

# UB BREAKTHROUGHS

THE UNIVERSITY OF BRIDGEPORT RESEARCH REVIEW

SPRING 2014

COVER STORY

## A Step Ahead

A NEW STUDY RESEARCHES HOW CHIROPRACTIC  
MANIPULATION OF THE ANKLE AFFECTS  
WALKING PERFORMANCE.

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Smartphone  
Science

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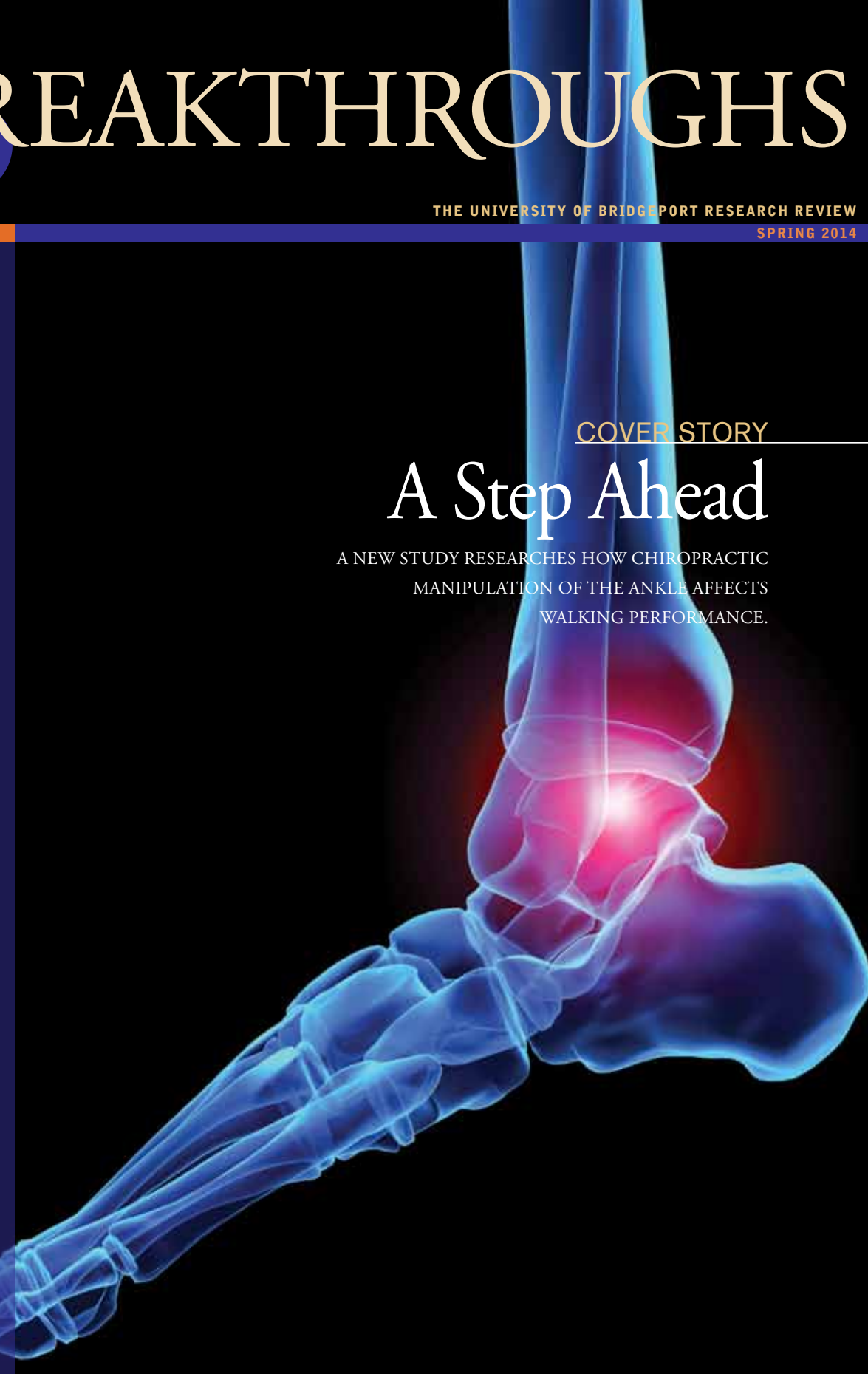
The Future of  
Nanotechnology

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BRIDGEPORT

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## From the Senior Vice President

Dear Colleagues,

This second annual edition of *Breakthroughs*, published by the University of Bridgeport (UB) Division of Graduate Studies and Research, showcases the research conducted by our faculty, often with the involvement of outstanding students. Our research enterprise is growing, as evidenced by the articles featured in this issue. As part of UB's growth, our new Ph.D. program in Technology Management has been launched and is scheduled to start in Fall 2014.

The academic disciplines highlighted in *Breakthroughs* are diverse but they have one thing in common: each attests to the exceptional research being conducted by UB faculty. Further, a growing number of projects are being conducted in partnership with other institutions and/or industry. Add to that the involvement of students and you have research that grows each discipline's body of knowledge, responds to the call for new scientific applications, and prepares our students for a seamless transition to continued education and the workforce.

I am pleased to announce that the University of Bridgeport will host the Zone 1 Conference of the American Society for Engineering Education (ASEE), scheduled for April 3-5, 2014. The ASEE Zone 1 Conference is held once every five to six years and we anticipate that it will attract more than 1,000 faculty, students and experts from academia and industry who are interested in engineering education, STEM Education, Research and Development in Engineering and Engineering Technology.

I hope that you enjoy this second issue of *Breakthroughs* and that it provides you with a glimpse of some of the innovative and interdisciplinary research being conducted by UB faculty and students.



Tarek M. Sobh, Ph.D., P.E.  
Senior Vice President for Graduate Studies and Research  
Dean, School of Engineering



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## A Step Ahead



### A NEW STUDY RESEARCHES HOW CHIROPRACTIC MANIPULATION OF THE ANKLE AFFECTS WALKING PERFORMANCE.

Turning over, sitting up unassisted, crawling, standing upright, and taking first steps are developmental milestones every parent anxiously looks for in a child's first year of life. The complexity of walking is almost incomprehensible, so it comes as no surprise that those first steps are wobbly and subject to frequent tumbles. But barring complications, a child quickly masters a steady gait, learning to pick up speed and go longer and longer distances unassisted.

Walking involves a kinetic chain that engages the feet, ankles, knees, hips, and so on. Add to that the phenomenon of the ankle's instantaneous axis of rotation, which in turn affects knee and hip movement and it's easy to see that the process is multifaceted. The mechanics of just lifting one foot are a highly complex series of tasks involving 26 bones and 40 muscles. And with each step, numerous additional bones and muscles are involved since walking is a function

of the entire human body, not just an isolated limb. Runners and other sports enthusiasts are probably more familiar with these biomechanics, but most of us take walking for granted because the ambulatory process is in large part subconscious.

Performance biomechanics for serious athletes is big business. Sports chiropractor practices are thriving in part because it is thought that joint manipulation improves competitive performance. Stephen Perle, D.C., UB Professor of Clinical Sciences and chair of the International Federation of Sports Chiropractic's research commission, has noted the rise in demand for chiropractic in sports performance. Perle, who served as medical director for U.S. outdoor track and field and cross country championships, as well as high school indoor track and field championships in the early 1990s, saw an increase in requests for his services, not just to treat injuries, but to prep competitors for races.

Whether you are an Olympic hopeful, marathon runner, or just walk for exercise, Perle is interested in the biomechanics of your gait. Specifically, he seeks to answer the questions, "does ankle manipulation improve your gait, and does that improvement have measurable characteristics?" His interest in research is one of the reasons he left behind a private practice in Manhattan for academia, when he became one of the first two chiropractors hired as full-time faculty for the University of Bridgeport College of Chiropractic in 1992.

Perle's current clinical trial is an exploratory stage study on a specific chiropractic manipulation of the ankle. He anticipates that the manipulated ankle will be able to bend better, which in turn should more equally distribute the walking process between the two limbs and improve walking

“Does ankle manipulation improve your gait, and does that improvement have measurable characteristics?”

— Stephen Perle

speed. Study subjects walk on a treadmill equipped with Microgate's Optojump, a device that measures the timing of feet walking or running on the treadmill. In the process of walking, both feet are on the ground approximately 40 percent of the time. Perle expects the manipulation to produce change in step to step differences and side to side differences in the two feet, known as variability. While a certain amount of variability is good, other amounts are bad, but researchers have not yet identified thresholds for optimal side to side or step to step variability in walking. If the manipulation in this study does improve gait and improves the variability, then the Optojump could be used to find people who would benefit from manipulation.

Perle himself is a man on the move. In addition to teaching full time at UB, he also has adjunct appointments at Murdoch University in Australia and in the French chiropractic program, is a speakers' bureau member of NCMIC Group, is a post-graduate instructor for New York Chiropractic College, serves as associate editor for *Chiropractic & Manual Therapies*, and is an editorial board member for seven scholarly publications. Perle has received numerous awards, including the Presidential Leadership Award from the American Chiropractic Association, The Connecticut Chiropractic Association's Malcolm Doyle Back Bone Award, and is a Fellow of the International College of Chiropractors. ■

## Picture This



### TWO INNOVATORS COMBINE THEIR EXPERTISE TO DEVELOP FACIAL RECOGNITION SOFTWARE.

The events of September 11, 2001 and continued threats of terrorism have prompted the demand for heightened security measures and inspired a new generation of surveillance equipment with multiple applications for security, law enforcement, and the military. Enter Ausif Mahmood, Ph.D., Chair of the Department of Computer Science and Engineering and Professor of Computer Science and Engineering and Electrical Engineering, whose list of research interests includes distributed architectures and algorithms and biometrics, the use of unique physical characteristics for identification; and Tarek M. Sobh, Ph.D., P.E., Senior Vice President for Graduate Studies and Research, Dean of the School of Engineering, and Distinguished Professor of Engineering and Computer Science, who is a renowned expert in the fields of robotics and computer vision.

They began to develop their idea for facial recognition software that could pinpoint and aggregate unique facial physiology into a composite of identifiers to be matched with database files for positive identification. The idea itself is not new; multiple researchers have approached this subject with varying success since the early 1970s and different face recognition strategies began to proliferate in the 1980s. Mahmood and Sobh's work further refines the process of one of these well-known strategies, the Eigenface technique, and incorporates the use of computational tools such as wavelet transform and principal component analysis.

For a year and a half, Mahmood and Sobh combined their expertise in computer science and computer engineering to work on developing efficient modules for full and partial face recognition, including recognition of specific facial features. A continuous cycle of research and testing resulted in refinements and improvements, and as the team received inquiries and consulted with various companies, they continued to develop and test partial

and full recognition algorithms. Applications of their early facial recognition software ranged from aiding the process of police artist sketching of alleged perpetrators to providing probabilistic facial matching for dating web sites, in addition to other uses in the security sector.

Fast forward to 2011, when Alan Dressler, co-founder of Central Computer Forensics Lab (CCFL), a high tech startup company housed in UB's CTech IncUBator, met Mahmood and Sobh. Dressler, a seasoned investigator and expert in cyber crime, computer forensics, and digital CCTV camera network installation, saw the potential for Mahmood and Sobh's software when packaged with a personalized database and simple video camera. He proposed partnering with them to develop the facial recognition software prototype and launch the product, named Face Checks™.

The Face Checks™ software program builds off of the Eigenface technique, employing hierarchical subgroups of individuals to search for the best facial match within each subgroup until the potentially best match is achieved. The improved technique shows an increase in recognition rates with various established databases. The additional use of a two-dimensional wavelet transform, combined with principal component analysis, enhances two-dimensional signal processing and analysis. Recognition efficiency is improved even more by using partial algorithms in artificial neural networks "trained" via sets of images in a database for convolution/feature matching. Mahmood and Sobh continue to improve the product's precision and reliability, which are critical for commercial application. The team is also developing a prototype for the adaptation of their facial recognition software for use in federated (third-party) authentication.

Face Checks™ is also being developed to work with moving targets, which adds additional layers of complexity. The goal is to work with people in natural motion, rather



Applications of the facial recognition product are numerous, with uses for border control, crime investigations, surveillance at high profile sporting events and concerts, and access control to high security facilities.

than individuals standing in a line that moves forward in increments as each person stops and is screened.

Applications of the facial recognition product are numerous, with uses for border control, crime investigations, surveillance at high profile sporting events and concerts, and access control to high security facilities such as government legislative buildings, military installations, and school buildings. The implications of determining database populations can become quite complex. Of course, in a smaller population size such as a university, it is much simpler to pinpoint identities compared to the volume of people who flow through an airport. There's also the issue of personal freedom if an individual's photo is available in vast networks. Although the technology has the potential to identify security risks, it may raise some constitutional and other legal issues. Non-security applications are in

demand as well, with uses including automated attendance monitoring in schools and offices.

It was a natural fit to launch the product through a partnership in UB's CTech IncUBator, where business acumen, faculty expertise, and student involvement are combined to adapt the software into a valuable and marketable security tool. The potential for this product drew the attention of Connecticut Innovations (CI), which translated into two \$25,000 small business grants to Face Checks™. CI, Connecticut's quasi-public authority responsible for growing Connecticut businesses through innovative financing tools and assistance, is UB's partner for the CTech IncUBator. The funding has enabled the acceleration of prototype development through the hire of UB engineering students and equipment purchases. ■



## Sharing History's Secrets

### ERIC LEHMAN UNCOVERS THE STORY BEHIND AN ICONIC FIGURE IN AMERICAN HISTORY.

A reporter with a microphone stops you on the street and asks you to name some famous entertainers from American history. You scratch your head as the camera light goes on and you rattle off some names — Shirley Temple, Marilyn Monroe, Elvis Presley, maybe P.T. Barnum. Of course, the answers will differ between the young and old. Regardless of your age, however, it is unlikely that you would name General Tom Thumb, even though he is arguably the first American celebrity to garner international acclaim, achieving this distinction before the end of the 19th century. Born in Bridgeport, Connecticut in 1838, Charles Stratton (his given name) was a little person who reached his lifetime height of 24 inches when he was six months old, living in obscurity until he was “discovered” at the age of five by Phineas Taylor Barnum, of the famed Ringling Brothers and Barnum & Bailey Circus.

Despite the phenomenal fame achieved and sustained from childhood until his death at age 45, Thumb's place in celebrity history has been relatively obscure, according to Eric D. Lehman, Senior Lecturer in English, who recently published *Becoming Tom Thumb: Charles Stratton, P.T. Barnum, and the Dawn of American Celebrity* (Wesleyan University Press, 2013). Lehman, a noted author who has published several books, essays, reviews and stories, became intrigued with the little-known story of this extraordinary Bridgeporter after reading a few biographies on Barnum and other books on the history of the local area. As Lehman explains, “I realized that we had so little on Stratton’s ‘voice,’ just a few letters, no diaries. So I despaired of

anyone writing about him until I was researching another book and realized that there are thousands of newspaper articles available on Stratton, including interviews, that no one had ever touched.” A combination of the Barnum Museum’s holding of around 700 pages of Stratton’s European letters written in 1846-47 and the explosion of digitized newspapers made accessible through electronic databases like the Library of Congress and America’s Historic Newspapers provided important, unique accounts of Stratton’s life.

Even though newspaper articles were available electronically, the research process was time consuming. Lehman pored through thousands of articles on Charles Stratton, putting together an accurate picture of his life at home and on tour. Mapping out forty years of performances and activities was no easy task, and matching anecdotal stories with hard facts often took weeks. Lehman also dug for insight into Stratton’s private life, something almost completely left out of previous scholarship. The recent discovery of a journal entry about a dinner with Barnum and Stratton, and the transcription by Barnum scholar A.H. Saxon was one of many gems that Lehman used to separate the real human being from the legend.

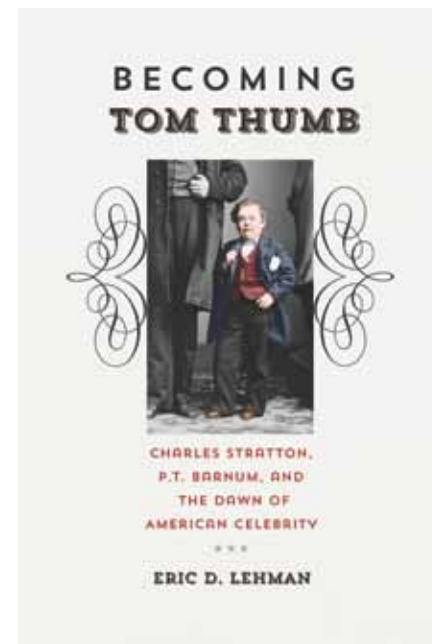
Lehman attributes the lack of scholarly biographical accounts of Stratton’s life to a variety of factors. For one, the nature of celebrity itself is short-lived, seldom extending past a generation or two, which may account for the dearth of preserved primary sources of the era, such as diaries and letters. Plus, Barnum’s own reputation for hoaxes, exaggeration, and lies, may have indirectly placed Stratton’s unique celebrity into question. Sadly, prejudice towards little people may also have played a part in the historical obscurity of Stratton’s fame. While his fame was almost fairytale-like in its time, according to Lehman, Stratton’s form of live entertainment, a mixture of stand-up comedy, song,

and dance, was considered “low culture” and may have been looked down upon by subsequent historical scholars.

Stratton was the consummate performer who maintained a full schedule of bookings that included two dozen tours of North America and five of Europe. According to Lehman, Stratton listed his profession as “traveler” on one of the census reports made during his adult life. In fact, Stratton was the first celebrity, along with his troupe, to travel on the transcontinental railroad. He gave at least 20,000 official shows for 50 million people.

Arguably, Stratton was the most “seen” human being prior to the advent of television. Among other firsts: he was the first non-diplomat to meet the kings and queens of Europe and was the first little person to attain such public prominence. Lehman notes that the rise of a celebrity culture during the mid-1800s coincides with Stratton’s own rise to fame, both aided by the simultaneous growth of the rail industry in the U.S. and ocean liner travel, improved photography techniques, mass produced souvenirs, and newspaper coverage.

A glimpse into America and Europe’s fascination with Stratton was something Lehman wanted to provide throughout the course of his book. The uncovering of a famous American comedian and likeable figure, thereby preserving Stratton’s place in history, was important, along with providing a brief glimpse into nineteenth century America. Also, Lehman wanted to bring justice to and tell the story of the most popular entertainer of his time who brought joy to people all over the world. ■







## Making it Work in } Zero Gravity }



### A TEAM FROM UB WORKING WITH NASA DESIGN AND BUILD A SPECIALIZED TOOL TO BE USED IN SPACE.

Some engineering students dream of working with NASA and long to be involved in any activity related to outer space. Last year, three mechanical engineering graduate students were given that opportunity by Zheng (Jeremy) Li, Ph.D., Associate Professor of Mechanical Engineering, who involved the students in his project funded by the National Space Grant Foundation's (NSGF) eXploration Habitat (X-Hab) Academic Innovation Challenge Grant program.

Li, who worked for more than a decade in industry research and development prior to his academic appointment, welcomed the challenge to develop a reduced gravity sample holder/manipulator tool for NASA's

Deep Space Habitat Geo-Lab. NSGF's X-Hab is a NASA-funded program designed to engage students in the science, technology, engineering and math disciplines through participation in authentic engineering projects. As one of four universities in the U.S. awarded a grant for 2012, UB's team was charged with the design, analysis, manufacture, and assembly of a subsystem that would be able to function in a deep space environment. Other 2012 X-Hab grant recipients were the Ohio State University, the University of Maryland at College Park, and Oklahoma State University.

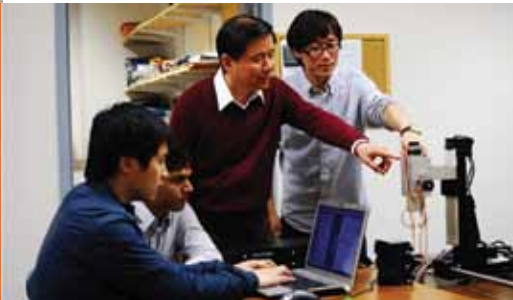
Since time constraints are a major issue for astronauts, automated tasks save precious time. To that end, Li and his team were charged with designing an automated microgravity sample holder and manipulator to be integrated into the existing Geo-Lab glovebox testbed. The holder/robotic-type manipulator needed to have the capability for Earth-based NASA personnel to explore the chemical composition of rock and soil materials by way of remote satellite communication during manned missions, thus freeing the astronauts for other important tasks. And, since the sample materials would almost certainly exceed the space required to return the samples to Earth, this tool could be used to help determine and prioritize which samples are most representative and should be kept. In addition, armed with important data secured in advance, Earth-based NASA scientists would have time to plan for appropriate storage, handling, and analysis for the extraterrestrial geological samples selected to make the trip to Earth.

The year-long project was held to a tight timetable with milestones, checkpoint reviews, and consultations with NASA engineers to produce a viable prototype. The project unfolded in stages, beginning with design, followed by manufacture and assembly, to culminate in product delivery, test-

ing, and integration. Li and his UB research team first met with the NASA engineering team via virtual conferencing and immediately set out to develop preliminary design concepts for review and consideration. Li divided activities among the students into the areas of design and 3D modeling, materials selection, and cost-effective manufacturing planning, mirroring the actual process and procedures for prototype design and development used in industry. Design versions were developed via CAD modeling, and 3-D FEA structural analysis was performed to produce multiple iterations that were evaluated through virtual technical meetings and correspondence between the UB and NASA teams. The best design option was selected—a small robotic arm attached to two linear slides and a vertical slide with a rotating table that can function as a zero-gravity sample holder and manipulator tool to handle geologic material from the moon and other bodies in the solar system. An important consideration of the design was the tool's seamless integration with the existing Geo-Lab glovebox testbed.

The next stage involved transforming the virtual prototype into an actual prototype in a short time period. Product assembly took place on campus with parts that met specifications for weight, cost, materials and integration. Named the Sample Holding System, the completed tool consists of a cantilever arm, rotary arm, and gripper with three-axis translation to allow the rotation of six degrees of freedom of a geologic sample in microgravity, with motion controlled by two linear slides and a single vertical slide (with rotating table). Since the motor control systems for slides and gripper arm must work together, they needed to be configured into a fully integrated system that can be controlled from one computer, which UB tested successfully. NASA's unique security system required additional modifications to be completed after delivery.

Li and his research team delivered the Sample Holding System prototype to NASA's Houston Johnson Space Center for system integration and further testing in May 2012. During their visit, the team met with NASA scientists and saw the Deep Space Habitat in which the Sample Holding System will be housed and operated. In September 2012, the model made its first trip with the NASA Desert Research and Technology Studies unit to an undisclosed location in the desert of California, where it was tested in a vacuum-controlled environment similar to that of space. Li hopes the knowledge gained from the project can be applied to further studies in the realms of geosciences, contamination control, and microgravity operations. In addition, the monumental endeavor has helped to improve modern product design and fundamental material research to improve aerospace exploration. ■





## AN IN-DEPTH LOOK AT THE CULTURE, PRACTICES, AND IMPACT OF THE SPIRITUAL CENTER, NAJAF, IRAQ, ON SHI'ITE COMMUNITIES AROUND THE GLOBE.

**N**ajaf, Iraq is a medium-sized city that is seldom named in Western media reports on the Iraq War, Arab Spring, Al-Qaeda, or other hot button Middle East religious-political topics. To Shi'ite Islam, however, Najaf is akin to the Vatican for Roman Catholicism: it is a major Shi'ite center for religious authority, education, religious economics, and a destination for pilgrims. This unique religious-socio-political-economic center and its global-religious impact captured the interest of UB assistant professor of World Religions and Global Development and Peace, Robert Riggs, Ph.D., while he was a doctoral student at the University of Pennsylvania, and has been a focus of his research since.

Ninety percent of the world's Muslims are adherents of the Sunni tradition and the remaining ten percent are Shi'ites who reside primarily in Iran, Iraq, Lebanon and Yemen. And while Mecca and Medina are important pilgrimage destinations for all Muslims, the medium-sized city of Najaf, Iraq is an important center for Shi'ite Islam. When Riggs realized that little research had been conducted and documented by Western scholars on the culture, practices, and impact of this spiritual center on Shi'ite communities around the globe, he set his sights on breaking new scholarly ground.

Riggs is especially interested in the relationship between religious authority, particularly ayatollahs, and the compulsory annual financial contributions made to religious authorities, including how contributions empower various authorities, and how they are perceived to impact religious education and care of the poor. An ayatollah is the top level of the religious authority hierarchy in Shi'ite Islam, comparable to a cardinal in Roman Catholicism (with no papal equivalent for Shi'ites). Ayatollahs have representatives within Shi'ite communities around the globe, and the ayatollahs may receive the tithes of the faithful directly, or the tithes may be collected and spent in the local community in the name of an ayatollah. This fundraising influences who studies in Najaf's hawzas (centers of religious education) since these students are funded through stipends. It also influences funding levels for local poverty relief, medical institutions, general education, and mission work. Most important, according to Riggs, is the connection between an ayatollah's power and influence and the amount of contributions voluntarily placed in

his care. It is a sort of competition for power and control, since Shi'ites are religiously required to give the obligatory 20 percent of their annual profits to the ayatollah of their choice. This creates a dynamic across the transnational network of Shi'ites as local and regional tithes fund would-be ayatollahs from Iran, Bahrain, Kuwait, Lebanon, Syria, India, Pakistan, Afghanistan, as well as France, England, and the U.S., who go to study in Najaf.

Riggs is intrigued by this tithing dynamic, especially in the age of globalized communication. The political, religious, and social changes evident in most Middle Eastern traditional societies are arguably a result of globalized communication. After all, the Internet and the ever-developing modes of electronic communication can serve at least two purposes: for the like-minded to communicate, and for the media to disseminate breaking events at lightning speed. As Riggs explains, globalization is changing the composition of religious communities and Shi'a Muslim hawzas, the premier of which are located in Najaf and in Qum, Iran. The reason for the communal transformations may originate from the educational system reforms that occurred in Lebanon and Iraq beginning in the 1930s, which have contributed to the current politicization of Shi'as across the Middle East. Riggs has managed to grasp the transformation of Lebanese and Iraqi Shi'a communities, and identify how these changes may impact continual globalization and grassroots religious community connections in the future.

After years of traveling to Lebanon and the broader Middle East, Riggs has gained a base of knowledge, expertise and friendship. He notes, "Although historians are not fortune-tellers, the study of history is integral for more accurate analysis of future possible outcomes." For these reasons, he anticipates that his study of Shi'a religious authority and schools in Lebanon and Iraq will be an important policy tool and academic contribution to the understanding of other cultures in this rapidly changing world.

Riggs focuses his research on the influence of contemporary Shi'a religious authority in Lebanon and Iraq. Specifically, he notes the wide influence of the mixed Islamic education and contemporary curriculum in the schools of Muhammad Rida al-Muzaffar (d. 1961), which he founded in the 1940s and 50s in Iraq. The school

## Bridging the Culture Gap







reforms of Muzaffar, who did not have any significant political aspirations during his career, are significant as they transcended modifications to other Middle Eastern educational systems. Current Shi'a activist attitudes are heavily influenced by a series of past events rooted in the educational systems founded by Muzaffar, whose students lived in both Iraq and Lebanon. This, Riggs argues, changed the future of both the Lebanese Reform Movement and also the Iraqi Reform Movement, spreading to even a pocket exile community in London. In addition, Riggs acknowledges that the newer phenomenon of Internet "ayatollahs," has also risen to challenge the structure of authority within Shi'a Islam by taking away the need for students to travel to Najaf, thus weakening the traditional center of power. Riggs has interviewed teachers at Muzaffar schools and notes that the religious figure is widely known, which reinforces the influence he has had on the transformational mixed secular and religious schools and the further alliance of Shi'a communities throughout the world.

Minimal international attention has been given to the exploration of the reform movement of Shi'a communities across the Middle East, underscoring the importance of Riggs' work. The current Shi'a political and social momentum has been substantially influenced by the schools of Muzaffar, and Riggs has exposed connections between modernization and the changing boundaries of Muslim religious authority by delving into the Shi'a awakening and the unification of the disenfranchised minority. These developments have transformed their position and permitted the mobilization of this group of people across national boundaries to gain substantial political and social rights.

Riggs acknowledges that years of Arabic language studies have enabled his extensive Shi'a research since most of the facts are found in Arabic books. Likewise, most cultural sayings cannot be directly translated but rather

come with years of language experience and personal exchange with native speakers. Having lived in the region for more than three years cumulatively, Riggs has reached near-native fluency in speaking, reading and writing Modern Standard Arabic and also has near-native fluency in speaking other dialects of Arabic. The level of Riggs' Arabic fluency has been crucial to discovering the impact of Muzaffar's religious schools.

Apart from its link to Middle Eastern understanding in both public policy and international diplomacy dimensions, Riggs hopes that his research on the global Shi'a community will help connect contemporary religious authorities and their role in society's activism to outsiders. The work will not only contribute to scholarly literature, but it will also add to the understanding of other politically relevant nations in the Middle East, particularly Iran. The discovery of the mobilization patterns of Shi'as across the region, which has been influenced in part through the Muzaffar's schools, is critical to the consideration of global networks and a new Shi'a global identity. It is the concept of collective affinity that Riggs hopes will contribute as a resource in diplomacy and policy-making, through the ever-shaping lens of globalization. Furthermore, he expects his study to help bridge understanding between the Western world and key figures, ideas and contextual language used in Arab communities in Lebanon, Iraq and the greater Middle East.

Riggs was awarded a UB Seed Money Grant in 2012 to continue his studies and plans to apply for additional funding. His research has been supported by the De Karman Foundation, The American Academic Research Institute in Iraq (TAARII), the Horowitz Foundation for Social Policy, The British Academy, and the British Society for Middle East Studies. His publications appear in the *Journal of Arabic Literature*, the *Journal of Shi'a Islamic Studies*, *Religion Compass* and the *Review of Middle East Studies* and he has contributed chapters to several collected volumes. His research has been presented at the annual meetings of the Middle East Studies Association, the American Academy of Religion and the American Oriental Society as well as a variety of international conferences such as the World Congress on Middle East Studies. ■



**Minimal international attention has been given to the exploration of the reform movement of Shi'a communities across the Middle East, underscoring the importance of Riggs' work.**



## Smartphone } Science }

### AN INNOVATIVE USE FOR SMARTPHONES COULD HELP LUNG CANCER PATIENTS BREATHE EASIER.

Lung cancer and other lung afflictions share a common symptom: reduced lung capacity. The associated sensation of lack of breath can have a significant impact on quality of life and outlook toward treatment and healing. Following surgery for lung cancer, learning to live with reduced lung function can be bewildering and challenging. Currently, patients use a spirometer to monitor their level of respiratory functioning. The advantage is that the device is low-tech and relatively inexpensive. The disadvantage is that the apparatus is bulky, and provides a measurement that must be interpreted. Miad Faezipour, Ph.D., Assistant Professor of Computer Science and Engineering and Biomedical Engineering, is researching a novel approach — the use of smartphone technology to create a portable, user-friendly Virtual Reality biofeedback tool for lung cancer and/or other breathing disorders.

Virtual Reality has been the stuff of movies and video games for decades, but has only been used in clinical therapy more recently. Virtual Reality imagery for cancer patients' visualization of their immune system killing the malignancy was documented in the mid-1990s. Biofeedback, the process of translating physiological measurements into meaningful data output for self-analysis regulation, is a therapy that has been used to manage migraines, chronic pain, and high blood pressure.

Faezipour aims to produce a Virtual Reality biofeedback application patients could use on their smartphones. Patients would connect a hands-free device to a smartphone, breathe into the microphone a few times and a 3-D virtual simulation of the lungs expanding and contracting would appear on the smartphone, along with simple coaching to better regulate the breathing at that moment and increase the percent of oxygen in the blood.

This application of Virtual Reality technology is a series of complex systems that must be able to function with precision and interact rapidly in order to be effective for biofeedback. The phases of the breathing cycle that produce unique acoustic signals are detected, recorded, analyzed, and transcribed to a virtually real image of the patient's lungs on a smartphone for viewing and breath adjustment. The biofeedback is expected to alert the patient when breathing is not normal before it is noticeable, thereby allowing him/her to adjust subsequent breaths and increase blood oxygenation.

Faezipour's research involves multiple stages and incorporates biology, biomedical engineering, computer science and engineering, and electrical engineering. The technology should be able to individually detect, record, analyze and classify particular breathing movements (inhalation, exhalation, and pauses between these phases). However, unlike

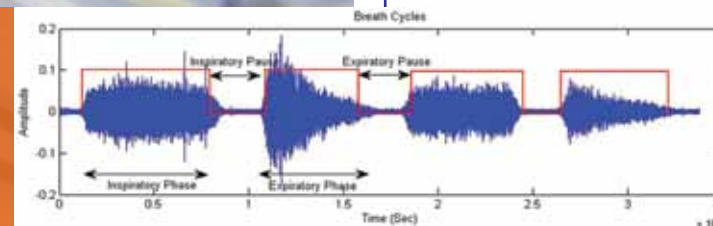
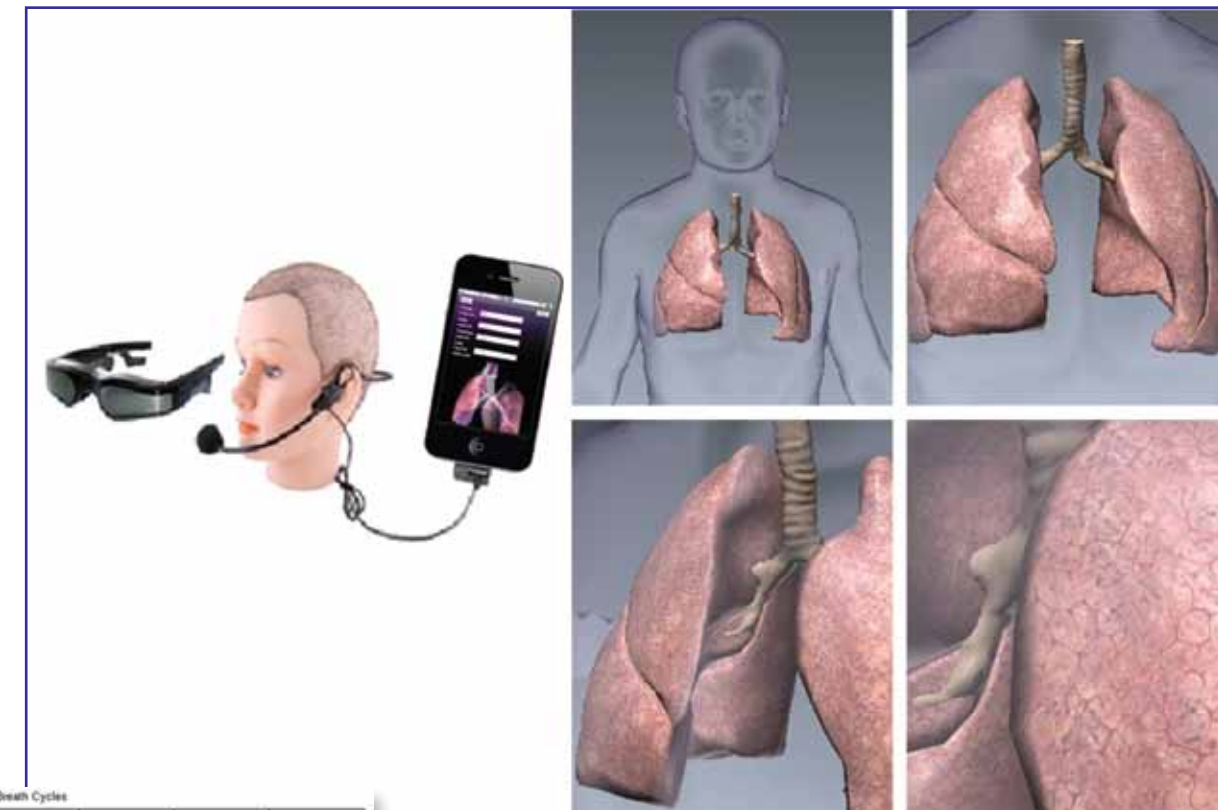


# BREAKTHROUGHS

## in Biomedical Engineering



The user-friendly, accurate smart-phone application will have the capacity to project a detailed animation of a patient's lung function on the screen of a hand-held device.



precise and expensive instruments found in a controlled clinical setting, Faezipour is researching how to accomplish these tasks using a simple hand-held device. Patients must contend with challenges posed by interfering sounds in a normal setting such as conversation, keyboard clicks, and TV broadcasts. Using algorithms to differentiate the acoustics of breathing from background noises and segment the breathing movements for classification, Faezipour hopes to produce an easy-to-use application that patients can use at home or work.

The signal analysis stage of Faezipour's research is close to completion, with an 86 percent accuracy rating. She hopes to achieve a 100 percent accuracy rating, deemed necessary for the continued advancement and eventual release of the breath signal project. Michael Autuori, Ph.D., Professor of Biology and Spiros Katsifis, Ph.D., Professor of Biology, have collaborated on the design and Ph.D. student

Ahmad Abushakra has served as Faezipour's research assistant. A preliminary version of this virtual therapy framework application has been devised that monitors breathing movements and integrates a visual effect of the lungs inflating and deflating as the patient inhales and exhales.

The final product, a user-friendly, accurate smartphone application, will have the capacity to project a detailed animation of the cancer patient's lung function. The remaining challenge involves the completion of a high definition animation, which will be integrated with the acoustic signal transmission, and identifying possible breathing/lung functionality disorders and/or diseases by further analyzing the acoustic signal of breath. In this way, the actual breath analysis of a patient will be visualized on a smartphone for use in real-time biofeedback therapy. Faezipour foresees the completion of this integrated framework within the next two years.

Currently, most research into smartphone technology medical applications is focused on cardiac care. Faezipour envisions the application of her research as a means to improve the lives of many individuals throughout the world. By aiding in the treatment of lung cancer patients, it can improve lung functionality and contribute to a better quality of life for the cancer patient and other patients with breathing disorders. Overall, equipping an individual with the tools to regulate and improve their own health not only empowers them, but also motivates the individual to progress along the road to recovery.

Faezipour joined the engineering faculty in July of 2011, secured a UB Seed Money Grant in her first six months, and quickly established the Digital/Biomedical Embedded Systems and Technology (D-BEST) Laboratory in the School of Engineering's technology building. Her

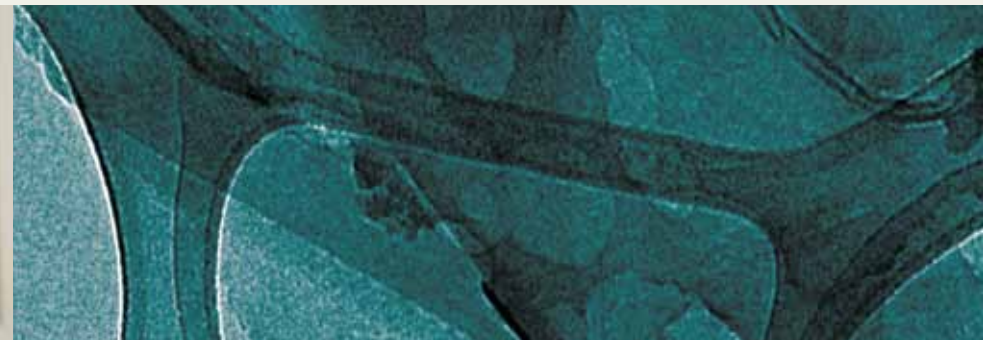
research interests lie in the broad area of biomedical signal processing and behavior analysis techniques, high-speed packet processing architectures, and digital/embedded systems.

Computer Science and Engineering Ph.D. student Ahmad Abushakra has been working with Faezipour as a research assistant; together they have already published two journal articles on this area of research in the Institute of Electrical and Electronics Engineers' *IEEE Journal of Biomedical and Health Informatics* as well presented components of this research in several world-class IEEE conferences. ■





## Is Germanium the Next Little Thing?



### MARIA GHERASIMOVA IS TESTING THE PROPERTIES OF GERMANIUM, WHICH COULD LEAD TO THE NEXT GENERATION OF TRANSISTORS.

The development of a method to mass-produce silicon transistors in the late 1950s followed by the explosion of innovation in Silicon Valley revolutionized the electronics industry and forever changed our lives. While we all know that silicon semiconductor transistors led to smart phones, tablets and a vast array of electronic gadgets, they also led to the creation of synthetic tissue for burn victims, artificial hip joints, deep space exploration vehicles and much more. However, unless you are a physics or chemistry buff, it's unlikely that you know, or even care to know, the science behind the discoveries.

Curiosity of the basic properties and possibilities is what motivates the research of Maria Gherasimova, Ph.D., Assistant Professor of Physics. In particular, Gherasimova is interested in the potential for a novel paradigm of a logical element that departs from the well-established metal oxide semiconductor field effect transistors (MOSFETs) developed in the 1970s that are still the mainstay of silicon chips. While graphene, a homogeneous, two-dimensional, atomically thin, honeycomb-shaped carbon crystal structure, is now the focus of much research in this area, Gherasimova has turned her focus to another member of the periodic table's carbon family with semiconducting properties: germanium. In fact, researchers first experimented with germanium before settling on silicon transistors.

The nature of silicon semiconductor transistors is such that they can "speak" the binary language of the logical operations required for electronics through a specific, albeit extremely small, assemblage, the MOSFET. This grouping of silicon, "doped" (a process in which impurities are intentionally introduced) at the lattice level with other metals

and oxides, conducts an electric signal used for binary logic. The miniature assemblage has been packed into increasingly smaller spaces through improved lithography over the past few decades, allowing for an increase in the number of functions performed per unit time, i.e. faster computation speeds in increasingly smaller products. Still, this innovation trajectory will have limits, since at some point the maximum number of MOSFETs that can be packed onto a small area on a chip and function finally will be reached.

Gherasimova is experimenting with quantum dot fabrication methods to create a new type of medium for binary language, quantum cellular automata (QCA), consisting of germanium island clusters (cells) on a substrate of silicon. The QCA cells, rather than interacting via electric current like MOSFETs, interact via electrostatic fields. A QCA wire would transmit information via changing the state of the neighboring cells that are used to encode the binary "0s" or "1s," thus achieving a logical circuit for information transmission without the use of electrical current.

Critical factors impact this process. For one, germanium island clusters need to have a consistent distribution and size on the silicon substrate, which is difficult to achieve through self-assembly since germanium islands naturally nucleate irregularly at random locations on a silicon substrate. Next, the germanium islands in the clusters need to be sufficiently close (only nanometers apart) for charge tunneling and the clusters need to be close enough for the electrostatic communication to occur (tens of nanometers apart). So Gherasimova is focused on identifying the optimal method to achieve uniform, sufficiently close distribution of these germanium islands.

**While graphene is now the focus of much research in this area, Gherasimova has turned her focus to another member of the periodic table's carbon family with semiconducting properties: germanium.**

An institutional seed money grant award in 2012 funded Gherasimova's multiple trips to IBM's T. J. Watson Research Center in Yorktown Heights, New York, where she performed experiments using IBM's modified ultra high vacuum (UHV) Hitachi transmission electron microscope (TEM) that has a focused ion beam (FIB) implantation capability within the same UHV environment. This enabled

experimentation and observation of germanium deposition and self-assembly on FIB-modified surfaces within the apparatus. FIB surface treatment on the silicon sub-

strate was used to "herd" germanium dot growth away from untreated surface area to the desired locations, i.e., control the location of the clusters as well as the individual islands within the clusters. In these recent experiments, Gherasimova focused on utilizing self assembly of small clusters of islands to achieve small inter-island separation distance instead of relying on the deterministic one-to-one ratio between the islands and FIB-encoded sites, which was the goal of her earlier work. Self assembly has the potential to overcome the limitation on minimizing this distance imposed by surface diffusion during the deposition.

Gherasimova is continuing her research on campus by analyzing the data and preparing the results for publication. She has presented her recent findings at the Materials Research Society meeting in the fall of 2012, and Connecticut Microelectronics and Optoelectronics Consortium Symposium in the spring of 2013. ■





## Music Matters

### ONE RESEARCHER ANALYZES THE ROLE OF MUSIC EDUCATION IN INNER-CITY SCHOOLS.

When you think of cherished school memories, acting in the school play or playing on the soccer team may come to mind. School is about far more than classes and tests, and many remember the times when they were engaged in creative, active, and personally meaningful learning experiences. While these meaningful experiences have been a part of American education for generations, there are great discrepancies in the availability and viability of such activities in suburban and urban schools. Limitations are often driven by budgets or policies focused on standardized testing, but are also related to the way teachers seek to understand and engage (or fail to engage) urban students.

Frank Martignetti, UB Visiting Assistant Professor of Music, experienced a shift in pedagogy as a music educator during his years of teaching in inner-city schools. This experience prompted him to devote research to the role music education can play, and, he believes, should play in the lives of inner-city students.

Like other teachers who succeed in urban schools, Martignetti was first confronted with the limitations of his own background and experience when he journeyed into the urban classroom. He learned about his students' life experiences, often vastly different from his own, and how those experiences shaped their approach to school, learning, and music. Martignetti quickly realized that his training in music education and classical music performance did not prepare him sufficiently to reach and teach these students. It was the beginning of a challenging, yet rich exploration to identify his students' musical strengths as a starting point and build from there, rather than succumbing to the cultural deficit model presumed by many. Martignetti knew that the role of music education cannot be understated, as it allows students to work cooperatively, develop self-discipline and focus, take risks, branch out and express themselves in creative ways. So, he has focused his research on recruitment, engagement and retention in secondary school music programs, and on bringing the voices of actual urban students and teachers to bear on music education research and policy literature.

With that in mind, Martignetti conducted a case study of eighth grade band students in New Haven, Connecticut's public schools, focusing on the critical transition between middle school and high school — when many students stop being involved in school music programs, or in music altogether. Through extensive class observation and interviewing students about the meaning of their experiences in school music programs, he attempted to gain insight into the factors affecting retention of band students between middle and high school.

The research indicated that participating students clearly derive a great deal of joy and benefits from the experience, primarily the joy of music making itself, as well as the strong bonds frequently formed with fellow students and teacher. However, results indicated there are significant issues regarding access to music education, as well as the breadth and perceived relevance of courses offered. Three main issues identified were: the absence of programs in certain high schools, actual or perceived scheduling conflicts due to block scheduling, and the paucity of opportunities to study instruments such as keyboard or guitar, which allow individuals to have a satisfying musical experience on their own outside of rehearsal. Subjects' responses also spoke to music educators' frequent failure to include and honor genres and styles near and dear to their students, which is problematic since music forms such a key part of adolescent identity.

In order to serve students well, policy-makers must make informed decisions that include knowledge of students and knowledge of the benefits of a comprehensive education that includes the arts. Unlike students, policy-makers may not fully appreciate the benefits and the precious connection between music students and teachers because they may have never been involved in the creative expression of music. In Martignetti's view, music is a powerful tool that can enhance human development and must have a growing presence in schools.

Technological advances and market forces have transformed music for many Americans into a product passively consumed, rather than a process engaged in with others, and Martignetti believes we are a poorer society for it, arguing that we need the benefits of active music making now more than ever. If music education can maintain and increase its presence in schools and broaden its traditional base of activities to include instruments and genres that figure prominently in contemporary culture, it can be a vehicle to change lives, and our culture, for the better. ■







## Shrinks, Sages and Suits }

**There was an overwhelming consensus among the study's participants that their misalignment is related to the three perspectives, creating tension and a relationship gap.**

### NEW PERSPECTIVES ON CORPORATE ROLES ADD DIMENSION TO THE STUDY OF IT VALUE.

Technology, society, and commerce are longtime partners. Since the beginning of time, technology has been integral to human progress. The industrial revolution is marked by significant gains in productivity, which was largely driven by advancements in management science and technology. For the last fifty years though, progress has been limited more by a dearth of valuable and timely information than by physical and mechanical challenges, which places computer information systems in

the spotlight. The proper application of computer systems can mean the difference between success and failure in many industries and fields that impact all of society.

With this kind of history, it would seem that technologists and their associated functions would be much adored and celebrated. Yet, much like the mutual incomprehension between humanists and scientists in higher education identified by C. P. Snow, IT professionals and their departments are often maligned by their non-IT counterparts. This well-known relationship gap between non-IT staff (known in corporate settings as the “suits”) and IT staff (referred to as the “geeks”), has been described by researchers as an organizational crisis, and was the subject of a study recently conducted by Arthur C. McAdams, Ph.D. McAdams spent thirty years in corporate IT roles ranging from computer programmer to chief information officer before moving on to academia in 2006 when he was appointed senior lecturer at the University of Bridgeport.

While his initial study was directed toward the relationships between the users (suits) and IT service providers (geeks), McAdams realized that the central problem was that neither party could measure the value of IT services in any mutually agreeable way. Traditional financial metrics failed to measure the value of knowledge work. Improvements in product and services based on new IT functionality had no meaningful measures, and efficiency gains appeared to be incomplete, hard to quantify, and misleading.

In his exploratory study at a multinational corporation, McAdams conducted interviews, focus group discussions, casual conversations, and impromptu dialogues during observations to better understand the perspectives of

participants in the study. As noted in existing research, he found that IT valuation was subjective. However, IT valuation in this study was differentiated between the three primary organizational functions (marketing, operations/IT, and finance) instead of the typical two parties (IT or non-IT). The categorization of attributes and attitudes that formed the three categories, which McAdams labeled “shrinks,” “sages,” and “suits,” is derived directly from participants as they described themselves and their colleagues.

His findings: the marketing “shrinks” view customers as the primary stakeholder, so they respond immediately to any market condition using any means necessary. To them, anything less would damage the brand. They have a sense of urgency and promote speed-to-market. “Shrinks” are not interested in engineering and financial matters, which they view as necessary, but subordinate, functions.

McAdams found the IT “sages” to be perfectionists. They despise imprecision and workarounds, and are not swayed by the crisis du jour. They insist on quality time to design the perfect, elegant, and timeless system. They are unyielding and care about the integrity of the system more than the immediate needs of customers and shareholders.

The rational, pragmatic, risk-averse finance “suits” round out the troika. They answer to shareholders so they impose metrics on “shrinks” and “sages” to ensure that “shrinks” do not “give away the store” and “sages” do not waste money on grand technology ventures. Much of their energy is devoted to mediating contentious negotiations between shrinks and sages.

McAdams cautions that as simple as these descriptions may appear, there was an overwhelming consensus among this group of participants that their misalignment is related to these three perspectives, creating tension and a relationship gap. In the past, the parties had fondly described conflicts as “family squabbles.” While uncomfortable, they were tolerated because the parties acknowledged the contribution of every perspective, and could agree that, in the end, their differences made them a stronger team.

Researchers have noted for years that perception represents reality in service functions. Yet with such a wide range of perceptions, it is little wonder that no single group will ever be satisfied with IT services. In this study, McAdams hopes he has added an important dimension to the study of IT value as an integral part of organizational performance. ■





## Reaching Out }

A COMMUNITY COMES TOGETHER TO INVESTIGATE BEHAVIORS LEADING TO SUBSTANCE ABUSE AND HIV INFECTION, AND TO OFFER PREVENTION EDUCATION TO STUDENTS.

First time college students make a number of important academic and personal decisions as they learn to manage the independence that comes with living away from home. Some of these decisions will have an important impact on their future, such as choice of school and major area of study, but equally important are social decisions, some of which involve spontaneous, risk-taking behaviors with potentially devastating, permanent consequences. National surveys reveal that drug and alcohol use, abuse, and dependence increase significantly in 18-25 year olds, and decline again dramatically for those 26 and older. Likewise, the rate of HIV diagnosis increases significantly and is the highest in the 20-24 year old age range, disproportionately high for people of color. Plus, alcohol and drug use increase the risk of unsafe sex.

With an interest to study attitudes and behaviors that can lead to substance abuse and HIV infection and to offer group-level prevention programming to college students, Tracey Ryan, Ph.D., Associate Professor of Psychology and Melissa Lopez, R.N., BSN, MPH, Director of Health Services, partnered with the Greater Bridgeport Area Prevention program (GBAPP) on GBAPP's Odyssey Project in 2010. The project is funded by the Substance Abuse and Mental Health Services Administration's Center for Substance Abuse Prevention (CSAP). Ryan's involvement in the project, now starting its fourth year, has been to research and analyze attitudes, perceptions, and behaviors surrounding alcohol and drug use and unprotected sex practices among college age students, in order to better understand how to effectively mitigate behaviors that can



lead to life-long physical and mental health challenges.

Ryan's research began with a needs assessment to help determine the level of risky behaviors among UB undergraduates. Data from surveys previously administered by UB's student affairs offices was analyzed, along with data collected via a sur-

vey administered by Ryan at the beginning of the project to approximately 120 UB students. Ryan served as co-investigator for the project's community assessment under the leadership of Gretchen Vaughn, Ph.D. licensed clinical psychologist and the project's primary investigator. The findings allowed Ryan and Vaughn to formulate a preliminary "snapshot" of student knowledge, attitudes and behaviors toward substance abuse and unprotected sex.

The snapshot, according to Ryan, confirms what researchers know — that young adults partake in unsafe sexual behaviors, knowing that they are not healthy or mistakenly believing that some are safe, despite significant programming in HIV prevention throughout middle school and high school. In addition, survey respondents reported that over half of their peers binge drink regularly, while just under one-fourth reported that they had actually done so. This prompted Ryan to ask, "Why does someone participate in risky behaviors, knowing that they are risky? Why do some mistakenly believe that certain behaviors are safe when, in fact, they aren't? Why are there false impressions about binge drinking?" Ultimately Ryan hopes her research will help discover how these risky behaviors can be reduced or eliminated.

GBAPP and Lopez stepped in to work with Ryan on the educational components: first GBAPP staff and then



“Why does someone participate in risky behaviors, knowing that they are risky?”

—Tracey Ryan

Ryan made classroom presentations on awareness around substance abuse and unsafe sex to psychology and human services students. Lopez, working with design faculty, engaged graphic design students to develop posters and other print media for a social marketing campaign, complete with poster competition and exhibition. During the project's first year, Ryan and Lopez ran multiple focus groups around the posters, engaging groups comprised of administrators, faculty, staff and students, with eight to 10 participants each. The focus groups were asked to evaluate which posters they considered to have the most potential to change attitudes and behaviors. Ryan was surprised with the results, explaining, "While some posters were quite provocative, even the most conservative faculty members found them to be appropriate for college campuses."

Odyssey Project programming on campus is part of a nationwide effort to reduce HIV infection rates among college students through education and activities. The Odyssey Project is under the leadership of Nancy Kingwood,

MSSH who serves as Project Director, with funding made available through The Minority AIDS Initiative. The model programming, provided by GBAPP staff to UB students, is comprised of SISTA, Sisters Informing Sisters on Topics about AIDS, for African-American females, and NIA, A Program of Purpose, which is designed for an African-American male audience. At UB, the men's and women's groups meet privately in the dorms. These intensive groups provide a place where, through group work and exercises, participants can talk about unsafe behaviors and how to change those behaviors. Data collected through surveys administered to group members is being used to validate the effectiveness of the programming models.

This year, Ryan and Lopez plan to start up new focus groups to identify barriers that prevent students from seeking HIV testing as well as factors that are more likely to motivate students to seek testing. ■



## The Future of Nanotechnology

### PRABIR PATRA ENVISIONS A TRANSFORMATION IN TECHNOLOGY AND MEDICINE THROUGH THE USE OF BIOLOGICALLY-INSPIRED NANOSTRUCTURES.

Inspiration from nature and the desire to push the boundaries of science are strong research motivators for Prabir Patra, Ph.D., chair of the Biomedical Engineering department and Associate Professor of Biomedical Engineering and Mechanical Engineering. Biologically-inspired nanomaterials are the focus of his research because, as Patra asserts, bacteria are one of the smallest engineers in the world and so, potentially, one can accomplish massive feats through harnessing their efforts. Equally fascinating is graphene, a homogeneous, two-dimensional, anatomically thin, honeycomb-shaped carbon crystal structure that transcends most scientific laws and norms. According to Patra, graphene's unique properties could have significant implications for drug delivery, among other uses. For example, a lubricating gel made from graphene could help decrease the amount of friction in drug delivery systems, which could transform medicine and the drug industry. In general, Patra selects projects that could change the way many physiological regulatory functions operate in medicine.

Accordingly, Patra's involved in multiple research projects taking place on campus and across the U.S., in collaboration with researchers at institutions such as Rice University, University of Texas at Dallas, Lamar University, Wesleyan University, the University of Connecticut, and MIT. All the projects include participation of UB students. While his group members are widely separated by geography and different research team colleagues, the prefix "nano" is usually common denominator. (See the inaugural issue of *Breakthroughs*, Fall, 2012.) Patra came to UB in January 2009 following postdoc appointments at the University of Massachusetts Dartmouth and Rice University. Patra has numerous high quality publications in the area of nanotechnology and biomedical engineering. He also developed and chairs UB's biomedical engineering department that started in 2010 and currently enrolls close to 80 students in its master's degree program.



Patra's findings about biologically inspired nano-medicine include:

- Single cell biomechanics of stress pathways has the potential to lend itself to the detection of very small levels of C-Reactive Protein (CRP), a strong indicator for the onset of heart disease. CRP is a marker for non-specific inflammation; cardiologists currently measure high sensitivity CRP (hs-CRP) at the milligram per liter level in the bloodstream. So the ability to measure significantly smaller levels of CRP would further aid cardiologists and other heart disease specialists. Patra is developing an extremely sensitive level of CRP detection by way of nano-particle layering of antigens and antibodies on a graphene chip that can bind CRP and produce measurable detection at the femtogram level for early disease prediction. For perspective, one femtogram is equal to one million nanograms, and one nanogram is equal to one million milligrams.

- Topical drug delivery incorporating graphene has the potential to selectively move the drug to a predetermined location by utilizing graphene's conductivity property. A current is passed through a wire to the graphene, which then heats the polymer chains and moves the drug that is suspended in the gel.

- 3-D printing has the potential to be adapted for tissue engineering. In collaboration with researchers at the University of Connecticut, Patra is investigating ways body tissue regeneration can be mimicked with 3-D printing.

- Graphene's binding property has the potential to help remove disease-producing substances in vivo. In the case of Alzheimer's disease, the Amyloid beta (A $\beta$ )-40 peptide is the major peptide that forms the Alzheimer's-causing plaque in the brain. Working with researchers from Brookhaven National Laboratory, Wesleyan University and the University of Miami, Patra and colleagues hope to harness graphene's binding association with the A $\beta$ -40 peptide as a mechanism to remove the plaque and potentially reverse the course of the effects of Alzheimer's.

- Non-invasive tuberculosis testing may be possible,

which would be a tremendous boost for testing in developing nations. A layer-by-layer, paper-based test using "invisible ink" comprised of a gel sensing protein is being developed to measure TB-associated protein in urine. The test would take about eight to 10 minutes to process.

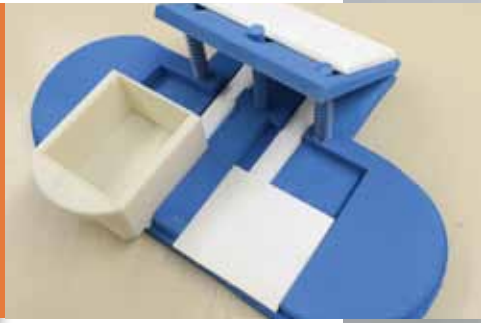
Patra recently brought a Defense Advanced Research Projects Agency (DARPA) Small Business Innovation Research (SBIR) subaward to UB in collaboration with Connecticut Analytical Corporation, a Connecticut-based business specializing in instrument design, applied research, and medical diagnostic investigation. Patra's role in the project is to research graphene and other physical forms of carbon as they interact with biological molecules. This \$1.1 million collaborative grant also involves Yale University, MIT, Case Western University, and Harvard University.

In addition to his involvement in research and teaching, Patra has also published promising research results in high quality papers. In December 2013, Patra and collaborators from Lamar University and Rice University published his startling findings in the prestigious journal, *Nature Communications*. The article, "Water Tribology on Graphene," is a report on the unique frictional behavior of graphene that could pave the way for biomedical lubricants and cosmetics. In April 2013, Patra and his collaborator from Rice University again published their seminal work on "Dynamic Self-Stiffening in Liquid Crystalline Elastomers" in *Nature Communications*. Their unique findings are contributing to research in the development of self-healing, biocompatible and adaptive biomaterials for tissue replacement. Patra recently joined the editorial board of *JSM Biotechnology and Biomedical Engineering*, and *ISRN Nanomaterials*; both are open access, international, peer reviewed, online academic journals.

An intense passion to unlock the secrets of nanotechnology in part for medical applications drives Patra's research focus. This intersection of nano-scale invention and medicine has the potential for diagnostic and treatment transformations. Whether it is graphene or other biologically inspired nanostructures, Patra's interest is in how they might be used as new tools for the diagnosis of disease in developing countries, new methods of drug delivery, or for artificial tissue. Conducting research with colleagues at UB and elsewhere, and with the close involvement of his students, will continue to consume Patra's time and energy as he seeks to investigate and harness the potential of this newer frontier in science. ■



## Collaboration in the Classroom



### AN EXPERIMENTAL COURSE OFFERS STUDENTS THE CHANCE TO WORK IN INTERDISCIPLINARY TEAMS TO CREATE AND MARKET NEW PRODUCTS.

A few years ago, Neal Lewis, Ph.D., Associate Professor of Technology Management, noticed the lack of opportunity for course-based interaction between engineering, business, and design students. While it makes sense in academia for students to focus on taking courses within their major and academic department, Lewis knows that industry is not as compartmentalized; research and development typically work hand in hand with marketing. It seemed logical to develop an inter-program experience that would incorporate elements of engineering, business, and design courses and produce a “real-world” endpoint.

Lewis reached out to School of Engineering colleagues, Navarun Gupta, Ph.D., Chair of the Electrical Engineering Department and Associate Professor of Electrical and Computer Engineering, Jani Macari Pallis, Ph.D., Associate Professor of Mechanical Engineering, and Dr. Gad J. Selig, Associate Dean of Business Development and Director of the Technology Management Program, as well as Art McAdams, Ph.D., Senior Lecturer in the School of Business, and Professors Richard Yelle and Alex White in the Shintaro Akatsu School of Design, to collaborate on this new project. The result: the creation of an experimental course in New Product Commercialization for engineering, business, and design students.

UB’s curriculum already offers a number of courses within the majors that include product design and concept development. As Lewis explains, “these courses are fairly typical of each discipline, and are adequate for the first phases of the product development process.” In fact, foundation courses on product design, product management, marketing, finance, and a basic understanding of strategic management are critical pre-requisites for the course. But this new course takes the next step, providing the interdisciplinary student teams with the resources needed to build

product prototypes, develop marketing materials, and perform patent surveys in support of commercializing new products.

The team behind the creation of the course secured two rounds of planning grant funding from the National Collegiate Inventors and Innovators Alliance (NCIIA), which covered course development and the pilot of the first class in the spring 2013 semester. Twenty students enrolled from three schools and six majors, including Electrical Engineering, Computer Science, Business Administration, Technology Management, Industrial Design, and Design Management. NCIIA just awarded a new multi-year grant to Lewis that will provide much-needed funding to establish the course as a permanent offering.

In New Product Commercialization, student teams are created with at least one engineering, management, and design representative per team, which translates into having “experts” from each represented major on a team. A comprehensive approach is employed, in which the team conceives of a product idea that is designed by the designer and engineer, with a prototype built by the designer, and a marketing and finance plan developed by the management student. Lewis notes that the concept is essentially, “mimicking what businesses do,” which takes the course beyond the endpoints of similar courses in the individual majors and simulates actual industry practice. Students quickly learn that they are working with people who think differently than they do and approach problems in a completely different way. This is one of the major learning steps in interdisciplinary teams: working with people who have a completely different set of skills and perspectives.

The teams are given the option to propose their own project ideas or use an existing company’s concept. (International Business Machines (IBM) Corporation and Pitney Bowes have approached Lewis to participate.) For

example, imagine an end product that can accurately and precisely read core body temperature via the bridge of your nose. What does the device look like? How could this idea be made into a prototype? Who would purchase the technology? These are some of the questions to be answered by the student team.

In addition to the in-class experience, some students will gain sufficient experience and impetus to actually launch a new company from prototype development. These promising entrepreneurs could then choose to open an office in UB’s own high-tech CTech IncUBator, a partnership with Connecticut Innovations that is housed on UB’s main campus. Successful teams also have the option to work with an existing incubator company or work with an existing area firm. In fact, two students are interested in starting their own businesses to launch products conceived in the course, and two graduating industrial design majors are creating their own design consulting business. Lewis is adapting and reinventing coursework to counteract the effects of a stiff economic climate and increased competi-

tion in the workplace — a new option in the workforce is to become self employed. It is the hope that the class may eventually spin off into other courses that will be relevant to the changing domestic employment outlook as well as across the globe.

As Lewis moves forward with the advice and collaboration of colleagues to permanently establish this course and others, new venues of entrepreneurial education and experience will be offered at UB, providing students with the chance to design complex products that can solve great issues in many disciplines, ranging from health to science to technology. By pushing students outside of their academic and skill-based comfort zones into a guided mentorship that typifies industry, this experimental course in New Product Commercialization is destined to produce future business leaders, technology gurus and design experts who are confident and have a measure of experience under their belts to transition successfully into entrepreneurial ventures after graduation. ■





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