Fall 2016 • Issue 31

SYNERGY

BECKMAN INSTITUTE FOR ADVANCED SCIENCE AND TECHNOLOGY

MULTIDISCIPLINARY MEDICINE Researchers at the Beckman Institute look at bone strength to help people with osteoperosis, examine the brain health of patients with epilepsy, and see how cholesterol affects the spread of cancer. And they are developing methods to help patients evaluate the risks associated with diagnoses. From human factors to engineering breakthroughs, Beckman research examines medicine from multiple angles.

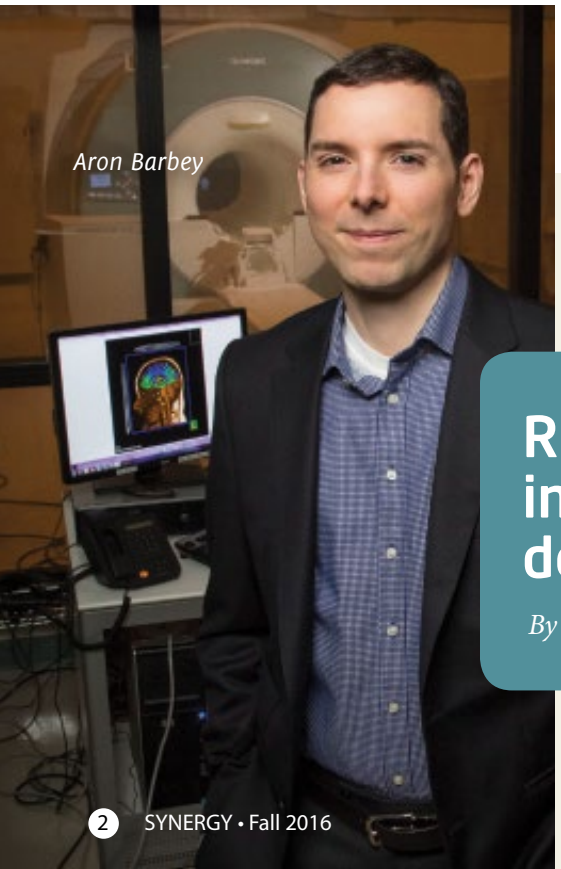
New Technology Can Help Patients with Epilepsy

By Maeve Reilly

In a collaboration with Carle Foundation Hospital, Beckman researchers have been using a new technique, magnetic resonance elastography (MRE), in a study of epilepsy.

Graham Huesmann, a neurologist and epileptologist at Carle, a research assistant professor of molecular and integrative physiology at Illinois, and a member of Beckman's NeuroTech Group, and Brad Sutton, associate professor of bioengineering and member of the Bioimaging Science and Technology Group, are using MRE technology developed at Beckman by the Sutton group in collaboration with Curtis Johnson, now an assistant professor at University of Delaware, to examine the brains of patients with mesial temporal lobe epilepsy, the most common form of partial or localization-related epilepsy.

"Seizures in this type of epilepsy start from one side," said Huesmann. "If they are untreated, they spread to both sides of the brain.



Aron Barbey

"It's a type of epilepsy that becomes more and more resistant to medication over time," said Huesmann. "Catching it early is unfortunately rare: it is often a missed diagnosis for many years. If you do catch it early and have the patients on medication, they might get 10 years and then that medication fails, and then they've got a second medication. Then they get two years and both of those fail and they have to go to three medications, four medications, and all the while the seizures are damaging the hippocampal structures on both sides of the brain because the seizure activity spreads. Often the disease has progressed and caused damage even before a patient ever gets on medications for treatment."

Long-Lasting Damage

Effects can be damaging to a patient's life, said Huesmann.

"Over time, with accumulated damage added to the side effects of some of the medications, the patients become incapable of forming new memories. They can't work, they can't drive: the disease destroys their lives."

Damaged tissue becomes hardened or sclerotic. Finding out what tissue is damaged is crucial to understanding potential treatments, including surgery, but because the brain is encased in a hard skull, it's difficult to measure the stiffness of tissue. By gently shaking the brain while a patient is having an MRI performed, the MRE technology and computational power from Blue Waters at Illinois allows researchers to construct stiffness maps, which allow them to examine the mechanical structure of the brain in order to see which tissues have been damaged due to the seizures.

"A typical MRI image is reflecting the current status of the tissue: what's happening right now," said Sutton. "But the mechanical properties of the tissue are reflecting what it's undergone over the lifespan, up to that point. When there's been some cumulative damage, some changes to the structure of the tissue, there's early degradation of the tissue like

Risk literacy in medical decision-making

By Rachel Buller

Joachim T. Operskalski, a graduate student in the Decision Neuroscience Laboratory at the Beckman Institute, is examining how people evaluate risk when making medical decisions.

"Decades of psychology research converge on the finding that people have a difficult time thinking clearly about probabilities and percentages, regardless of their educational level or ability to reason about other topics," said Operskalski. "In the context of modern medicine, this

Graham Huesmann, left, and Brad Sutton, right, are developing new methods to help patients with mesial temporal lobe epilepsy.

what we see with advanced age. So stiffness is becoming this sensitive measure that's reflecting the cumulative damage or changes to the tissue over time."

The goal of the clinical study is to identify the patients with the disease early and devise interventions that can help the patients maintain their quality of life.

"We learn a lot of information about how to stage their treatment and progression based on what the stiffnesses look like," said Sutton. "Mechanical properties are a new piece of information that we wouldn't have gotten out of the brain images in the past, so we're really interested in what that means about the status of the tissue, how's it related to other measures that we already get, like blood flow and function."

Preventing Damage

"One of the clinical goals is to identify these patients early. Right now the state of the art clinical tools only identify the disease after damage has been done" said Huesmann. "MRE looks very promising as a clinical tool that can easily and cheaply be used to diagnose these patients early, before damage has been done. This will allow us to devise interventions, whether medication or device or surgery, as early as possible to prevent that gradual decline and degradation. We want to preserve as much of their quality of life as possible."

Joachim T. Operskalski

can have serious consequences when the relative risks of aggressive treatment and more conservative approaches must be weighed against one another."

In an essay recently published in the "Perspectives" section of *Science*, Operskalski and Aron Barbey, assistant professor of psychology and member of Beckman's Cognitive Neuroscience Group, outline several steps in communicating effectively about risk without having to appeal to the subtleties of probability theory.

"Our work begins with the observation that the human mind is able to deal with information in some formats but not others, and we make recommendations for communicating information about risk in a way that facilitates an accurate understanding of the nature of risk in the world," said Operskalski.

Here is an example they use to make their point. Imagine you are asked to interpret a positive result on a screening test for a condition afflicting

continued next page

Risk literacy, continued.

0.1 percent of the population. You are told the test is 99 percent sensitive (missing the diagnosis 1 percent of the time), and has a 5 percent false positive rate. Most people intuitively judge the chance of the positive result being accurate at somewhere between 95 and 99 percent, which is incorrect. The correct answer becomes apparent, however, when the problem is framed in terms of how often the diagnosis occurs out of a meaningful denominator: 50 people out of 1,000 test positive, but just one person out of the 1,000 actually has the disease. Framing risk problems in this manner, as frequencies instead of probabilities, or by using visual diagrams to convey the same information, helps medical professionals and patients to communicate with one another more effectively. It makes the relative sizes of the different probabilities clear.

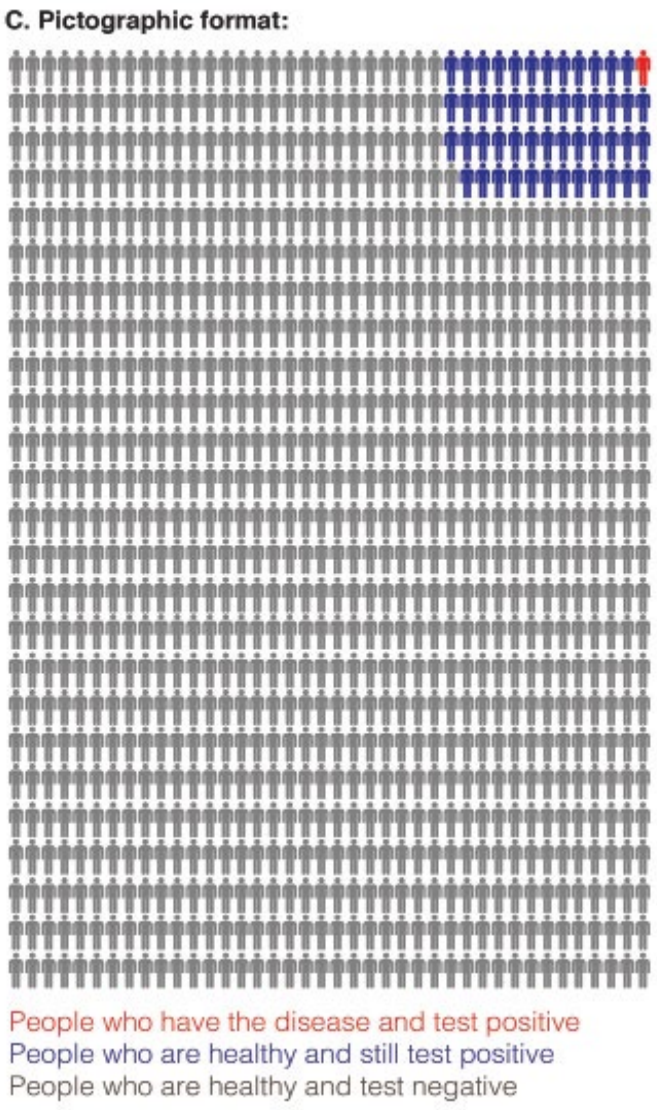
This is especially important given advances in other fields.

"Our colleagues in bioengineering are making dramatic progress in medical diagnostic technology that will save lives while also improving the quality of those lives," said Operskalski. "Even as they make strides to reduce the uncertainty in characterizing illness or predicting its outcomes, some uncertainty will always remain. By studying the psychology of medical decision-making, we hope to equip physicians and patients alike with the ability to think about risk in a way that shows an appreciation for that uncertainty in the world."

The researchers in the Decision Neuroscience Lab use MRI and cognitive tasks to examine the relationship between brain function and the ability to reason about risk.

They also emphasize the potential benefits it has for patients.

"Patients are being empowered to make decisions about their own healthcare," said Operskalski. "By understanding the psychology and neuroscience of uncertainty, we hope to reveal the source of our cognitive limitations while also discovering ways to teach and communicate effectively about matters of risk and uncertainty, such that we can overcome our limitations together."



Visual diagrams help patients comprehend risks when making decisions about health care.

Eric Currier

Currier Studies the Preliminary Signs of Osteoporosis

By Kaitlin Kamp

According to the National Osteoporosis Foundation, about 54 million Americans have osteoporosis and low bone mass, placing them at increased risk for bone fractures. In order to determine how osteoporosis can affect bones, Eric Currier, a Beckman graduate student in mechanical science and engineering, examines mice femurs to find the determinants of bone strength.

Since 2014, Currier has worked with Mariana Kersh, assistant professor in mechanical science and engineering and a Beckman affiliate faculty member in the Bioimaging Science and Technology Group.

Bone Strength

Currier's research goal is to study the effects of macro- and microstructures on the strength of bone.

"Macrostructure is at the whole bone scale, while microstructures are the smaller structures that make up the bone," said Currier. "Macrostructure parameters include total bone length, ultimate load, and apparent modulus, or the relation of stress to strain. Microstructure parameters include parameters such as cortical thickness, cortical diameter, porosity, trabecular length, trabecular thickness, and connectivity." Cortical and trabecular refer to the two types of tissues that form bone.

To determine this correlation, Currier performs computerized tomography (CT) scans in Beckman's Microscopy Suite on both un-deformed and deformed mice femurs. He scans the bones and compares the two phases to calculate strain. Currier can apply compression and tension to the specimens using a Deben testing stage as they are simultaneously scanned in three dimensions by the Xradia microCT scanner.

"It's actually very difficult to get mechanical testing data while in a CT scanner because there's a lot of x-rays going through and it's very dangerous, so it has to be closed. It's very nice to have this Deben testing stage that I can control from the outside," said Currier. "I couldn't do my research without this piece of equipment."

Once he has the images, Currier uses Vic-Volume, a digital volume correlation software, to examine the three-dimensional scans piece by piece or voxel by voxel, comparing the un-deformed to the deformed shapes.

Who is at Risk?

Currier tracks how the voxels change in the un-deformed to deformed phase and then is able to calculate the strain, because of how much a voxel is displaced. Determining the amount of strain allows Currier to correlate the strain to strength

continued page 14

New equipment in the Molecular Imaging Laboratory allows Erik Nelson to examine the effects of cholesterol on breast cancer tumor progression.

Imaging Small Animals in Real Time

By Maeve Reilly

You probably are aware that high blood cholesterol levels can cause problems in your arteries, leading to heart disease, a heart attack, or a stroke.

But are you aware of other effects of cholesterol, including impact on tumor progression in certain cancers?

Using a new tool in the Molecular Imaging Laboratory (MIL), Erik Nelson, assistant professor of molecular and integrative physiology, studies how cholesterol affects tumor progression in breast cancer.

"There's pretty strong clinical data showing that breast cancer patients who have either elevated cholesterol in their diet or elevated circulating levels of cholesterol have a poor prognosis for the progression of the disease," said Nelson. "Cholesterol can also be a risk factor for the onset of disease."

New Imaging Tool

The MIL, part of the Biomedical Imaging Center at Beckman, recently acquired a PerkinElmer IVIS Spectrum CT live-animal imaging system. Collective cross-campus contributions from the Office of the Vice-Chancellor for Research, Beckman Institute, several colleges, departments, and individual principal investigators made the purchase possible. The IVIS system is the only *in vivo* small animal dedicated imaging system on the market that supports both 3D optical and x-ray computed tomography (CT), which allows for both functional and anatomical imaging.

"This is an imaging machine that allows you to detect bioluminescence or fluorescence, and the real advantage of it is you can image small animals while they are still alive, in real-time, and you can image luminescence or fluorescence throughout their entire body," explained Nelson. "It's a really good way of tracking, in my field for example, whether your cancer is growing, or whether it's spreading to different organs."

Preventing Cancer Metastasis

Nelson is looking at how statins, drugs that limit the production of cholesterol such as Lipitor or Crestor, can be used as either a treatment or to prevent cancer metastasis. His study is funded by the National Cancer Institute.

"A machine like the IVIS is great because otherwise we'd have no way to track our cells or track how fast the cells are growing until necropsy (after the animals are humanely euthanized)," said Nelson. "The only alternative to the IVIS is basically to do terminal assays, and that makes it impossible to track the same tumor growth through time."

IVIS allows the researchers to examine the cells as they grow and spread. Using the CT scanner on top of the IVIS scan provides for a 3D image, which can give more detail as to the exact location of the cancer cells.

"For a lot of my work, we're looking at metastasis to the bone, so we can see exactly if these cancer cells are on top or inside the bone," said Nelson.

continued page 14

Moore Named Interim Director


Jeffrey Moore

Jeffrey Moore, the Murchison-Mallory Professor of Chemistry and professor of materials science and engineering, has been named interim director of the Beckman Institute.

The Institute, home to more than 600 researchers and staff and more than $18 million in external research funding to date in FY16, pursues interdisciplinary research in the physical sciences, computation, engineering, biology, behavior, cognition, and neuroscience.

A Beckman faculty member since 1994, Moore has served as co-chair of Beckman's Molecular and Electronic Nanostructures theme, and is a member of the Autonomous Materials Systems Group. He was interim head of the Department of Chemistry from 2012-2013, and in 2014, he was named a Howard Hughes Medical Institute Professor. He is also lead investigator on a Department of Energy Joint Center for Energy Storage Research (JCESR) project entitled "Non-Aqueous Redox Flow Battery."

"For anyone who thrives on interdisciplinary research, our Beckman Institute is an absolute gem. What a privilege it will be working with its outstanding staff and faculty as the interim director."

"For anyone who thrives on interdisciplinary research, our Beckman Institute is an absolute gem," said Moore. "What a privilege it will be working with its outstanding staff and faculty as the interim director."

Moore has published over 300 articles covering topics from technology in the classroom to self-healing polymers, mechanoresponsive materials and shape-persistent macrocycles. He is a Fellow of the American Academy of Arts and Sciences, the American Chemical Society, and the Royal Society of Chemistry, and has received numerous awards for his contributions to teaching and research.

He received his B.S. in chemistry in 1984 and his Ph.D. in materials science in 1989 from the University of Illinois. He was an assistant professor at the University of Michigan before joining the Illinois faculty in 1993.

Moore replaces Art Kramer, an original faculty member at the Institute, who served as director from 2010-2016. Kramer is retiring from the University of Illinois.

Beckman Postdoc Focuses on Chemical Changes in Tissues

By Kaitlin Kamp

Tomasz Wrobel, a Beckman Institute Postdoctoral Fellow, is optimistic about advancements in cancer research.

"We are so close to the end goal," said Wrobel.

Originally from Krakow, Poland, Wrobel began his undergraduate career at the Jagiellonian University in Krakow studying chemistry, then stayed to finish a master's degree in the same field. As a part of the master's program, he participated in an Erasmus Mundus program, Advanced Spectroscopy in Chemistry: the goal of the program is to enhance the quality of European higher education and create intercultural understanding through cooperation with third world countries. During that experience, Wrobel spent a year working and studying in France.

"My most important piece of education comes from what I've done in France, combined with what I did in Krakow," said Wrobel. "The Advanced Spectroscopy in Chemistry program exposed me to a lot of different cultures and I had the chance to study things that are not available to me at my home university. I learned different techniques and different views. It was a really awesome experience."

That experience inspired him to pursue a Ph.D. in the Faculty of Chemistry at his alma mater, where he completed his dissertation on "Atherosclerotic tissues and cells analysis by means of vibrational spectroscopy imaging and chemometrics." Atherosclerosis is a disease in which plaque builds up in the arteries, and can lead to problems such as heart attack, stroke, or death.

"I was researching atherosclerotic tissues, their chemical composition and how that relates to the disease's progression, as well as how we treat the disease, and how it changes once treated," said Wrobel.

The work of Rohit Bhargava, a full-time faculty member in Beckman's Bioimaging Science and Technology Group, inspired Wrobel to come to Beckman.

"His research is the most interesting in our field, and I really wanted to work with him," said Wrobel.

Wrobel has focused his research on prostate cancer while working with Bhargava, a professor of bioengineering, Scott Carney, professor of electrical and computer engineering and member of Beckman's Bioimaging Science and Technology Group, and Andrew Smith, assistant professor of bioengineering.

"The essence of my studies focuses on the chemical changes occurring in tissues in different diseases.

"Currently, we are looking at cancer. Cancer, when it develops, changes not only the morphology of the tissue but also the chemical composition," said Wrobel.

How Do Diseases Change?

In order to study the chemical composition, Wrobel uses infrared imaging. Because infrared imaging is based on the absorption of infrared light, Wrobel and his colleagues can derive information about chemical compositions based on the changes in infrared intensity of different frequencies that have been absorbed. They take that information and put it into a machine-learning algorithm to do a diagnosis.

This process has allowed Wrobel and other researchers to understand how a disease changes.

"Thanks to Bhargava, we created a proper model for how much changes throughout the disease. We can say whether its grade 2, grade 3, or grade 4 cancer," said Wrobel.

Now, Wrobel said, they can also do this work in a spatial matter. Previously in spectroscopy, single point measurement was normally used. With new technology, Wrobel can create images of chemical composition distribution, which allows the researchers to create a visual margin of error.

Wrobel explained how important this is for the cancer community, especially surgeons.

"One of the potential applications is for surgeons performing tumor removal. It's difficult for a surgeon to determine which tissues are still cancerous: should they take it out or leave it? In certain cases, this can be extremely crucial. Our system can measure the tissue and say if it's healthy or not. It's a really big deal, especially if you think about brain cancer where every little millimeter removed is important. That's crucial," said Wrobel.

Predicting Recurrence

Chemical spectroscopy focuses on the chemical composition overall, and can predict the recurrence of certain diseases, such as prostate cancer, with much higher accuracy. Wrobel hopes to increase the accuracy even more.

"Bhargava's technique obtained an accuracy of 74 percent while the histology

Tomasz Wrobel

"In the cancer community, we need more precise diagnosis, so there will be less treatments applied to misdiagnosis. This can prevent stress and spending money unnecessarily. This also pushes the technology to be automated, because computers are more objective than humans. If we can make it automatic, it's really safer."

based prediction was close to guessing 63 percent. One of my projects is pushing that to 90 to 95 percent accuracy," said Wrobel.

In addition to increasing the accuracy, Wrobel and his team hope to increase speed of the diagnosis. Recently there has been a change in the capabilities used, specifically in high-definition imaging. Previously, image distributions were compared to a pixelated optical image with some structure of the tissue. Now, Wrobel's team is almost to single-cell resolution, which is much closer to optical techniques. This allows them to pinpoint a single cell that's abnormal, instead of a whole region. While this breakthrough is exciting, creating the higher-resolution images requires more time.

"We're working with a new source of infrared radiation that has improved the speed by 1,000. Instead of measuring a piece of tissue in an hour, we can do it in a minute. If you want to push this into the clinic, which is our goal, you need a fast method," said Wrobel.

Achieving Accuracy

Wrobel understands the importance of accurate cancer diagnosis, especially in cases like prostate cancer, where the cancer is not always dangerous.

"Prostate cancer is quite variable, especially when it recurs, which is hard to predict. This leads to cases of over- and under-treatment for different patients," said Wrobel

"If you're 85 years old and get prostate cancer, it's important to know if you should get treatment or not based on the type of tumor. If not, there's no reason to get chemotherapy, lose your hair, have surgery, and spend time in the hospital. The predictions of how problematic it will be is the main reason why it's misdiagnosed. Do you have to treat it or not? Our method will help that."

Wrobel hopes his work with Bhargava will help improve cancer diagnosis and make people healthier.

"In the cancer community, we need more precise diagnosis, so there will be less treatments applied to misdiagnosis. This can prevent stress and spending money unnecessarily. This also pushes the technology to be automated, because computers are more objective than humans. If we can make it automatic, it's really safer," said Wrobel.

Technological Services at the Beckman Institute

By Kaitlin Kamp

Many of the research innovations at the Beckman Institute have been coupled with changes in computer technology that no one could have foreseen when the Institute opened in 1989—before most people knew what the Internet was and long before the advent of personal computing and cellphone apps.

The Institute's Information Technology Services (ITS) group has excelled at advancing its services as the backbone for Beckman's technological needs. The ITS group at Beckman has existed in a number of forms since that time, but the group has been responsible for network and systems security support, printing, file storage, web hosting, server and desktop administration support, business application development, general computing assistance, and consulting services for computing needs.

While the tasks of the department appear as a never-ending laundry list of responsibilities, Nancy Mansfield, director of ITS, explained that the group's primary role is to "keep the wheels on the bus."

Early Years

Al Marquardt, former co-director of ITS (1993-2016), began working in what was then called the Systems Services Group. Mansfield started in 1994.

"We had people in the office who had to learn how to use a computer," said Marquardt. "They hadn't seen a computer until they started working here. One of the first things I did was teach people how to use a mouse."

Along with training Beckman personnel to use computers, the group had to keep abreast of computing changes, such as switching from MS-DOS to Windows and, later, introducing Microsoft Office to staff.

Technological changes were rapid and altered not only the computing world, but how researchers could access and share information. Marquardt and Mansfield both saw how the advent of the World Wide Web affected computing expectations. In 1992, Mosiac, an early web browser, was developed at the National Center for Supercomputing Applications (NCSA), then located on Beckman's 5th floor where the ITS offices are now.

These technological changes were well-received throughout the Beckman Institute.

"The changes were easier because Beckman leaders knew they needed to happen. We were serving a need, rather than trying to make people convert to a new way of doing things," said Marquardt.

"Many people picked it up on their own, people were more willing than expected to learn," said Mansfield.

> *"People don't think about it, but here in the Institute there are about 100 researchers for every ITS staff member. It doesn't take much for a workday to get hairy."*
>
> —Marc Taylor

However willing people were to accept the changes, providing services to staff was not without its challenges. Shortly after Mansfield joined the small shop of four employees, the founding director of Systems Services and other employees resigned, leaving only Marquardt and Mansfield. During this time, all techno-

From left, Nancy Mansfield consults with former employee Dave Mattson. Marc Taylor explains a process, and Al Marquardt, former ITS co-director, on the job.

logical responsibilities for Beckman were left on their shoulders.

"It was hectic, but I think we handled it quite well," said Mansfield.

Marquardt and Mansfield decided to make the best out of their situation.

"We took it as an opportunity to learn more than we had learned in the past," said Marquardt.

Marquardt and Mansfield managed to build their team up again, eventually to 13 people, including Marc Taylor, senior systems engineer, who joined the group in 1998. Taylor had a degree in engineering from the University of Illinois and fell into ITS after graduation.

"There were no classes for IT during that time. You just learned it as you went along, that's how we did it," said Taylor.

His first job with ITS was to maintain the public printing system. When Taylor was hired, the group included eight or nine people, the same number as today.

"People don't think about it, but here in the Institute there are about 100 researchers for every ITS staff member. It doesn't take much for a workday to get hairy," said Taylor.

Eighteen years later, the ITS group still faces many challenges due to rapidly changing technologies and continually adapts to tackle them.

Technology Today

Beckman researchers and staff have grown more accustomed to using technology. For ITS, this means the work has shifted from teaching people to use programs to using these programs to their fullest potential.

"As technology has changed, it's gotten easier but more complicated," said Mansfield.

"It's a lot like technology every day in your home. There's more and more of it, more programs, more devices, more places to store files. It's gotten more complex, but as the tools have gotten better, it's becoming easier to manage," said Marquardt.

Future Challenges: Centralized Technology

As campus looks to centralize computing services, the ITS staff will remain essential to providing expertise for Beckman researchers and staff.

"We understand the philosophy and mission of the Beckman Institute," said Marquardt. "We're going to help researchers connect with campus resources rather than us supplying them directly. Rather than service supplier, we'll be consultants.

"I have a problem and need someone in my office in the next five minutes. You can't do that from across campus. What we bring to the table is that very strong customer service perspective. We follow through and make sure work gets done."

"People enjoy a familiar face. It's really personal. If you have certain applications or certain ways you do things, it's nice to have the same person or group of people coming in so you don't have to keep repeating yourself," said Mansfield.

In 2016, Marquardt retired after more than 20 years at the Beckman Institute.

"He's been quite a mentor to me, the whole time I've been here," said Taylor.

"You can't just accept change, you have to seek it out. Or else the world will pass you by," said Marquardt.

2016 Student Award Recipients Named

Congratulations to the following students who were recently named recipients of the Beckman Institute student awards. The awards were presented during a ceremony on Saturday, April 23, 2016 in the Beckman Institute atrium.

BECKMAN UNDERGRADUATE FELLOWSHIP

Supported by funding from the Arnold and Mabel Beckman Foundation, the fellowship offers University of Illinois undergraduate students the opportunity to pursue interdisciplinary research at the Institute during the summer.

Claire Boyer is a junior in speech and hearing science with a speech pathology concentration. She has been working in the Adult Learning Lab with Elizabeth Stine-Morrow, professor of educational psychology and full-time faculty member in the Human Perception and Performance Group, examining social and emotional cues in language processing in order to help to identify areas of compensation for cognitive decline in aging.

Xuelin Guo is a junior in materials science and engineering, with a minor in computer science. She has been working with John Rogers, professor of materials science and engineering and chemistry and full-time faculty member in the 3D Micro- and Nanosystems Group, on guided solidification of eutectic optical metamaterials onto three-dimensional microstructures.

Justin Lien is a junior pursuing a double major in psychology and molecular and cellular biology, with a minor in chemistry. His research advisor is Wendy Heller, professor of psychology and member of the Cognitive Neuroscience Group. His research proposal is entitled "Genetic Risk, Traumatic Brain Injury, and Schizotypy Spectrum Traits in Youth."

Qing Lin is a junior in materials science and engineering. Her research advisor is John Rogers. Her research proposal is entitled "Three-Dimensional Assembly of Multilayer Microstructures and Their Applications in On-Chip Antenna."

Elliot Young is a sophomore in materials science and engineering. His research advisor is Joseph Lyding, professor of electrical and computer engineering and member of the Nanoelectronics and Nanomaterials Group. His research proposal is entitled "Investigation of the Crystal Structure and Band Gap of 2D Materials."

ERIK HAFERKAMP MEMORIAL AWARD FOR UNDERGRADUATE RESEARCH

In honor of Erik Haferkamp's life and achievements, his family, friends, and colleagues established the Erik Haferkamp Memorial Fund, which provides awards to undergraduate students who are conducting research in neuroscience at the Beckman Institute.

Kimberly Sam is majoring in molecular and cellular biology with a minor in Spanish and chemistry. She is looking at the consequences of repetitive low-force mechanical injury on neurons with Parijat Sengupta, research assistant professor in the Bioimaging Science and Technology Group and bioengineering, and Stephen A. Boppart, professor of electrical and computer engineering, bioengineering, medicine and co-chair of the Bioimaging Science and Technology Group.

JANSSEN FAMILY UNDERGRADUATE RESEARCH AWARD

The Janssen Family Award supports summer research for undergraduate students in neuroscience or psychology, with preference to support female students.

Rachel Pharris is a junior in psychology. She has been working in the Adult Learning Lab with Elizabeth Stine-Morrow, professor of educational psychology and full-time faculty member in the Human Perception and Performance Group, studying the cognitive processes of aging and how aging affects memory, learning, and decision making.

CARLE NEUROSCIENCE INSTITUTE UNDERGRADUATE RESEARCH AWARD

These awards allow promising undergraduates to pursue research in neuroscience or psychology at the Beckman Institute in collaboration with clinicians in the Neuroscience Institute at Carle Foundation Hospital during the summer.

Misha Ahmad has a double major in psychology and global studies, with an emphasis on global health. Under the direction of Ryan Dilger, assistant professor of animal sciences and director of the Piglet Nutrition and Cognition Laboratory, she plans to develop procedures to perform immunohistochemistry and immunofluorescence.

Nhan Huynh is a senior in molecular and cellular biology with a minor in electrical and computer engineering. He works in the lab of Dan Llano, assistant professor in medical molecular and integrative physiology, investigating the massive set of projections that the auditory cortex (AC) sends to the inferior colliculus (IC) in order to study the neural pathways of information processing and create devices that can exploit the innate circuitry of the brain.

Celebrating the 2016 Student Awards are Vice Chancellor for Research Peter Schiffer, Justin Lien, Qing Lin, Xulein Guo, Rachel Pharris, Elliot Young, Kimberly Sam, Shiyu Chang, Saumya Tiwari, Zhangyang Wang, Misha Ahmad, Nhan Huynh, and Beckman Institute Director Art Kramer.

NADINE BARRIE SMITH MEMORIAL FELLOWSHIP

In honor of Nadine Barrie Smith's life and achievements, Nadine's husband, Andrew Webb, established the Nadine Barrie Smith Memorial Fund that is supported by Nadine's family, friends, and colleagues. The fund provides fellowships to female engineering graduate students who are conducting research in the general field of medical imaging (e.g., ultrasound, optical, magnetic resonance) at the Beckman Institute.

Saumya Tiwari is an M.D./Ph.D. student in bioengineering and was previously a Beckman Graduate Fellow. She is working with Rohit Bhargava, professor of bioengineering and full-time faculty member of the Bioimaging Science and Technology Group, on developing a new imaging technology to identify and predict disease progression.

Yang Zhu is pursuing her Ph.D. in bioengineering. Working with Michael Insana, professor of bioengineering and full-time faculty member in the Bioimaging Science and Technology Group, Zhu's project in the ultrasound laboratory focuses on determining the microstructures that cause acoustic scattering and the signals viewed in clinical images.

THOMAS AND MARGARET HUANG AWARD FOR GRADUATE RESEARCH

In honor of Thomas and Margaret Huang's contributions to science, technology, and society, the Thomas and Margaret Huang Fund for Graduate Research was established by the Huang family and their friends and colleagues. The fund provides awards to graduate students who are conducting research in the Human-Computer Intelligent Interaction (HCII) theme at the Beckman Institute.

Shiyu Chang is a fifth-year Ph.D. student working under the supervision of Thomas Huang in the Image Formation and Processing (IFP) Group. His research focus is on "similarity" in networks.

Zhangyang Wang is a fourth-year Ph.D. student working with Huang. His principal area of interest is addressing machine learning and visual computing problems using advanced feature learning techniques.

Signs of Osteoporosis, continued.

and study the bone parameters contributing to the different strain values.

Currier hopes that that his work might one day be used to determine who is at risk to develop osteoporosis.

"As we age, there's a risk of osteoporosis developing in our bones. With a growing older population, this disease is going to have a bigger impact. If we get a CT scan of a patient's leg or a hip, we can look at the different structural parameters that are making up the bone, like cortical thickness, cortical diameter, porosity, trabecular length, trabecular thickness, and connectivity. We can then predict if that patient is at risk for osteoporosis," said Currier.

Doctors can then perform preventative care to avoid injury in the future.

Currier began his education at Bradley University in Peoria, Illinois, where he received his bachelor's degree in mechanical engineering.

"As an undergraduate at Bradley, I realized that, if I went to graduate school, I wanted a university with larger facilities, more funding, and better resources. This is why I look at UIUC," said Currier. "Then Mariana Kersh approached me about tissue biomechanics and I knew that was what I wanted to do. All those opportunities I knew I wanted were all at Beckman."

Imaging Small Animals, continued.

The IVIS system complements other non-invasive *in vivo* imaging tools within MIL such as positron emission tomography (PET) and single photon emission computed tomography (SPECT) scanners.

"The IVIS provides our users with an outstanding imaging tool using integrated optical and X-ray microCT technology," said Iwona Dobrucka, senior research scientist. "We can not only detect fluorescence and bioluminescence with an excellent sensitivity but also use x-ray imaging in order to locate optical signals in relation to animal anatomy. Through interfacing the IVIS system with existing nuclear imaging scanners such as PET and SPECT, we became a unique highly specialized facility, which allows for multimodal non-invasive monitoring of living organisms. Such multipurpose systems are in use only in best cancer research facilities, so we're glad that we can provide this service to our users."

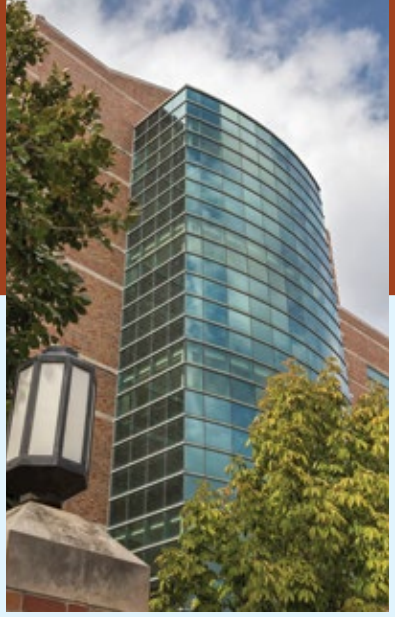
Pan Selected for Scientific Reports Board

Dipanjan Pan, assistant professor of bioengineering and full-time faculty member in the Bioimaging Science and Technology Group, has been invited to join the editorial board of the journal *Scientific Reports* (Nature Publishing) and will become the editor for the chemical biology subject area.

Robb Receives 2016 Henkel Award

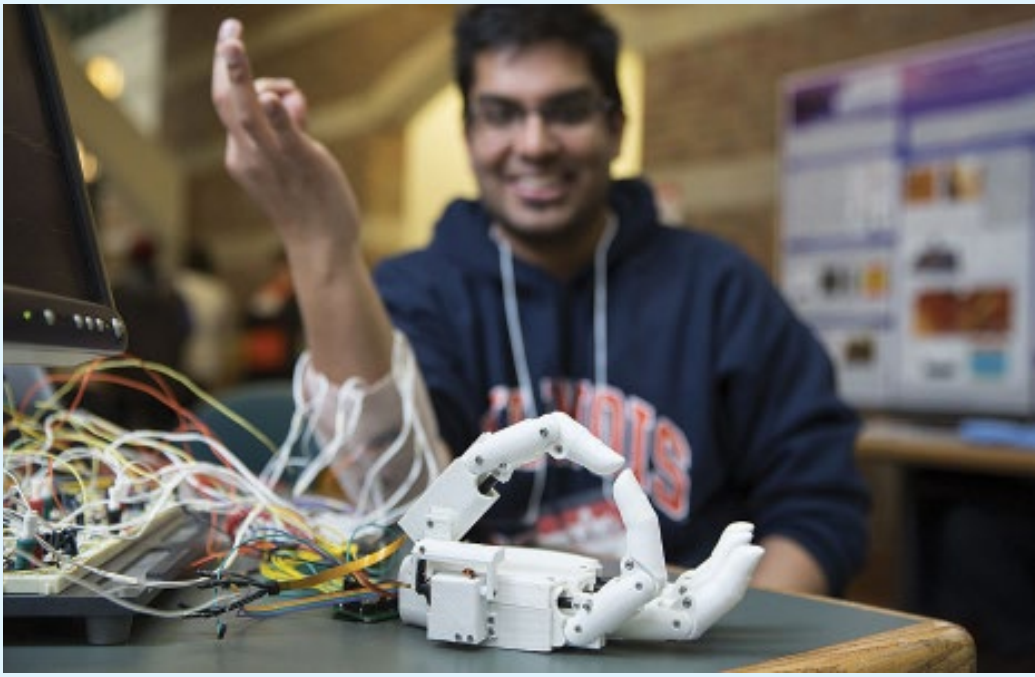
Maxwell Robb, a Beckman Institute Postdoctoral Fellow, recently won the 2016 Henkel Award for Outstanding Graduate Research in Polymer Chemistry from the American Chemical Society.

Honors & Awards



Boppart Receives 2016 EMBS Award

Stephen Boppart (left), professor of electrical and computer engineering, bioengineering, and medicine and full-time faculty member in Beckman's Bioimaging Science and Technology Group, received the 2016 Technical Achievement Award from the IEEE Engineering in Medicine and Biology Society.



Akhtar receives Illinois Innovation Prize

Aadeel Akhtar, a graduate research assistant in the Artificial Intelligence Group, has been awarded the Illinois Innovation Prize for his work developing highly advanced, low-cost prosthetic hands with sensory feedback.

Stumpf Named Guggenheim Fellow

Rebecca Stumpf, associate professor of anthropology and affiliate in the Bioacoustics Research Laboratory, is one of six University of Illinois professors named 2016 Guggenheim Fellows.

Beckman Graduate Research Assistants Awarded Dissertation Completion Fellowships

Zhangyang Wang, from the Image Formation and Processing Group, and Peiyun Zhou, from the Cognitive Science Group, were both awarded Dissertation Completion Fellowships by the Graduate College. Both Wang and Zhou work as graduate research assistants at Beckman. Wang is a doctoral candidate in electrical and computer engineering, and Zhou is a doctoral candidate in educational psychology.

Support the Beckman Institute

Beckman Scholarship Fund
Supporting students and postdocs at the Beckman Institute

Beckman Support Fund
General support for research, operations, travel, equipment, and facilities

Erik Haferkamp Memorial Fund
Supporting undergraduate research in neuroscience

Janssen Family Undergraduate Research Award
Supporting undergraduate research in neuroscience or psychology

Nadine Barrie Smith Memorial Fund
Supporting women engineers in medical imaging

Thomas & Margaret Huang Fund for Graduate Research
Supporting graduate research in human-computer intelligent interaction

Make a secure online gift today:
beckman.illinois.edu/about/giving

For more information, please contact:
217-244-1176
giving@beckman.illinois.edu

SYNERGY is a publication of the Communications Office of the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. Each issue spotlights the people and science that make the Institute one of the premier facilities for interdisciplinary research in the world.

Editor
Maeve Reilly
mjreilly@illinois.edu

Writers
Kaitlin Kamp

Designer
Laura Adams

Join our mailing list:
go.illinois.edu/Beckman_subscribe