Global Research, Local Impact: Keat Ghee Ong

Mechanobiology: Sangyoon Han Measures Cellular Force

Rupak Rajachar Accelerates Healing in Humans—and Whales

Optical Elastography Gathers Better Data for Avon

Making Stents: NSF Graduate Research Fellow Roger Guillory
Dear Friends, Colleagues, and Alumni,

Welcome to the latest issue of the Michigan Tech Biomedical Engineering Newsletter. As always, there has been plenty of growth and improvements in the Department. We are offering more courses at all levels, we have recruited new faculty into the Department, our research and graduate programs continue to grow, and our graduates are doing better than ever.

Starting this fall semester, the Department will begin offering minor degrees in Biomedical Engineering, Biomaterials, Medical Devices & Instrumentation, and Stem Cell & Tissue Engineering. We are excited about these new offerings. We think they will be very popular with non-BME engineering students in particular. We hope these minors will offer students in other majors an opportunity to gain some awareness of the intricacies of biomedical engineering and also open new career opportunities for them.

Dr. Sangyoon Han and Ms. Sunyoung (Sunny) Ahn have both recently joined the Department. Dr. Han is an expert in cellular mechanobiology and Ms. Ahn is an expert in statistics. Both bring wonderful new talent and expertise to the Department. We couldn’t be happier now that they’re part of our BME family.

Inside this Newsletter, you will read about some exciting developments in the Department. You will find updates on our research activities. Many are new initiatives just now coming to fruition. We’re excited to share a few of the many accomplishments of our BME students. On page 8, we’ve highlighted the student teams who competed in, and won (!) the Stryker Engineering Challenge, an engineering and robotics challenge sponsored by Stryker Corporation each year.

I hope you enjoy reading about all the new things going on here in the Department of Biomedical Engineering. Please feel free to reach out to me if you want to learn more about the Department, want to get involved with the Department, or if you simply want to say “hi” and let us know about the exciting new things you have been up to lately.

Sean J. Kirkpatrick, PhD
Professor and Chair
ABOUT THE DEPARTMENT

The Department of Biomedical Engineering at Michigan Tech is among the world’s leaders in providing quality education and research. We have 12 faculty, several adjunct faculty, three staff members, 40 graduate students, and 300 undergraduate students. We are housed in the Minerals and Materials Engineering Building at the center of Michigan Tech’s campus in Houghton. We offer programs leading to Bachelor of Science, Master of Science, and Doctor of Philosophy (PhD) degrees in Biomedical Engineering.

OUR MISSION

The Department of Biomedical Engineering serves the University, the community, and the biomedical engineering profession through education, research, and design activities. The department offers innovative educational programs that integrate biological sciences and engineering, and apply engineering tools, methods, and practices to solve problems in biology and medicine. Graduates of our programs are highly-skilled biomedical engineers who understand the ethical, social, and economic implications of their work.

DESIGN & PROTOTYPING LAB

Our new Design and Prototyping Laboratory (left) has two 3D printers for rapid prototyping of biomedical devices. Computers with numerical simulation tools enable concept design and verification, and a design station, equipped with cameras and a wall display enable multi-location design discussions.
Keat Ghee Ong wants to make knee implants smarter in his position as the Portage Health Foundation Endowed Professor of Technological Innovations in Health. Bones respond to mechanical forces. The right amount of pressure is actually needed to help them to grow better after, say, a knee implant surgery or a bone fracture following a car accident.

“In a severe injury, the bones cannot heal themselves and they need a fixation plate,” Ong says. “What I’m trying to do is make that plate smart, so it can tell exactly if there’s too much mechanical loading, too much force, as the bones grow back together.”

Such a smart plate could read what happens as a patient walks or goes through physical therapy, and possibly warn doctors of continually weak areas. Ong has published research on developing real-time biosensors including internal implants and wound suture devices.

Bringing about these devices is a collaboration. Ong says his position is meant to bridge engineering development and the patient experience by integrating research from material science to kinesiology.

In addition to interdisciplinary research between Michigan Tech departments with support from the Portage Health Foundation, Ong’s work has involved researchers from Georgia Tech, University of Oregon, and Mayo Clinic. He also wants to incorporate feedback from local patients. Building community is a key goal of his endowed professorship. “How can we make direct impacts with our research?” he asks. “The purpose of this grant is to think about that and start to make a difference.”

Fluoroscopic image of a rat during treadmill walking. The rat, which had a large fracture at the right femur, was implanted with a bone plate that can measure real-time forces at the fracture site and wirelessly transmit the data to a nearby device at a rate of 30 measurements per second. Picture courtesy of B. Klosterhoff, Georgia Tech.
Sangyoon Han joined Michigan Tech’s Department of Biomedical Engineering last fall as an assistant professor. Before coming to Michigan Tech, Han was a postdoctoral researcher at Harvard Medical School Lab of Computational Cell Biology, and also at the University of Texas Southwestern Medical Center.

Han earned a PhD in Mechanical Engineering at University of Washington in the area of cell mechanics, multiphysics modeling, and bioMEMS, and BS and MS in Mechanical Engineering at Seoul National University.

Mechanobiology is Han’s research focus. His goal is to better understand how mechanics affects cell biology. Ultimate applications, he says, include cancer cell metastasis, stem cell differentiation, and atherosclerosis. All are strong mechanotransduction-related physiological and pathophysiological events.

“Cells are sensitive to mechanical forces outside the cell membrane,” says Han, “The force sensor, referred to as a focal adhesion, consists of a special receptor across the membrane and more than one hundred of cytoskeletal adaptor proteins. These focal adhesion proteins have redundant and diverse roles in signaling and structural development of the adhesion.”

Han identifies the active force of living cells, through the adhesions on their environment. He then links that active force to any force-sensing (by focal adhesion) and force-generating (by cytoskeleton) dynamic molecular activities in cell components.

To do this, he uses high-resolution imaging of living cells on a soft substrate, capturing deformation of a gel and trajectories of the force-sensing proteins at the same time.

Han developed a novel force reconstruction software that converts the measured gel deformation into a force map over a cell footprint. Using time series data extracted from the image data, he monitors feedback between the cellular structure and its mechanical forces.

Han shares his Matlab-based, open-source software with the mechanobiology community. Han and his team are also building a physical device using bioMEMS for active force application to cells and tissue.
Made of fibrous connective tissue, tendons attach muscles to bones in the body, transferring force when muscles contract. But tendons are especially prone to tearing. Achilles tendinitis, one of the most common and painful sports injuries, can take months to heal, and injury often recurs.

Michigan Tech researcher Rupak Rajachar is developing a minimally-invasive, injectable hydrogel that can greatly reduce the time it takes for tendon fibers to heal, and heal well. “To cells in the body, a wound must seem as if a bomb has gone off,” says Rajachar. His novel hydrogel formulation allows tendon tissue to recover organization by restoring the initial cues cells need in order to function.

Rajachar and his research team are looking at both normal and injured tissue to study cell behavior, both in vitro and in vivo with mouse models.

The hydrogel they have created combines the synthetic—polyethylene glycol (PEG), and the natural—fibrinogen.

“Cells recognize and like to attach to fibrinogen,” Rajachar explains. “It’s part of the natural wound healing process. It breaks down into products known to calm inflammation in a wound, as well as products that are known to promote new vessel formation.”

The team’s base hydrogel has the capacity to be a therapeutic carrier, too. One formulation delivers low levels of nitric oxide (NO) to cells, a substance that improves wound healing, particularly in tendons. Rajachar combines NO and other active molecules and cells with the hydrogel, testing numerous formulations.

Two commonly prescribed, simple therapies—range of motion exercises that provide mechanical stimulation, and local application of cold or heat—activate NO in the hydrogel, boosting its effectiveness. “Even a single injection of the PEG-fibrinogen-NO hydrogel could accelerate healing in tendon fibers,” says Rajachar.
“Numbers are power. Numbers speak louder than words,” says Sunyoung Ahn. “With statistics, an argument can be effectively and efficiently strengthened rather than being ambiguous. A statistical result which is appropriately performed can help to reduce the vulnerability of a conclusion.”

Ahn should know. She earned not one but two master’s degrees in Statistics, one at the University of Texas, Dallas and the other at Ewha Womans University in Seoul, Korea. She also has a Master’s of Applied Mathematics from the University of Washington in Seattle.

Ahn joins Michigan Tech as a Lecturer and Biostatistician in the Department of Biomedical Engineering and a Lecturer in the School of Mathematical Sciences.

In her position in the BME department, Ahn helps biomedical researchers—both faculty and graduate students—design the experiments, apply the appropriate statistical analysis test, and interpret results.

“I love to interact with students,” she says. “It is a great privilege to help students achieve their learning goal and see their learning process.”

TAGGING WHALES WITH NOAA

Rupak Rajachar and PhD student Ariana Tyo just returned from Provincetown, Massachusetts, where they spent two weeks with NOAA researchers deploying a telemetry tag into untagged humpbacks in the Gulf of Maine.

“Our lab is working on improving the retention of the tag in the blubber. Seeing how it gets deployed and talking to those who are using it allows us to get a full picture of the mechanisms we can use,” Tyo explains. The new tag enters only into a whale’s blubber layer and releases an adhesive hydrogel to help it stay in with less injury and infection.

“The most memorable part of the experience was being able to see these animals up close and really appreciate how beautiful they are,” adds Tyo. “Seeing how they interact with each other and how smart they are really brings a new beauty and sense of importance to our project.”

In some ways, says Tyo, the research is at the mercy of the whale cooperating with the research vessel. “If the vessel cannot get close enough, we can’t tag.”
Michigan Tech BME students took first place in the Eighth Annual Stryker Engineering Challenge competition in Kalamazoo. This year, six universities competed. In addition to Tech, teams came from Notre Dame, Western Michigan University, Michigan College Alliance, Purdue and Miami of Ohio.

Michigan Tech was the only biomedical engineering team in the competition. All other teams were comprised of mechanical and electrical engineering students. Undergraduates Becky Daniels, Melanie Thomas, Emil Johnson and Nicholas Turowski competed. They each earned a $1,000 scholarship and an interview for a Summer 2019 Internship with Stryker.

During the overnight competition, university teams spend 12 hours planning, designing, prototyping and testing to prepare for a robotics challenge created by Stryker engineers.

“Last year was our first year in the Stryker competition and we took second place,” says Biomedical Engineering Department Chair Sean Kirkpatrick. “We’re trying to build a community in the BME around this competition.”

BME students from the 2017 team—Ana-Lisia Powdhar, Zachary Vanderstelt, Peter Beach and Sterling Korstad—helped recruit the 2018 team. “I went to the first meeting not knowing what to expect,” said Turowski. “I was met by last year’s team and they seemed really excited to talk about the competition.”

Biomedical Engineering Professor Keat Ghee Ong is the team’s advisor. Joe Thompson, associate director of industry engagement in Michigan Tech’s Pavlis Honors College, also mentors the team.

Stryker Corporation, active in more than 100 countries, is one of the world’s leading medical technology companies, offering products and services to help improve patient and hospital outcomes.

“It was exciting to see how our ideas came to life, and how prototypes became the actual parts that contributed to our victory. It was a constant reminder of why we chose to pursue engineering.”

BME student Melanie Thomas

And another congratulations to Zac Vanderstelt, Peter Beach, Ana-Lisia Powdhar, and Sterling Korstad, who took second place last year, with advisor Dr. Keat Ghee Ong.
Biomedical engineering doctoral student Roger Guillory II was recently awarded a National Science Foundation Graduate Research Fellowship. His research focuses on evaluating degradable metals (zinc based) for cardiovascular-stent applications. He is co-advised by Professors Jeremy Goldman (Biomedical Engineering) and Jaroslaw Drelich (Materials Science and Engineering).

Guillory grew up in Houston, Texas. “I knew I wanted to pursue an advanced degree many years ago,” he says. “I understood that it would give me the power to learn from an accomplished scientist in extreme proximity, but I also was attracted to the idea of probing the unknown. I have always wanted to learn more about what has not been explored, and pursuing an advanced degree allows me to do just that.”

His research interests include biodegradable metals, vascular materials, biomaterials characterization, vascular grafts, and in vivo systems. Guillory says the GRFP award is a validation of sorts for the research conducted at Michigan Tech.

“Being awarded this fellowship proves to me that the work we do here in our labs, and at Michigan Tech have a considerable impact outside of our University and respective disciplines.”

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Hannah Cunningham has been working with kids since high school. Volunteering at the Society of Women Engineers’ annual Invent it. Build It. event for middle school girls was a natural thing for her to do. She took part while attending SWE conferences in Nashville, Philadelphia, and most recently at the National SWE WE17 Conference in Austin, Texas.

Girls grades 6-8 who attend the workshop leave with a better understanding of engineering and a strengthened confidence in engineering-related skills. The event shows girls what an engineer looks like and instills the confidence that they too can be an engineer.

As a table leader, Cunningham directs four or five girls through an engineering challenge, making sure they think critically, develop their engineering skills, and work as a team.

“At that age it can be difficult to see your own contribution,” says Cunningham. “It’s even more difficult to respect your own work without comparing it to everyone else’s. I try not to remember myself as a middle schooler,” she adds, “but some of the girls definitely remind me of myself at that age. They don’t really have an idea yet what they want to do. But when faced with the project or challenge, they work at it, and work hard, until they’ve come to the final product.”

Cunningham also teaches first and second graders at the Michigan Tech Center for Science and Environmental Outreach. “Even if the topic is not related to engineering, such as wildlife exploration, I always make sure to develop a project that includes engineering to develop kids’ creativity, teamwork, and technical skills. The supplies can be simple, recyclable materials.”

Last summer, Cunningham spent eight weeks in the Department of Molecular Biology at Aarhus University in Denmark, as part of an International Research Experience for Students (IRES). Her team was funded by the National Science Foundation (NSF) to look at biosensor technology and how it can be used in point-of-care devices to diagnose diseases like tuberculosis or malaria.

Cunningham’s project involved using DNA as a temperature gauge in circuits, bringing a level of precision to nanothermometers embedded in a microdevice.

As for her own career goals, Cunningham would like to develop and research products beneficial for human health. “Anything dealing with treating, modifying, or enhancing human movement is fair game,” she says.

Cunningham earned her BS in biomedical engineering last spring. This fall she will return to Michigan Tech to pursue an accelerated Master’s degree in Kinesiology. She spent the past year working in the Integrative Physiology Laboratory of Professor Jason Carter (KIP) studying sleep deprivation and pain perception in older adults.

Involvement with SWE has shown Cunningham the many different roles women can have in engineering.

“I always make sure to develop a project that includes engineering to develop kids’ creativity, teamwork, and technical skills. The supplies can be simple, recyclable materials.”

“Even though my own educational path has slowly directed me away from engineering, I still feel strongly I can be involved—even if my future job title isn’t ‘engineer.’”
JINGFENG JIANG: 3D ULTRASOUND TO COMBAT BREAST CANCER

Jingfeng Jiang’s research team uses its graphics processing unit (GPU) to perform advanced processing of raw ultrasound data so physicians can use that information in their clinical workflow.

Jingfeng Jiang is the principal investigator on a project that has received a $450,187 research and development grant from the National Institutes of Health, “Elastography-Based Analytics for Benign and Malignant Breast Disease.”

BME STUDENTS PREVAIL AT LSTI RESEARCH FORUM

BME senior Hannah Cunningham won the Grand Prize at the 3rd Annual Life Science & Technology Institute (LSTI) Research Forum. Cunningham won the undergraduate category for her poster, titled “Total Sleep Deprivation and Pain Perception During Cold Noxious Stimuli in Older Adults.”

Two more BME graduate students won Merit Prizes for their posters: Salil Sidharthan Karipott, “Mechanically Active System for Controlled Loading Environment to Promote Vascularized Bone Regeneration,” and Pegah Forooshani, “Biomimetic Recyclable Microgels for on Demand Generation of Hydrogen Peroxide and Antimicrobial Applications.”

David Ross won Merit Prize in the undergraduate category for his poster, “Bioactive PDMS Surface for Optimal HMSC Sheet Culture.”

LSTI seeks to enhance interdisciplinary research at Michigan Tech.
For the past 18 years senior design teams have showcased their projects at Michigan Tech’s annual Design Expo. BME teams consistently win top honors. A panel of distinguished judges—corporate representatives, community members, and Michigan Tech faculty and staff—critique the projects.

**First Place 2017 Senior Design Award**

*Enhanced Measurement and Analysis of Gait Disturbances*

Team Members: Justine Reed-Sandum and Dex Driggers, Biomedical Engineering; Sonja Hedblom, Mechanical Engineering; and Nic Schweikart, Computer Engineering

Advisor: Jingfeng Jiang, Biomedical Engineering

Sponsor: Aspirus Keweenaw

**First Place 2018 Innovation Award**

A big part of the Design Expo competition is learning what it takes to be an entrepreneur and going out on a limb—sometimes literally—to try new and creative solutions to complex problems. Applications are evaluated based on the team’s ability to demonstrate:

- A clear value proposition for their proposed innovation
- Distinction of their innovation over alternative solutions
- A defined and actionable plan for realizing economic or societal impact from their innovation
- The scale of that impact

**Nerve Stimulation through Powered Surgical Instruments: Cerebral Ultrasonic Aspiration**

Team Members: Peter Beach, Sterling Korstad, Ana-Lisia Powdhar, Matthew Sampson, and Rachel Stites, Biomedical Engineering

Advisor: Orhan Soykan, Biomedical Engineering

Sponsor: Stryker Instruments

Project Overview: “We conceptualized, designed, prototyped, and tested a modification of Stryker Instruments’ Sonopet ultrasonic handpiece. Currently, one of the main uses for the handpiece is for the removal of malignant tissues in the brain. During these operations, the surgeon must periodically switch from the handpiece to a nerve monitoring probe that reports the proximity of the operation to the major cranial nerves. Our modification combines the functionality of these two devices.”

**Third Place 2017 Senior Design Award**

*Customizing Transcatheter Nitinol Stents for Treatment of Hypoplastic Left Heart Syndrome in Infants*

Team Members: Emma Davis, Kat Farkas, Amanda Gogola, and Ami Kling, Biomedical Engineering

Advisors: Jeremy Goldman and Smitha Rao, Biomedical Engineering

Sponsor: Spectrum Health Innovations—Helen DeVos Children’s Hospital

**First Place 2017 Innovation Award**

*Customizing Transcatheter Nitinol Stents for Treatment of Hypoplastic Left Heart Syndrome in Infants.*
O rhan Soykan is a multidisci- 
plinary scholar who specializes in the research and development of implantable devices, biosensors, molecular medicine, and more. He is also a professor, and technical and scientific consultant.

How did you choose this path? Or, did it choose you?

While I was a young student attending different schools, I learned a lot from dedicated teachers and benefited from their wisdom. Now that most of them are gone, I feel that the only way that I can pay back is to help with the education of the next generation of engineers, in all disciplines and in all schools. This is why I like to teach at Michigan Tech, where students from Departments other than Biomedical Engineering also take the Medical Devices course that I teach. I give regular lectures at other schools, such as Drexel University, and advise students at the University of Minnesota. However, I know that engineering is a fast moving field, so I stay connected with industry by consulting with them regularly, including firms in the Twin Cities area, Indiana, California, U.K. and Sweden, to keep myself current with the new technologies and trends in the field.

Your current teaching focus at Michigan Tech involves traditional aspects of engineering. What are the biggest challenges faced by your students in these areas?

Biomedical Engineering is a diverse field, and is getting more diverse each day. However, most of the recent research has been focusing on the various aspects of tissue engineering and molecular biology, which is very exciting and very promising. Yet, the medical device industry is still using the traditional electronic tools and materials to construct its products. Hence the biomedical engineers are still expected to be well versed in the classical areas, such as programming, circuits, mechanics, chemistry and physics, which is why I urge all students, not just the ones enrolled in Biomed, to study and master the fundamentals.

What advice would you give to future biomedical engineers/researchers both currently studying here at Michigan Tech, but also at the beginning of their careers?

For those who are considering advanced degrees, such as MS, PhD, MBA, JD, DVM, MD, and so on: do not delay, start your graduate studies as soon as you get your BS degree. For those who want to start working as professionals, be humble, keep learning, and write back to your teachers at Michigan Tech once in a while to keep us proud of your achievements.

You first came to Michigan Tech as a graduate student from Turkey. Why did you decide to come back after working as a scientist at Medtronic for over 20 years?

I feel like I never left Houghton after I received my MS degree in 1986. Even when I worked at Medtronic and lived in the Twin Cities, I used to come back to Houghton to teach, attend meetings at Michigan Tech, meet with my colleagues and so on. I think Houghton is a very special place to live: its mild winters are ideal for me to train for my annual marathons. Having snow on the ground for many months is the best thing for someone who loves cross country skiing. And, as a private pilot, where else can I find a nice airport with very little traffic and a large group of friendly pilots. Did I say that Houghton is also a safe place to live and has an excellent group of intellectuals that I can meet frequently at KBC?
FENG ZHAO: SCAFFOLDS

BOTTOM TO TOP  Cell-made aligned nanofibrous scaffold; cell-repopulated scaffold; scaffold with aligned capillaries; blood vessel wall made from the biomaterial and cells.

BAKHTA RATH RESEARCH AWARD

Zichen Qian and Associate Professor Feng Zhao have won the 2018 Bhakta Rath Research Award, Michigan Tech’s top honor to a doctoral student and faculty advisor.

The pair won for their work on nanoscaffolding in tissue engineering. Vascularizing tissue implants is their goal. Qian and Zhao use cells from human skin to make a material of highly aligned nanofibers, or scaffold. On top of the scaffold, they grow stem cells, which help to stabilize micro-vessels and mature them.

Qian graduated from Michigan Tech in 2017 with a PhD in Biomedical Engineering. He now works as a scientist at Merck developing engineered cell lines for manufacturing therapeutic biologics. He and Zhao have co-authored 15 publications.

CAB YOUNG INVESTIGATOR AWARD

Feng Zhao received the Chinese Association for Biomaterials (CAB) Young Investigator Award, recognizing an individual who has demonstrated outstanding achievement and leadership in biomaterial-related research and profession.
A preformed functional vascular network provides an effective solution for solving the mass transportation problem in large engineered tissues after implantation. Using stem cell sheets, Feng Zhao creates blood vessels at different scales (vascular grafts for bypass surgery and microvessels for tissue vascularization) by controlling microenvironmental parameters, including oxygen and nanostructure.

Pictured: cellular bundles and grooves organized by stem cells and nanofibers on a vascular graft surface (top); tissue-engineered capillaries embedded within a biofabricated cardiac tissue (bottom). Photo credit: Feng Zhao, Qi Xing, and Zichen Qian
For work on reversible underwater adhesives, the Office of Naval Research has recognized BME Associate Professor Bruce Lee with a Young Investigator Program (YIP) award.

Lee focuses on adhesives inspired by nature. More specifically, the natural glues made by mussels that anchor them to rocks, boats and docks. His past work on hydrogels and tissue adhesives led him to look more closely at what makes these adhesives work underwater—and how people could use them.

“Think of a band-aid—our adhesive would be a less painful way to remove a bandage—or being able to detach or reattach a prosthetic limb or a wearable sensor.”

As a participant in the Office of Naval Research Young Investigator Program, Lee plans to continue delving into not only what makes mussels sticky but also how to reverse that adhesion.

“There is no smart adhesive out there that can perform underwater,” he says. “The chemistry that we can incorporate into the adhesive, causing it to reversibly bond and de-bond, is quite new.”

FIT-TO-SHAPE SEALANT & ADHESIVE

Lee’s research team is exploiting the ability for catechol to form strong reversible bonds with inorganic surfaces. They recently developed a moldable nanocomposite hydrogel that can transition from a self-healable, physically crosslinked network to a more covalently crosslinked network. “This material initially exhibits the ability to be remolded and adhered to the convex contour of a tissue surface,” say Lee. “With time, the hydrogel is fixed in its new shape and functions as a fit-to-shape sealant.” Their sealant uses no cytotoxic crosslinking reagent, and needs no mixing tip for mixing precursor solutions. It also demonstrates burst pressure (~320 mmHg) potentially suited for sealing renal vein and intestinal anastomosis.
Electrospinning holds great promise for designing functional 3D biomimetic scaffolds for tissue engineering applications. The technique allows for the reproducible fabrication of 3D scaffolds with control over the porosity and thickness.

Photo credit: Smitha Rao and Samerender Nagam Hanumantharao, Patent Pending
To aid in chronic tendon injury repair, tendon cells are cultured with an injectable hydrogel. Cells of interest maintain their tendon cell behavior in the presence of the hydrogel. A composite image of tenocytes verifies colocalization of nuclear, cytoskeletal, and cell specific markers: Nuclei (DAPI-blue); f-actin cytoskeleton (Phalloidin-red); and tenocyte specific marker (Scleraxis-green).

Photo credit: Rupak Rajachar
A team led by BME Department Chair Sean Kirkpatrick has partnered with Avon to develop a laser-based technology that measures the elasticity and firmness of skin. The basic process: project bright green laser light on untreated skin, swab a bit of Avon product on, use a puff of air to stress the skin, then measure how much the scattered laser light—called laser speckle—shifts.

“That light that is scattered back is in a random diffraction pattern—and that pattern moves around,” he explains. “The real art of all this is tracking the motion of that diffraction pattern and mapping it back to the skin.” The team’s technology includes the optics, software for data acquisition, and the algorithms that map the laser’s diffraction patterns to skin. Their measurement scheme stays within the upper 70 microns, maybe 100 microns, of the skin’s epidermis. Shallow as it is, changes in the epidermis are linked to visible wrinkles and loss of firmness.

**Optical Elastography Gathers Better Data for Partner Avon**

Ami Kling, right, operates the optical elastography equipment that measures skin elasticity following application of Avon products to Kelley Christensen’s, left, inner upper arm. Abhinav Madhavachandran, middle, monitors the imaging on a laptop.

**In the News**

Crain’s Detroit Business reported on FM Wound Care, a startup cofounded by BME Associate Professor Megan Frost and entrepreneur Jeff Millin. They hired Weilue He (PhD ’16) and Julie Osborne (MS ’17), both who earned their BME degrees at Michigan Tech. Frost’s advanced technology infuses bandages with nitric oxide. She got the idea after suffering a serious infection following oral surgery. Read “Biomedical startup aims to change post-op care,” at crainsdetroit.com.

Frost is currently serving as the Interim Department Chair of Kinesiology and Integrative Physiology at Michigan Tech.

**Crain’s Detroit Business**

“FM Wound Care seeks to develop a bandage that will actively kill bacteria for days or possibly weeks, preventing infection before it can start.”

BME Associate Professor Megan Frost
Want to make a gift to the Department of Biomedical Engineering?

Although Michigan Tech is a state-assisted institution, it receives less than one-third of its funding from state appropriations. Your gift helps keep our department on the cutting edge.

There are two ways to give:
• Use Michigan Tech’s online gift form at mtu.edu/givenow.
• Call the Michigan Tech Fund at 906-487-2310.

Please specify the Biomedical Enhancement Support Fund 1454. Thank you!