Cleveland State University
2121 Euclid Avenue
Cleveland, Ohio 44115-2214
engagedlearning

NONPROFIT ORG.
U.S. POSTAGE
PAID
CLEVELAND OH
PERMIT #500

CHANGE SERVICE REQUESTED

CLEVELAND STATE UNIVERSITY

FENN

COLLEGE OF ENGINEEERING

2013 - 2014 ISSUE

WELCOME TO THE 2013-2014 ISSUE OF FENN!

These are exciting times for our college. In addition to having the first female Dean in the history of the college, continuously rising enrollments, increasing research activities, and the upcoming hiring of new faculty and staff, we are currently planning the renovation of our facilities. Please read throughout to find out about a sample of our cutting-edge research in biomedical engineering, our new faculty, our strategic partnership with Parker Hannifin, our inspiring student stories, our activities to promote diversity, research and cooperative education, and other interesting news. I hope you will enjoy the reading!

George P. Chatzimavroudis, Ph.D.
Interim Associate Dean of Operations, Fenn College of Engineering

FENN
2013-2014 ISSUE

INTERIM ASSSOCIATE DEAN OF OPERATIONS
FENN COLLEGE OF ENGINEERING
George P. Chatzimavroudis, Ph.D.

MARKETING COMMUNICATIONS REPRESENTATIVE
Nancy Carlucci Smith

GRAPHIC DESIGN
Patsy D. Kline

PHOTOGRAPHY
Brian Hart

PRESIDENT
Ronald M. Berkman

DEAN, FENN COLLEGE OF ENGINEERING
Anette Karlsson, PH.D.

CONTACT US

Mailing Address:
Cleveland State University
2121 Euclid Avenue SH 104
Cleveland, Ohio 44115-2214

Campus Locaiton:
Cleveland State University
Stilwell Hall Room 104
1960 East 24th Street
Cleveland, Ohio 44115-2214

P: 216.687.2555
F: 216.687.9280

www.csuohio.edu/engineering/

FOLLOW CSU!

- www.twitter.com/engagecsu
- www.facebook.com/clevelandstateuniversity
- www.linkedin.com/company/cleveland-state-university
- www.flickr.com/photos/csuohio/
- www.youtube.com/CSUchannel
- www.pinterest.com/clevelandstate/
- http://instagram.com/engagecsu
- http://clevelandstate.tumblr.com/

FENN is published annually by Fenn College of Engineering and University Marketing. Sustainably designed and printed to reflect Cleveland State University's commitment to environmental stewardship.

contents

2 New Dean
28 New Faculty
36 Co-Op
38 Diversity Council
40 News

4

RESEARCH

BIOMEDICAL

EMERGING FACULTY RESEARCHERS — Dr. Chandrasekhar Kotapalli, investigates axonal regeneration and guidance with state-of-the-art microfludic devices with micrometer precision.

16

PARTNERSHIP

PARKER HANNIFIN

Dr. Antonie van den Bogert, Professor and Parker Hannifin endowed chair of the Human Motion and Control Lab, advances research of the first "Smart" prosthetic limbs.

20

STUDENTS

BRIGHT VIKINGS

NEXT GENERATION OF ENGINEERS — Mariela Gonzalez-Nieves has a Bachelor's Degree in Chemical Engineering and is the first member of her family to graduate from college.

An interview with Dean Anette Karlsson

FENN COLLEGE OF ENGINEERING'S

MEET THE NEW DEAN

DR. GEORGE CHATZIMAVROUDIS SAT DOWN TO TALK WITH DR. ANETTE KARLSSON, THE NEW DEAN OF THE FENN COLLEGE OF ENGINEERING, ABOUT THE COLLEGE'S SUCCESSES AND THE IMPACT SHE HOPES TO HAVE ON THE COLLEGE AND UNIVERSITY.

GC: Tell us about the path that led you to Cleveland State and the Fenn College of Engineering.

AK: I grew up in Sweden and received my Bachelor's and Master's degrees in Mechanical and Aerospace Engineering from the Linkoping University. My professional career led me to the aerospace division of SAAB. I was part of a design team for the multipurpose military airplane JAS 39 Griffin, working on the composite parts of the airplane. That was a lot of fun! Eventually, I decided I was interested in pursuing a further graduate degree. I received my Ph.D. in Mechanical and Aerospace Engineering from Rutgers University. I held teaching and research positions at Rutgers and Princeton. Before coming to Cleveland State, I spent the past 10 years at the University of Delaware as a professor and chair of Mechanical Engineering.

GC: What attracted you to Cleveland State University and the Fenn College of Engineering?

AK: Cleveland State is transitioning from a commuter school to a more traditional residential University with strong research programs. This offers a unique opportunity for me to make a difference in academic leadership. The Fenn College of Engineering has, since its start in 1923, focused on first-generation college students and students with limited financial resources, which is something that is very important to me. Being a first-generation college student myself, I know that there are many challenges for this group of students. I hope to create an environment where students from all backgrounds can get the support they need to succeed with their goals.

GC: How do you feel as the first female Dean of the College?

AK: I am not sure if being the first woman serving as Dean of the College will necessarily change how I approach things. I do think being a woman engineering Dean means a lot of different things. For example, it does show how far we have come with regard to equality and equity for women in this country. In fact, Cleveland State now has women Deans for both the College of Sciences and Health Professions (Dr. Meredith Bond) and the College of Engineering. In addition, we have a woman provost, Dr. Deirdre Mageean. I am not sure if there is a University in the country that has women in all of these positions! As a woman in engineering, I think I have a broader understanding for issues relating to diversity in general. One of the issues that I will work hard on is to increase the number of faculty and students who come from groups that are traditionally underrepresented in engineering, providing the support that they need to succeed.

GC: What other issues will you focus on?

AK: I will build on our strength as engineering educators. Our students are known for being "ready-to-go engineers" that are highly sought after by local employers. We will continue to build on this, attracting more students to the College, and making sure they all graduate as excellent engineers. Part of this focus is to enhance and rebuild our co-op program. We will also develop more direct collaborations with local companies for research and development, and assist with providing continued education for their employees. As we increase our research activities, we will strengthen our graduate programs and be strong contributors to innovation and entrepreneurship in Northeast Ohio.

GC: Welcome to Cleveland State University and the Fenn College of Engineering!

AK: Thank you! I am glad to be here. ■

RESEARCH

MICROFLUIDIC PLATFORMS FOR INVESTIGATING AXONAL BIOLOGY

CHANDRASEKHAR KOTHAPALLI, Ph.D.
Department of Chemical and Biomedical Engineering
TISSUE ENGINEERING RESEARCH

The human brain contains billions of cells and trillions of connections, making it one of the most complex and highly dynamic organs in the human body. The predominant cell types include various neural, glial, and endothelial cells.

During embryo formation, a highly-controlled spatio-temporal pattern of guidance molecules and extracellular matrix (ECM) proteins induce sequential and progressive differentiation of embryonic stem cells into neural precursor stem cells. During later stages of development, these precursor cells further differentiate into specific neural and glial (astrocyte and oligodendrocyte) lineages. The resulting mature neurons migrate to their intended location, send processes to appropriate targets, and effectively communicate with their surrounding environment. The main projection from the neuronal cell body, that is, an axon can travel long distances through dense ECM before connecting to the intended target. Having a detailed knowledge of the mechanisms of axon growth and guidance is essential for understanding the nervous system's development, functioning, and to effectively treat damages of the nervous system by injury, for example, trauma and stroke, or disease such as Multiple Sclerosis, Alzheimer's, and others. Studies have shown that axons fail to regenerate and accurately reestablish the lost neuronal network connections after an injury to the nervous system. Such pathological changes, if left untreated, could ultimately result in irreversible muscle atrophy, paralysis and death.

The process of axonal outgrowth and guidance depends on the chemo-affinity of growth cones — the tip of the axon — to sense and respond to multiple attractive and repulsive guidance molecules operating at different length scales in the environment. Studies have shown that in addition to the concentration of the gradient of guidance molecules, the steepness of the gradient is also crucial for axon guidance. The precision and mechanism by which the guidance molecules are generated, distributed and maintained within the nervous system are not clear yet. This is because, in an in vivo environment, it is not easy to control the microenvironment around the neurons, and evaluate the role of the multitude of biomolecules to which the growth cones are exposed. On the other hand, biomolecular gradients within conventional in vitro platforms are quite unstable, difficult to quantify, often lack defined spatio-temporal control, and generally fail to distinguish the effect of biomolecular gradients on axon outgrowth and guidance.

To overcome these limitations, we design, fabricate and implement state-of-the-art microfluidic devices in the laboratory that facilitate well-defined cell culture environments (2D or 3D) with micrometer precision, quantifiable characterization and experimental reproducibility. These devices allow user-defined control over the spatio-temporal diffusion and distribution of growth factor gradients in the ECM environment, and the ability to directly visualize cells within that environment. Using these devices, we investigate and quantify the survival of specialized neuronal populations, for example, corticospinal motor neurons, dorsal root ganglion neurons, their axonal outgrowth and directionality, and targeting of tissues in response to diffusing or surface-bound chemogradients within 3D microenvironments. In addition, we are also interested in elucidating the effect of heterotypic cell-cell interactions and the resulting paracrine/ autocrine signaling on axonal biology.

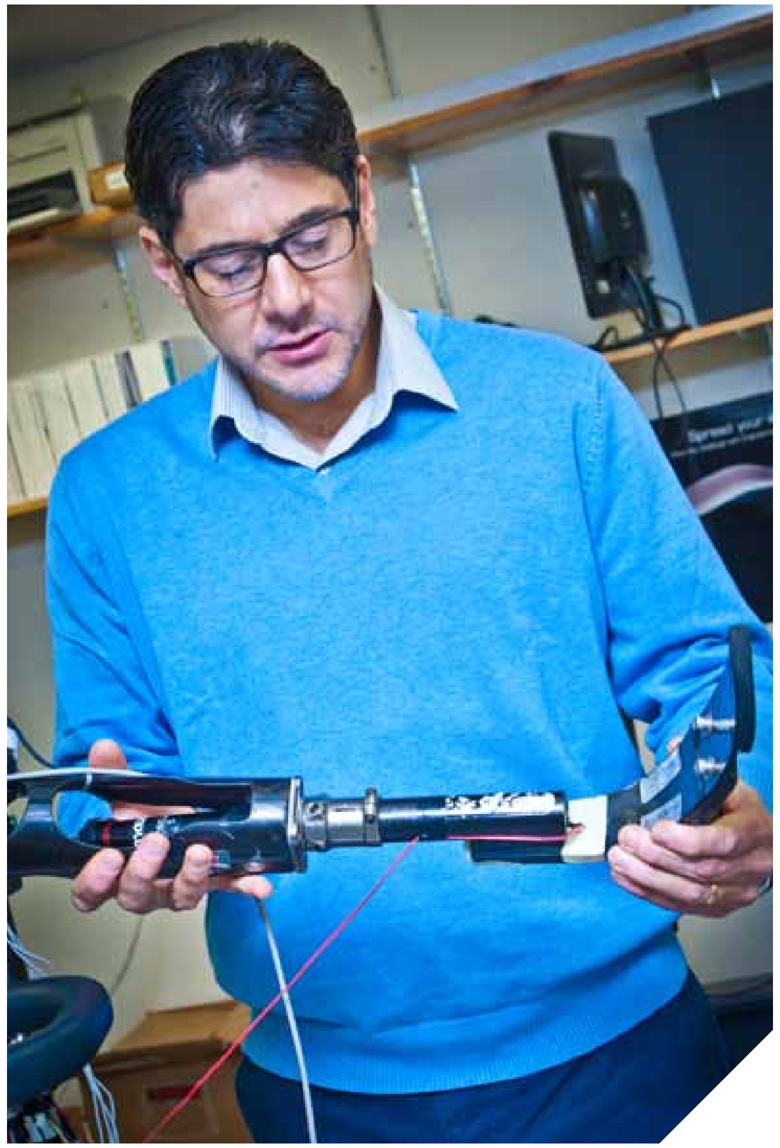
In conclusion, recreating the neural microenvironment in a simple inexpensive microfluidic system in vitro to understand the role of each component (ECM molecules, growth factor gradients, mechanical stimuli, inflammatory environment, etc.) might serve as a guide to the robust design of tissue engineering approaches, for example, in nerve grafts or injectable hydrogels, for effective axonal regeneration and guidance in vivo. ■

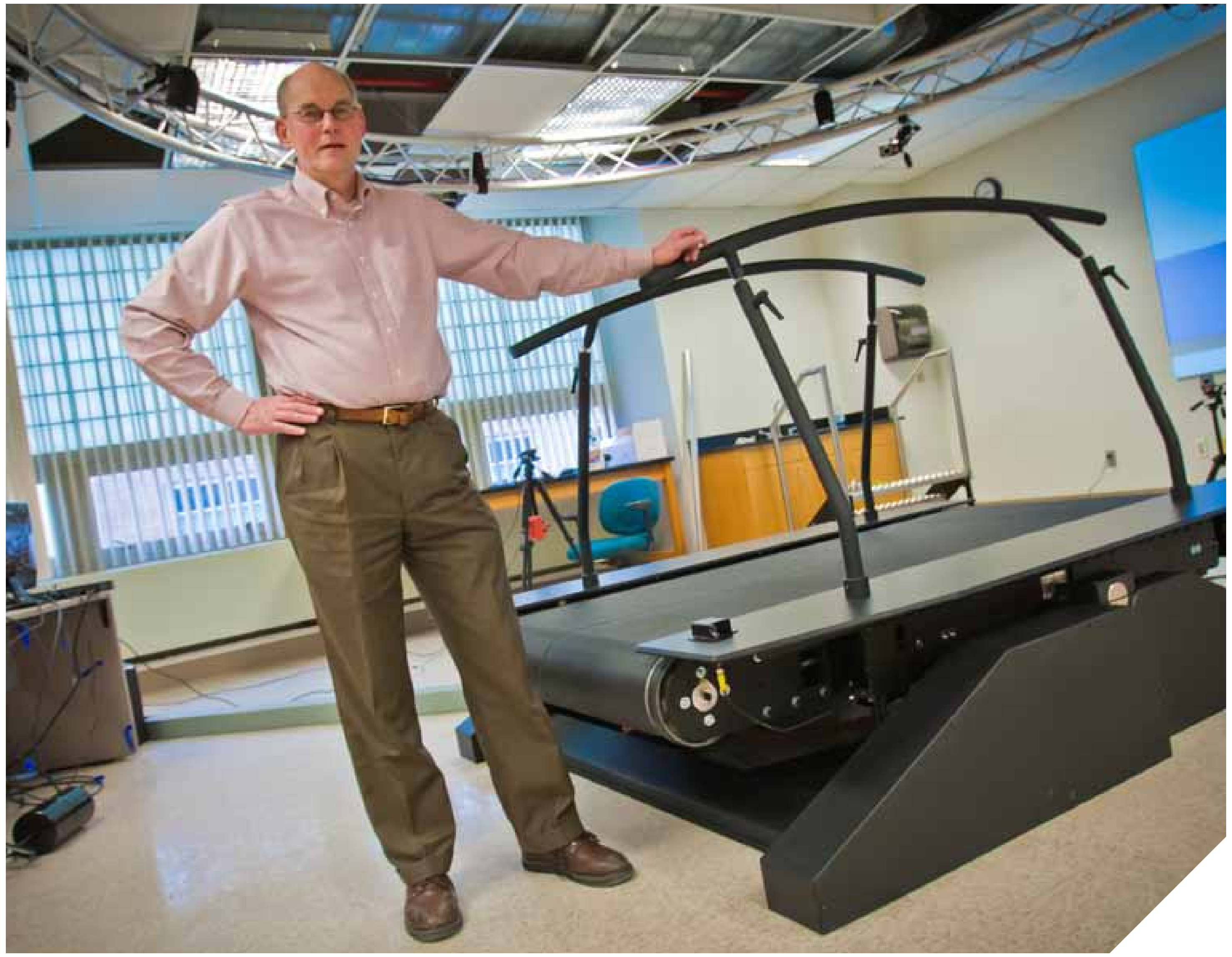
{new} CONCEPTS IN PROSTHETIC LEGS

In 2010, over 350,000 Americans underwent above-knee leg amputations. This number will only increase in the coming decades due to the aging population and the increase in diabetes. The number of diabetic adults tripled between 1980 and 2005, one-third of Americans may be diabetic by 2050, and most leg amputations result from diabetic complications. Decreasing the activity level of amputees due to inadequate prostheses not only reduces their quality of life, but also produces negative side effects. For example, abnormal hip motions due to leg prostheses contributes to back pain and arthritis.

The goal of this research is to develop a new, practical leg prosthesis that restores normal walking patterns to amputees.

DRS. SIMON, RICHTER AND VAN DEN BOGERT HAVE DEVELOPED A NEW TYPE OF LEG PROSTHESIS CALLED SEMI-ACTIVE.





HANZ RICHTER, Ph.D.
Department of Mechanical Engineering
PROSTHESIS RESEARCH

DAN SIMON, Ph.D.
Department of Electrical and Computer Engineering
PROSTHESIS RESEARCH

ANTONIE VAN DEN BOGERT, Ph.D.
Department of Mechanical Engineering
PROSTHESIS RESEARCH

Today's artificial legs can be categorized as either active or passive. An active leg prosthesis uses motors to actively control the knee and ankle joints. Active prostheses provide the advantage of high levels of control, but the disadvantage of high energy demands makes them impractical for many applications. A passive leg prosthesis uses low-power components, such as valves, to control the stiffness of the knee and ankle joints. Passive prostheses provide the advantage of low power consumption, but they cannot always provide the high levels of control needed for everyday tasks.

Drs. Dan Simon, Hanz Richter and Antonie van den Bogert have developed a new type of leg prosthesis called semi-active. A semi-active prosthesis includes hydraulic oil-based components that store energy in high-pressure chambers when the user places weight on the prosthetic leg, and that retrieve the energy when the user takes weight off of the leg. The semi-active prosthesis provides the best of both worlds: low power consumption that is characteristic of passive prostheses, and high levels of control that are characteristic of active prostheses.

Several challenges have been solved during the prosthesis design that are due to the interaction of humans with computer controlled systems. First, when designing a leg prosthesis, human behavior and prosthesis behavior must be optimized simultaneously. Second, the prosthesis electronics, hydraulics, and controls need to be optimized simultaneously. These design challenges have been addressed with evolutionary algorithms (EAs). EAs are computer programs that are motivated by processes observed in nature, such as natural selection, ant colony organization, species migration, and insect swarming.

Finally, the new prosthesis design needs to be validated with realistic tests. Prosthesis testing is difficult with human subjects because of regulatory requirements; the potential danger to human test subjects; the difficulties of measuring important quantities such as speeds, pressures, and forces; and the difficulties of replicating identical conditions between tests. Therefore, a prosthesis-testing robot that emulates the motion of a human hip has been developed. The hip robot allows to test and compare leg prostheses under a variety of test conditions, including different walking speeds and patient weights. ■

Attachment & PROLIFERATION

OF OSTEOBLASTS ON NANO-TEXTURED Ti-6AL-4V SURFACES*

JOANNE BELOVICH, Ph.D. AND
SURENDRA TEWARI, Ph.D.
WITH REBECCA JENSEN,
MASTER'S CANDIDATE
Department of Chemical and
Biomedical Engineering
BONE IMPLANT RESEARCH

The Ti-6Al-4V alloy is extensively used for bone tissue implants for dental implants, hip replacements and other types of orthopedic surgeries. This is due to its low cytotoxic leachability, low density and adequate mechanical properties.

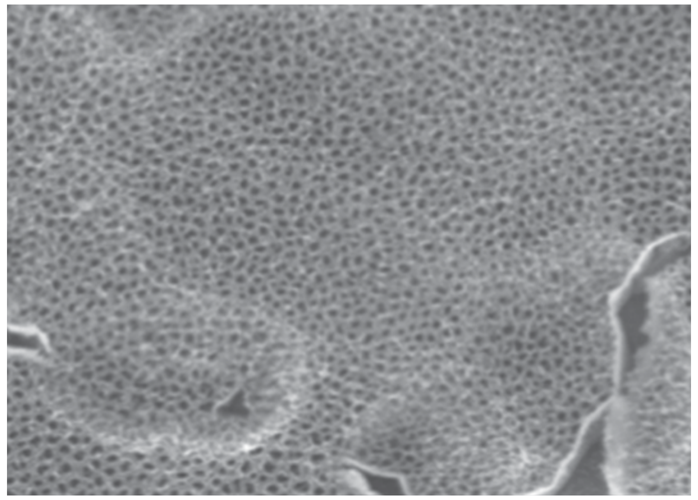
Attachment, migration and proliferation of bone-forming osteoblast cells on the implant surface immediately after surgery determine how readily the implant is integrated into the surrounding bone by the formation and attachment of new bones on its surface. It is believed that the quality of this initial osteo-integration also determines the useful life of these implants. An inadequate initial integration leads to an accelerated implant loosening which is a serious issue in orthopedic surgeries, since the replacement of an artificial hip tends to be less successful than the initial hip replacement surgery itself.

Osteoblasts, the bone forming cells, are typically about 10-µm in diameter (similar to a dust particle in size). The osteoblasts cytoskeleton is made up of a complex network of about 10-20nm diameter microfilaments. The biological interaction of the osteoblasts with an implant substrate is therefore a strong function of its micro and nano-surface topography as well as its surface chemistry.

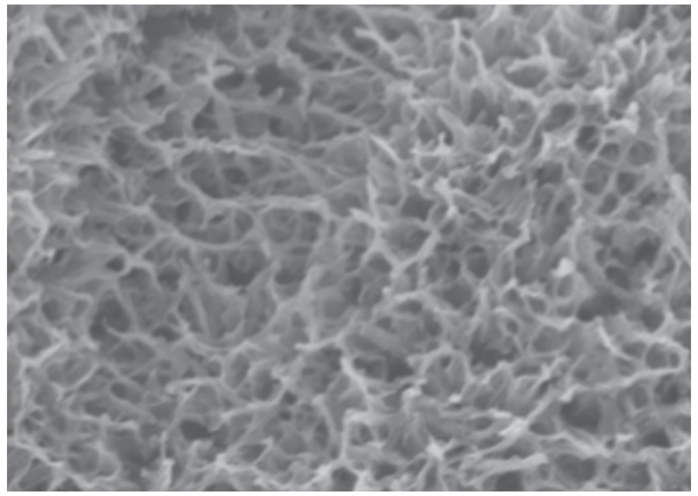
This research project studies the influence of surface nanotopography on attachment, migration and propagation of osteoblast cells.

Anodization creates a thin titanium oxide surface, containing about 50 nm diameter pits, on otherwise a smooth surface. The NaOH etched surface also contains nanometer size pits, but its spongy topography, containing spiky features, more closely resembles cellular cytoskeleton. Preliminary experiments in this research project indicate that NaOH etched topography is more conducive for cell adhesion. ■

*RONALD MIDURA, PH.D. FROM THE CLEVELAND CLINIC LERNER RESEARCH INSTITUTE PARTICIPATED IN THIS PROJECT.

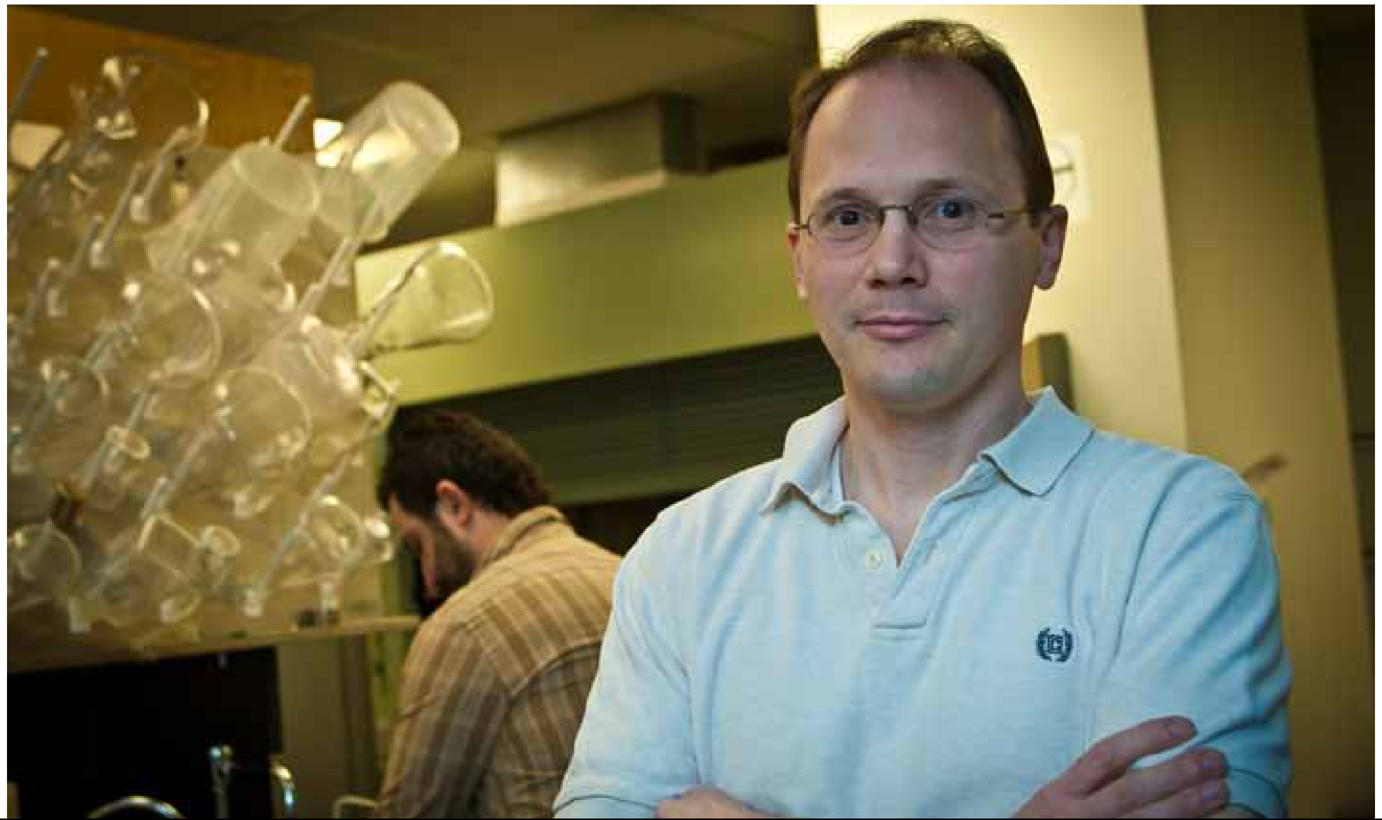


ANODIZED Ti-6Al-4V



NaOH TREATED Ti-6Al-4V

REBECCA JENSEN
MASTER'S CANDIDATE
Department of Chemical and
Biomedical Engineering
BONE IMPLANT RESEARCH



THERANOSTICS THROUGH PROTEIN-BASED NANOPARTICLES

NOLAN HOLLAND, Ph.D.
Department of Chemical and Biomedical Engineering
BIOMATERIALS

A team of students and collaborators in the Biologically Inspired Materials Laboratory in the Department of Chemical and Biomedical Engineering are developing an innovative platform for combining the delivery of therapeutic agents with contrast agents for diagnostic imaging. This research is part of the emerging field of theranostics — combining therapy and diagnostics. Theranostics primarily targets overcoming the limitations of current cancer treatments, as well as branching out to other disease states as well.

A basic paradigm in theranostics is to use nanoparticles that are loaded with therapeutic agents and to concentrate them in the tissues where they are needed using various mechanisms, including the attachment of small chemical species that specifically target certain cells. In the process of targeting tissues, it can be important to observe where the particles end up in the body. This is accomplished through the inclusion of a contrast agent for an imaging modality such as MRI, PET, or CT.

The theranostic platform development in our lab is unique in that the entire construct — the particle for drug loading an MRI contrast agent and targeting motifs — are all combined in a single molecule providing a simplified approach for their synthesis. The approach being utilized is flexible in that it allows for the loading of different drugs as well as relatively easily making particles that target tissues of different disease states. This is all accomplished by using protein engineering to design protein-based materials having these specific criteria.

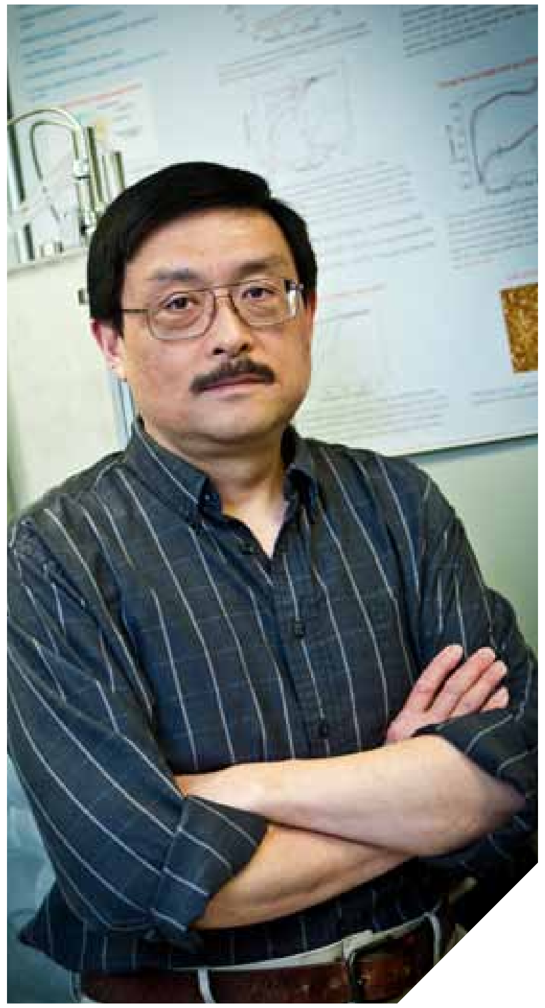
The core material for the protein-based theranostic nanoparticles is elastin-like polypeptide (ELP), a polypeptide based on the sequences found in native elastin proteins. ELP constructs have been designed that assemble into well-defined nanoparticles under in particular conditions. When these particles are stabilized they can then be loaded with a drug. An MRI contrast agent — gadolinium — has been added to these particles by the inclusion of a protein domain that binds the gadolinum ion. Targeting is accomplished using short peptide sequences that bind specifically to receptors found in abundance on cancer cell surfaces.

The entire construct, including the ELP, gadolinium binding domain, and the targeting peptide, are encoded in a single gene using standard molecular biology techniques. Bacteria transfected with the gene are used to biosynthesize the product. After purification the polypeptide is put in conditions where they assemble into the complete theranostic particles. The end result is a protein-based theranostic capable of targeted delivery, being detected by MRI, and drug release at the intended site of action. ■

RESEARCH

FEED

FIELD-**E**FFECT **E**NZYMATIC **D**ETECTION



SIU-TUNG YAU, Ph.D.
Department of Electrical and Computer Engineering
BIOSENSORS RESEARCH

An ultrasensitive, specific and rapid detection method

DR. SIU-TUNG YAU DEVELOPED AN ULTRA-SENSITIVE ENZYMATIC ELECTROCHEMICAL DETECTION METHOD BASED ON QUANTUM MECHANICS PRINCIPLES. THE TECHNIQUE, CALLED FIELD-EFFECT ENZYMATIC DETECTION (FEED), EMPLOYS AN EXTERNAL GATING VOLTAGE TO PROVIDE INTRINSIC AMPLIFICATION OF THE SIGNAL CURRENT BY INDUCING AN INTERFACIAL ELECTRIC FIELD TO MODULATE INTERFACIAL CHARGE TRANSFER. WITH THIS TECHNIQUE, DR. YAU IS ABLE TO DETECT MOLECULAR ANALYTES SUCH AS GLUCOSE AND ETHANOL ON THE PICO-MOLAR LEVEL.

Dr. Yau's latest research is the incorporation of FEED with immunosensors for solving real problems in biomedical research. To date, FEED is used to detect protein biomarkers such as CA125, a biomarker for ovarian cancer. This research demonstrates that a gating voltage can be applied to the detecting electrode, on which antibody-based immune-structures are immobilized, to provide amplification of the detection signal. The voltage-controlled signal amplification of the detection system increases the sensitivity and lowers the detection limit of the system. A detection limit of 0.9 U/ml was obtained in the research. Another important biomarker that is detected using FEED is prostate specific antigen (PSA), a biomarker for prostate cancer. The detection was performed with PSA dissolved in serum in order to simulate real samples from humans. The detection is demonstrated on the femto-gram/mL level with a detection limit that achieved 58 fg/mL. The high selectivity of the detection system is reflected in the fact that PSA detection is successful on the fg/mL level, where biological substances other than PSA have a 1-million-fold higher concentration. The research suggests the possibility of early detection of the recurrence of prostate cancer after the removal of the prostate gland.

An even more practical application of FEED is the detection of Escherichia coli (E. coli) is a bacterium usually found in the intestines of healthy humans. E. coli O157:H7 is a strain of E. coli that causes severe intestinal infection in humans. Foodborne outbreaks due to E. coli O157:H7 is caused by consumption of undercooked ground beef, raw milk, unpasteurized apple juice, water and contaminated produce. The low infectious dose of 2 to 2000 of ingested cells makes the detection and control of E. coli O157:H7 a challenging task for food safety. FEED is used to detect E. coli O157:H7 in milk and beef juice with detection limits of 120 cell/mL and 51 cell/mL, respectively. The voltage-dependent intrinsic amplification provided by the technique allowed the detection to be performed without pre-enrichment of the sample and centrifugation followed by the resuspension of the pellet in a buffer solution, resulting in a significantly shortened assay time of 67 minutes. Note that current PCR or ELISA detection of E. coli requires pre-enrichment of the sample, making the detection at least several hours long. The novel detection approach can be used as a detection platform for ultrasensitive, specific and rapid detection of bacteria in foods and possibly in other kinds of matrices.

This invention of Dr. Yau's will find further applications in biomedical/clinical research, the food industry, environmental protection and security. ■

PARTNERSHIPS

PARKER HANNIFIN ENDOWED CHAIR RESEARCH ADVANCES

SMART PROSTHETIC LIMBS

ANTOINE van den BOGERT, Ph.D.
Professor and Parker Hannifin Endowed Chair for Human Motion and Control
DEPARTMENT OF MECHANICAL ENGINEERING

ADULTS AND CHILDREN WITH MOBILITY IMPAIRMENTS MAY SOMEDAY EXPERIENCE AN UNPRECEDENTED LEVEL OF INDEPENDENCE, THANKS TO A PARTNERSHIP BETWEEN CLEVELAND STATE UNIVERSITY AND PARKER HANNIFIN CORPORATION.

PARKER RECENTLY PLEDGED $1.5 MILLION TO CSU FOR AN ENDOWED PROFESSORSHIP AND RESEARCH INTO HUMAN MOTION AND CONTROL. THE PRIMARY OBJECTIVE OF THIS RESEARCH IS TO IMPROVE ADVANCED PROSTHETICS AND ORTHOTICS IN THEIR ABILITY TO REPLICATE THE MOVEMENT OF HEALTHY HUMAN LIMBS.

Professor Antonie (Ton) van den Bogert, an internationally renowned researcher in biomechanics, has joined the Fenn College of Engineering's Department of Mechanical Engineering as the Parker Hannifin Endowed Chair in Human Motion and Control. He has been affiliated with the College since 1999 as an adjunct professor.

The opportunity to collaborate with Parker engineers on potentially life-enhancing technology is a challenge that excites the native of The Netherlands.

"People who have lost the use of their legs because of paralysis, stroke, spinal cord injury or disease suffer physically, psychologically and emotionally," says Dr. van den Bogert, who has long been intrigued by the control of human movement. "Helping them get back on their feet through science and technology is an exciting opportunity to impact human lives."

The Parker gift provides funding for a new human motion and control laboratory and equipment, including a rare V-Gait treadmill that uses motion sensors and 10 cameras to capture human movement. CSU's V-Gait is one of only a few worldwide.

"With the V-Gait, we can test subjects while they walk. We can have them move uphill and downhill, and we can push the treadmill sideways to measure their motions and muscle actions as they react to the disturbance. The lab provides a unique and rich testing environment that allows us to study human movement and control in very great detail, and then transfer

Top: **LUUK DOBBE, GRADUATE STUDENT AND DR. ANTONIE van den BOGERT**
Location: **FENN COLLEGE OF ENGINEERING MOTION & CONTROL LAB**

that knowledge into mechanical devices," says Dr. van den Bogert.

That's where Parker Hannifin comes in. The Cleveland-headquartered firm is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of markets.

Dr. van den Bogert said, "I want to make an impact by designing control systems that are inspired by human movement. My interest is trying to figure out how to control the motors on robotic legs so they're as smart as our muscles and our nervous system. We want to build some sort of brain into these devices, so they operate like a normal limb would. This is the sort of thing we hope to discover in our new lab."

Dr. van den Bogert is highly respected for his innovative work analyzing human movement and for developing computer simulation methods to study the effects of neuromuscular control and mechanical devices on human movement.

"Originally, I was a physicist. But I transitioned into biomechanics because I enjoy coming up with ideas that are useful in the real world. You can develop something today and it could be on the market a few years later. Of course, you also can work for 10 years on one idea.

"My expertise is computational models; Parker's expertise is designing motion hardware and controls," he says. "Joining forces complements both our strengths and combines theory with human experimentation and engineering to develop assistive technology; that is, smart prosthetic limbs and assistive devices."

CSU's Department of Mechanical Engineering plans to expand its faculty by adding an expert in robotic devices, presenting opportunities for collaboration between Dr. van dan Bogert and the new recruit.

Doctoral students also are being recruited, thanks to a $400,000, four-year grant from Parker to provide research fellowships.

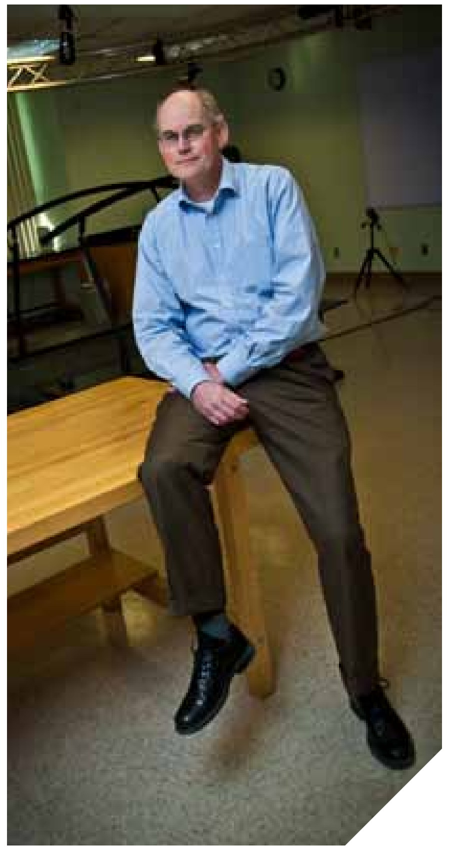
Even Dr. van den Bogert's undergraduate students are getting engaged in his work. "They are fascinated by technology that helps people," he says. "For their Mechanical Engineering projects, I have one student who is designing a wheelchair lift and another who is designing a mechanical leg.

"Developing fundamental knowledge of how humans control movement is an area that needs greater understanding. The Parker Hannifin Endowed Chair makes it possible to implement a long-term plan that will make Cleveland State a world leader in the development of technology for sports and rehabilitation," he adds. "I am especially looking forward to having a partner in Parker Hannifin that can bring this research into the marketplace and to the people who need it most." ■

FUN FACTS

- Dr. van den Bogert invented and patented the Kickstart Orthosis, a device that helps disabled people walk faster and farther. The device was inspired by the anatomy of horses, and the long tendons that enable them to walk and run.

- He received a Technical Achievement Award from the Academy of Motion Picture Arts and Sciences in 2004 for his contributions to the development of 3D human animation. However, he does not have an Oscar on his mantel; the award did not come with a statuette.



MEET DR. van den BOGERT

ANTONIE (TON) VAN DEN BOGERT HOLDS A Ph.D. IN BIOMECHANICS FROM THE UNIVERSITY OF UTRECHT IN THE NETHERLANDS, WHERE HE RESEARCHED THE MOVEMENT OF HORSES.

HE SERVED AS A POST-DOCTORAL FELLOW AND ASSISTANT PROFESSOR OF KINESIOLOGY AT THE UNIVERSITY OF CALGARY IN CANADA, WHERE HE SPECIALIZED IN THE MECHANICS OF SPORTS PERFORMANCE AND SPORTS INJURIES IN HUMANS. DR. VAN DEN BOGERT CAME TO CLEVELAND IN 1998 AND CONTINUED HIS WORK ON SPORTS INJURIES AND ORTHOPEDICS AT THE LERNER RESEARCH INSTITUTE OF THE CLEVELAND CLINIC FOR 12 YEARS.

MOST RECENTLY, HE FOUNDED ORCHARD KINETICS LLC, A CLEVELAND COMPANY DEDICATED TO RESEARCH AND INNOVATION IN BIOMECHANICS. HE CONTINUES TO SERVE AS COMPANY PRESIDENT.

HE IS THE CURRENT PRESIDENT OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS.

Originally published in the *Cleveland State Magazine*, Winter 2013 Issue

As she has started searching for job positions, she is crediting the co-op program for providing her with invaluable experiences that have landed her numerous interviews.

MELISSA RIEDTHALER

Department of Chemical and Biomedical Engineering

Melissa Riedthaler is a senior Chemical Engineering student at Cleveland State University. She credits the Honors Program and the Chemical and Biomedical Engineering department for her success. The Honors Program sponsored her for all her course tuition and allowed her to get a head start on her Master's studies and research while working on her Bachelor's degree through the accelerated 4+1 program.

Melissa's research is a process engineering analysis of catalytic gasification as a waste management strategy. The project is supported through a grant from NASA received by Professor Jorge Gatica. Through the support by the Chemical and Biomedical Engineering department, the CSU Honors Program and NASA, Melissa presented her research findings at the Ohio Academy of Science in April 2013.

Melissa has also gained significant professional experience through the co-op program. She worked at AkzoNobel for two years, and then at Lubrizol for her last co-op term. As she has started searching for job positions, she is crediting the co-op program for providing her with invaluable experiences that have landed her numerous interviews. After graduating with a Bachelor's Degree, she plans to work full-time and continue her Master's studies. ■

Mariela is the first of her family to graduate from college but the road there was not an easy one . . . she aims at walking at the graduating ceremony in 2013 alongside her son.

MARIELA GONZALEZ

Department of Chemical and Biomedical Engineering

In 2012, Mariela Gonzalez-Nieves graduated with her Bachelor's Degree in Chemical Engineering from the Fenn College of Engineering at Cleveland State University. She is the first of her family to graduate from college but the road there was not an easy one.

Twenty years before, at the age of 18, her hope was to continue her education so that one day in the future she could help others. She knew early on she would earn a degree in an engineering field. Mariela began her studies at a nearby community college. Working and attending school full time was no easy task. Her son was three at the time and with no vehicle she caught eight buses a day to fulfill her daily tasks. Two courses shy of attaining an associate degree, the strenuous activity finally led to her becoming physically ill. She had to choose between school and work. Because she was a single mother, she chose work so that she could take care of her son.

Years passed but the yearning of returning to school never faded. In the spring of 2008, she enrolled at Cleveland State University and declared a major in the field of chemical engineering. That very same semester she severely injured her back and performing even the smallest task such as that of sitting became a challenge. This however did not diminish her determination in any way. Mariela continued and in the spring of 2012, she attended commencement and accepted her degree.

Every student has the option of purchasing a stole with their graduation garments. A stole represents the utmost achievement a student can accomplish from their long years of study and adversity. To Mariela, it meant so much more. She purchased one stole for her son. And as she placed the stole over her son's neck she reminded him of what patience, motivation, and perseverance could lead to. At the age of 20, her son will graduate with a BS in computer engineering. What could possibly seem reminiscent of a closing, with the accomplishment of academic goals, is just the beginning of a new path.

In May 2012, Mariela decided to continue her education even further. Her choice to earn a Master's of Science Degree in Chemical Engineering would allow her to work in research and development. She applied for and was accepted in the 4+1 accelerated program in the Chemical and Biomedical Engineering department at Cleveland State University. She aims at walking at the graduating ceremony in 2013 alongside her son. ■

One important decision he made as a high school student in the Cleveland area was to enroll in Cleveland State's Post-Secondary Enrollment Options Program (PSEOP) during his junior and senior years.

QUINTON SHUSTER

Department of Chemical and Biomedical Engineering

Quinn Shuster is a Chemical Engineering major at Cleveland State University.

One important decision he made as a high school student in the Cleveland area was to enroll in Cleveland State's Post-Secondary Enrollment Options Program (PSEOP) during his junior and senior years. This allowed him to take classes at CSU for both high school and college credit, and this provided him with a sizable head start on his college education requirements, allowing him to work and still be able to graduate on time.

Upon graduation he will be joining Lubrizol Advanced Material's Avon Lake, Ohio plant as a Project Process Engineer. Quinn was offered this position after completion of his last co-op term with the company. He attributes a lot of the credit for him obtaining this position to Cleveland State, as the first internship he received at Lubrizol was for a position which he applied for through the University's job posting website. In fact, the Honors Program and the Chemical Engineering department helped him create a co-op schedule which allowed him to graduate in eight undergraduate semesters as well as co-op at Lubrizol.

In 2012, Quinn received the Academic Excellence Award from the Chemical Engineering department, recognizing him as the most outstanding student in the program. He has also been performing research in Professor Jorge Gatica's laboratory on process analysis and optimization of reactors scheduling in biorefineries; he recently presented some of his findings at the annual meeting of the Ohio Academy of Science.

Quinn will continue his graduate studies (as part of the accelerated 4+1 BS/MS program in chemical engineering) while working at his new position at Lubrizol. ■

He points out that the course work that he experienced at CSU was immersive, the research opportunities on the cutting edge, the community outreach fulfilling, and the networking opportunities extensive.

JONATHAN CARDINALE

Department of Electrical and Computer Engineering

Science Technology Engineering and Math (STEM) fields are the future of modern society and the reason for which Jonathan Cardinale chose to pursue a degree in Electrical Engineering from Cleveland State University. He recently graduated summa cum laude. He points out that the course work that he experienced at CSU was immersive, the research opportunities on the cutting edge, the community outreach fulfilling, and the networking opportunities extensive.

The coursework equipped him with knowledge to start his career and keep him competitive in the global job market of the future. He emphasizes the hands-on experience as one particular aspect of the CSU curriculum that makes a graduate like him more capable in the global world economy. The fact that laboratories accompany traditional engineering classes allows students to take the concepts learned in the classroom and apply them in a meaningful way.

Research opportunities at the undergraduate level help to give the students the project experience that is necessary in the corporate world. Specifically, Jonathan speaks enthusiastically about his experience doing research with Dr. Nigamanth Sridhar in developing an inertial movement unit to help track the movements of physical therapy patients. Tracking these movements will hopefully enable physicians and patients to coordinate a more successful recovery.

As an urban University, CSU focuses not only on student education and success, but also on the urban community success. While at CSU, Jonathan participated in student scientific organizations, including being the Chairperson of the CSU student chapter of the Institute of Electrical and Electronics Engineers (IEEE). Due to the support received from the CSU community, the IEEE student chapter was able to hold many events that helped the Cleveland community. Collaborating with the student chapters of other groups, including the American Society of Mechanical Engineers (ASME), the Society of Women Engineers (SWE), and the American Institute of Chemical Engineers (AIChE), it hosted a robotics competition for the local Cleveland high schools.

Finally, Jonathan praises the College and University for helping with networking via on-campus recruiting, meeting with accomplished alumni, and attending lectures by industrial visitors. Via these various avenues, he has started his professional career with Rockwell Automation as an Embedded Software Engineering Associate. Nevertheless, he is planning to pursue a Master's Degree in Software Engineering. ■

Michel immigrated to the United States at the age of 17, starting his new life by taking preparatory classes at Cuyahoga Community College and paying his tuition by working. Two years later he transferred to Cleveland State University to pursue a Chemical Engineering degree.

MICHEL KAHWAJI JANHO

Department of Chemical and Biomedical Engineering

Michel Kahwaji Janho immigrated to the United States at the age of 17, starting his new life by taking preparatory classes at Cuyahoga Community College and paying his tuition by working. Two years later he transferred to Cleveland State University to pursue a Chemical Engineering degree.

The engaged learning system at CSU allowed Michel to be more open to other people and more involved in group and community activities. His numerous conversations with his professors helped him learn more about the inter-workings of various lab equipment, the industrial reasoning behind certain engineering design decisions and allowed him to discuss different ideas with highly knowledgeable individuals.

Classes such as "Reactor Design" and "Process Synthesis and Optimizations" helped Michel realize the power of computer simulations in the design process and the importance of energy integration and process optimization from an economical and an environmental perspective, while the weekly meetings required for the Senior Design class allowed him to better present his arguments on a person to person level and more importantly listen and appreciate other people's opinions and ideas and integrate them into his own work. The "Integrated Design Experience", a project presented to students while still in the introductory chemical engineering courses and being worked on through various classes in the curriculum, enabled Michel to clearly see how all his classes fit together in designing and operating a plant as well as the importance of economic considerations in the design process. Required presentations in a number of classes followed by advice and constructive criticism from the instructors as well the students in class taught Michel how to convincingly present his ideas to a larger audience, while the various scholarship opportunities available through the college enabled him to quit his job and focus on his academic career.

In the summer of 2011 Michel started a research internship with Professor Jorge Gatica, working on optimizing a bio-ethanol production process via the use of process simulations, energy integration and Life Cycle Analysis (LCA). He then presented his work at various conferences including the University Clean Energy Alliance of Ohio (UCEAO), the Ohio Academy of Science and the American Institute of Chemical Engineers (AICHE) regional meeting in which he participated in the regional student paper competition and was placed first enabling him to represent the north central region in the national student paper competition at the yearly national AICHE meeting. Michel's presence at the national meeting was made possible by financial support from the Chemical and Biomedical Engineering department, the College of Graduate Studies and the Fenn College of Engineering. The amount of support and enthusiasm provided by the faculty and the department Chairperson made Michel realize the importance of such an event and pushed him to do his best at the competition in which he was placed second in the nation.

Michel is currently working on his Master's degree in Chemical Engineering at Cleveland State University, continuing his thesis and working on publishing a number of papers on the subject. ■

Amy began working as a part time intern for Eggeman Engineering and Consulting with work focusing on transportation engineering for phase one of the Cleveland I-90 Innerbelt Bridge Project.

AMY KALABON

Department of Civil and Environmental Engineering

Amy Kalabon is a Civil Engineering student in the Fenn College of Engineering at Cleveland State University. With a cumulative GPA of 3.88, she will graduate with a Bachelor's Degree. She will continue at Fenn College in the accelerated Master's program, working towards her M.S. degree. Her Master's thesis will be on the uncontrolled cracking of concrete bridge parapets under the support of the Ohio Department of Transportation (ODOT).

Academically, Amy is a CSU Scholar Student and has excelled in all of her classes. She was the first author in a paper, titled "The Rise and Fall of the Ohio and Erie Canal, published in 2012 by the Journal of Professional Issues in Engineering Education and Practice of the American Society of Civil Engineers (ASCE). She has earned many honors as well as scholarships. Her scholarships include the Choose Ohio First STEM Scholar Scholarship, the William Hill Endowed Scholarship, American Institute of Constructors Scholarship, and the Hoist and Crane Engineering Award. This past year, Amy applied for the National Science Foundation Graduate Research Fellowship and earned a significant national academic achievement being accorded an Honorable Mention. She also applied for a fellowship with the American Concrete Institute (ACI),and she was accepted as one of twelve finalists chosen across the United States and Canada to travel to Minneapolis in April 2013 for an interview and to attend the national ACI convention. At the convention, she was awarded the BASF Construction Chemicals Fellowship.

Throughout her studies, one of Amy's goals has been to earn experience within her major which was made easy through Fenn College's faculty and career services. Amy's experience started the summer of her freshman year, assisting a graduate student on his research on culverts affecting the surrounding habitat. During her sophomore year, Amy began working as a part time intern for Eggeman Engineering and Consulting with work focusing on transportation engineering for phase one of the Cleveland I-90 Innerbelt Bridge Project. She also worked for Professor Norbert Delatte enhancing the website of the project of Civil Engineering Failure Case Studies (http://beta.matdl.org/failurecases/Main_Page) and adding many cases. As a student research assistant, she worked on a bridge parapet cracking project for ODOT, assisting in the collection of data from four local Cleveland area bridges by using tools such as the rebound hammer, ultrasonic pulse velocity meter, and a digital rebar locator. Most recently, Amy has been working for URS Corporation as a geotechnical engineering intern.

Amy has always been very involved in extracurricular activities at CSU throughout her college studies. She is secretary of Engineers Without Borders (EWB), ASCE, Tau Beta Pi Honor Society (TBP), and the CSU Women's Volleyball Club. As secretary of EWB, Amy was privileged to travel to August Pine Ridge, Belize, to help finish up a three-year project of building a hurricane shelter/school building. Being ASCE secretary, Amy took a very large role in the planning to host ASCE's three-day Ohio Valley Student Conference of 2013 at CSU. Even after taking on so much work, Amy says she wouldn't have done it any other way. Through her great experiences with CSU, Amy was not only able to learn, but also to develop and expand within her major as well as make irreplaceable and lifelong relationships. ■

"Of the many things I personally took away from this project was the realization that this building was not just a mass of steel and concrete. It is a monument to the collective efforts of many people from many backgrounds brought together for the single purpose of elevating others."

RICHARD S. OBRATIL

Department of Civil and Environmental Engineering

The goal of Engineers Without Borders (EWB)–USA is to provide communities around the world with the technical solutions they need to improve their standard of living. For the Cleveland State University's EWB Student Chapter, the task was to increase the classroom space available for more than 400 children in the village of August Pin Ridge, located in the Central American country of Belize. Because of village's proximity to the Atlantic Ocean, the chapter also incorporated into the project an increase of the community's hurricane shelter capacity. The design that was settled upon incorporated three large classrooms, a library, computer room, and an office for the school's principle. This 3,700 square-foot structure was designed to withstand the winds of a category III hurricane and also included toilets and sinks tied into a new onsite waste water treatment system. The new restroom facility would allow the existing 25-year-old cesspools and outhouses to then be decommissioned.

Involved from the beginning of the project, CSU Civil and Environmental Engineering graduate student Richard Obratil was provided with the unique opportunity to not only work on the building's design, but also to live in Belize and run the construction project. Richard was finishing with his Master's in Civil Engineering in December 2010 and was about to start his Master's in Environmental Engineering in the same department when the project was approved by EWB-USA for construction. He was asked by the chapter faculty advisor if he wanted to go to Belize to participate. Richard had traveled to Belize on the chapter's assessment trip in May of that year, so he was familiar with the region and, without hesitation, agreed to go.

Richard went to Belize for a 6-month stay. The project was an amazing experience for him. "You were continually learning new things every day, not just in engineering and project management but public relations, accounting and politics", Richard says. Problem solving and decision making was happening every day to keep the project moving forward. Richard points out that the village's contribution also was significant. Over a hundred people volunteered their time to work on the project, contractors and suppliers in Belize donated services and materials, and those in the village unable to work on the project directly provided food to several student groups that traveled there to work on the school.

Richard says that "of the many things I personally took away from this project was the realization that this building was not just a mass of steel and concrete. It is a monument to the collective efforts of many people from many backgrounds brought together for the single purpose of elevating others." ■

Since childhood, Asmita and her sister used to visit her father's workplace and realized how much this field changed the community over several years, making life easier and simpler through technology. Asmita always wanted to be a part of this change.

ASMITA CHINCHORE

Department of Mechanical Engineering

While at high school in India, Asmita Chinchore participated in all activities, clubs and societies related to engineering, computer sciences and workshop activities. By the end of her high-school years, she was sure that Mechanical Engineering was her greatest passion. The fact that her father also is a mechanical engineer, who owns a small manufacturing unit, probably contributed to her decision. Since childhood, Asmita and her sister used to visit her father's workplace and realized how much this field changed the community over several years, making life easier and simpler through technology. Asmita always wanted to be a part of this change.

After her undergraduate studies in India, she came to the United States to pursue a Master's Degree in Mechanical Engineering at Cleveland State University. Her thesis research is to study wind turbines computationally. She says that choosing the Fenn College of Engineering at CSU was one of the best decisions of her life. The faculty and staff, the modern equipment and the friendly atmosphere have allowed her to further enhance her skills. The college gave her a sense of belonging and so did the city of Cleveland. It has helped her to be an independent individual and provided her with exposure to the technical field of her interest. This is especially important as she points out that she comes from a society where people think that females should be educated up to the Bachelor's level or take a job in a field which would allow them to keep their family as their first priority. She considers herself fortunate that her family let her choose the field of her choice and supported her decision of pursuing a Master's Degree in Mechanical Engineering

Asmita also is the secretary of the student organization Growing STEMs and a member of the American Society of Mechanical Engineers, the Cleveland Transfer Connection (in which she is also a Lead Learner coach), and the Society of Women Engineers. She was recently awarded a Monte Ahuja scholarship and a graduate assistantship in the Mechanical Engineering department. She is a trained classical dancer and partner in the CSU student organization Bollywood Dance Club. ■

CRASH COURSE

NEW FACULTY

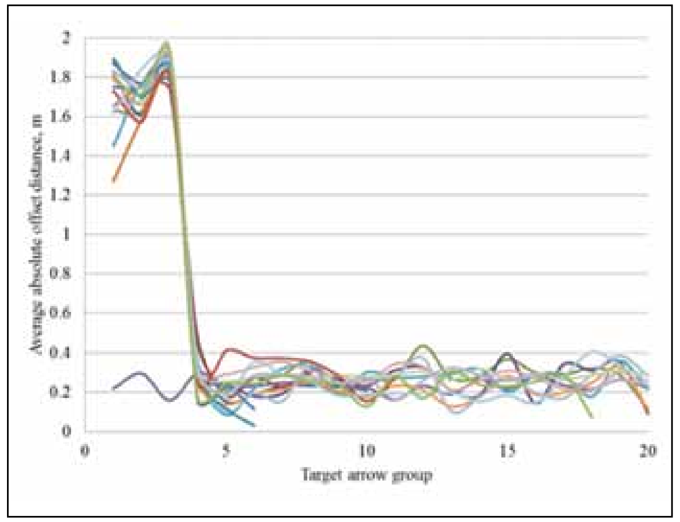
JACQUELINE JENKINS, Ph.D., P.E.
Assistant Professor
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

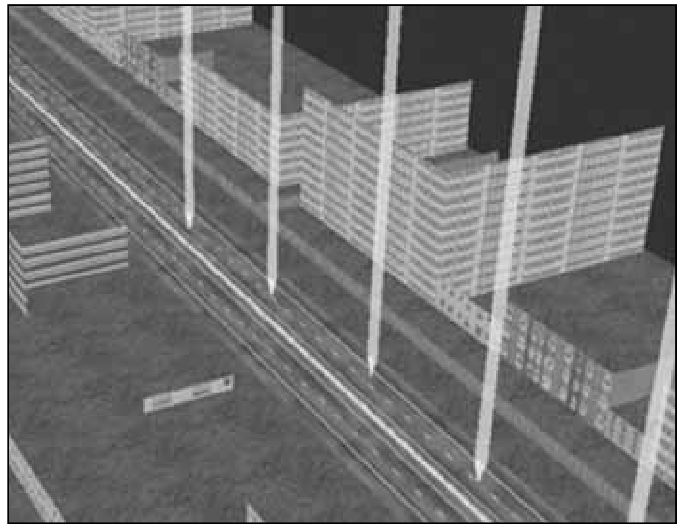
DRIVING SIMULATION LAB

Dr. Jacqueline Jenkins holds a B.A.Sc. degree in Civil Engineering from the University of Waterloo and M.E. and Ph.D. degrees from Texas A&M University. Specializing in transportation engineering, Dr. Jenkins' research is focused on examining the characteristics of users as they relate to the planning, design, operation and maintenance of transportation facilities. Her overarching goal is to improve how the needs, capabilities and limitations of drivers, cyclists and pedestrians are considered, thus improving the safety and efficiency of such systems.

WORK ZONE RESEARCH

As a member of the CSU University Transportation Center, Dr. Jenkins is actively researching issues concerning the safety and efficiency of work zones. In collaboration with the Texas Transportation Institute and Ohio University, Dr. Jenkins is currently studying the Ohio Department of Transportation's (ODOT) work zones speed zone policy. As part of this project, the team is evaluating the Variable Speed Limit (VSL) pilot program, that launched in 2012 after the passing of House Bill 487 by the Ohio General Assembly. The VSL pilot program allows speed limits within construction zones to vary based on the type of work being conducted, the time of day, or other appropriate criteria; as well as increased penalties for certain traffic violations occurring while work is being performed within the construction zone.





NEW FACULTY

Dr. Jenkins is also collaborating with Ohio University to review ODOT's policy for estimating road user costs stemming from construction and maintenance projects. This project includes an evaluation of various sketch planning tools used to predict the formation of queues caused by lane closures and will result in a recommendation for changes to the ODOT policy.

Both of these projects will have Dr. Jenkins and a group of CSU students collecting traffic volume and speed data in work zones throughout Ohio.

DRIVING SIMULATION RESEARCH

Driving simulators provide researchers a controlled environment to study various aspects of driver performance. Dr. Jenkins has conducted various driving simulation studies to investigate issues such as driver distraction caused by cellular telephone conversations, the impact of longer vehicles on the passing maneuver, and driver comprehension of protected and permitted left turn displays. At CSU, she has been continuing her work to develop a methodology to determine when participants have become comfortable controlling a driving simulator.

PRACTICING STEERING IN A DRIVING SIMULATOR

When participants begin to drive a driving simulator, they may need to adjust their existing motor skills to successfully use the controls (e.g. steering wheel) to interact with the driving simulator. During this period of adjustment, their driving performance may not be as intended. Participants may be observed having difficulties maintaining lane position, changing lanes, negotiating curves, and completing turning maneuvers. These difficulties may be seen as erratic steering behavior, over steering, or making large steering corrections. The type, magnitude, and persistence of these observed difficulties may be different for different people, different steering tasks, and different driving simulators which vary in the type and fidelity of the visual displays, control mechanisms, and audible and motion inputs.

Practice scenarios typically provide participants a fixed length or fixed time to drive, or allows them to drive until they feel comfortable controlling the vehicle. These scenarios are not regularly accompanied by an analysis of driving performance and therefore do not offer the needed assurance that participants are ready to proceed with subsequent experimental scenarios.

The purpose of this research is to develop a scenario for participants to practice steering in CSU's University Transportation Center and verify the improvement in steering control over time by analyzing driving performance. The developed scenario provided participants a target acquisition task requiring repeated steering inputs, similar to a slalom course. One hundred target arrows (T1, T2…T100) were placed in one of three lateral positions (P1, P2, P3) across the roadway making the participants steer either left or right to acquire each subsequent target arrow. This particular scenario was designed so that each participant's performance could be evaluated, free of any threshold, criterion, or benchmark value, making it applicable to any participant and driving simulator.

Twenty five participants performed the target acquisition task while maintaining a travel speed of approximately 25 mph. The majority of participants exhibited a remarkable improvement in steering performance, indicating a significant adjustment in their use of the controls.

Monitoring the improvement in driver performance will be useful in future studies to assess whether participants have received sufficient practice. Dr. Jenkins plans to build upon this success by developing a real time evaluation tool, interfaced with the developed practice scenario, and marketing its use as part of a standard protocol for conducting driving simulation studies.

This work was carried out with the assistance of undergraduate student Brian Moran and funded by CSU's 2012 Undergraduate Research and Creative Achievement program. ■

NEURO SCIENCE ON A CHIP

CHANDRASEKHAR KOTHAPALLI, Ph.D.
Assistant Professor
DEPARTMENT OF CHEMICAL AND BIOMEDICAL ENGINEERING

Dr. Kothapalli earned his Bachelor's Degree in Chemical Engineering from Andhra University, India, and a Master's Degree in Chemical Engineering from Mississippi State University. He pursued a Master's Degree in Materials Science and Engineering from the University of Connecticut, specializing in biomaterials. He received his Ph.D. in Bioengineering from Clemson University, where he identified and optimized biomolecular cues comprising extracellular matrix components and growth factors, for regenerating elastin in aortic aneurysmal blood vessels. Dr. Kothapalli joined the Massachusetts Institute of Technology (MIT) as a Postdoctoral Fellow in Professor Roger Kamm's group. At MIT, he designed and developed microfluidic assays to evaluate neurite responses to growth factor gradients in vitro, and investigated mechanisms underlying axonal targeting of projection neurons, for example, corticospinal motor neurons, in three dimensional cultures. He continued his postdoctoral fellowship at the City University of New York, working on glioblastoma cell migration and proliferation in 3D milieu. Dr. Kothapalli's research resulted in two U.S. patents that are in their final stages of approval, 25 peer-reviewed publications and proceedings, and more than 30 conference and seminar presentations. Dr. Kothapalli holds adjunct staff appointments in the Lerner Research Institute at the Cleveland Clinic, and in the Division of General Medical Sciences at Case Western Reserve University School of Medicine.

Dr. Kothapalli's current research activities are focused on two interdisciplinary themes – microfluidic devices to investigate cell-cell and cell-tissue interactions and stem cell based therapies to replace or regenerate tissues and cells lost due to an injury or disease.

TOWARDS PERSONALIZED MEDICINE

One of the most intriguing and fundamental questions in biology is: How does a cell interact with the neighboring cells or extracellular matrix within any tissue in the body? As an extension, can one visualize and quantify cell response to a new pharmacological drug, real-time in situ? The cellular interactions supposedly occur via multiple mechanisms, such as direct physical contact, diffusion of soluble biochemical factors, electrical signal transmission and biomechanical cues. Understanding such cellular interactions is important because they regulate tissue and organs, for example, liver, heart, brain function, under healthy and non-healthy conditions. Cell-cell interactions, for example, may become perturbed in diseased tissues and may contribute to not only a disease initiation. For example, neurodegenerative disorders — but also during later stages of disease progression such as cancer metastasis.

Although experiments are carried out in vivo, (e.g., animal models to monitor cell-cell interactions and cell signaling within their native microenvironments) they are limited by expensive animal models, lack of control over local experimental conditions, complex imaging setup, and variability in genetic makeup between mammalian species. Studying cell-cell interactions in vitro is advantageous due to more tightly controlled experimental conditions, higher experimental throughput, and lower costs. Among in vitro approaches developed over the past few years, microfluidics is proven to be a powerful technology to study cell biology, offering significant improvements over traditional cellular assays, such as user-defined assay design and precise control of the cellular and non-cellular microenvironment. Microfluidic devices are made using a micro-fabrication technology, where a positive relief of the design is patterned onto a silicon wafer using photolithography techniques. In particular, microfluidic systems are designed with a wide variety of micro-channel dimensions and geometries for generating soluble and insoluble gradients, on-chip valving and pumping through multilayer fabrication, and incorporation of membranes and three-dimensional (3D) hydrogels for increased functionality. (Fig. 1)

The first generation of microfluidic devices enables the study of cellular behavior of a single cell type under well-defined biochemical gradients, shear stress, and cell-ECM interactions. Dr. Kothapalli's research efforts focuses on developing next generation of microfluidic devices that can integrate multiple cell types and controlled microenvironments at physiologically relevant length- and time-scales (Fig. 1). These devices enable user-defined control of the distance and the type of interaction between different cell populations, along with spatio-temporal delivery of biochemical and biophysical stimuli, either stand-alone or in combination, to different cell populations. Developing such state-of-the-art microfluidic platforms for modeling, measuring, and imaging cell-cell signaling will help improve the understanding of the effects of cell-cell — same type or different types of interactions on cellular behavior, tissue morphogenesis, and disease pathogenesis. These devices may also act as surrogate organ platforms for preclinical drug and toxicity testing, as well as clinical diagnostics assays of individual patient samples, as an early step toward personalized medicine.

CELL-CELL INTERACTIONS

During nervous system development, numerous guidance molecules play a critical role in directing the tip of growing neurites (growth cones) to their final destinations, resulting in the formation of a complex circuitry. Studying the precise mechanism by which these guidance molecules are presented to the growth cones (for example, diffusion, binding to ECM, and cell signaling) has been an intense area of research over the past few years and numerous in vitro systems have been employed for this purpose. Traditional assays widely used over the past few decades are limited by their two-dimensional cultures, difficulty in quantification, lack of control on growth-factor delivery and sensing, and low reproducibility. (Fig. 2)

Dr. Kothapalli recently developed a microfluidic assay in which primary neurons can be seeded in a 3D scaffold and cocultured in the presence of another cell type that is transfected to release a guidance cue over the culture period (Fig. 2A). The device has a chamber for filling a 3D gel, three channels for supplying media and seeding cells, and a growth-factor gradient is created across the 3D scaffold mimicking in vivo conditions (Fig. 2B). When hippocampal neurons are cultured in these devices in the bottom channel, netrin transfected fibroblasts in the right channel, and non-transfected dermal fibroblasts in the left channel, to create a netrin gradient across the gel (Fig. 2C), then a significantly higher number of extending neurites are attracted toward netrin-transfected fibroblasts, compared to cultures with no fibroblasts or cultures that receive netrin exogenously instead. The hippocampal neurons also express elevated levels of DCC-receptor (a surface protein) in response to netrin released from fibroblasts compared to exogenously supplemented netrin (Fig. 2C). Results offer great insight into the functioning of guidance molecule sensing by growth cones in the presence of different microenvironmental conditions, and the utility of this device in drug screening and fundamental neurobiological assays.

Dr. Kothapalli's current studies are focused on improving this design by modifying the 3D gel chamber geometry to provide independent control

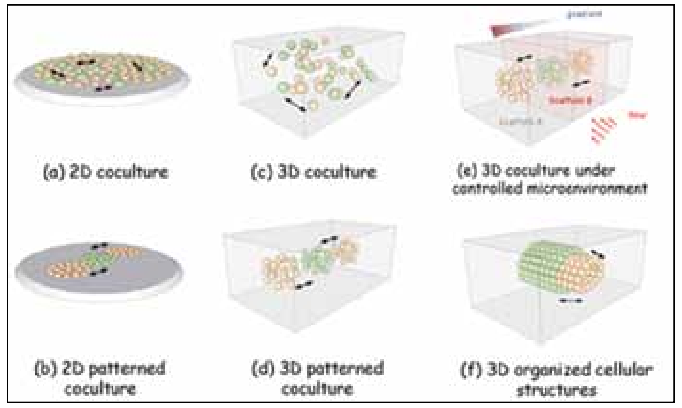


FIGURE 1. CONFIGURATIONS FOR STUDYING PARACRINE AND PHYSICAL INTERACTIONS BETWEEN TWO DIFFERENT CELL POPULATIONS (GREEN AND ORANGE) WITHIN A MICROFLUIDIC DEVICE.

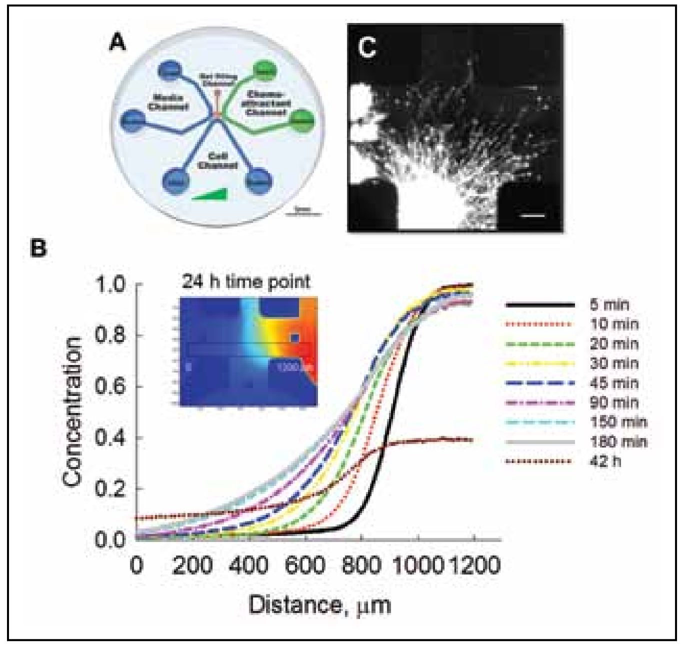


FIGURE 2. (A) A THREE-CHANNEL MICROFLUIDIC DEVICE DEVELOPED TO STUDY AXONAL TURNING IN 3D SCAFFOLDS UNDER A GROWTH FACTOR GRADIENT. (B) DIFFUSION PROFILES OF BIOMOLECULES WITHIN 3D GEL REGION IN THE DEVICE. A SNAPSHOT OF GRADIENT AT 24 H TIME POINT IS IN INSET. (C) CONFOCAL MICROSCOPY IMAGE OF DCC-TRANSFECTED HIPPOCAMPAL NEURONS CULTURED IN THE PRESENCE OF NETRIN-1-TRANSFECTED FIBROBLASTS IN RIGHT CHANNEL AND NORMAL FIBROBLASTS IN LEFT CHANNEL.

of the chemo-attractant absolute concentration and gradient strength for elucidating the growth-cone chemo-attractant gradient sensitivity in a 3D scaffold. The advantages of this device include the ease of handling and cell culture in 3D environment, rapid generation of pressure differentials and growth-factor gradients across a 3D gel on demand, provision to coculture up to three different cell types, live-cell imaging, precise quantification of axonal turning in 3D, high-reproducibility of experimental observations, and ability to even culture tissue samples under controlled environments. This microfluidic platform could have applications in optimization of biomaterials for neural tissue engineering, studying cancer cell migration, stem cell differentiation into highly specialized neurons, and angiogenesis.

CELL-TISSUE INTERACTIONS

Corticospinal motor neurons (CSMN) control the most precise voluntary movement in humans. CSMN degenerate centrally in the neurodegenerative motor neuron diseases, such as amyotrophic lateral sclerosis (ALS), primary lateral sclerosis (PLS), and hereditary spastic paraplegia. Studies have shown that CSMN axonal damage is primarily responsible for the loss of motor function in spinal cord injury. Attempts at therapeutic regeneration of CSMN under injury or disease conditions are limited by an incomplete understanding of the mechanisms that control the precise development of these neurons: sequential generation, specification, differentiation, axon guidance, and target selection. Dr. Kothapalli hypothesizes that a thorough understanding of CSMN axon targeting might enable enhancement of CSMN axon outgrowth and establishment of functional connectivity toward repair of diseased corticospinal circuitry. (Fig. 3)

Earlier studies have shown that molecular mechanisms of CSMN axon targeting involve attractive and repulsive, diffusible and surface-associated, axon guidance cues. However, a more detailed molecular mechanistic understanding would be advanced by a tissue culture device that allows testing of different combinations of cues, interacting with CSMN in three dimensions. Towards this end, Dr. Kothapalli and his collaborators have developed a microfluidic device for the investigation and quantification of axon outgrowth responses of highly purified CSMN interacting with target tissue explants (Fig. 3A). The device can confine tissue explants while allowing them to readily communicate with nearby cells via secreted factors (Fig. 3B). In the device, CSMN are co-cultured in a collagen matrix in close proximity to explants of target tissue, for example, spinal cord segment. CSMN were isolated from new-born mouse and purified using flow-assisted cell sorting technique. Axons can explore nearby space in three dimensions, as they do in vivo. The system contains two chambers for culturing target tissue explants (Fig. 3C), allowing direct comparisons of potentially differential effects on axon outgrowth.

This microfluidic device enables the study of small numbers of cells, higher throughput testing of different targets than in conventional tissue culture, simultaneous testing of diffusible cues, and potentially functionalizing the collagen matrix with surface-associated cues. Using this device, he demonstrates specific targeting of CSMN axons, including axons of purified CSMN, to spinal cord tissue explants, as well as a specific trophic effect of these explants on CSMN axon elongation (Fig. 3D). In general, this device enables direct comparison and investigation of the effects of distinct target tissues on axon outgrowth and guidance by purified projection neurons (Fig. 3E). CSMN survive within these devices long enough to investigate not only survival, but also axon outgrowth and targeting.

This device could further be used to identify and characterize diffusible and surface-associated molecules controlling CSMN axon targeting, including controls over spinal cord segmental specificity. It could also be used to identify molecular controls over CSMN survival and the importance of intermediate and final targets on survival. This device enables a range of approaches to increasingly specifically investigate axon targeting of distinct projection neuron subtypes, toward identification of molecular controls over development, maturation, and function of neuronal circuitry.

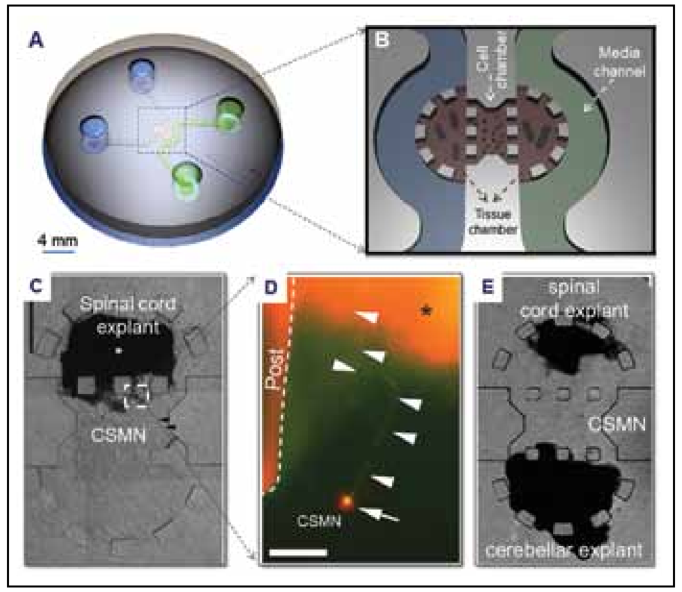


FIGURE 3. (A AND B) SCHEMATIC OF THE MICROFLUIDIC DEVICE SHOWING MEDIA CHANNELS, TISSUE CHAMBERS AND CELL CHAMBER. (C) IMAGE OF DISSOCIATED MOTOR CORTICAL CELLS (ARROWHEADS) AND SPINAL CORD TISSUE EXPLANT (ASTERISK) SEEDED IN THE DEVICE. (D) FLUORESCENT MICROGRAPH SHOWING RETROGRADE DiI LABELING FROM A SPINAL CORD TISSUE EXPLANT (ASTERISK) IN BOTH THE AXON (ARROWHEADS) AND SOMA (ARROW) OF A CSMN PRE-LABELED IN VIVO WITH GREEN FLUORESCENT MICROSPHERES, AND CO-STAINED FOR NEUROFILAMENT IN GREEN (SCALE BAR: 50 µM). (E) CELLS LOADED IN THE DEVICE WITH TISSUE EXPLANTS FROM SPINAL CORD AND CEREBELLUM.

STEM CELL-BASED THERAPIES

An injury (e.g., trauma, stroke) or disease (e.g., Amyotrophic Lateral Sclerosis, Parkinson's) in the central nervous system (CNS) results in an inflammatory environment and disturbs healthy bodily functioning, leading to progressive degeneration, loss of specialized cell populations (motor neurons, dopaminergic neurons, oligodendrocytes, etc.) and their functional pathways. Unless a healthy tissue microenvironment is reinstated under these conditions on a priority basis, CNS function could be severely compromised resulting in muscle atrophy, paralysis and death. Annually, thousands of people are diagnosed with various CNS injuries and diseases, highlighting the increased clinical relevance for hastened therapeutic intervention. Unfortunately, neurons have a limited ability for self-repair and regeneration in an inflammatory CNS, due to both the presence of an external inhibitory growth environment and the lack of internal signaling molecules. Studies have shown that alternate approaches based on drug delivery and gene therapy to replace lost cellular populations and accurately re-establish axonal networks barely slowed disease progression or restored functional circuitry. Thus, in recent years, cell and tissue repair strategies focused on improving secondary cellular degeneration and exogenous cell transplant therapy have been gaining ground for replacing lost critical cell populations. (Fig. 4)

The utility of stem cells has been the focus of recent research for their ability to yield large quantities of mature neural and glial (astrocyte, oligodendrocytes) cells on-demand for transplantation purposes. Stem cells offer a potentially unlimited source of precursor cells for therapeutic applications. Dr. Kothapalli hypothesizes that tissue engineering approaches combining 3D scaffolds and diffusible biomolecular cues offer a sustainable biomimetic microenvironment for enhanced differentiation and assembly of special cells and organotypic tissues. Recent studies have shown that stem cells could be differentiated into specific neural (motor neurons, dopaminergic neurons, etc.) and glial lineages by manipulating their microenvironment (Fig. 4). For example, the presence of 3D collagen scaffold and 1 µM retinoic acid (RA) promoted stem cell differentiation into predominant motor neurons lineage (Fig. 4B), while 3D matrigel scaffold and combination of RA (1 µM) and sonic hedgehog (300 nM) promoted dopamine producing neurons. This researcch also found that tissue biomechanics and growth factor dosages play an important role in regulating this differentiation and maturation process. Current studies are aimed at understanding the molecular mechanisms driving this differentiation process. These findings not only serve as an experimental model for early differentiation events in lieu of in vivo studies, but also are of tremendous relevance for neurodegenerative diseases modeling, drug and toxicology screening, tissue engineering and regenerative medicine therapies. ■

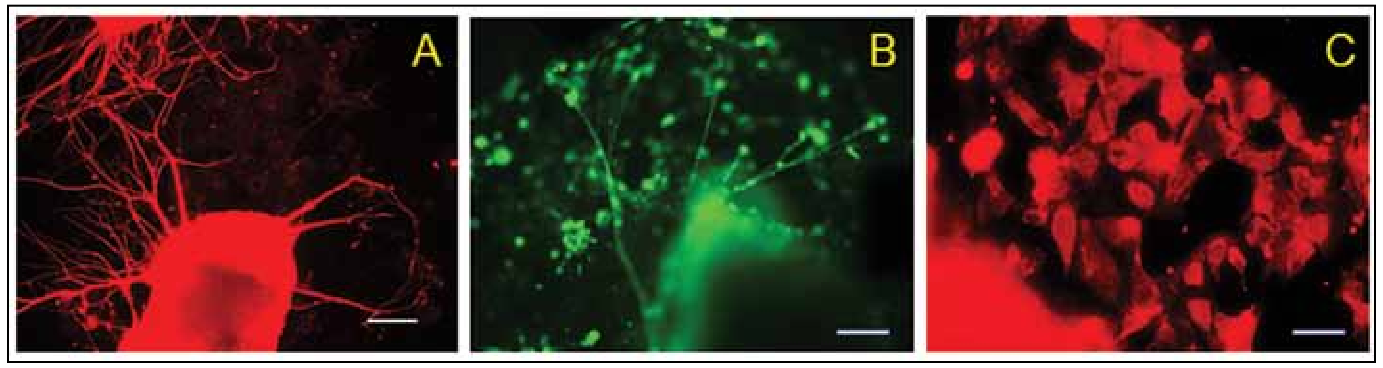


FIGURE 4. IMMUNOFLORESCENCE IMAGES OF MURINE STEM CELLS DIFFERENTIATING INTO (A) EARLY DEVELOPMENTAL STAGE NEURONS, (B) MOTOR NEURONS AND (C) DOPAMINERGIC NEURONS. SCALE BAR: 100 µM.

FENN COLLEGE OF ENGINEERING COOPERATIVE EDUCATION PROGRAM

One of the most important educational components of an engineering college is cooperative education (co-op). It is important that a co-op program is incorporated into the academic undergraduate curriculum. It allows engineering students to connect with real engineering working environment to enhance classroom knowledge in order to better understand the profession. A structured engineering co-op program provides a "vehicle" for students to physically be in a company/organization, while alternating their classroom study and co-op program. Co-op opportunities with local and regional industry cover a vast area of disciplines and applications. Companies interested in engineering co-op students include many from the chemical, automotive, energy production, control and automation, food, construction, aerospace, utilities and other industries.

A core element of the mission of Fenn College of Engineering is building successful partnerships with industries, agencies and government entities with the purpose of becoming an indispensable catalyst for current and future growth as well as providing economic development in the region.

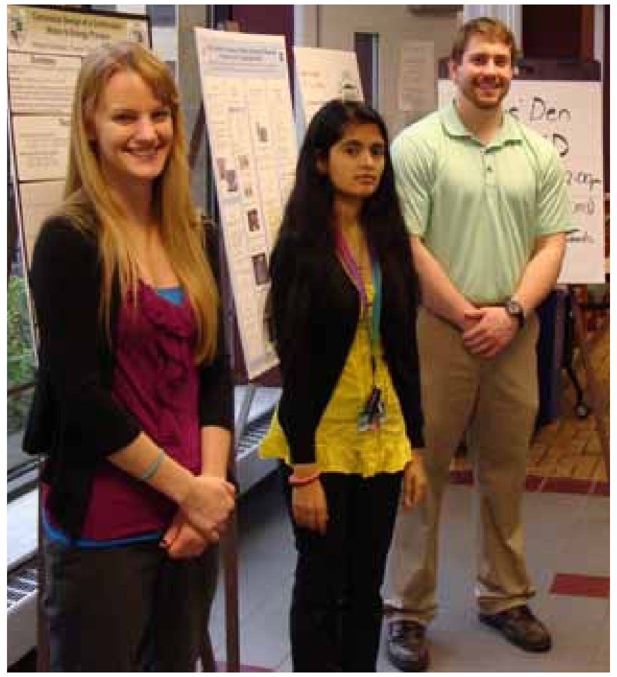
Approximately 1,200 undergraduate engineering students were enrolled in the College during fall 2012. In the past, students were placed in internships with regional companies. Recently, the College created a structured co-op program, which became accredited by the Canadian Association for Co-operative Education (CAFCE). Every student participant now has a Cleveland State University faculty mentor while performing their co-op assignment that includes regular communication between Cleveland State and the employer. The student is required to prepare and submit semester co-op goals as well as a final report to their faculty mentor.

Sandra English was hired in July 2012 as a co-op coordinator to manage the program and help integrate components within the curriculum of each undergraduate program of the College. The number of co-op applicants and students placed increased dramatically within a few months. In preparation for the Fall 2013 semester, 100 co-op applications were received — demonstrating a high demand for the co-op program.

Additional expansion of the program is planned to further assist students with their co-op placements as well as assist the increasing number of co-op companies. ■

I am perhaps one of your first female co-op engineering students. I enrolled at Fenn College in the fall of 1947 with approximately 700 males. In the past, co-op provided students with an opportunity to earn enough money to pay our tuition and college expenses. My co-op experience ended when I dropped out of college in 1949 to get married and support my husband graduating (Franklin J. Hrbak '51) from Fenn. After five children, I returned to Fenn, graduating Cum Laude in 1974. I was hired by Lincoln Electric as their first woman engineer. After 10 years with Lincoln I "retired" to run EME, Inc., — a custom engineering controls and test equipment family business. Who says women can't have it all? It just takes a more circuitous path and perseverance. I believe mentoring is vital, not only to guide students in their career choices, but also to allow students to experience the practical realities. Best efforts on re-vitalizing the Fenn Co-op tradition.

— MARGUERITE JOST HRBAK '74



Sandra L. English, Esq., is the Coordinator for the Fenn College of Engineering Cooperative Education program at Cleveland State University. She holds a Bachelor of Arts degree from Ursuline College and joint Juris Doctor and Master of Public Administration degrees from Cleveland-Marshall College of Law and the Maxine Goodman Levin College of Urban Affairs at Cleveland State. As the Coordinator for the college's co-op program, she serves as the primary point of contact and liaison with internal and external constituencies. She coordinates the administrative and academic components of the program.

Prior to joining Cleveland State, Sandra English served as an Assistant Cuyahoga County Prosecutor. In 2008, she joined the University as the Assistant Director of Law Admissions and Multicultural Recruitment at Cleveland-Marshall College of Law. As a result of her efforts, the Law School received the first Law School Admission Council (LSAC) National "Diversity Matters" Award in June 2010. English served as the advisor to the Hispanic Law Students Association, co-advisor to the Black Law Students Association and coach for the C|M|LAW Frederick Douglass Moot Court Competition Team which won the National Black Law Student Association (NBLSA) Midwest Regional Competition and ranked number four in the country at the National Competition in 2011.

On October 6, 2011, Cleveland State awarded English with the Distinguished Service Award for professional staff. In January 2013, Dean Anette Karlsson of the Fenn College of Engineering appointed English to the Dean's Diversity Council and nominated her as the College representative for the Architecture, Construction and Engineering (ACE) Mentor Program of the Cleveland Board of Directors. English's volunteer activities include serving on the Ursuline College Alumni Board, membership in Alpha Kappa Alpha Sorority, Inc., participant for the LeadDIVERSITY class of 2011 through the Diversity Center of Northeast Ohio and recipient of the Center for Progressive Leadership's 2011 Ohio Political Leaders Fellowship Program.

"Diversity and inclusion are at the center of the University's mission".

President Ronald Berkman

The Dean's Diversity Council (DDC) started as an adhoc committee that was established in spring 2011. The committee members are a mix of college faculty, staff and students as well as others from outside the college and CSU. It has a unique structure and it is directed by the Dean of the Fenn College of Engineering.

Under the auspices of Dean Anette Karlsson, the committee was formally structured and a charter was established with a mission statement and goals. In addition, an action plan was developed.

The mission of DDC is to promote a culturally and intellectually rich environment for diversity and inclusion, and support the education success and personal development of all members of the Fenn College of Engineering. Cleveland State University President Ronald Berkman has stated that "Diversity and inclusion are at the center of the University's mission". **Therefore, the following are the goals of the Fenn College of Engineering DDC, at this early stage of its development:**

1. **Enrich the campus climate for diversity and inclusion**
2. **Strengthen recruitment, retention, achievement and graduation of diverse students**
3. **Strengthen and promote multicultural programs**

DDC consists of individuals appointed by the Dean of Engineering in consultation with the co-chairpersons. Members represent the demographics of CSU and the community. Council members serve at a minimum a two-year term which can be extended to two terms. The chairperson actually has a three-year commitment: one year as co-chair, one year as chair and one year as past chair.

Several activities were conducted to celebrate diversity and inclusion, including the following two major events:

1. **Celebrating Diversity at Fenn College of Engineering in March 2012**
2. **Week of Diversity and Inclusion Celebration in February 2013**

The Week of Diversity and Inclusion Celebration was held in the college during the week of February 11, 2013. The event included an opening ceremony with games and a raffle; a lecture on "Women in Engineering" by Kathy Lorentz, Principal, KA Lorentz, Inc.; a lecture on "Diversity in Engineering" by Anita Bankole, Value Stream Manager, Parker Hannifin Corp. and Joshua Odoi, CSU alumnus and Manufacturing Engineer, GKN Drivelin; a multicultural film series; and a closing ceremony. ■

Left Top: MOUNIR IBRAHIM Left Bottom (L-R): CELEBRATING DIVERSITY AT FENN COLLEGE OF ENGINEERING IN MARCH 2012 This Page Top (L-R): PHOTO ONE DR. BYRON WHITE, CSU VICE PRESIDENT OF UNIVERSITY ENGAGEMENT AND CHIEF DIVERSITY OFFICER AND; PHOTO TWO MEMBERS OF THE DDC: JENNY JIA, LILI DONG, GREGG SCHOOF, MOUNIR IBRAHIM, SANDRA L. ENGLISH, AND CHRIS HARDULAK

PARKER HANNIFIN MOTION AND CONTROL LAB OPENS

In July, the College celebrated the grand opening of its new Parker Hannifin Motion and Control Lab. In this cutting-edge facility, Dr. Antonie van den Bogert is leading research to advance "smart" prosthetics and computerized "exoskeletons" with the potential for helping paralyzed individuals and others who need assistive technology.

ENGINEERING RESEARCH DAY

Fenn's Engineering Research Day was held on April 19, 2013. The keynote speakers were Dr. Antonie van den Bogert, the Parker Hannifin Endowed Chair in Human Motion and Control, and Craig Maxwell, Vice President of Technology and Innovation at Parker Hannifin. Maxwell's presentation gave students, faculty and staff insight into Parker Hannifin's view on research and collaborations with Cleveland State, including Dr. van den Bogert's research. Poster sessions featured student research.

YEAR THREE FOR PATHWAYS TO ENGINEERING SUMMER CAMP FOR HIGH SCHOOL TEACHERS

The Pathways to Engineers Summer Camp for high school math, science and technology teachers was held for its third year at Fenn College. The camps are funded by the Ohio Board of Regents. This year's camp featured a way of teaching mathematics to bring more real world examples and application of mathematics to engineering design and practice.

CONCRETE CANOES SET SAIL AT CSU DURING THE OHIO VALLEY STUDENT CONFERENCE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

The concrete canoe regatta was a highlight of the Ohio Valley Student Conference of the American Society of Civil Engineers Conference (ASCE) that was hosted by CSU in May. The 2013 conference brought 400 student engineers representing 14 colleges from Ohio, Pennsylvania and Kentucky to Cleveland for three days of carefully calculated competition – and fun.

Youngstown State University won the regatta held at Hinckley Lake. The student teams competing were required to design, build and race canoes with concrete hulls. The vessels were judged on appearance, structure and a floatation test.

NSF AWARDS CSU A COMPUTER SCIENCE EDUCATION DEVELOPMENT GRANT

Dr. Nigamanth Sridhar from the Department of Electrical and Computer Engineering, in collaboration with colleagues from the College of Business and the College of Education & Human Services of CSU as well as the University of California, San Diego, was awarded a grant by the National Science Foundation (CSU's funding: $814,886) for the project "Computing In Secondary Schools", a project designed to provide computer science education professional development to high school teachers in Ohio. This is the first and only program in Ohio to prepare teachers for licensure in Computer Science.

STUDENTS SELECTED FOR ACI STUDENT FELLOWSHIP AWARDS

Civil and Environmental Engineering students Amy Kalabon and Alice Sommerville are recipients of the ACI Foundation Student Fellowship Awards for the 2013-14 academic year. The ACI Foundation is a subsidiary of the American Concrete Institute.

Kalabon was awarded the ACI BASF Construction Chemicals Student Fellowship. Sommerville was awarded the Cagley Fellowship.

ENGINEERS WITHOUT BORDERS RECEIVE NCEES AWARD FOR AUGUST PINE RIDGE SCHOOL AND HURRICANE SHELTER PROJECT IN BELIZE

The Engineers Without Borders student group and the Department of Civil and Environmental Engineering received the National Council of Examiners for Engineering and Surveying (NCEES) Engineering Award for Connecting Professional Practice and Education. The award is for the students' work on the design, funding and construction of the August Pine Ridge School and Hurricane Shelter in Belize. The cash award of $25,000 was presented in August at its annual conference in San Antonio, Texas.

FENN ACADEMY RECEIVES $10,000 GIFT FROM LINCOLN ELECTRIC

Fenn Academy received a $10,000 gift from Lincoln Electric. This donation will fund engineering recruitment as well as the general activities of Fenn Academy, which provides educational activities designed to encourage high school students to pursue a college education and careers in engineering. Fenn Academy is a partnership with the Fenn College of Engineering at CSU, 44 Northeast Ohio high schools, five government agencies and five donor corporations.

PROFESSOR ALEXANDER IS RECIPIENT OF IEEE UNDERGRADUATE TEACHING AWARD

Dr. Charles Alexander in the Department of Electrical and Computer Engineering is the recipient of The Institute of Electrical and Electronics Engineers (IEEE) Undergraduate Teaching Award. This is an annual international award established to honor teachers of electrical and electronics engineering.

IEEE STUDENT CHAPTER WINS BIG AT THE 2013 STUDENT ACTIVITIES CONFERENCE

The IEEE Student Chapter won four out of eight competitions at the 2013 IEEE Student Activities Conference. Fenn College students who competed include: Taylor Barto, Jay Bocian, Colin Centa, Patrick Conway, John Dichazy, Daniel Frehmeyer, Luke Louder, Ryan Monteleone, Emily Nemeth, Steven Reba, Kevin Reisdorff, Markus Spielhaupter and John Cardinale, IEEE Student Chair.

CLEVELAND STATE UNIVERSITY 1964

"WE ARE PROUD OF OUR STUDENTS, FACULTY, STAFF AND ALUMNI WHOSE ACCOMPLISHMENTS AND ACHIEVEMENTS HAVE CONTRIBUTED TO THE TRADITION OF BEING A PROMINENT ENGINEERING COLLEGE IN NORTHEAST OHIO AND THE NATION."

DR. ANETTE KARLSSON,
DEAN, FENN COLLEGE OF ENGINEERING