of cells, biomaterial scaffolds, and mechanical and biochemical stimulation.

The biomaterial scaffold is an artificial structure capable of supporting three-dimensional tissue formation. It provides a structure that mimics the in vivo microenvironment of the target tissue. Cells are seeded into the scaffold, attach and proliferate, secrete growth factors, and form their own matrix. During this process, the scaffold – usually made of biodegradable polymers – initially provides mechanical support to the cells and then gradually breaks down. New tissue is formed and takes over the mechanical load.

Useful research

“The knowledge we gain from this study will help us in the design and optimization of scaffolds for ligament regeneration. It also provides useful reference for

At the conclusion of their senior design project on a bioreactor for ligament growth, Erick Blank and Danielle Beski presented a poster of their findings at a regional conference.

other researchers who might choose the materials for the regeneration of other tissues or organs,” Li said.

Students use LTU's state-of-the-art environmental scanning electron microscope to study the mechanical properties and microstructure of different types of nanofiber scaffolds. They also conduct various biochemical tests to evaluate the interaction of the cells with the polymeric nanofiber materials.

Sixteen LTU students on five teams have conducted research on this topic for their senior design projects. Student teams advanced the research project by tackling subtopics such as scaffold material selection and synthesis, biomechanical testing, biocompatibility evaluation, electrospun fiber braiding, scaffold surface modification, and drug-containing nanofiber electrospinning. A cell trans-



“The knowledge we gain from this study will help us in the design and optimization of scaffolds for ligament regeneration.”

MENT
ON

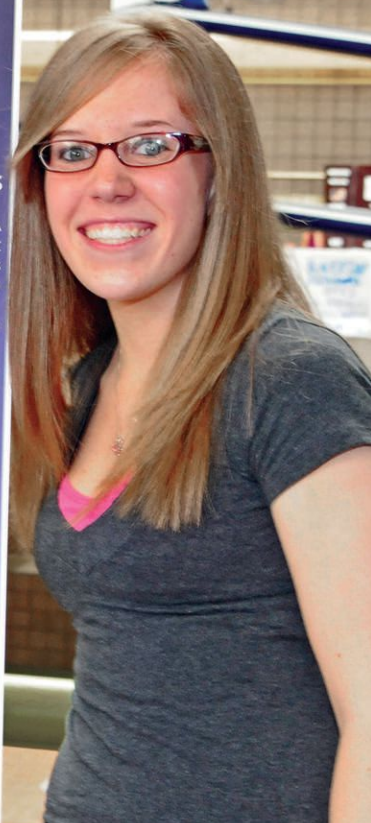
OUR GOALS

DESIGN AND BUILD A REACTOR TO CULTURE LIGAMENT-LIKE CELLS ON A SCAFFOLD

BY CYCLIC TENSION TO PROMOTE DIFFERENTIATION AND INCREASE MECHANICAL PROPERTIES OF THE CELLS

OBTAIN RESULTS TO SHARE WITH THE SCIENTIFIC COMMUNITY

GROWTH FACTORS IN VITRO BIOREACTOR CELLS



fection study involved a student in the molecular and cell biology program.

The research has yielded one journal article, one manuscript in review, another in preparation, and nine conference presentations/posters. Seven of the 16 students have gone on to pursue a graduate degree, while the others have found research-related jobs in the medical sector.

A major advantage of this approach is that the students commit two full semesters to the research project. That allows plenty of time for the new researchers to tackle complex tasks after they receive training.

“All the training and organization is not wasted by having students leave the project before they have accomplished

Undergraduate students on the research team assembled by Yawen Li (second from left in front) had the opportunity to work with researchers from William Beaumont Hospital, the University of Michigan, and LTU’s College of Arts and Sciences.

anything meaningful,” Li said. “There’s a requirement that the students produce something that’s beneficial to them and the research project.”

The approach promotes both individual excellence and teamwork. The undergraduate teams had the opportunity to work with researchers from William Beaumont Hospital, the University of Michigan, and LTU’s College of Arts and Sciences.

Under the research-based-learning model defined by Li, students start with a literature review over the summer before their senior year. At biweekly meetings, each student presents a summary of an assigned article, followed by discussion to relate the different studies to the research project. Some lab skills training also starts in the summer.

Selecting a subtopic

At the first meeting of the fall semester, the student team selects the subtopic it will tackle as a senior design project. The scope and objective of the project is clearly defined. This process gives the students a sense of ownership of the project.

By early October, the senior design teams complete basic lab skills training and present their project proposal with a detailed experimental plan. Then they work on setting up their experiments and conducting pilot tests.

The student teams usually start the spring semester with design modification/optimization and large-scale testing. The faculty meets weekly with the teams for updates on the experimental progress and to help with troubleshooting and data analysis if needed. Most of the data analysis is done as the students perform their experiments. By mid-April, the students complete their experiments and prepare for a poster session and final presentation.

“Undergraduate research can be a high-impact educational practice,” Li said. “It requires dedication from the participating faculty and also a culture across the campus that encourages undergraduate research and provides a network of support for the faculty and students.” □ EP



Students use LTU’s state-of-the-art environmental scanning electron microscope to study the mechanical properties and microstructure of different types of nanofiber scaffolds.



GREEN INFRASTRUCTURES

Community involvement builds long-term support for stormwater controls

Sustainability has become an important goal for municipalities in the United States, and LTU Civil Engineering Professor Donald Carpenter has been raising awareness about practical ways to reduce stormwater runoff that can overburden sewer systems, cause runoff pollution and health concerns, and lead to

long-term soil erosion.

Civil engineers have developed a number of tools for reducing stormwater runoff, but Carpenter has found that public support is the most important component in any long-term sustainability project.

Public input also helps guide planners to more effective solutions with fewer negative side effects. When there is buy-in from the start, planners and engineers can devise more palatable solutions that will have long-term support, Carpenter points out.

“The goal should be to get more community involvement through education and outreach. When you get community acceptance, local officials will take more ownership of the implementation and stewardship of the project going forward,” he said.

When presenting plans to improve sustainability, it’s important to give the community some choices. “We should present a vision and conceptual designs and then give the community alternatives and



Donald Carpenter

choices,” Carpenter said. “The community can react, and people can say which part of the plan they like or don’t like. They need to discuss it.”

Carpenter is founder and director of Lawrence Tech’s Great Lakes Stormwater Management Institute, which promotes positive environmental change in the Great Lakes region through research, education, and the practical application of low-impact development and stormwater management techniques.

He is an accredited green design professional (LEED AP) and practicing professional engineer (PE) whose expertise and research interests include low-

impact development, innovative stormwater best management practices, hydraulic and hydrologic modeling, and field data collection for performance monitoring.

Reducing runoff

In southeast Michigan, stormwater and runoff pollution started more than a century ago when the first municipal sewer systems were built. The early generation of combined sewer systems that handle both sewerage and stormwater runoff were easily overwhelmed by moderate rain events.

The suburban sewer systems developed 50 or 60 years ago are generally better because rainwater and sanitary water are

separate, but they still suffer from problems with capacity. “We have learned a great deal about stormwater management through engineering and technology in the past few years, and we need to implement what we have learned,” Carpenter said. “But engaging the public along the way has become an essential part of the process.”

Last year he was selected to monitor the results of a \$2 million project to reduce stormwater runoff in Detroit and eliminate some sewer overflows into the Detroit River.

The Great Lakes Shoreline Cities Green Infrastructure Project for Detroit’s near east side will deploy green infrastructure strategies to manage and retain stormwater in areas outlined by the Lower East Side Action Plan (LEAP) and RecoveryPark. The projects are located within the East Jefferson district of the Detroit Water and Sewerage Department (DWSD) where there are on average nine combined sewer overflows into the Detroit River every year.

The U.S. Environmental Protection Agency (USEPA) is providing a \$1 million grant for the stormwater abatement project, and the Fred A. and Barbara M. Erb Family Foundation and the Kresge Foundation have put up the \$1 million match required for the federal grant.

LTU will provide pre-construction and post-construction monitoring of runoff into the combined sewer system for the LEAP and RecoveryPark green infrastructure projects.

“The opportunity to green the city of Detroit and subsequently improve water

and air quality is exciting,” Carpenter said. “This project will demonstrate what can be done on a larger scale as the city reinvents itself.”

LEAP involves approximately 40 vacant lots that will be cleaned and greened utilizing the expertise of the Greening of Detroit. RecoveryPark is managing approximately 32 acres to reduce stormwater runoff through the use of green infrastructure techniques, including bioswales and rain gardens. The runoff will then be conveyed to storage facilities for use as irrigation for the greenhouse farms.

River preservation

Carpenter has also been retained by the Clinton River Watershed Council (CRWC) to help local communities identify innovative ways to manage stormwater.

Last year the study focused on identifying site-specific concepts to filter and retain stormwater while also adding beauty and community amenities in the downtown areas of Rochester and Clarkston, and at Clinton Township’s civic center. Proposed stormwater management techniques include bioswales, rain gardens, rain chains, tree boxes, and porous surfaces.

The communities selected for this project are participants in CRWC’s WaterTowns program, which focuses on placemaking as a way to assist communities within the Clinton River watershed and along Lake St. Clair to maximize their waterways as assets for community and economic development.

Continued



Donald Carpenter’s study of six harbors on the Great Lakes includes this marina that is part of the New Baltimore harbor on Michigan’s east coast.

“Green infrastructure is more than just stormwater treatment,” Carpenter said. “Green infrastructure also means creating places where people can interact with the environment in a positive way.”

Harbors study

Carpenter is also sharing the leadership on a \$175,000, two-year study on how six Michigan communities with small, shallow-draft harbors can plan for economic sustainability in response to the long-term trend of lower water levels in the Great Lakes.

Although there has been a dramatic reversal in the last two years, a decade-long trend of lower water levels in the Great Lakes has hurt economic activity in Michigan communities with harbors. As a result, public harbors in the state have been required to develop five-year master plans in order to qualify for financial support from the Waterways Commission of the Michigan Department of Natural Resources.

Joining Carpenter on this study is Sanjiv Sinha, vice president of Water Resources Environmental Consulting & Technology, Inc., a Florida-based company with six offices in Michigan. “Research is badly needed to inform both the development process and the content of these plans,” said Sinha, who has collaborated with LTU on several projects over the past decade.

The project team has called upon Associate Professor Constance Bodurow of studio[Ci] in LTU’s College of Architecture and Design to help set up community design charrettes.

The overall goal is to come up with a financial model and a toolkit of planning resources to be used in the development of a master plan for attaining long-term financial sustainability.

In addition to looking for ways to improve the functionality of harbors, civil engineers like Carpenter have to consider placemaking – the planning, design and management of public spaces to promote beneficial activity. “Placemaking and sustainable infrastructure are tools that are now being used for harbors,” he said. □EP

Civil engineering grad student gets on-the-job training

Rachel Pieschek, a master’s degree candidate in civil engineering, keeps on learning when she moves from the classroom to her full-time job as a graduate assistant to LTU Professor Donald Carpenter.

Growing up in Green Bay, Wisconsin, Pieschek couldn’t decide if she wanted to pursue a career in engineering or architecture. The desire to do both led her to Lawrence Tech, where she graduated in 2014 with dual degrees in civil engineering and architecture. As an undergraduate she found herself gravitating to the issues involved in water management, and now she is pursuing a master’s degree in civil engineering.

But it is her day job that may exert the most influence on her ultimate career path.

Pieschek is working on three research projects with Carpenter: a sustainability study for several Great Lakes harbors; a stormwater management study for the Clinton River Watershed Council; and a demonstration project for the Great Lakes Shoreline Cities Green Infrastructure Project in Detroit.

The purpose of the Clinton River watershed grant is to demonstrate how communities can use practical tools like rain gardens and porous paving to reduce stormwater runoff and improve overall water quality.

Pieschek did a lot of the groundwork

for the reports that Carpenter delivered to Clarkston, Clinton Township, and Rochester. She did calculations on what green infrastructure improvements could be made in specific situations and prepared cost estimates. She put together posters and PowerPoint presentations for public meetings.

“I also met with city engineers and city managers to figure out what they were looking for,” she said.

A major part of the Detroit project is a demonstration project for an urban farming operation on three blocks on Detroit’s east side. The goal is to divert and capture rainwater for future use in the farming operation while also reducing the overall stormwater runoff.

Pieschek is doing the computer hydraulic modeling to predict the impact of the demonstration project. She will then take data captured by monitoring equipment to check the accuracy of the computer model.

“I’m seeing the project planned and built, and I will be able to compare the results from before and after,” she said. “It’s an educational experience in itself.”

□ EP

LTU civil engineering graduate student Rachel Pieschek demonstrates how porous paving materials reduce stormwater runoff by letting water flow through.





LTU's biomedical engineering program continues to grow with new graduate degree

ORGANIC GROWTH

Lawrence Tech's biomedical engineering program will offer a new master's degree in the fall and expects to exceed 100 undergraduate students during the next academic year. The program will gain additional facilities when LTU's new Taubman Complex opens in 2016 (see page 27).

Growth is definitely the goal of Gerald (Jerry) LeCarpentier, who was named director of the program in August 2014. Earlier, from 2002 to 2012, he was a research associate at the University of Michigan, where he worked on the early detection of breast cancer. While in Ann Arbor, he also worked on a multidisciplinary team to develop electrical and mechanical imaging prototypes.

Given his expertise in imaging technologies, he quickly went to work on enhancing the already strong instrumentation component of the curriculum at Lawrence Tech.

He is also increasing collaboration with practitioners and researchers in the biomedical engineering field, which is very strong in the region. He has brought in professional colleagues from the Karmanos Cancer Institute, Detroit Medical Center, and University of Michigan to give seminars for the first-year introductory course he teaches.

With a critical mass of health systems in close proximity to LTU's campus in Southfield, there will continue to be plenty of job opportunities for graduates of the biomedical engineering program, according to LeCarpentier.

There are also many opportunities for research and senior capstone design projects. "We offer both in-house experiences as well as local and regional partnerships.

There is a strong collaborative spirit in the metro Detroit area, and I am very thankful for the quality of regional relationships our faculty and I have cultivated," he said.

LTU's location also provides the opportunity to participate in the dramatic rebound of the American auto industry, which remains centered in southeast Michigan. The study of ergonomics and crash safety has been an important source of employment in the area for many years.

Automotive opportunities

More than 10,000 Lawrence Tech graduates work in the automotive industry, and companies in that sector actively recruit at Lawrence Tech for engineers and designers. LeCarpentier believes all this activity on campus creates more opportunities for the biomedical engineering program.

"The key to our success will be the natural collaborative efforts and multidisciplinary approach inherent in our biomedical engineering curriculum here at LTU," LeCarpentier said. "Our faculty offer tremendous expertise in this educational process."

With these connections in one of the nation's top regions for engineering and technology, the faculty can help students in the new master's degree program find industry partners for applied research and design projects. The faculty also provides expertise in biomechanics, tissue engineering, bioMEMS, bioinstrumentation, and medical imaging.

At Lawrence Tech graduate students

can pursue the latest advanced knowledge in engineering analysis, biology/physiology, bioelectric physics, biocompatibility, biomechanics, mechanobiology, and experimental methods.

LeCarpentier looks forward to new labs for biomechanics and bioinstrumentation when the Taubman Complex opens.

His program already benefits from having the Detroit area's first environmental scanning electron microscope, which will remain in its existing location in LTU's Engineering Building.

The new Taubman Complex will be connected to both the Science Building and the Engineering Building. "Having the new building connecting the two is both symbolic and functional," LeCarpentier said. "Biomedical engineering is a bridge between engineering and the physical and life sciences.

"I can't even anticipate the results of all the cross-pollination that will happen," he said. "I do know that this is an exciting time to be in biomedical engineering at Lawrence Tech." □ EP

Jerry LeCarpentier (R), director of LTU's biomedical engineering program, discusses data acquisition techniques with students Justin Michael Pilarski (L) and Steve Krammin after a class in the biomedical engineering lab.

COURSES

CHANGING

New Kern grant extends entrepreneurial education at Lawrence Tech



Lawrence Technological University's long-term partnership with the Wisconsin-based Kern Family Foundation and the Kern Entrepreneurial Engineering Network (KEEN) moved to a new phase in 2014 with a three-year \$697,000 grant to support further expansion of entrepreneurial-minded learning in the curricula for undergraduate engineering students.

This is expected to be the final phase of a series of grants the Kern Family Foundation has made, totaling more than \$2.4 million since 2003. The goal has been to incorporate the entrepreneurial mindset into undergraduate engineering education at LTU.

"We believe that this final phase of support will result in a comprehensive entrepreneurial education experience for our engineering undergraduates," said LTU Provost Maria Vaz, the principal investigator for two of the Kern grants,

including the most recent.

A key component of the program supported by previous grants is the modification of close to 50 courses in the engineering curriculum, including courses required for engineering students in the College of Arts and Sciences. This approach incorporates many principles of problem-based learning and active and collaborative learning. Classroom work has been supplemented by co-curricular and extracurricular entrepreneurial activities, such as internships and industry-sponsored projects.

Lawrence Tech has also modified the freshman introduction to engineering course into an interdisciplinary design studio experience that incorporates the foundations of entrepreneurially minded learning. "Having the students solve open-ended design problems and learn how to ask the right questions of a customer are critical entrepreneurial skills

that students engage in right from the beginning of their college education," said Professor of Civil Engineering Donald Carpenter, co-principal investigator for the grant.

The four major components of the latest phase of this ongoing academic enhancement aim to:

- Develop and institutionalize a multidisciplinary sophomore experience utilizing the principles of a project-based studio environment to instill an enterprising attitude in students.
- Integrate opportunities for entrepreneurial-minded education in the junior year that will link the required freshmen and sophomore entrepreneurial design studios with the senior capstone project.
- Explore the integration of entrepreneurial-minded, problem-based learning problems that are currently part of fundamental science courses into the sophomore entrepreneurial engineering design

KEEN funds thermofluids faculty network

As part of an initiative funded by the Kern Family Foundation, a faculty team from the College of Engineering discusses the best way to tackle an in-class assignment during a training session for problem-based learning and active and collaborative learning. Members of the team are (L-R) James Mynderse, Mansoor Nasir, Nishantha Bandara, Susan Henson, and Jim Kerns.



Thomas DeAgostino

studio experiences and into the junior year curriculum.

- Implements a focused training process for other faculty so that all LTU students will have the same educational experience across the curriculum. To help implement this ambitious agenda, LTU's College of Engineering has opened the Entrepreneurial Engineering Design Studio and introduced a new curricular experience that will eventually cover all four undergraduate years.

The director of the new studio is Thomas DeAgostino, an experienced engineer who has 25 years of experience in both engineering and business at Ford Motor Company and General Motors. In the fall semester, he taught two sections of Fundamentals of Engineering Design Projects, the first studio course in the College of Engineering.

Two new engineering studios for sophomores will be constructed in the Taubman Complex, which is scheduled to open in fall 2016.

Junior-year, discipline-specific entrepreneurial experiences – which already exist in some departments and programs

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Junior-year, discipline-specific entrepreneurial experiences – which already exist in some departments and programs

LTU Mechanical Engineering Assistant Professor Liping Liu is the principal investigator for a \$20,000 KEEN Topical Network grant from the Kern Family Foundation to establish a faculty network for investigating entrepreneurially minded learning in the thermofluids discipline.

The grant will help foster collaboration among faculty members across institutions who share a passion for thermofluids education. They will explore curriculum improvement, innovative delivery methods, and content integration from multiple courses in this area. The participants all teach at colleges and universities that are members of the Kern Entrepreneurial Engineering Network (KEEN).

KEEN, which is funded by the Kern Family Foundation, has a mission to “graduate engineers with an entrepreneurial mindset, so that they can create personal, economic



Liping Liu



Andrew Gerhart

and societal value through a lifetime of meaningful work.”

This interinstitutional project began in January 2015 and involves six faculty members from five different universities. Liu is the PI, and one of the co-PIs, Associate Professor Andrew Gerhart, is also from LTU. Other co-PIs are from the University of New Haven, Gonzaga University, the University of Dayton, and Western New England University.

Thermofluids is an important and indispensable component of the mechanical engineering curriculum. A sequence of core courses – Thermodynamics, Fluid Mechanics, and Heat Transfer – are the focus of the proposed work. In particular, students often miss the fact that the three courses are not independent topics and in fact all stem from the same basic physical principles.

The team will investigate the connectedness of the three courses, how they may be better integrated, and how the entrepreneurial mindset may be used to better instill the principles of thermofluids.

“We aim to create a pathway for information sharing, class material exchanging, as well as discussion of teaching methodologies that will significantly enhance our students’ learning experience in thermofluids education,” Liu said. □ EP

– will be expanded in different engineering disciplines as a bridge to senior projects.

These entrepreneurial experiences will help undergraduates develop the skills that companies seek – good interpersonal and professional skills, as well as the ability to communicate ideas, understand what the customer wants, and create value, according to DeAgostino.

“We have an obligation to deliver to all our engineering students the

Andrew Gerhart (L) and Donald Carpenter of the College of Engineering, who lead the ACL/PBL program at LTU, watch a faculty team complete an in-class task during a training session.

skill sets that they will need to be successful,” he said.

LTU's Entrepreneurial Engineering Design Studio is an incubator where students, faculty, community members, and corporate partners can develop new products and manufacturing processes. It will be a conduit for faculty-led research projects with corporate partners that can also provide research experience to students.

Vaz said the Kern grants have affected the culture of LTU's faculty and leadership, leading to the transformation of the students' educational experience. “We want to make sure that as many faculty as possible are trained so that there are no gaps in a student's curriculum and every student has the same experience,” she said.



Continued

Lawrence Tech hosts KEEN Innovation Encounter competition

In 2002, the Kern Family Foundation began funding new educational programming at LTU. In 2009, the relationship expanded with a five-year, \$1.1 million grant to further integrate the entrepreneurial mindset into the education of undergraduate engineering students. The program was based on the premise that LTU graduates who develop an entrepreneurial approach to engineering will have more career opportunities as leaders of new companies and enterprises or as managers in large organizations.

The 2009 grant set an ambitious agenda of changing the culture of both the faculty and university leadership in order to transform the educational experience for Lawrence Tech engineering students.

In the process of wrapping up this earlier grant, Professor Donald Carpenter and Associate Professor Andrew Gerhart will benchmark the experiences of the other participating KEEN colleges and universities and develop a training program.

Carpenter and Gerhart have also assisted three other KEEN member institutions with faculty development workshops, and Lawrence Tech will host another workshop later this year. □ EP

Lawrence Technological University hosted its fifth Innovation Encounter in October 2014, and the home team finished third in the competition.

Innovation Encounter, which is funded in part by a grant from the Kern Family Foundation, is an annual activity of the Kern Entrepreneurial Engineering Network (KEEN) for colleges and universities. It challenges students to use a creative problem-solving process and to identify and act on societal values, business principles, and customer awareness.

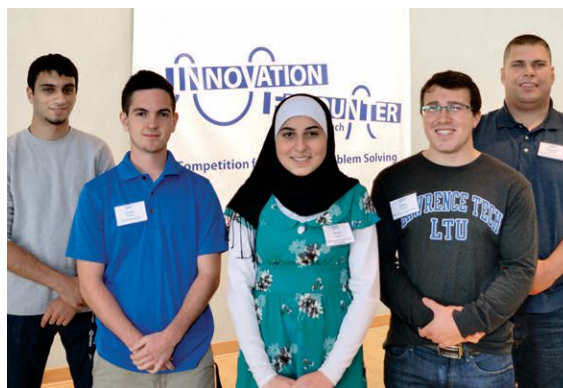
Student teams from six KEEN colleges – Bucknell University, Ohio Northern University, the University of Detroit Mercy (UDM), Kettering University, and Worcester Polytechnic Institute, as well as LTU – competed by finding a solution, creating materials

to showcase their solution, developing a business case, and preparing an oral presentation.

The event was kicked off by the motivational keynote speaker, Thom Nealsson, who is a member of LTU's Industrial Advisory Board. Then the student teams participated in a workshop presented by Professor Jonathan Weaver of UDM's Mechanical Engineering Department. This workshop allowed students to learn about the theory of creative problem solving and practice with problem-solving exercises.

In the evening, Mike Heneka, president of Faurecia North America based in Auburn Hills, Michigan, welcomed the students. Faurecia is a leading global supplier of automotive seating, interior systems, automotive exteriors, and emissions-control technologies.

Then Mike Twork and Dan Vander Sluis of Faurecia presented the problem statement that each team had to solve by 3 p.m. the next day. □ EP



Representing LTU at the Innovation Encounter were (L-R) students Dario DiPaola, Justin Becker, Nada Saghir, Dewight Moyer, and Tony Fakhouri.

BME professors give workshop on the entrepreneurial mindset

In another example of the growing impact of grants from the Kern Family Foundation, LTU Biomedical Engineering Assistant Professors Eric Meyer and Mansoor Nasir gave a workshop titled "Medical Leaps and Bounds" at the 2014 Thumb Education and Community Day Conference in Marlette, Michigan.



Eric Meyer

Local community, industry, and education participants learned how the entrepreneurial mindset is being fostered in college students through training that has been implemented in courses in the biomedical engineering program at LTU.

The workshop included group activities



Mansoor Nasir

to practice entrepreneurial skills in the engineering design process, including "Bisociation," which is an opportunity-recognition technique used to brainstorm ideas. Participants were

encouraged to apply the entrepreneurial mindset to their own professions.

The development of entrepreneurial mindset traits and tools has been made possible by LTU's close relationship with the Kern Entrepreneurial Engineering Network (KEEN) and long-term funding from the Kern Family Foundation.

"KEEN believes that entrepreneurship is a mindset and that the entrepreneurship pro-

cess can be formalized," Meyer explained.

Meyer and Nasir have been developing entrepreneurial skills modules for several courses in the biomedical engineering curriculum. They are using current, real-world opportunities created by the "Quantified Self" social movement to motivate students to practice entrepreneurial-minded learning techniques.

The "Quantified Self" examples were used to demonstrate how technology convergence and miniaturization in hand-held devices have made it much easier to measure and track personal health and wellness parameters. This movement is creating many opportunities to develop new devices, products, and services, including mobile apps. □ EP

LOOKING AHEAD

Mechatronics master's program covers all the basics of product design



James Mynderse

Assistant Professor James Mynderse, director of the mechatronics program in LTU's A. Leon Linton Department of

Mechanical Engineering. "Our goal is to provide students with a combination of classroom theory and hands-on experience."

LTU's approach to mechatronics reflects in the University's motto, theory and practice. Theory classes include dynamics, vibrations, control theory, and the integration of sensors and actuators with computer systems. Two laboratory classes provide students with experience developing an integrated electro-mechanical system and the required communication and engineering skills.

Another distinction of the LTU program is that it further extends the College of Engineering's emphasis on entrepreneurial education through problem-based learning and active and collaborative learning. Mechatronic Systems I, a lab course, challenges students to design, build, and demonstrate a robot that solves a real-world problem.

"Students are assigned the project during the second class period," Mynderse explained, "then we alternate lecture material with hands-on practice until the students have the skills needed to design their own robot."

Product development

Mechatronics experience and skill sets are especially important in a fast-paced and cost-conscious business environment. Shortened product cycle times and tighter profit margins require concurrent

Continued

Lawrence Technological University's master's degree program in mechatronic systems engineering was one of the first in the country, and it continues to grow as industry seeks more product designers with the right qualifications.

Mechatronic systems engineering is now well established at Lawrence Tech with 23 graduate students enrolled in the program during the 2015 spring semester. All the courses are taught in the evening because many students have full-time engineering jobs. These students typically spread their course work over two years.

Mechatronics is a multidisciplinary field that combines mechanical systems (thermal, fluid, dynamics), electronic systems (sensors, actuators, communications), computer systems, and control systems. Examples of mechatronic systems are becoming ubiquitous, rang-

ing from cell phones to robotic surgical systems.

LTU graduate student Zeran Gu (L) and adjunct professor Giuseppe Santangelo fly a spherocopter prototype in the Taubman Student Services Center at Lawrence Tech. In the background are graduate students Mark D'Angelo, BSME'14, and Cheng Zhang.

ing from cell phones to robotic surgical systems.

During the development of a new product, a mechatronics systems engineer may be responsible for the design of a mechanical system, the development of algorithms to operate specific mechanisms, and the integration of requisite sensors and actuators. Those assignments must be combined with an additional competency – the parallel design process that is replacing sequential design.

Theory and practice

"We're reaching the point where anyone doing product design has to know at least the basics of all four systems," said

development of mechanical, electrical, and software systems. The ability to communicate and resolve system integration issues early in the product development cycle reduces engineering resource requirements and potential product defects, thereby maximizing profitability and product quality.

Mechatronics graduate students can get directly involved in product develop-

ment while still taking courses. That's the experience of Zeran Gu, BSME '13, and Cheng Zhang, two graduate students who are working with Mynderse and Adjunct Professor Giuseppe Santangelo on the development of a spherical unmanned aerial vehicle (UAV).

Santangelo is the founder and CEO of Skypersonic that has developed a spherical UAV prototype called a spherocopter

that flies like a regular drone but can also roll along the ground because of its spherical structure. That unique shape also allows it to move inside large pipes. The spherocopter is scheduled to go into production this year.

Gu derived the mixer function to convert directional commands from the user into specific motor actions. He also worked on the electronics design of the spherocopter.

Zhang investigated the mechanical design and properties of the spherical surround.

Together with undergraduate student Atila Gracco da Silva, the team proved the feasibility of the proposed rolling mode and worked on the final software for the overall spherocopter.

According to Gu, his bachelor's degree in mechanical engineering at LTU has equipped him with the can-do spirit that enables him to continue to grow outside the classroom. "I know how hard it is to finish a project. However, even at the darkest hour, the spirit I gained at LTU allows me to see the light," Gu said. "Because I have done so many projects before at LTU, I know it is going to work at the end of the day."

With this positive attitude, Gu has been given many responsibilities as a part-time intern at Akebono. "LTU provided me with opportunities to apply knowledge into practice. That is why I can do so many projects and learn more from them," he added. □ EP

LTU students finish fifth at World Robot Olympiad

LTU robotics engineering students Phil Bigos and John Marnon have found that studying robotics engineering is a great way to see the world.

In the fall they represented the United States and traveled to the Olympic Village in Sochi, Russia, where they finished fifth in the college division of the World Robot Olympiad (WRO).

Teams from 50 countries competed this year, including 22 teams in the college division that was won by Taiwan.

In addition to an impressive showing, the two LTU students learned a lot about the world and met fellow robotics enthusiasts from almost every continent. That was especially true for the outgoing Bigos, who was easily recognizable in his American flag cape.

Many participants from other countries had their photos taken with Bigos, and more than 200 signed his cape. "Phil was the most popular guy there," Marnon said.

The college division competition was called "Mars Colony." Two opposing robots competed on the field in opposite directions to harvest and deliver different colored balls that represented minerals to be delivered to factories on the surface of Mars. A team's point total for deliveries made was modified by the time needed to complete the course.

The LTU seniors placed among the top eight teams that advanced to the final round. They had to write the new code and

make adjustments to their robot's sensors in response to last-minute changes in the field of play and other conditions.

Another challenge they faced was the requirement to use LabView, a coding language that is initially easier to read and therefore popular. But it's not the code they usually use and is also harder to use for complicated tasks, according to Bigos.

In May, Bigos and Marnon are scheduled to become the first two graduates of LTU's Bachelor of Science in Robotics Engineering program.

This is the first year that the United States competed at WRO. LTU Professor of Computer Science CJ Chung coordinated seven state tournaments and the national competition, held at LTU, for selecting the teams to represent the United States, which was held at LTU. Chung went to Sochi as the WRO-USA national organizer and also as the coach of the LTU team. □ EP



Robotics engineering students John Marnon (L) and Phil Bigos display the banner that acknowledged some of the sponsors for their trip to Sochi, Russia.



Lawrence Tech offers a head start for careers related to robotics

In 2011, Lawrence Technological University became the first university in Michigan – and only the second in the country – to offer a bachelor’s degree in robotics engineering. Four years later, the first cohort is preparing to graduate, and enrollment in the degree program has risen to 39.

LTU’s Bachelor of Science in Robotics Engineering is an interdisciplinary blend of mechanical, electrical, and computer engineering and computer science for students with a passion for robotics and automation. As part of the robotics engineering curriculum, students get extensive experience in base code programming, robot mechatronics, and mechanical design concepts.

All four Unified Robotics courses I through IV – have a lab component.

“What sets our program apart is that students get to implement what they learn in the classroom directly to robotic systems in the lab that they design and build from scratch,” said Associate Professor Giscard Kfoury, director of the robotics engineering degree program.

Students design, fabricate, assemble, and control their robots in the unique “tinker

lab.” In 2014, the A. Leon Linton Department of Mechanical Engineering opened its Prototyping Lab equipped with Tormach personal CNC mills and MakerBot 3D printers.



Robotics engineering students Mark Kenney and Kristin Jordan hold polylactic acid plastic parts for a quad copter that were printed on one of the Makerbot 3D printers in LTU’s Prototype Lab.



Mechatronics graduate students use both machines for their projects, and the Blue Devil Motorsports teams manufacture parts for their SAE competition vehicles.

Entrepreneurial dimension

Like most of the engineering curriculum at LTU, the robotics courses also have an entrepreneurial element. Sometimes students are asked to come up with a robot that can make life easier for a customer in a specific situation. They also must include marketing elements when they present the robots they design and build.

Developed with the input of leading robotics manufacturers in the metro Detroit region, the program maintains strong ties with the industry, providing students with important networking and employment opportunities. Almost every student has a job or internship in the field by the time they reach junior year, and many of those positions will lead to full-time employment and a promising career path following graduation.

For Mark Kenney, a junior in robotics engineering, an internship with the crash

safety team at Ford Motor Company is proving to be a perfect supplement to his education because it gives him the opportunity to apply what he has learned in the classroom.

Kristin Jordan is another junior with a work-study internship at Ford. She analyzes the performance of wheel-speed sensors and identifies improvements that can be implemented on these systems.

Junior Vince Nicolazzo has a full-time internship at Siemens. He uses digital manufacturing software to perform off-line programming and then downloads his program to a robot.

Freshman Adam Drotar already has obtained an internship as a software developer. “The coding classes required for robotics engineering have been very helpful,” he said □ EP

LTU Associate Professor Giscard Kfoury talks to students Adam Drotar, Mark Kenney, and Anthony Knapp about a robot they are building to perform a specific task.

STUDENT SOLUTION

The Bloomfield Hills company Reverie® produces high-end beds that are adjustable for maximum comfort and health. When the company decided to look at the possibility of introducing a chair with similar attributes, the R&D department turned to students at Lawrence Technological University.

The student team was asked to come up with a prototype for a motorized recliner that can attain a zero-gravity posture, which occurs when the torso is angled and the thighs and lower legs are raised above the heart. It's a position that takes pressure off the spine and relieves muscle tension throughout the body.

Reverie took advantage of LTU's Industry-Sponsored Projects (ISP) program that marries senior projects that are mandatory for engineering students with research projects for companies. The program gives companies access to LTU's testing and diagnostic facilities.

In exchange for paying all the expenses involved, companies retain the intellectual property that comes out of the research. Since the student teams are often working with proprietary information, the ISP program enables the client company to set guidelines for confidentiality. It's a high-quality, cost-effective way to conduct research or develop products.

Reverie asked the LTU students to design the zero-gravity chair utilizing the company's patented DreamCell™ mattress technology and the company's data for a range of body sizes.

The students had to design and construct a new frame that incorporates an electric motor and accommodates a Bluetooth solid-state control system. Most importantly, the design had to provide the



wide range of mechanical flexibility required to achieve a zero-gravity posture.

The company provided design review, feedback, and guidance on how to complete the project. The students achieved the project goals and met company deadlines and their own academic timetable in the fall semester of 2014.

Leo Vera, vice president for special operations at Reverie, said the university team was able to provide some pure research-and-development work that the company's staff didn't have time for. "We have a lot of urgent projects that we have to deliver to clients, and there's a lot of competition for staff time," Vera said. "There's not much time for the exploration of futuristic ideas, and working with

Lawrence Tech Associate Professor Vernon Fernandez (L) joins the students who worked on a research project for Reverie, Shaun Tait, Tom Stellmach, Alex King, and Alicia Mickler. Kneeling in front is Alex Campbell, a member of the team who has since been hired by Reverie.

the University gave us that opportunity."

Vera termed the chair a "blue ocean project," and there are no plans in place to take this product to market. "But the project generated some really good ideas that we will focus on and perhaps incorporate into our bed technology," Vera said.

The students' work might even result in a patent application.

Growing companies like Reverie also want to maintain contact with universities for recruitment purposes. In this case,

the company hired an LTU team member, Alex Campbell, for a full-time position as an electrical engineer.

The Industry-Sponsored Projects program is a logical outgrowth of Lawrence Tech's long-standing "theory and practice" philosophy. It also fits in with the strong emphasis on cultivating the entrepreneurial mindset, which is a major goal across the engineering curriculum.

Associate Professor Vernon Fernandez, coordinator of the ISP program at LTU for the past five years, said that many benefits emerge from the ISP projects. "Companies benefit by participating with academia, where new ideas are born, and

they benefit from getting their projects completed," he said. "Students benefit by being able to work on real-world projects and also by being exposed to profession-

als from industry and working toward their standards. Faculty also benefit from working with industry on current projects and applications." □ EP



New chapter formed

In 2014 a student chapter of the American Society of Mechanical Engineers was launched at Lawrence Tech. The officers are (L-R in the back) Ashley Lucas, secretary; Josh Piehl, president; and Matthew Brown, Student Government representative. In front are Afaf Saleh, vice president; and Sarah Hill, treasurer.

Students turn their senior project into a promising product

The opportunity to win a cash award to fund a senior project convinced two biomedical engineering students at Lawrence Tech to try for a provisional patent on an idea for a new medical diagnostic device.

As a result, Amanda Bukhtia and Kaitlyn Tingley are going well beyond the usual parameters set for senior projects to develop a prototype for a biosensor that could provide faster test results for methicillin-resistant *Staphylococcus aureus* (MRSA).

According to the National Institute of Allergy and Infectious Diseases, MRSA has evolved from a controllable nuisance into a serious public health concern, becoming one of the most common infections contracted during a hospital stay. Recently, new strains have emerged outside of hospitals that are capable of causing severe infections in otherwise healthy people.

This senior project got its start when Bukhtia and Tingley and other students preparing for the Coulter College competition (see story on page 32) visited an acute care unit for the elderly at Beaumont Hospital in Royal Oak.

The student team decided to pursue another product for the competition, but Bukhtia and Tingley were intrigued when one of the medical practitioners commented that the available tests for MRSA were too slow. A plate-based culture screening can take 48-72 hours to complete. A polymerase chain reaction test reduces the time to three to four hours, but involves an investment in equipment.

The students came up with a test for the MRSA infection using a microfluidic sensor that they believe will provide results in less than an hour. They also hope to eliminate some of the false positives that currently occur with the polymerase chain reaction test that can pick up other infections, whereas

their testing technique is specific to MRSA.

There are expenses involved in taking a senior project like this to the next level of product development. For the past several years a grant from the Kern Family Foundation has earmarked money to cover those expenses. Proposals are critiqued by a group of LTU engineering alumni, known as the Legends, who have experience with product development and entrepreneurial enterprises. Twice a year they select winners of the Legends Entrepreneurial Student Award (LESA).

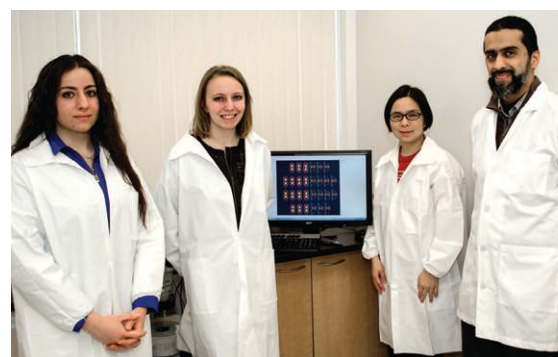
"Meeting with the LESA board got us motivated to do it right away," Tingley said. "We had to practice communicating and presenting our idea to people from different disciplines than ours."

A LESA interview includes some tough questions about a team's proposed product and development process, as well as friendly advice on how to get a product off the ground. The applicants benefit from the collective wisdom of alumni with many years of entrepreneurial experience. The LESA panel awarded the students a \$1,500 grant and in the process provided much more.

"We received great advice regarding product patents, funding, and marketing which will aid in the future outlook of our project," Bukhtia said. "The panel also volunteered to help us pursue our business-related goals."

Associate Professor Yawen Li was the faculty advisor for their senior project, and Assistant Professor Mansoor Nasir joined the team because he had prior experience with similar detection techniques.

The students needed to conduct testing in a lab equipped to handle Biohazard Level 2 bacteria, and Li was able to enlist the support of Professor Gregory Auner, a



Biomedical engineering students Amanda Bukhtia and Kaitlyn Tingley (L-R), have the support of two faculty members, Yawen Li and Mansoor Nasir, on their senior project. On screen is a possible configuration for their proposed biosensor.

collaborator on previous research projects at nearby Wayne State University. The two students received the necessary training to do their lab work at Wayne State after finishing their modeling and design work at Lawrence Tech.

When it is completed, their biosensor, which integrates electronics, mechanics, and chemistry, will be only two inches wide. The students are testing different configurations to see which one works best and how the design can be optimized.

Like most Lawrence Tech students who have internships or jobs in addition to their studies, Tingley and Bukhtia had to juggle their schedules to find time for research. One of the challenges they faced was figuring out what they could accomplish before the end of the spring semester when they will be graduating.

The next step will be a provisional patent to protect their idea for a year while they perfect their research to support a full patent application. Once again they will have to fit their research work into busy schedules since both have jobs lined up following graduation. □ EP

A Students tune into the technology that drives the music business

A former church in Plymouth is now a little bit of heaven for audio engineering technology students at Lawrence Technological University.

These students don't just learn how to twist knobs to make a rock band sound great. Expert instructors explain the electronics and circuitry behind the sound board, as well as the business part of making music.

The program is under the leadership of Kenneth Cook, chair of LTU's Department of Engineering Technology, who has been teaching at the University for an astounding 51 years, in addition to having a long and successful career as an engineer with stops at Beaumont Hospital, GTE, Trans Industries, and other companies.

"We add knowledge of microcomputers and microcontrollers to how to twist



Entertaining ENGINEERING

the knobs, so they learn what's behind the knobs – the engineering of sound, music theory, the music business, and electronics," Cook said.

There is a small training studio on campus, but the program found its perfect home thanks to a chance relationship with Chris Breest, who has worked as a recording technician and music writer for more than 15 years. He bought an old church in his native Plymouth and converted it into a state-of-the-art recording studio, now known as Plymouth Rock Productions.

Breest happened to chat with a Lawrence Tech faculty member on an airplane

bound for Los Angeles where he was working on sound for the X Games. "Six or eight months later, she called, and said, 'We're thinking of establishing a program in audio engineering, and I thought of you.'"

Now Breest handles the studio training for the program. He also has personal experience in curriculum development, having designed his own major in audio engineering during his college days at Western Michigan University. Experts in the field fill other roles – a former auto executive in charge of eliminating bothersome noise from auto interiors, Dieter Geist, teaches acoustics and systems

integration; a veteran musician teaches music theory; and Cook teaches a tough circuits class so students

understand how all that cool audio gear actually works.

"One of the things that really sets this program apart is that it's not attached to a music school, as most of them are," Breest said. "I think that makes those programs weaker on the technical side, and our program is much stronger on the technical side. We teach you not only how to cut a record, but acoustics, eliminating noise, vibration, and harshness, things that will provide you with a sustainable career path. We don't neglect the music side, but I think the big benefit is being part of such a prestigious engineering and technological school."

The maximum class size is 10, and students say they appreciate the personal attention.

Steven Pascoe of Southfield, a junior in audio engineering, said he considered majoring in physics at first, but the audio engineering program offered a way for him to combine science and the love of performance he gained in high school theater. Currently he's interning at a music publishing company, learning the legal and licensing side of the music business,



Students (L-R) Meshach Williams, George Kasmikha, and Mark Pisaneschi set up microphones for a recording session while instructor Ben Blau sits behind the drums.



LTU students Kai Schmidt (L) and Meshach Williams sit at the sound board at Plymouth Rock Productions as instructor Ben Blau points out some of the sound levels that can be adjusted.

and working with live sound at a coffeehouse. Employers are taking notice, too, especially the Farmington Hills office of the sound equipment maker Harman International, which has hired several graduates. There are also grads working at Panasonic's auto sound facilities in the Detroit area.

The main studio in the former church sanctuary is anchored by a nine-foot-long, 500-pound sound board that can handle up to 64 live inputs. There are expensive, high-quality microphones and speakers all around,

stacks of amplifiers, and a bewildering array of drums and other musical instruments.

Typical of the program is instructor Ben Blau, a lifelong musician who started his recording career at 15, and was formerly chief instructor at the Recording Institute of Detroit, where he worked from 1990 to 2001. He went on to develop a sound recording program at Schoolcraft College. He is in charge of the audio principles and advanced audio principles courses for the LTU program.

"What impresses me most about this program is the scope of the offerings," Blau said. "We're preparing students to function in many different areas, with a great balance between theory and practical applications, and between all the various categories of sound. Our students can train to be studio engineers, broadcast engineers; they can work in electronic music production, sound for pictures – TV, film, video games – industrial applications of audio engineering. They can apply their knowledge to automobiles and airplanes, improving the acoustical cabin experience for the passenger."

Kai Schmidt, a junior from Farmington, N. Y., agreed: "This program has you getting practice with the actual equipment versus just a lot of theory. It's very hands on."

Meshach Williams, a junior from Cologne, Germany, who learned about Lawrence Tech from a sister-school relationship with the English university he attends, said he's also impressed with the

program's technical side.

"I wanted to learn very technical audio skills, so I feel confident enough when I am using technical equipment that nothing surprises me, that nothing is too much for me," Williams said. "I knew that Lawrence Tech was a really renowned engineering school so I thought it would be a good place to learn this skill set." □ MNR

Audio engineering students worked on premium sound system as interns

A recent graduate of the audio engineering technology program and a senior are helping to promote the new premium audio sound system for the Mini Cooper that they worked on as interns at Panasonic Automotive Systems of America.



Katherine Wilbert, BSAET'14, and Alex Porchia, who will graduate with the same degree this May, were assigned to the Abbey Road project when they interned at the Panasonic facility in Farmington Hills, Michigan. The Panasonic team worked with audio engineers from the legendary Abbey Road Studios of Beatles fame to produce a premium sound system to be offered to the British Motor Corp., which makes the Mini Cooper.

The sound system was demonstrated at the North American International Auto Show in Detroit, and an agreement was later reached to make it available in the 2016 model of the Mini Cooper.

Wilbert and Porchia have been hired by Panasonic. They work on a number of projects in the company's audio and acoustics division, but have been asked to help promote the Abbey Road sound system they previously worked on.

Porchia emphasized that this is not a licensing agreement to put the Abbey Road name on a product developed by Panasonic on its own. Abbey Road audio engineers came to Michigan to help recreate the unique recording sound that was made famous by the Beatles album, "Abbey Road."

The studio continues to be used by many popular musicians and singers, including Adele.

The challenge with an automobile sound system is to properly tune it for a small space. Wilbert and Porchia were able to contribute to that process as interns because of the courses they had taken at LTU. For example, an audio engineer needs to understand how to read measurements of frequency response and signal amplitude in order to properly tune an audio system.

"My LTU degree prepared me with a lot of fundamental concepts that are very relevant to the industry," Porchia said. "You must have a really good understanding of audio technology in order to help create the next greatest audio solution for a vehicle." □ EP

Katherine Wilbert and Alex Porchia were at Motor City Mini in Southfield in March to answer questions about the Abbey Road premium sound system that will be available in the Mini Cooper later this year.

ITC establishes power engineering scholarship, internship

ITC Holdings Corp., the nation's largest independent electricity transmission company, based in Novi, has donated \$250,000 to Lawrence Technological University to establish the ITC Power Engineering Endowed Scholarship in LTU's College of Engineering.

It will provide a full-time student with half tuition each year, as well as a paid internship to increase the recipient's hands-on experience.

Power engineers develop, maintain, and modernize "the Grid," the vast network of transformers, generators, motors, and electronics that supply electrical power.

"As a corporation, we're also hoping to engage with Lawrence Tech in areas like academic programs, research initiatives, and industry collaboration as we look to provide students with real-world experience," said Joseph Welch, chairman, president and CEO of ITC, who joined LTU's Board of Trustees in 2014. "Supporting and encouraging top students to pursue power engineering as a career will only serve to strengthen and improve our company and our industry."

Thanks to a grant from the National Science Foundation, LTU also offers 10 scholarships of up to \$10,000 per year for two years to community college graduates to complete a bachelor's degree in electrical engineering with a power engineering concentration. □

Mechanical engineering alumnus awarded honorary degree

Successful entrepreneur A. Leon Linton, BSME'62, received an honorary degree and gave the address at Lawrence Technological University's 82nd commencement exercises in May 2014.

Linton founded Southern Systems, Inc. in 1968 to design, manufacture, and install conveyor systems, automation equipment, and electrical controls on a turnkey basis. The company serves manufacturers of heavy trucks, construction equipment, military tanks, oil field pipe, aircraft, furniture, and appliances.

He is one of Lawrence Tech's most generous supporters. In 2008, the University's Department of Mechanical Engineering was named in his honor, reflecting his outstanding professional contributions and support. He also is a member of LTU's Capital Campaign Steering Committee.

Linton attended night classes at Lawrence Tech while working in construction and installation of conveyor systems, machinery, and automation equipment.



Joseph Welch



A. Leon Linton received his honorary degree and citation from LTU Board of Trustees Chairman Lloyd Reuss (L) and President Virinder Moudgil (R) at LTU's commencement exercises in May 2014.

The three recipients of Lawrence Tech's Alumni Achievement Award were also from LTU's College of Engineering:

- Judith Curran, BSEE'83, the vehicle line director of Global CD Vehicles at Ford Motor Company.
- Elizabeth Howell, BSEE'92, a former vice president of ITC Holdings Corp., who now has a consulting business.
- Gordon Riske, chief executive officer of KION Group AG in Germany, which is the world's second largest manufacturer of forklift trucks and warehouse technology. He was an electrical engineering student at Lawrence Tech in the 1970s. □

Automotive industry courts LTU students

LTU engineering students learned about the growing opportunities in the automotive industry when MICHauto and the Detroit Regional Chamber hosted a program on campus in February entitled, "Discover Auto: Engineering Career Series."

The main speaker was Jeff Nichols, executive director of advanced technology integration and business development at American Axle & Manufacturing. A panel explained what it is like to work in the auto industry as a young engineer. The panelists were all LTU alumni: Brittany Forgue, BSME'08, of Nissan; Matthew Haggard, BSME'14, of American Axle & Manufacturing; and Nate Knaebel, BSME'08, of Lacks Enterprises.

Students also had the opportunity to network with representatives of American Axle, IAC, IAV, Lacks Enterprises, Nissan, Toyota Motor Corp., and Visteon. □



Answering questions about what it is like to work in the auto industry are (L-R) LTU alumni Nate Knaebel of Lacks Enterprises, Matthew Haggard of American Axle & Manufacturing, and Brittany Forgue of Nissan. The moderator is MICHauto Director Rob Luce.

Construction starts on new engineering facilities

In September 2014 Lawrence Tech broke ground for the new Taubman Complex, which will be the home of the Marburger STEM Center. The new building will provide advanced facilities for robotics engineering, biomedical engineering, life sciences, and several related programs.

The first phase is a 34,000-square-foot, three-story structure that has an estimated price tag of \$17 million and is scheduled for completion in time for the 2016 fall semester. It will be connected to both LTU's Science Building and Engineering Building at the southeast corner of the campus quadrangle.

The design architect is Thomas Mayne of California-based Morphosis, the architect of record is the Detroit-based Albert Kahn Family of Companies, and the general contractor is DeMaria Building Company of Detroit.

The building will create a collaborative learning environment that brings students and faculty closer together and to promote further interdisciplinary cooperation between LTU's Colleges of Engineering, Arts and Sciences, and Architecture and Design.

The first phase of the Taubman Complex will house the Marburger STEM Center named in honor of President Emeritus Richard Marburger. This academic center will be dedicated to coordinating a rigorous focus on teaching science, technology, engineering and mathematics – the STEM disciplines. In this case, the acronym STEM also stands for systems, technology, and educational mentoring.

The new building will be named for former LTU student A. Alfred Taubman, the retail pioneer and noted philanthropist who donated \$1 million to cover planning for the new building and offered a \$10 million challenge grant that has now been matched by over \$20 million in new pledges and cash for its construction. Taubman was among the speakers at the groundbreaking ceremony.

Subsequent construction phases should bring the structure to 125,000 square feet. As a private university, Lawrence Tech is funding the Taubman Complex entirely through the philanthropy of alumni, corporations, foundations, and other friends. □



The Taubman Complex will connect with LTU's Science Building at left as well as with the Engineering Building. It will be the home of the Marburger STEM Center.

Lawrence Tech places in top 100 for graduates' earning power

Lawrence Technological University is in the top 100 colleges and universities nationwide in the 2015 PayScale College Salary Report, which measures the earning power of college graduates.

The survey showed that LTU graduates with a bachelor's degree earned an average of \$58,300 early in their careers and \$97,600 by mid-career. The average mid-career salary for recipients of bachelor's degrees from LTU ranked 83rd among more than 1,000 colleges in the survey.

PayScale is a salary, benefits, and compensation information company. Its annual compensation survey of college graduates degrees is based on more than 1.4 million employee records.

For the first time, the PayScale College Salary Report also included salary data on graduates who go on to receive one or more additional degrees after receiving their bachelor's degree from the ranked schools. LTU ranked 90th in that section.

The PayScale survey documents that students get the best return on their college investment by majoring in science, technology, engineering, or math (STEM). More than half of LTU graduates (55 percent) included in the PayScale survey majored in STEM subjects, which was also true for most of the other high-ranking colleges. □



Education to veterans ranked high

Lawrence Technological University was ranked 18th in the 12-state Midwest region – and first in Michigan – in the inaugural ranking of the best colleges for veterans compiled by *U.S. News & World Report*. LTU was one of 234 colleges nationwide that scored well for graduation rate, faculty resources, reputation and other markers of academic quality measured in the 2014 edition of "Best Colleges" from *U.S. News & World Report*.

In addition, LTU's online master's degree programs in engineering were ranked 17th in the country in the 2014 *U.S. News & World Report* survey of the best online college programs for veterans.

LTU's College of Engineering offers online master's degrees in engineering management and industrial engineering.

"Lawrence Tech's academic programming has always been designed to accommodate nontraditional students such as returning veterans," said LTU's College of Engineering Dean Nabil Grace. "In recent years we have built a strong foundation for our online programs in engineering."

LTU is also on the 2014 Military Friendly Schools list compiled by Victory Media, the publisher of *G.I. Jobs* magazine. □



College of Engineering moves up in U.S. News rankings

LTU's College of Engineering moved up significantly in the rankings of best undergraduate programs for engineering, while overall the University continues to be ranked among the best in the region in the 2015 edition of *U.S. News & World Report Best Colleges*.



The College of Engineering went from 41st last year to 23rd in the latest rankings for the entire country. The *U.S. News* engineering rankings are based solely on the judgments of deans and senior faculty at peer institutions.

LTU also remains in the top half of the top tier in the *U.S. News* 12-state Midwest Regional University 2015 rankings for best colleges. □

Henry Ford Trade School Alumni Association creates engineering scholarship fund

The Henry Ford Trade School Alumni Association has donated \$750,000 to create an endowed scholarship fund for undergraduate mechanical engineering students at Lawrence Technological University.

The donation is among the top 10 largest gifts ever received by LTU to establish an endowed scholarship, and the largest from an organization. Interest income from the endowment will provide need-based scholarship assistance to recipients.



A check representing a \$750,000 endowed scholarship for mechanical engineering students is displayed by Lawrence Technological University President Virinder Moudgil (L) and John Graf, president of the Henry Ford Trade School Alumni Association.

“Through this permanent fund, we will perpetuate and celebrate Henry Ford’s legacy in education and create new generations of highly skilled engineers who are so essential to sustaining American ingenuity and economic leadership,” said John J. Graf, president of the Henry Ford Trade School Alumni Association.

The Henry Ford Trade School opened in 1916. The curriculum emphasized the mechanical arts leading to apprenticeships and journeyman status in the skilled trades, but also included standard high school subjects. The school produced 8,000 graduates prior to closing in the 1950s.

When Lawrence Tech was founded in 1932 on Ford Motor

Company’s campus in Highland Park, one of the first acts of LTU founder Russell Lawrence was to create a scholarship fund to attract Trade School graduates.

Numerous Ford Trade School alumni went on to earn Lawrence Tech degrees. One of those graduates, William D. Innes, advanced to executive vice president at Ford and led North American operations in the 1970s. Another was Lewis C. Veraldi, Ford’s vice president of product and manufacturing engineering, who oversaw development of the Taurus, the best-selling car in America for many years. □

LTU ranked 18th for online master’s degrees in engineering

The online graduate school guide, “Best Master’s Programs,” has ranked Lawrence Technological University 18th in the top 50 nationwide for online master’s degrees in engineering.



The rankings, which can be viewed at www.bestmastersprograms.org, are based on an equal weight of program quality, as measured by *U.S. News & World Report*, and estimated program cost.

“Savvy prospective graduate students want to know where to go to get the best bang for their buck, and this ranking effectively evaluates which engineering schools are doing the best job of balancing cost and quality,” said Michelle Rindy, who helped compile the ranking.

LTU offers online master’s degrees in industrial engineering and engineering management.

“Choosing to complete your engineering degree online offers flexibility on a number of levels, allowing you to get the education to advance in your field, without actually having to leave the field to do it,” Rindy said.

The “Best Master’s Programs” website publishes rankings and information about the top programs in popular fields, as well as career and salary information. □

On display at the Auto Show in Detroit



Nicholas Pakledinaz, team leader of LTU’s Formula Hybrid team, answers questions from visitors to the Lawrence Tech exhibit at the North American International Auto Show held in Detroit in January. Student work from LTU’s transportation design bachelor’s degree program was also on display.

Faculty **Achievements**

Gerhart facilitates summer camp for engineering students

With support from the Kern Entrepreneurial Engineering Network, for the past three years LTU Associate Professor Andy Gerhart has worked closely with The Henry Ford in nearby Dearborn to develop and administer week-long summer enrichment programs for undergraduate engineering students from around the country.

For almost a century, The Henry Ford has been chronicling the accomplishments of innovators and entrepreneurs, and recently has been the home of the public television series, “Innovation Nation,” narrated by Mo Rocca.

Students in multiple engineering disciplines have attended the summer camps, coming from a dozen universities across the U.S., including Baylor, Gonzaga, Santa Clara, and Boston.

Throughout the week, the students explored the core competencies of creativity and innovation through activities and games, and they studied and implemented various methods of creative problem solving through teamwork on various problems and product development projects/tasks.

Two of the five weekdays were spent visiting The Henry Ford. The students toured the Ford F-150 truck assembly plant and participated in a college-level version of The Henry Ford’s Innovation 101 curriculum at the Benson Ford Research Center. □



Engineering undergrads from around the country have come to Lawrence Tech and The Henry Ford for a summer enrichment program led by LTU Associate Professor Andy Gerhart (at right in the back row). In front of him is Paula Gangopadhyay, the chief learning officer of The Henry Ford.

International industrial engineering conference fills a gap and keeps growing

Associate Professor Ahad Ali is a firm believer in networking and keeping up with best practices in industrial engineering and related fields. Yet five years ago he couldn’t find a single industrial engineering professional in his home country of Bangladesh.

When he checked in other countries in South Asia and the Middle East, the results were also discouraging. “There were 15,000 members of the industrial engineering profession



Ahad Ali

in the United States, but in many other countries there were almost none,” Ali said. “We saw a need and decided to do something about it.”

In 2010, he organized and chaired the international conference on Industrial Engineering and Operations Management (IEOM) in Dhaka, Bangladesh. Since then it has been held in Malaysia in 2011, Turkey in 2012, Indonesia in 2014, and Dubai in March of this year. Attendance has grown from around 100 at the first conference to close to 500 at the 2015 conference.

Ali continues to organize and run the conference with help from Lawrence Tech staff on finances and the website. This year four LTU students accompanied him to Dubai to help manage a myriad of details.

Along the way, Ali has developed a database of more than 50,000 people, of which half are students. A professional society has been created, and now there are plans to publish a journal.

Rapid development in this part of the world is creating unique challenges for the engineering community. “There are different levels of readiness of engineering graduates from various parts of the world,” Ali noted. “We are providing a special focus on best practices in industrial engineering and manufacturing engineering, including engineering management.”

Ali is director of LTU’s master’s degree programs in industrial engineering and manufacturing systems. He is also the director of the Smart Manufacturing and Lean Systems Research Group. His research partners include Chrysler, Ford Motor Company, DTE Energy, Delphi Automotive Systems, and Harley-Davidson Motor Company. □

LTU helps DTE develop agricultural energy-efficient incentives

Research from Lawrence Technological University has been used to shape some of the agricultural energy-efficiency incentives instituted by DTE Energy. Michigan’s agricultural community can apply for cash incentives to help pay for equipment upgrades that lower electricity usage, including irrigation systems, refrigeration, grain dryers, and components for greenhouse and dairy operations.

The LTU research project commissioned by DTE Energy, Michigan’s largest utility company, was led by Associate Professor Robert Fletcher of the A. Leon Linton Department of Mechanical Engineering, with assistance from six engineering students working both on campus and at the Michigan Agricultural Commodities (MAC) facility in Marlette, Michigan.

MAC, which also has facilities in eight other Michigan



Robert Fletcher

Continued

Faculty Achievements

communities, is a private farming co-operative-type company that buys, sells, stores, and distributes agricultural commodities such as corn, wheat and other grains, dry beans, and edible soya beans.

As part of a year-long project, Fletcher and the students established a data acquisition capability for power and energy use, and then tested various grain-drying fan systems both with and without the use of variable-frequency drive power controls.

The LTU research team quantified the energy savings potential of variable control systems under a spectrum of well-controlled operating conditions, thus providing an accurate reference for possible energy savings for grain storage bins and silos fans. These quantified energy savings were then used to project energy savings on a larger scale for the MAC facilities and operations.

“What we have learned as a result of our project can smooth out the utility demand in a rural area like Marlette,” Fletcher said. “Furthermore, the MAC Marlette facility will see an economic benefit by sizably reducing its energy use.”

In rural areas, Fletcher explained, the utility grid is typically widely spaced and, in some instances, at the limits of its distribution capability. As a result, any kind of power interruption or excessive demand at a facility like the MAC Marlette facility could interrupt energy distribution on the utility grid. □

LTU faculty named ESD Fellows

Lawrence Tech Professor Badih Jawad and Instructor Filza Walters were named to the College of Fellows of the Engineering Society of Detroit (ESD) at the annual benefit dinner at Detroit’s Cobo Center in June 2014. Members of ESD’s College of Fellows must display outstanding and extraordinary qualifications and experience in their profession.

Jawad is chair of the A. Leon Linton Department of Mechanical Engineering, and Walters is director of the combined bachelor’s and master’s degree program in architectural engineering.

A member of ESD since 1986, Jawad currently serves on the Membership Ambassador Council and has been active in recruiting students to join ESD and in nominating LTU students to receive ESD awards over the years.

A member of ESD since 2009, Walters is a member of the ESD Affiliate Council and has served as chair for two terms. She also serves on the ESD Editorial Board and has been a mentor and judge for the Future City Competition, and a speaker at the ESD/DTE Energy Conference.

Also named to the College of Fellows this year was LTU alumnus Kirk Stuedle, BSCE’87, the director of the Michigan Department of Transportation. □



Badih Jawad



Filza Walters

Arslan wins Marburger Award

Assistant Professor Selin Arslan of LTU’s A. Leon Linton Department of Mechanical Engineering was the faculty winner at the Mary E. and Richard E. Marburger Fund for Excellence in Achievement Awards for 2014.

Arslan is a native of Turkey who earned her PhD from Columbia University in New York City. Since joining the LTU faculty in 2010 she has consistently received outstanding evaluations from her students. She is known for excellent lectures that are made more engaging by a bit of humor.

She advises doctoral and master’s students, conducts research, and serves as director of the Master of Science in Mechanical Engineering degree program. Recently she helped revitalize the LTU student chapter of the American Society of Mechanical Engineers (ASME).

Arslan has also made a significant contribution to LTU’s Industry Sponsored Projects initiative, having undertaken three projects. One of the projects was sponsored by Toyota for two semesters.

Although a junior faculty member, Arslan has a very impressive track record of publishing nine peer-refereed papers, two of which appeared in professional journals. She presented at the ASME IMECE 2012 Congress and Exposition and the SAE World Congress 2013.

One student said, “Dr. Arslan was amazing at making things easy to understand while still being very comprehensive. She was extremely knowledgeable in her field and was always able to answer any question that I or the class had. ... She is very friendly and approachable and makes class enjoyable with her teaching style.” □

Lobbestael joins LTU engineering faculty

Adam Lobbestael has joined the faculty of LTU’s Department of Civil Engineering as an assistant professor. His areas of expertise include soil mechanics, slope stability, soil-structure interaction, and numerical modeling.

He recently completed his PhD in civil and environmental engineering (geotechnical) at the University of Michigan, Ann Arbor, where he also earned bachelor’s and master’s degrees in the same field.

In his doctoral research, he used advanced numerical modeling to characterize the dynamic response of earthen levees with cutoff walls. He also investigated the use of a high-performance fiber-reinforced cementitious composite for use in levees in seismic regions.

Lobbestael is the faculty advisor of LTU’s team in the national GeoWall competition. (See page 34.) □



Selin Arslan



Adam Lobbestael

Alwerfalli named to second workforce education committee

Following his nomination by the Michigan Economic Development Corp. (MEDC), LTU Mechanical Engineering Professor Daw Alwerfalli is serving on the Workforce and Education Working Group of the Lightweight Innovations for Tomorrow Group (LIFT), which was formed in 2014 in conjunction with a \$140 million federal grant to support manufacturing education in Michigan.



Daw Alwerfalli

The group includes experts in manufacturing from the University of Michigan, The Ohio State University, and Edison Welding Institute, an Ohio technology innovation nonprofit.

The working group oversees the development and application of cutting-edge lightweight metals and smart materials for future cars, trucks, and airplanes, as well as lighter and stronger vehicles for the military and industry with better performance and fuel efficiency.

For the past three years Alwerfalli has served on the MEDC steering committee for Michigan Advanced Technical Training, known as the MAT2 coalition. The steering committee includes CEOs of German manufacturing companies with U.S. operations based in Michigan who are supporting MEDC in adopting the German Dual Education Systems for vocational training at the community college level.

Henry Ford College, Macomb Community College, Oakland Community College, Mott Community College, and Wayne County Community College District are all involved. Alwerfalli is the lead assessor of the readiness of these community colleges to join the MAT2 coalition. □

Carpenter wins Teaching Using Technology Award

Civil Engineering Professor Donald Carpenter was the 2014 recipient of the Teaching Using Technology Award at Lawrence Tech.

Carpenter designed a stormwater trail on campus to demonstrate various techniques for reducing and filtering water runoff. Subsequently, he developed a virtual stormwater trail with informational videos that describe the various stormwater management techniques that can make watersheds more sustainable.

The short videos and descriptions may be accessed through QR codes posted on the tour signage. Visitors can interact with the trail using their smart phones or tablets. There is also an interactive tour booklet online.

The tour can be viewed entirely online at www.ltu.edu/water/tour.asp and www.ltu.edu/lid/sample.asp.

The tour references techniques used in civil engineering, architecture, and urban design. It promotes the value of an LTU education through its outreach to high schools and

government agencies and nonprofits interested in preserving a sustainable water supply, LTU Provost Maria Vaz noted in presenting the award.

“This hybrid and virtual tour engages students outside the traditional classroom and allows for just-in-time learning engagement,” Vaz said. □



LTU President Virinder Moudgil and Provost Maria Vaz congratulate Professor Donald Carpenter for winning the Teaching Using Technology Award.

Hua helps organize MobiMedia conference in China

Assistant Professor Kun Hua is the workshop and tutorial chair for the eighth International Conference on Mobile Multimedia Communications (MobiMedia) to be held at Southwest Jiaotong University in Chengdu, China, in May.

MobiMedia will address subjects related to the successful acquisition, processing, transmission and delivery of multimedia content where the mobility of the users is a key feature. It will provide an international forum where industry, researchers, and academia can interact and exchange experiences, ideas, and research results.

The event is endorsed by the European Alliance for Innovation, which is devoted to the advancement of innovation in the field of information and communications technology, known as ICT. All accepted papers will be published by the Association of Computing Machinery.

In addition, Hua has recently served as the guest editor of three special issues of the *International Journal of Distributed Sensor Networks*. □



Kun Hua

Promoting entrepreneurial education in India

Former LTU Dean of Engineering Devdas Shetty (center) and LTU's Don Reimer (second from right) were speakers at a workshop and symposium on creative product design held at Chandigarh University in India in July. At left is Satbir Singh Sehgal, dean of research in Chandigarh University's Mechanical Engineering Department, and at right is the university registrar, D.S. Cheema.



Student **Achievements**

Lawrence Tech finishes second again in Formula Hybrid competition

For the second year in a row Lawrence Technological University's student team finished second in the Hybrid Drive Class of the 2014 Formula Hybrid International Competition held at the New Hampshire Motor Speedway in Loudon, New Hampshire.

LTU finished first in the autocross race and second in endurance race. The team ended up with 253.63 points, just behind the University of Idaho in the 12-team Hybrid Drive Class for vehicles that can run on both gasoline and electricity. Dartmouth College won the seven-team Electric Drive Class.

Lawrence Tech could have overtaken Idaho with two more laps in the endurance race, but fell short when the spokes on the right rear wheel broke after 16 laps, putting the LTU vehicle out of commission.

"This is a great competition, and we love being part of it. This year we came very close to taking it all," said LTU Associate Professor Rob Fletcher, the team's faculty advisor. "We were dealing with electrical issues right up to the driving events."

Dartmouth College and the University of Vermont finished first and second, respectively, in the Electric Drive Class. LTU crossed the finish line first when it went up against those two teams in the autocross competition and also finished ahead of them in the endurance race, which was won by the University of Michigan.

The Formula Hybrid competition sets a very high standard for racing. Only five of the 21 teams in the two divisions



Members of the LTU Formula Hybrid team are (L-R in the back row) faculty advisor Robert Fletcher, Matthew Haggard, Zach Ketner, San Wong, Donald Henderson, Joe Polizzi, Joe Falzon, Nicholas Pakledinaz, Matt Moyer, Jared King, Dan Victorson, and Jim Cass. In front are Adam Tallman, Johnny Agrusa, and Eric Onan. (Missing: Ryan Tietz)

answered the bell for the endurance race finale. Yale University, which edged out LTU for first place in the Hybrid Drive Class last year, failed to make it around the track and finished fourth this year.

"This is a very hard competition. Some teams that I talked to don't plan on coming back," Fletcher said. "But this is where I want our team to be. We want it to be tough. That is what makes it such a fantastic competition."

The Formula Hybrid International Competition for college students was founded by the Institute of Electrical and Electronics Engineers, SAE International, and the Thayer School of Engineering at Dartmouth. □

Concrete canoe team improves



Lawrence Tech's paddlers pull ahead of Michigan State in one of the heats of the 2014 North Central Conference concrete canoe competition sponsored by the American Society of Civil Engineers. LTU narrowly missed qualifying for the national competition, finishing second in aesthetics, third in the actual race, and fourth overall. LTU also won the sportsmanship award for offering assistance to the University of Toledo team when its canoe broke in transit. From left to right in the canoe are LTU engineering students Kyle Schmidt, Alyse Finley, Alida Toth, and Jordan Britz.

LTU student team finishes third in Coulter College competition

A team of six biomedical engineering students from Lawrence Tech finished third among 19 universities and also won the People's Choice Award at the fifth Coulter College workshop for the development of biomedical devices.

Coulter College is a training program for the process of translating biomedical innovations into viable products. Collegiate design teams are guided by faculty and clinical experts through a highly dynamic process that helps them better understand how to identify innovations that can meet clinical needs and then gain financial support for the product development process.

The Biomedical Engineering Society held the program in August in Coral Gables, Florida, with support from the Wallace H. Coulter Foundation. Topics covered at the workshop included intellectual property protection, regulatory strategy, reimbursement codes, and working with technology transfer offices and funding sources.

"This workshop gives teams of students the opportunity to experience the entire process of finding an unmet clinical need to formulating a solution and then pitching it in front of venture

capitalists,” said LTU Assistant Professor Mansoor Nasir, the team’s faculty advisor.

The Coulter College workshop drew teams from Syracuse, Columbia, Georgia Tech, the University of North Carolina at Chapel Hill, and the University of Illinois at Champaign-Urbana, which took first place in the competition.

This was the LTU students’ first year at the competition. The teams were given advance assignments and were asked to identify three unmet medical needs. LTU’s team toured an acute care unit for the elderly at Beaumont Hospital in Royal Oak and interviewed medical practitioners about what would make their work easier.

Subsequent market research revealed that the original idea the students were planning to present, a walking aid device for low light conditions, was not unique. So during the workshop they modified their idea to provide walking assistance to patients with Parkinson’s disease.

“I am proud of the students. Their idea was elegant and the presentation was clear, confident, and articulate.” Nasir said. “Competition aside, I think the experience the students got through Coulter College will really help them during their senior projects and their professional careers.” □



Representing Lawrence Tech at the Coulter College competition in Florida were (L-R) LTU faculty advisor Mansoor Nasir, Danielle Manley, Akram AlSamarae, Kaitlyn Tingley, Mateusz Koper, Amanda Bukhtia, Stephen Krammin, and faculty advisor Molly McClelland, an associate professor at the University of Detroit Mercy.

LTU wins national award in architectural engineering competition

A team from Lawrence Technological University was the winner in the integration category of a national student design competition sponsored by the Architectural Engineering Institute (AEI) of the American Society of Civil Engineers.

The Charles Pankow Foundation Annual Architectural Engineering Student Design Competition was held at the AEI’s annual student conference in Philadelphia in March 2014. It attracted top students from the country’s leading architectural engineering programs.

Lawrence Tech took first place in integration, the only required category in the competition. The team also earned

two runner-up awards in the optional categories of mechanical design and electrical design.

This year’s challenge was to address the design, integration, and construction issues for a high-rise office building in San Francisco. Students worked in multidisciplinary teams to integrate the engineered systems with the building’s architecture while emphasizing sustainable design. The competition encourages collaboration, research, innovation, and peer review.

“The student teams did an extraordinary job highlighting the important role of architectural engineering in the industry as a whole. Using critical thinking and creativity, the students demonstrated the bright future this specialty has in the profession,” said Kenna Chapin, chair of the ASCE Charles Pankow Foundation Annual Architectural Engineering Student Design Competition.

The Pankow competition calls into play many of the practices that students have studied in LTU’s five-year master’s degree program in architectural engineering, which has an architectural design core along with the engineering curriculum. This multidisciplinary approach places emphasis on optimizing building design through the integration of engineered systems. Lawrence Tech’s program is one of about two dozen in the country.

The nine participating students formed the first cohort of the LTU program and received master’s degrees in May 2014. Almost all of the students already had full-time or part-time jobs in the field.

The LTU students entered the Pankow competition as their master’s degree capstone project. They set up three-person teams to focus on the electrical, structural, and mechanical parts of the design process. Through an intense collaborative effort, all team members contributed toward the winning entry in the integration category.

“These awards recognize the talents and caliber of our students and are a testament to their academic preparedness. Since the inception of our five-year master’s program, we have had the goal of exceeding the established programs around the world,” said Filza Walters, director of LTU’s architectural engineering program. “The level of innovation, professionalism, and poise our students have attained is now being recognized.” □



Members of LTU’s team that took first place in the main category of the Pankow architectural engineering competition are (L-R in the back row) Kevin Lambert, Breanne May, Zachary Lahrman, Michael Paciero, and Michael McMurphy. In the front are Rachel LaCasse, Francesca Montana, Elizabeth Ozzello, and Timothy Truitt.

Student Achievements



KEEN conference

LTU civil engineering major Justin Becker won an award from the Kern Entrepreneurial Engineering Network (KEEN) for the video he put together on KEEN's influence on campus. His prize was a trip to Tempe, Arizona, to attend the KEEN winter conference and meet Jamie Hyneman (L), a special effects expert and co-host of the television series, "MythBusters." At right is Doug Melton, KEEN's program director.



Competing north of the border

For the second year in a row Lawrence Technological University was the only American team to compete in the 2015 Great Northern Concrete Toboggan Race held in Kelowna, British Columbia. Having recorded the second fastest time the previous year, the LTU racers were a little disappointed when their toboggan didn't perform as well in the rainy and foggy conditions on race day. But being the only American entry in a 17-team field was an accomplishment in itself.

New LTU team advances to GeoWall national finals

LTU's inaugural GeoWall team will compete as one of 20 finalists at the national level during the 2015 International Foundations Congress and Equipment Expo.

GeoWall is a national student competition sponsored by the Geo-Institute of the American Society of Civil Engineers. College students must design and build a model of a mechanically stabilized earth-retaining wall using paper reinforcement. Each team submits a report on its wall design based on background research and laboratory testing.

At the national competition each team has a time limit in which to complete three phases: wall assembly, construction, and loading. Teams lose points if they do not stay within all parameters.

The team members are Kimberly Klieber, Christopher Bragg, Jeffery Mannor, Lauren Gersch, and Raymond Pruitt. The faculty advisor is Assistant Professor Adam Lobbestael. □



LTU GeoWall team members Raymond Pruitt (L) and Lauren Gersch prepare parts of a wall for one of many time trials in advance of the national finals.

Arab American engineers support LTU students



Farah Anoni (third from left) was one of two Lawrence Tech students to receive scholarship support for the 2014–15 academic year from the Michigan chapter of the Arab American Association of Engineers and Architects. Joining her at the award presentation were several other LTU students and Civil Engineering Assistant Professor Mena Bebawy (R).

Student Awards

Outstanding Member of a Student Organization

American Society of Civil Engineers:
Architectural Engineering Institute:

Biomedical Engineering Society:
Blue Devil Motorsports:
CEO:
Institute of Electrical/Electronic Engineers:
Paul Michel Award:
SAE Collegiate Chapter at LTU:
Society of Women Engineers:

Alpha Eta Mu Beta Honor Society:
Chi Epsilon Honor Society:
Eta Kappa Nu Honor Society:
Phi Alpha Epsilon Honor Society:
Pi Tau Sigma Honor Society:
Tau Beta Pi Honor Society:

Kimberly Klieber
Chris Fazzalare and
Israel Ortiz
Daniel Greenshields
Robert Gandolfo
Rodrigo Mesquita
Brian Podczervinski
Arthur Connor
Seth Johnson
Christina Harkiewicz

Justin Killewald
Ashley Meade
Eli Cromwell
Steven Gunther
Michael Abramson
Michael Abramson

Outstanding Service Award

Architectural Engineering:
Biomedical Engineering:
Civil Engineering Concrete Canoe/Toboggan:
Civil Engineering Concrete Toboggan:
Electrical & Computer Engineering:
Mechanical Engineering:

Engineering Technology:

Nada Saghir
Dylan McEvelly
Jordan Britz
Felicia Koch
Mark Ahem
Adam Tallman and
Emily Theisen
Autumn Boehm



College of Engineering Dean Nabil Grace (R) congratulates Tomas Horne, BSET'14, during the annual "ring ceremony." Most LTU students join in the Order of the Engineer as they prepare to graduate.

Academic Excellence Award

Architectural Engineering:
Biomedical Engineering:
Civil Engineering:
Computer Engineering:
Electrical Engineering:
Mechanical Engineering:
Engineering Technology:
Civil Engineering/Architecture Degree:

Farah Anoni
Michael Diccio
Terry Fahey
Eric Beyer
Eric Onan
Colin Holzman
Lori Allison
George Grzywacz and
Shantel Miller

Outstanding Student Award

Architectural Engineering:
Biomedical Engineering:
Civil Engineering:
Electrical & Computer Engineering:
Mechanical Engineering:

Engineering Technology:

Mike Paciero
Stephen Osterhoff
Shantel Miller
Anqi Du
Stephen Werner and
Sean Concienne
Raid George



The LTU chapter of Tau Beta Pi held an induction ceremony in April 2014. In the back row (L-R) are faculty advisor Lewis Frasch, Christopher Fazzalare, Jonathan Slater, Jordan Britz, and President Michael Abramson. In the front are faculty advisor Lisa Anneberg, Hollie Wall, Farah Anoni, Bhavika Patel, Past President Emily Theisen, Jacob Richter, and faculty advisor Philip Olivier.

By the Numbers

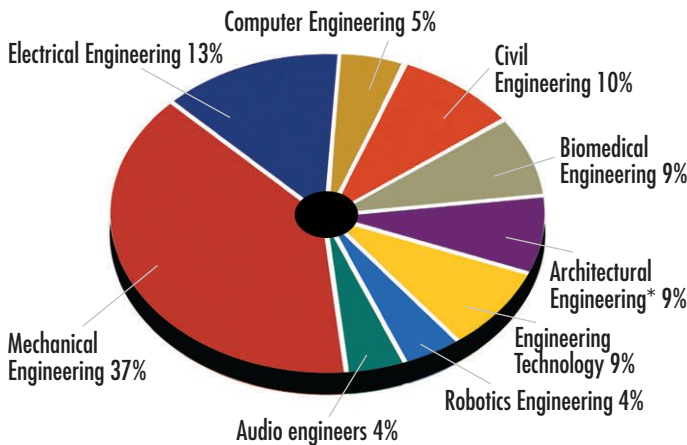
A statistical snapshot of LTU's College of Engineering and the Southeastern Michigan region.

The Southeast Michigan region is one of the nation's top technology centers:

- 1st in advanced automotive sector jobs and businesses
- 1st in architectural and engineering jobs
- 1st in degrees in science and engineering technologies
- 2nd in share of workforce in technology – 14.4 percent
- 2nd in engineering degrees
- 2nd in life science jobs
- 3rd in STEM degrees earned
- 4th in technology industry jobs – 242,520

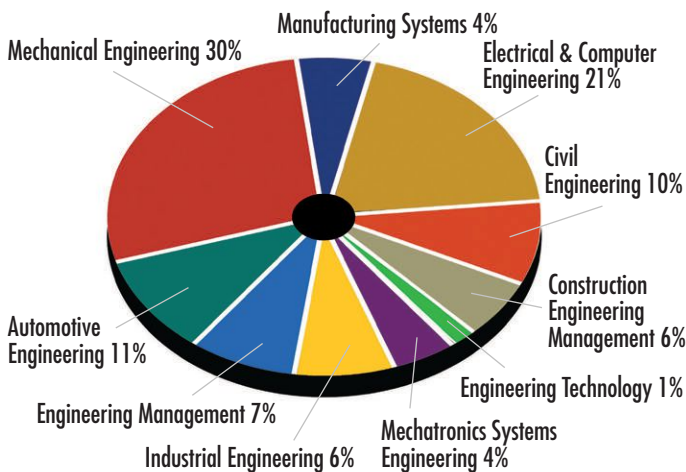
Source: Anderson Economic Group for Automation Alley, 2015

2014 undergraduate enrollment by major (926)

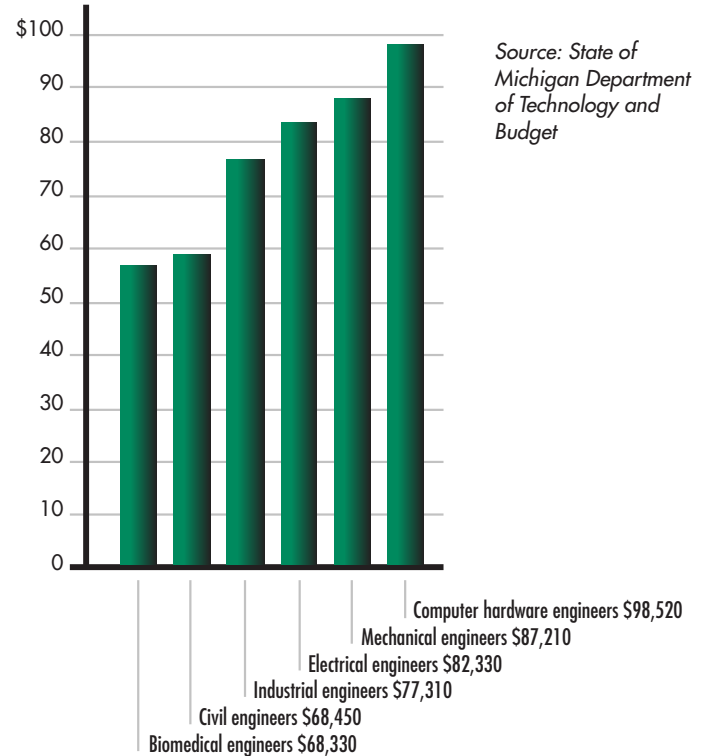


* Five-year program resulting in a master's degree

2014 graduate enrollment by major (592)

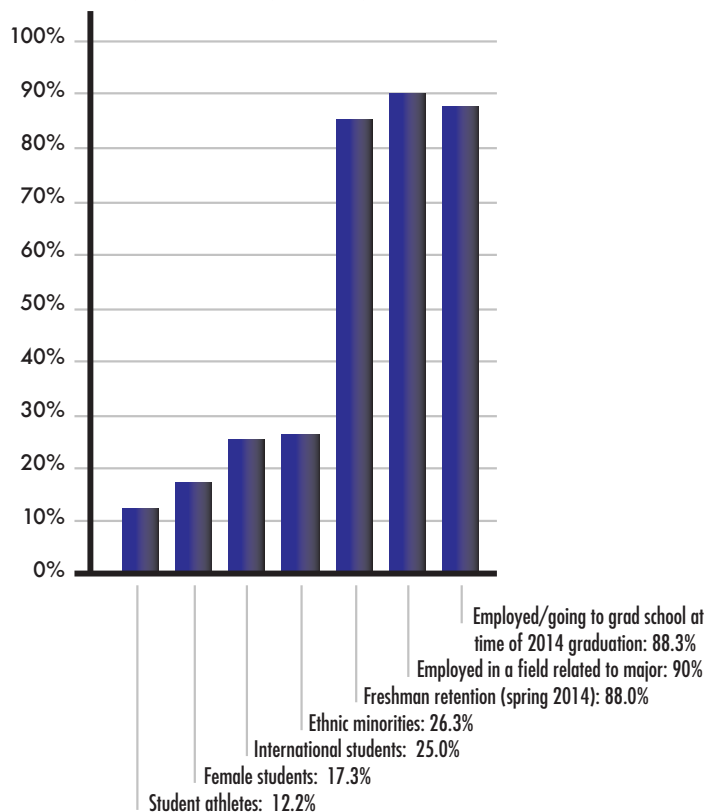


Median engineering salaries in Michigan, 2013



Source: State of Michigan Department of Technology and Budget

LTU undergraduate engineering majors for 2014



Opportunities in Engineering at Lawrence Tech

Lawrence Technological University offers a wide range of engineering programs at its campus in Southfield, MI. For more information, contact the Office of Admissions at 800.225.5588 or admissions@ltu.edu, or visit ltu.edu/futurestudents.

Associate

Construction Engineering Technology
Manufacturing Engineering Technology

Bachelor's

Audio Engineering Technology
Biomedical Engineering
Civil Engineering
Computer Engineering
Construction Engineering Technology and Management
Electrical Engineering
Electrical Energy Systems
Electronics Engineering
Embedded Software Engineering
Industrial Operations Engineering
Mechanical and Manufacturing Engineering Technology
Mechanical Engineering
Alternative Energy
Automotive
Manufacturing
Nanoscience and Nanotechnology
Solid Mechanics
Thermal Fluids
Robotics Engineering

Master's

Architectural Engineering (combined bachelor's and master's programs)
Automotive Engineering
Biomedical Engineering
Civil Engineering
Construction Engineering Management
Electrical and Computer Engineering
Engineering in Manufacturing Systems
Engineering Management*
Engineering Technology
Fire Engineering
Industrial Engineering*
Mechanical Engineering
Mechatronic Systems Engineering

Doctoral

Civil Engineering
Engineering in Manufacturing Systems
Mechanical Engineering

Minors

Aeronautical Engineering
Energy Engineering
Nanoscience and Nanotechnology

Undergraduate Certificates

Electrical Power Systems
Embedded Systems
Entrepreneurial Skills

Graduate Certificates

Aeronautical Engineering
Energy Engineering
Fire Engineering
Telecommunications Engineering

**Also offered online*

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Governor returns to campus to pitch better road funding

Michigan Gov. Rick Snyder and Transportation Director Kirk Steudle, BSCE'87, returned to LTU's Center for Innovative Materials Research (CIMR) in December 2014 to make the case for additional funding for road repairs.

Two years earlier Snyder also chose CIMR as the backdrop for his ambitious proposal for new revenue sources to support more than \$1 billion in additional road work annually. The Legislature has scheduled a constitutional referendum in May when voters will be asked to approve a complex funding package that would raise the state sales tax.

LTU was a fitting backdrop for this message because the Michigan Department of Transportation (MDOT) has supported research led by LTU Engineering Dean Nabil Grace on using carbon fiber reinforced polymer (CFRP) materials, which are corrosion-free, to replace steel in bridge construction.

Grace and LTU research teams have been conducting research on CFRPs and other innovative materials for bridge construction for more than 25 years. "The predicted result is a bridge system that will last twice as long as most bridges now in service with minimum repair work or reconstruction and a significant reduction in the long-term burden on taxpayers," Grace said.

In July 2014, Gov. Snyder visited Lawrence Tech to discuss what he called "the bridges of the future." He met with representatives of Tokyo Rope, the Japanese company that has supplied the CFRP materials for bridges built in Michigan. The Michigan



During a public discussion about road funding at Lawrence Tech, Engineering Dean Nabil Grace (R) discusses what caused a chunk of concrete to fall from a highway bridge. To his left are Michigan Gov. Rick Snyder and Transportation Director Kirk Steudle.

Economic Development Corp. has committed \$3 million to the construction of a carbon-fiber manufacturing facility that Tokyo Rope may build in Michigan.

MDOT has used CFRP materials from Tokyo Rope and designs based on LTU

research for bridges in Detroit, Jackson, and Southfield. The next CFRP project, which is scheduled for completion this year, is near Port Huron.

A \$690,000 MDOT contract is funding a four-year study to evaluate the long-term capacity and durability of CFRP prestressing and post-tensioning strands under various conditions.

Another MDOT contract of \$390,000 is funding a seven-year project to collect, analyze, and review data from the bridges that have been built with CFRP materials, as well as information and literature from other sources on this type of bridge construction.

In 2014, LTU researchers wrapped up a \$349,000 contract with the Federal Highway Administration using pooled funds from the state transportation departments of Iowa, Michigan, Minnesota, Oregon, and Wisconsin.

"There is still a lot of work to do, but we are confident that our research here at Lawrence Tech will produce design guidelines for sustainable bridges that will be in service for 100 years," Grace said. □EP