

2012

# Nebraska Biomechanics Core Facility 2011-2012 Annual Report, Issue 10

Nebraska Biomechanics Core Facility  
*University of Nebraska at Omaha*

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# Nebraska Biomechanics Core Facility

*Rethink the Impossible*

June 2011 – August 2012

Issue 10



We have had a very exciting year here at the Nebraska Biomechanics Core Facility (NBCF). I am proud to announce that on October 24<sup>th</sup>, we will host the official Ground Breaking ceremony for the new Biomechanics Research Building at the University of Nebraska at Omaha. This is truly an amazing accomplishment for our laboratory and our department. When the donor presented me with the award, it brought tears to my eyes. To share this with my colleagues and students has been a dream come true. There have been a lot of interesting meetings (e.g., a four hour meeting about door handles and a long discussion about an ‘asylum’ door) and a lot of patience on our architect and contractor’s parts. Yet, we have weathered the brunt of the storm and are more than excited to unveil our new building in August of 2013.

In addition, we hope that you will join us for the American Society of Biomechanics meeting, September 4-7, 2013, here in Omaha, Nebraska. There will even be a night at the new Biomechanics Research Building. We cannot wait to share our new facilities and research projects with our friends.

Our success often leads to new opportunities to advance our research initiatives. Unfortunately, these opportunities require funding beyond allocations provided by the state. We continually pursue and frequently receive grants that support our research efforts. You will read about many of these awards on the following pages. While this funding is critical, charitable gifts from individuals, such as yourself, are also vital to advancing our work. Private support, for example, further enables us to:

- purchase upgraded equipment and new technology
- attract and retain outstanding faculty and graduate students

To learn more about how you can support the important work of the NBCF, turn to page 18. Your gift will make a difference — enhancing our scientific pursuits and ultimately helping to improve the lives of those we serve and beyond.

Thank you for your consideration,  
Nick Stergiou, Ph.D.

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## NBCF Directors, Faculty and Staff

Nick Stergiou, PhD .....	Director, NBCF
Sara A. Myers, PhD .....	Assistant Director, NBCF
Mukul Mukherjee, PhD.....	Assistant Director, NBCF
Dan Blanke, PhD .....	Director, School of HPER
Ka-Chun (Joseph) Siu, PhD.....	Director, Robotic Surgery Laboratory
Melanie McGrath, ATC, PhD.....	Director, Sports Medicine Laboratory
Jeff Kaipust, MS .....	Laboratory Technician
Amanda Fletcher, MS .....	Laboratory Technician

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UNIVERSITY OF  
**Nebraska**  
Omaha



# Featured News

## Breaking New Ground

The Nebraska Biomechanics Core Facility (NBCF) is pleased to announce that construction of the new Biomechanics Research Building at the University of Nebraska Omaha began on June 15, 2012. The privately funded, 23,000 square foot facility will be on the northwest corner of the north campus. The facility will be linked to the Health, Physical Education and Recreation building, where the NBCF is currently housed. This facility has been the dream of Drs. Nick Stergiou and Dan Blanke for many years and is the product of the work done by Dr. Stergiou, his students, and the collaborators at the University of Nebraska-Lincoln and the University of Nebraska Medical Center.

The new facility will provide a larger, more private space for researchers within NBCF and the entire state of Nebraska to continue their on-going work in human movement. The new research facility will consist of laboratories in the following areas: gait, virtual reality, balance, motor development, cognition, robotic surgery and biotechnology. In addition, a large machine shop will enhance the work in the area of prosthetics for amputees.

The Biomechanics Research Building is the first standalone biomechanics research facility in the world. Construction is set to end in August of 2013, just in time for the 37<sup>th</sup> Annual Meeting of the American Society of Biomechanics, which will be held in Omaha on September 4-7, 2013.



The construction site as can be seen by the southeast corner of the HPER building (Top) and the sign designating our new home (Bottom). Renderings of the future home of the Biomechanics Research Building courtesy of Schemmer Architects (Below).



# Featured News

## 37<sup>th</sup> Annual American Society of Biomechanics Conference

Dr. Nick Stergiou and the organizing committee, Drs. Jeff Hawks, Terry Grindstaff, Sara Myers and Joseph Siu are happy to announce that the American Society of Biomechanics Conference is coming to Omaha in 2013! This event will be held at the CenturyLink Center and the Hilton Hotel in downtown Omaha. The Universities of Nebraska (Omaha, Lincoln, and Medical Center) and Creighton University have been instrumental in the proposal to host the conference and the early planning stages.

We are strongly emphasizing student involvement and mentorship opportunities for future growth of scientists in this area. Areas of interest include biological sciences, exercise and sports science, health sciences, ergonomics and human factors, and bioengineering and applied science. It is the hope of the program chair to also incorporate neuroscience topics into the program this year.

The four-day event will consist of poster and podium presentations selected by Dr. Rakie Cham (University of Pittsburgh), the program chair for this conference. We are also excited to announce that we will have two social evenings during the conference, one at our new Biomechanics Research Building and one at the Henry Doorly Zoo! We look forward to seeing you there!

<http://www.facebook.com/2013ASB>

<http://biomech.unomaha.edu/ASB/>



### Nonlinear Workshop 2011

On July 25-29, 2011, the NBCF hosted the third annual nonlinear workshop. Participants traveled from all over the US, England and Ireland to Omaha to learn nonlinear mathematics and their application to human movement studies. If you are interested in attending, please check our website. Information about the current year is typically released in January.

Pictured (left to right): Nick Stergiou, Chris Thompson, Pamela Haibach, Denise McGrath, Amir Mohagheghi, Cesar Martinez and Jenna Yentes.



### Nonlinear Workshop 2012

On July 30-August 3, 2012, the NBCF hosted the 4<sup>th</sup> annual nonlinear workshop, with record attendance! 18 clinicians and scientists from the US, Italy, Spain, Ireland and Denmark. This workshop covers five days of lectures, hands on learning and social events.



Pictured (left to right): Front row: Masafumi Terada, Kate Worster, Mary Proffitt, Robert Gregory. Second row: Tim Foran, Diane Allen, Kristen Snarski, Covadonga Lopez, Gail Widener, Laura Prosser. Third row: Nick Stergiou, Mu Qiao, Mark Lester, David Clizbe, Stacey Gorniak, Daniel Leib, James Finley. Back row: Shane Wurdeman, Peter Raffalt, Nate Hunt, John McCamley. Not pictured: Tyler Rooks and Kim Vasquez

# Staff Updates

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The NBCF would like to welcome our newest faculty member to the team! Dr. Mukul Mukherjee has been working with the NBCF since 2007. He was recently awarded a position as an Assistant Director of the NBCF and as a Research Associate Professor. His undergraduate degree is in Physical Therapy from Delhi University in New Delhi, India. He completed his doctoral studies in Biomechanics, Motor Control and Rehabilitation Sciences at the Kansas University Medical Center. As a research faculty he will continue to lead several research projects in the NBCF. These include investigating the effects of virtual reality on walking, how the brain activity changes with learning, and how people navigate in different environments when they have sensory loss.



Amanda Fletcher, MS, joined the NBCF in October 2011. She earned her Bachelors of Science Degree in Exercise Science from Nebraska Wesleyan University and completed coursework for a Master's degree in Exercise Science from the University of Nebraska at Omaha. She works as a laboratory technician, helping with data collections, planning the American Society of Biomechanics 2013 Conference and a variety of other tasks.



Denise McGrath, PhD, joined us from Ireland and worked as a postdoctoral research associate in the NBCF for the academic year '11-'12. She received her Bachelor's degrees in Sport and Exercise Science and Biomedical Engineering from the University of Limerick, Ireland. Her PhD work at the University College Dublin focused on movement variability and use of inertial sensors. She has now returned to Ireland as Lecturer in Biomechanics at the University of Ulster, but continues to work closely with us.



Yawen Yu, PhD, joined the NBCF in August 2011 as a postdoctoral research associate. She earned her PhD in Kinesiology at the University of Minnesota and has a clinical background as an Occupational Therapist. Her research focuses on the relationship between perception and action; particularly, how humans understand what they can do through how they move. Supported by the NASA EPSCoR program, she is now investigating the effects of altered sensory information on gait variability.



Mu Qiao, PhD, joined in the NBCF in Fall 2012 as a postdoctoral research associate. He received his PhD from the Kinesiology program at Arizona State University in the summer of 2012. He studied how the joints in the lower extremities control walking and running. He is now engaged in the NASA EPSCoR supported program on the effect of virtual reality on walking.



Elena Sarabia Cachadiña, PhD, came to the NBCF from Spain in August 2012. She received her Master's degree in Physical Activity and Sports Sciences from the University Politecnica de Madrid (Spain). She completed her PhD from the University Pablo de Olavide (Seville, Spain) in exercise physiology. She is currently working in the NBCF with the gait variability projects as a postdoctoral research associate.



Anastasia Kyvelidou, PhD, came back to the NBCF from Greece via Boston, Massachusetts. She received her Bachelor's in Exercise Science from Aristotle University in Greece and Master's in Exercise Science from University of Nebraska Omaha. Her PhD is from the University of Nebraska Medical Center. After one-year as a postdoctoral research assistant at Northeastern University she returned to Omaha. She is currently working on our motor development related projects and the development and validation of our Gait-o-Gram device as a postdoctoral research associate.



# Staff Updates

Eric Cutler, MSE, is entering his second year as a doctoral student and came to the NBCF after completing his Master's Degree in Mechanical Engineering at the University of Nebraska-Lincoln. He has worked on several engineering related projects (building scaffolding to support the motion capture system, a machine for the diagnosis and treatment of low back pain, and a device for remote gait monitoring) as well as his own dissertation project.



Daniel Leib, MS, completed his Bachelor's degree in Exercise Science at Indiana University of Pennsylvania and his Master's degree in Biomechanics at Ball State University. He joined the NBCF in fall of 2012 and will be studying towards a PhD with an emphasis in Biomechanics while working closely with Dr. Sara Myers on motor control and gait projects. A haiku courtesy of Dan: "A new doc student; Never seeing the blue sky; Science is my wife".



Troy Rand, BA, attended the University of Northern Iowa where he received his Bachelor's degree in Exercise Science with an emphasis in Sports Psychology. During his undergraduate studies Troy realized he never wanted to leave the university, an environment conducive to learning and growth, it was a place he could always see himself. Troy started as a Master's student, under the direction of Dr. Sara Myers, in the summer of 2011. He plans to continue his education and pursue a doctorate degree.



Ryan Hasenkamp, BS, is a first year Master's student with the NBCF. However, Ryan is not new to the lab as he has worked with us as an undergraduate research assistant over the past three years. He received his undergraduate degree in Exercise Science from the University of Nebraska at Omaha in December 2011, and started working on his Master's the following semester. Currently, Ryan is working as a teaching assistant under the direction of Dr. Sara Myers.



Alek Diffendaffer, BS, has recently joined the NBCF in August 2012 to pursue a Master's degree in Exercise Science with an emphasis in Biomechanics. He is originally from Berthoud, Colorado and went to Hastings College in Hastings, Nebraska for his undergraduate degree in Exercise Science. His research is primarily dealing with gait issues with peripheral arterial disease patients under the direction of Dr. Sara Myers.



2012-2013 lab members from left to right. Front Row: Ryan Hasenkamp, Chun-Kai Huang, Melanie McGrath, Mukul Mukherjee, Nick Stergiou, Sara Myers, Jeff Kaipust, Jenna Yentes. Second Row: Amanda Fletcher, Elena Sarabia Cachadiña, Yawen Yu, Jessica Renz, Carlee Howe, Natasa Kyvelidou, Josh Haworth, Jung Hung Chien. Back Row: Alek Diffendaffer, Troy Rand, Mu Qiao, Dylan Goodman, Bryan Arnold, Shane Wurdeman, Dan Leib, Whitney Korgan, Eric Cutler, Ka-Chun Siu, Austin Davidson, Dan Blanke

# Grants and Projects

## ***Walking Impairments in Peripheral Arterial Disease***

The NBCF is quite proud of the work investigating walking impairments and treatment options in peripheral arterial disease (PAD). This project has been ongoing for the past seven years. PAD is a major vascular disease affecting 8 to 12 million people over the age of 65 years in the United States. Most people are familiar with cholesterol blockages that lead to a heart attack. However, cholesterol builds up in all arteries and leads to poor blood flow in the arms and legs. The blockages in the legs can eventually lead to difficulties in walking because of pain and/or cramping.

Our work has shown that patients with PAD have weaker muscular responses at the ankle. Therefore, they are not able to push forward during walking as effectively as healthy individuals. We have also established that patients with PAD have more variable movement patterns at the ankle, knee and hip as compared to healthy controls. Furthermore, we have found that the problems are present in both legs even if PAD is only affecting blood flow in one leg. The changes in walking patterns occur before pain starts, which means that pain itself is not causing the changes. We have also discovered that PAD patients experience no benefit during walking from pharmacological treatment. Our team is currently working to find out if blood flow, muscular changes or other mechanisms are responsible for mobility problems in these patients.

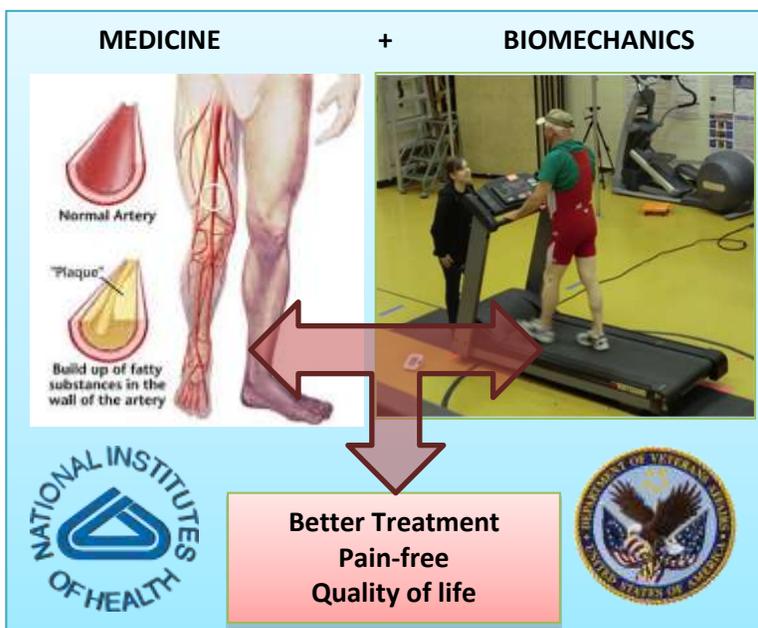
We know that our work in this area is very important to improving treatment options, rehabilitation and slowing the progression of the

disease. The federal government has also demonstrated their support in this area by funding a 5-year NIH R01 (PI: Dr. Iraklis Pipinos) and most recently a Department of Veterans' Affairs Merit Award (PI: Dr. Jason Johanning). These monies, as well as several grants from the state of Nebraska and private foundations, have led to the success of this research.

This project is currently led by Dr. Sara Myers, Assistant Director of the NBCF. Dr. Myers has been working intimately with this project since the beginning. She has personally been involved in hundreds of data collections as well as overseeing the development of several publications. Dr. Myers, along with Dr. Stergiou, worked

tirelessly to ensure the success of this project.

Our clinical collaborators are Dr. Jason Johanning and Dr. Iraklis Pipinos from the Department of Surgery at University of Nebraska Medical Center and the Veterans' Affairs Nebraska-Western Iowa Health Care System. Graduate students Shane Wurdeman and Ryan Hasenkamp are the NBCF laboratory personnel working on this project. In addition, Jeff Kaipust and Amanda Fletcher assist with data collection and analysis, along with several other graduate and undergraduate students from the NBCF.



Dr. Myers



Dr. Pipinos



Dr. Johanning

# Grants and Projects

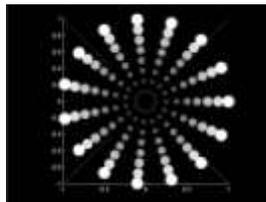
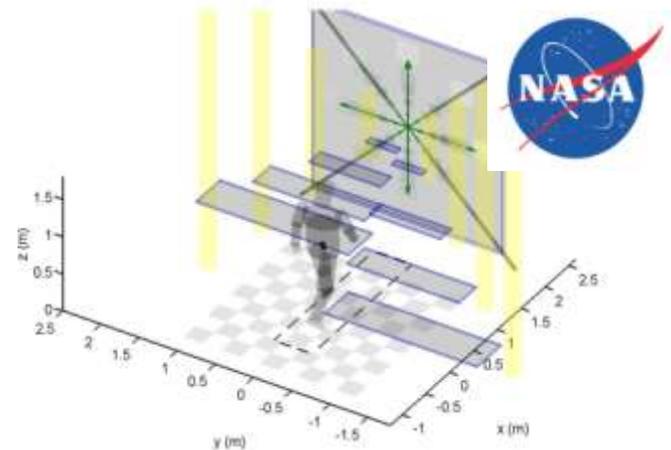
## Virtual Reality and Human Movement

As costs continue to decline and system usability improves, innovative virtual reality (VR) approaches have emerged that demonstrate the value for scientific understanding and treatment of difficult clinical conditions. The rationale behind these applications is that a VR system will allow the patient to move in an environment that can be more pleasant than a hospital room, where the therapist can also incorporate additional challenges to be tried in a user friendly and safer situation. However, research has not kept pace with the engineering. Thus, the scientific support for the application of these systems is limited.

Currently, Dr. Mukherjee, Assistant Director of the NBCF, is leading several projects that explore the effect of VR on our ability to walk and react to different stresses during walking (e.g., walking with a load, walking through narrow corridors). The NBCF is working on the second year of a three-year grant from NASA to investigate how the feeling of touch below the foot can be stimulated to benefit astronauts who face severe balance and walking problems after returning to Earth from space. In our laboratory, we study the integration of advanced biotechnologies, like VR, with sensory (e.g., vision, touch) stimulation to develop effective, quick and inexpensive treatment for different pathological populations.

Other project members include Dr. Ka-Chun (Joseph) Siu, an Assistant Professor in Physical Therapy at the University of Nebraska Medical Center. Drs. Mukherjee and Siu are assisted by post-docs Drs.

Yawen Yu and Mu Qiao, and graduate students Jung Hung Chien and Chun Kai Huang.



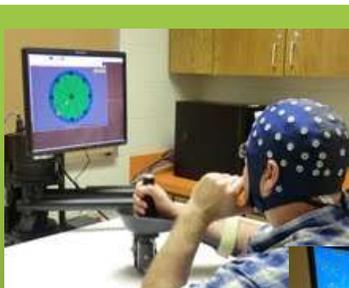
Above: VR setup in a computer model. Left: Typical VR stimulus. Below: Data collection from the NASA EPSCoR project: split-belt treadmill adaptation (Left) and post-adaptation (Right).



## Robotic Rehabilitation in Chronic Stroke Survivors

Dr. Mukherjee has also been overseeing a project investigating the use of VR and an upper extremity robot to improve rehabilitation in patients that have suffered from a stroke. These projects involve the study of brain activity while being presented with different types of stimuli and feedback. The goal is to determine whether training with this unique robot will enhance the learning process in new environments. A newly awarded grant from the NSF will allow us to expand this work using fNIRS technology. The Major Research Instrumentation Program through the NSF has allowed us to purchase this state-of-the-art brain imaging system to quantify activity in the cerebral cortex during functional postures, such as sitting, standing and walking.

Dr. Mukherjee works closely with Dr. Wen Pin Chang from Creighton University and Dr. Tony Wilson from the University of Nebraska Medical Center. Undergraduate, Bryan Arnold, also assists with data collections and processing.



Above and Right: These pictures feature a typical data collection set-up using the robot and EEG.

# Grants and Projects

## Motor Development



Funded by a Dennis Weatherstone Pre-Doctoral Fellowship from Autism Speaks, doctoral candidate Joshua Haworth has been working at the NBCF with children that have been diagnosed with Autism Spectrum Disorder (ASD). He is investigating the link between perception and movement in children with and without ASD. Children with ASD have difficulty properly identifying the movement of living beings versus inanimate objects. To investigate how children with and without ASD perceive movement, he measures both eye and standing posture movement. We hope that this work will lead to new treatment options and early diagnosis of ASD. NASA Nebraska Space Grant has provided him an opportunity to extend his work in control of posture into adults.

In 2012, we concluded our four-year, federally funded project. We have shown that the perceptual-motor treatment with vibration did not improve sitting in children with cerebral palsy in comparison to perceptual-motor treatment alone. However, as sitting did improve, children started exploring their surrounding environment and thus advancing cognitive development. Extending this concept, Dr. Yawen Yu started studying how infants take advantage of postural sway to perceive their ability to reach.

## Robotic Surgery

In an effort to reduce blood loss during surgery and shortening the hospital stay after surgical procedures, robotic-assisted surgery has become a popular choice for patients. Robot-assisted surgery is a form of surgery performed by a surgeon who controls a specialized robot. Becoming an expert in robotic surgery requires extended training outside the operating room. In this project, we developed a risk-free and low-cost environment using virtual simulation for surgical trainees to learn robotic surgical skills. Dr. Ka-Chun (Joseph) Siu and his team have successfully created a program using training simulators. They are now moving into the next phase and have developed a portable version of the simulator for new surgeons to learn robotic surgical skills whenever and wherever they prefer.



Calibrating the eye tracking equipment for a child standing on the force platform (Top). An adult subject tracking an object on the screen while maintaining upright posture (Bottom).



A trainee using the DaVinci robot while movement of the arms is recorded with electro-goniometers (Left). Simulator trainers that reflect similar movement and responses as the DaVinci system (Right).



# Grants and Projects

Robotic surgery continues to be funded by the State of Nebraska through the Nebraska Research Initiative. Dr. Siu and his doctoral student, Chun-Kai Huang, have dedicated their efforts to the success of this project. Upon the opening of the Biomechanics Research Building in August of 2013, there will be a dedicated laboratory to this project!

## **Sports Medicine**

Dr. Melanie McGrath continues to collect data in the NBCF as part of her University Committee on Research and Creative Activity funded pilot study investigating biomechanical, strength, posture, and balance changes in knee ligament reconstructed NCAA student-athletes. This study will help guide future research in the prevention of post-traumatic osteoarthritis in patients following knee surgery. In addition, athletic training student, Holly Remmenga, will be investigating changes in gait and balance in runners who use minimalistic, "five-finger"-style shoes.

## **Lateral Stepping**

During healthy walking there is greater variability in one's movement from side-to-side than in the front-to-back direction. Since the variability is higher in the side-to-side direction, it is thought that moving in that direction requires more control from the brain. This study intends to investigate how the amount of variability is affected if walking occurs in the side-to-side direction using a lateral stepping training program.



## **Amputee Gait**

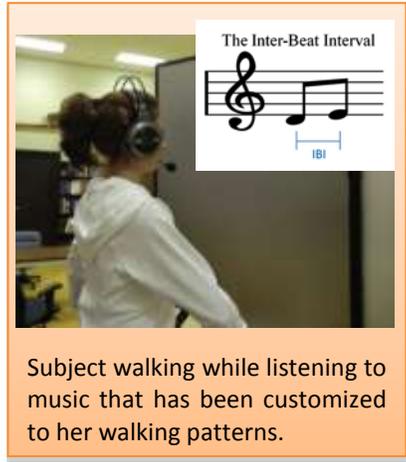
Due to the years of conflict in Iraq and Afghanistan, increased awareness has been raised concerning the inadequacy of current lower limb prosthetic rehabilitation guidelines. In an effort to improve prosthetic rehabilitation guidelines, the NBCF has started implementing state-of-the-art analyses that are very different from traditional biomechanics



measures. Acknowledging that every individual has a unique walking style or pattern, we are investigating walking with a prosthesis from the perspective of "How do we determine the best prosthesis for an individual?". Thus, our goal is to determine the means to identify the prosthesis that best fits to each individual's unique walking pattern, rather than trying to identify the prosthesis that could be considered the solution for every individual.

## **Music and Walking**

Even the most serious science doesn't have to be boring! We are investigating how to keep people moving and maintaining happy, active lives through listening to music. Not just any music, however; music with a specifically controlled tempo can be helpful in maintaining balance and avoiding falls. Jeff Kaipust and Nate Hunt have done considerable work in this area by having individuals walk while listening to tones with different temporal structures. That is, tones that weren't played perfectly to the beat of a metronome, but instead varied just a little bit in specific



# Grants and Projects

ways to change how people walked. Daniel Leib is developing ways to apply this custom music to potential rehabilitation and fall prevention training for older adults and Parkinson's disease patients.

## ***Injury Prevention in Pre-teen Female Athletes***

Elastic bands demonstrate the potential to be a cost effective, portable, and relatively simple training method for a variety of training purposes. Jon Carey has been exploring elastic band training programs and the effect they have on balance and strength. In light of the prevalence of knee and other lower extremity injuries in young female athletes, the current focus is on the potential of a training program that may increase strength and neuromuscular control, possibly reducing the injury rate in youth.

## ***Pulmonary Disease and Walking***

The NBCF has continued working with Dr. Stephen Rennard, a world-renowned pulmonologist from the University of Nebraska Medical Center. The ongoing studies are aimed at understanding the overall effects of chronic obstructive pulmonary disease and their effects on daily function, such as walking performance. We have recently begun investigating the connection between walking and breathing with the intention of developing novel rehabilitation protocols in the future.

## ***Stair Negotiation***

Risk of falls is a major concern in the increasingly aging population. Stair climbing, being an activity of daily living, increases this risk. Through our studies at the NBCF, we have been able to describe the biomechanical changes that occur during stair climbing. In addition, we are also assessing how cognitive loading increases the risk of falls while navigating stairs as well as exploring biomechanical characteristics during stair climbing in the older adult and the frail populations.

## ***Alzheimer's disease***

One of the early signs of Alzheimer's disease, sometimes predating cognitive decline, are changes in walking patterns. In addition, Alzheimer's patients also suffer from other motor dysfunctions, such as poor

balance control. In a series of studies at NBCF, in association with our collaborators at the University of Nebraska Medical Center, we are investigating the link between cognitive decline and gait variability and balance control in these patients.



The use of elastic bands can offer an inexpensive alternative to prevent injury and assist in rehabilitation.



Patients with pulmonary disease undergo testing on both the treadmill and while walking overground. This helps us understand the connection between walking and breathing.



Subject descending the stairs while performing another motor task (carrying a box) and performing a counting task.

# Collaborations

Neil Huben, a May 2011 University of Nebraska at Omaha graduate, is a former NBCF research assistant. Awarded a 2011-2012 Fulbright Fellowship, Neil spent 10 months conducting research with Dr. Vassilia Hatzitaki at Aristotle University of Thessaloniki (AUTH), Greece. In Dr. Hatzitaki's Motor Control and Learning Laboratory (MCLL), he studied the effects of visual and auditory stimuli on postural sway and balance. Working with Dr. Stergiou and Dr. Hatzitaki, he helped to establish collaboration between the NBCF and the MCLL. Today, the NBCF and MCLL continue collaboration, providing opportunities for international scientific exchange to students.



From left to right: Iordanis Kanakis, DJ Eikema, Neil Huben, Dr. Hatzitaki, George Sofianidis.



Dr. Givens

In July 2012, we began a collaboration in low back pain research with Dr. Deborah Givens, the current chair of Creighton University's Department of Physical Therapy. This new project is an extension of the work of the late Dr. Kevin Granata and involves the development of a device for the diagnosis and possible treatment of low back pain. This apparatus uses mechanical perturbations to measure delays in low back reflexes in individuals with low back pain. These delayed reflexes have been shown to present along with low back pain, both of which are results of low back injuries. Delayed reflexes also increase the likelihood of future low back injuries, resulting in a cycle of reinjury. This apparatus will also be used in an intervention to prevent future low back reinjury in individuals with low back pain by retraining their reflexes using mechanical perturbations.

Dr. Jeff Hawks from the Materials and Mechanical Engineering Department at the University of Nebraska-Lincoln, and his student Chase Pfeifer are investigating sport biomechanics at the NBCF. Early in 2012, Alex Henery, a former Husker and current Philadelphia Eagles kicker, was brought to the NBCF to analyze the biomechanics of a kick. They have also collected data with a former Florida State kicker and a current high school kicker. These data were also used for Mr. Pfeifer's Master's Thesis. A video (BTN commercial) about Alex Henery's visit to the NBCF can be found at [http://youtu.be/i\\_9\\_gWOyRns](http://youtu.be/i_9_gWOyRns).



Former University of Nebraska-Lincoln football player, Alex Henery in the NBCF.



Treadmill at Johnson Space Center.

During the Fall of 2011 and again in the Summer of 2012, Dr. Melissa Scott-Pandorf, from the Johnson Space Center visited the NBCF to observe data collections and establish methodology for our ongoing projects with NASA. In the Fall of 2011, we began a series of experiments using our virtual reality system to determine the effect of a sensory stimulus while walking on a split-belt treadmill. We have been working closely with Dr. Scott-Pandorf to analyze the preliminary results, fine tune the protocol and prepare for data collections at the Johnson Space Center. In the Fall of 2013, Dr. Mukherjee and JC Chien will travel to Houston, Texas to collect data on a six degree-of-freedom treadmill. In addition, Dr. Jacob Bloomberg, from Johnson Space Center visited the NBCF in the Fall of 2011 to present his research at our weekly Journal Club and discuss future collaborative projects.

# Visitors



## **NBCF LAB TOURS:**

College of Education Summer Scholars .....	June 2011
College of Engineering Junior High School Students .....	July 2011
John Scott and Scott Family Foundation .....	July 2011
University of Nebraska-Lincoln Athletic Department.....	October 2011
Varner Hall and Board of Regents .....	November 2011
Athletic Training Accreditation Site Visit .....	November 2011
University of Nebraska Medical Center High School Alliance .....	December 2011
University of Nebraska at Omaha Athletic Training High School Day .....	December 2011
MARS Middle School Visit.....	December 2011
University of Nebraska at Omaha Chancellor's Office.....	December 2011
Creighton University, Department of Physical Therapy .....	January 2012
University of Nebraska at Omaha, Research and Creative Activity .....	February 2012
Dr. Brian Caulfield from the University College Dublin, Dublin, Ireland.....	April 2012
University of Nebraska at Kearney Research Students .....	May 2012
NU Foundation and Burton Prosthetics.....	September 2012

## **SOCIAL EVENTS**

### **FALL PICNIC**



### **GCMAS 2011**



### **LAB SOCIALS!**



### **JOSH'S WEDDING**



### **5K FUN RUN**



### **ASB 2012**



### **SUMMER BBQ**



### **HAPPY HOUR**



### **CONFERENCES**

### **GRADUATION**

### **ASB 2011**

# Visitors

**Dr. Stephen Guastello**  
Marquette University  
“Nonlinear dynamics in cognitive workload and fatigue.”



**Dr. George Casale**  
U. of Nebraska Medical Center  
“Translational studies of peripheral arterial disease by quantitative wide-field fluorescence microscopy.”



**Dr. Christou Evangelos**  
University of Florida  
“Aging and learning novel fine motor tasks.”



**Dr. Jennifer Huberty**  
U. of Nebraska at Omaha  
“Improving self-worth to increase physical activity adherence in women.”



**Dr. Wen Pin Chang**  
Creighton University  
“Electrophysiology of robot-assisted upper extremity movement using EEG.”



**Dr. Karl Newell**  
Pennsylvania State U.  
“Variability and motor control.”



**Dr. William Warren**  
Brown University  
“Behavioral dynamics of visually-guided motion”



**Dr. Mark Shelhamer**  
Johns Hopkins U.  
“Is fractal scaling relevant to motor control?”



**Dr. Vassilos Vardaxis**  
Des Moines University  
“Bilateral lower extremity dynamics pre and post unilateral total hip arthroplasty (THA).”



**Dr. Natalia Dounskaia**  
Arizona State U.  
“Directional preferences of arm movements.”



**Dr. Jacob Bloomberg**  
Johnson Space Center  
“Adaptive effects of spaceflight on astronaut sensori-motor function.”



**Drs. Michael Turvey and Claudia Carello**  
U. of Connecticut  
“An idiosyncratic view of locomotion.”



**Dr. Rick Neptune**  
U. of Texas, Austin  
“Biomechanical analysis of human movement.”



**Dr. Paul DeVita**  
East Carolina U.  
“The bio-adaptable nature of the human condition.”



# Student Awards!!!



1. Austin Davidson: University of Nebraska at Omaha Committee on Research and Creative Activity Student Award for Travel (2x), 2012
2. Austin Davidson: University of Nebraska at Omaha College of Arts and Sciences Travel Award (2x), 2012
3. Austin Davidson: NASA Nebraska Travel Award, 2012
4. Ben Bowder: NASA Nebraska Space Grant and EPSCoR Fellowship, 2011-2012
5. Bryan Arnold: University of Nebraska at Omaha College of Arts and Sciences Travel Award, 2012
6. Carlee Howe: University of Nebraska at Omaha Helen B. Hewett Scholarship, 2012
7. Chun-Kai Huang: Force and Motion Travel Scholarship, 2012
8. Elena Kokkoni: Force and Motion Travel Scholarship, 2011
9. Eric Cutler: Gait and Clinical Movement Analysis Society Travel Award, 2012
10. Eric Cutler: University of Nebraska Medical Center First Year Doctoral Fellowship, 2011-2012
11. Jennifer Yentes: NASA Nebraska Space Grant and EPSCoR Fellowship, 2011-2012
12. Jennifer Yentes: Force and Motion Travel Scholarship, 2011
13. Jennifer Yentes: American Society of Biomechanics Travel Award, 2011
14. Jennifer Yentes: NASA Nebraska Travel Award, 2011
15. Jennifer Yentes: NASA Nebraska Travel Award (2x), 2012
16. Jennifer Yentes: University of Nebraska Medical Center Regents Tuition Fellowship, 2011-2013
17. Jennifer Yentes: University of Nebraska Medical Center Graduate Studies Bukey and McDonald Fellowship, 2011-2013
18. Jessica Renz: University of Nebraska at Omaha Fund for Undergraduate Scholarly Experience, 2012
19. Jessica Renz: University of Nebraska at Omaha Committee on Research and Creative Activity Student Award for Travel, 2012
20. Jessica Renz: University of Nebraska at Omaha Helen B. Hewett Scholarship, 2012
21. Jessica Renz: University of Nebraska at Omaha Richard W. Latin Memorial Scholarship, 2012
22. Jon Carey: NASA Nebraska Travel Award, 2012
23. Jon Carey: University of Nebraska at Omaha Committee on Research and Creative Activity Grant, 2011
24. Jon Carey: University of Nebraska at Omaha, Department of Health, Physical Education and Recreation Part-Time Teacher of the Year Award, 2011-2012
25. Joshua Haworth: Autism Speaks Weatherstone Pre-doctoral Fellowship, 2010-2013
26. Joshua Haworth: NASA Nebraska Space Grant and EPSCoR Fellowship, 2011-2012
27. Joshua Haworth: Force and Motion Travel Scholarship, 2011
28. Nate Hunt: NASA Nebraska Space Grant and EPSCoR Fellowship, 2011-2012
29. Ryan Hasenkamp: University of Nebraska at Omaha Committee on Research and Creative Activity Grant, 2012
30. Shane Wurdeman: Force and Motion Travel Scholarship, 2012
31. Shane Wurdeman: Gait and Clinical Movement Analysis Society Travel Award, 2012
32. Shane Wurdeman: American Society of Biomechanics Travel Award, 2012
33. Shane Wurdeman: American Society of Biomechanics Grant-in-Aid, 2012
34. Shane Wurdeman: AAHPERD Research Consortium Grant-in-Aid, 2012
35. Shane Wurdeman: Orthotic and Prosthetic Education and Research Foundation Award, 2012
36. Shane Wurdeman: University of Nebraska Medical Center Graduate Fellowship, 2012-2013
37. Shane Wurdeman: University of Nebraska Medical Center Regents Tuition Fellowship, 2012-2013
38. Troy Rand: University of Nebraska at Omaha Committee on Research and Creative Activity Grant, 2012
39. Troy Rand: University of Nebraska at Omaha Graduate Research and Creative Activity Grant, 2012
40. Troy Rand: NASA Nebraska Travel Award, 2012
41. Whitney Korgan: NASA Nebraska Travel Award (2x), 2012
42. Whitney Korgan: University of Nebraska at Omaha Fund for Undergraduate Scholarly Experience, 2012
43. Whitney Korgan: University of Nebraska at Omaha Committee on Research and Creative Activity Grant, 2012
44. Whitney Korgan: NASA Nebraska Space Grant and EPSCoR Fellowship, 2011-2012

# Award Highlights

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Shane Wurdeman received the American Alliance for Health, Physical Education, Recreation and Dance Graduate Research Grant as well as the American Society of Biomechanics Graduate Grant-in-Aid for his project investigating adaptations to different prostheses in amputee gait. He has also been awarded the Orthotic and Prosthetic Education and Research Foundation Award for his work in this area.

Dr. Nick Stergiou and doctoral candidate, Shane Wurdeman. *Photo courtesy of Eric Francis Photography.*

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Undergraduates Austin Davidson, Jessica Renz and Whitney Korgan received travel awards from the University Committee on Research and Creative Activity, NASA Nebraska Space Grant, College of Liberal Arts & Sciences and the College of Education to travel to national scientific conferences. These included the *Annual North American Society for the Psychology of Sport and Physical Activity meeting* in Honolulu, Hawaii, the *Annual American Society of Biomechanics meeting* in Gainesville, Florida and the *Gait and Clinical Movement Analysis Society meeting* in Grand Rapids, Michigan.

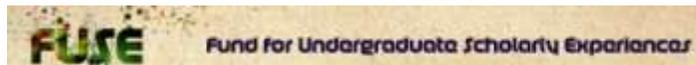


Austin, Jessica and Whitney



Jessica and Whitney

This year two undergraduate students, Jessica Renz and Whitney Korgan, working in the NBCF were awarded \$2500 FUSE grants, Funds for Undergraduate Scholarly Experience. With these grants, they were able to further their projects which looked at stepping patterns on the stairmill device and adaptations while walking on the Woodway® curved treadmill.



Dr. Sara Myers was awarded two grants this year to continue her research. The University Committee on Research and Creative Activity provided her with funds to investigate the relationship between ambulatory activity patterns and gait variability. In addition, the Fund for Investing in the Research Enterprise provided her with funds to study the effects of blood flow on dynamics of the neuromuscular system.



Troy Rand received several awards during his first year with the NBCF. He received a grant from the University Committee on Research and Creative Activity for \$500, and one from the Graduate Research and Creative Activity program for \$5000. Both of these grants were funded to support his thesis topic investigating the standing posture and fall risk in the elderly. He also received NASA Nebraska Space Grant travel funding to present a poster at the *Gait and Clinical Movement Analysis Society* for work with peripheral arterial disease. He won the Best Poster Award at this conference.

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In April 2012, Jon Carey, was awarded the School of Health, Physical Education and Recreation part-time teaching award. Jon started with the NBCF in spring of 2010 and was the teaching assistant for Physiology and Anatomy in spring 2011. Jon has been teaching as part-time faculty within the department for one year and now teaches at Nebraska Wesleyan University in Lincoln, Nebraska.



# Last Year's Publications

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- Cignetti F, Decker LM, Stergiou N. (2012). Sensitivity of the Wolf's and Rosenstein's algorithms to evaluate local dynamic stability from small gait data sets. *Ann Biomed Eng.* 40(5):1122-30.
- Decker LM, Cignetti F, Potter JF, Studenski SA, Stergiou N. (2012). Use of motor abundance in young and older adults during dual-task treadmill walking. *PLoS One*, 7(7):e41306.
- Decker LM, Cignetti F, Stergiou N. (2012). Wearing a safety harness during treadmill walking influences lower extremity kinematics mainly through changes in ankle regularity and local stability. *J Neuroeng Rehabil.* 9:8.
- Deffeyes JE, Harbourne RT, Stuber WA, Stergiou N. (2011). Approximate entropy used to assess sitting postural sway of infants with developmental delay. *Infant Behav Dev.* 34(1):81-99.
- Dusing SC, Thacker LR, Stergiou N, Galloway JC. (2012). Early complexity supports development of motor behaviors in the first months of life. *Dev Psychobiol.* 2012 May 9. [Epub ahead of print]
- Haworth J, Vallabhajosula S, Tzetzis G, Stergiou N. (2012). Optimal Variability and Complexity: A Novel Approach for Management Principles. In: Banerjee, S. (Ed.) *Chaos and Complexity Theory for Management: Nonlinear Dynamics*. IGI Global, USA.
- Huisinga JM, Schmid KK, Filipi ML, Stergiou N. (2012). Gait mechanics are different between healthy controls and patients with multiple sclerosis. *J Appl Biomech.* 2012 Aug 22. [Epub ahead of print]
- Huisinga JM, Yentes JM, Filipi ML, Stergiou, N. (2012). Postural control strategy during standing is altered in patients with multiple sclerosis. *Neuroscience Letters.* 524(2):124-128.
- Huisinga JM, Schmid KK, Filipi ML, Stergiou N. (2012). Persons with multiple sclerosis show altered joint kinetics during walking after participating in elliptical exercise. *J Appl Biomech.* 28(3):249-57.
- Huisinga JM, Filipi ML, Stergiou N. (2012). Supervised resistance training results in changes in postural control in patients with multiple sclerosis. *Motor Control.* 16(1):50-63.
- Huisinga JM, Filipi ML, Stergiou N. (2011). Elliptical exercise improves fatigue ratings and quality of life in patients with multiple sclerosis. *J Rehabil Res Dev.* 48(7):881-90.
- Huisinga JM, Filipi ML, Schmid KK, Stergiou N. (2011). Is there a relationship between fatigue questionnaires and gait mechanics in persons with multiple sclerosis? *Arch Phys Med Rehabil.* 92(10):1594-601.
- Kaipust JP, McGrath D, Mukherjee M, Stergiou N. (2012). Gait variability is altered in older adults when listening to auditory stimuli with differing temporal structures. *Ann Biomed Eng.* 2012 Sept 7. [Epub ahead of print]
- Kaipust JP, Huisinga JM, Filipi M, Stergiou N. (2012). Gait variability measures reveal differences between multiple sclerosis patients and healthy controls. *Motor Control.* 16(2):229-244.
- Koutakis P, Mukherjee M, Vallabhajosula S, Blanke DJ, Stergiou N. (2012). Path integration: Effect of curved path complexity and sensory system on blindfolded walking. *Gait Posture.* 2012 Jul 26. [Epub ahead of print]
- Patras K, Zampeli F, Ristanis S, Tsepis E, Ziogas G, Stergiou N, Georgoulis AD. (2012). Hamstring-dominant strategy of the bone-patellar tendon-bone graft anterior cruciate ligament-reconstructed leg versus quadriceps-dominant strategy of the contralateral intact leg during high-intensity exercise in male athletes. *Arthroscopy.* 28(9):1262-70.
- Patras K, Ziogas G, Ristanis S, Tsepis E, Tsiaras V, Stergiou N, Georgoulis AD. (2011). Endurance markers are related with local neuromuscular response for the intact but not for the ACL reconstructed leg during high intensity running. *J Sports Med Phys Fitness.* 51(4):708-14.
- Ristanis S, Tsepis E, Giotis D, Zampeli F, Stergiou N, Georgoulis AD. (2011). Knee flexor muscle responses under fatigue after harvesting the hamstrings for anterior cruciate ligament reconstruction. *Clin J Sport Med.* 21(4):288-93.
- Smith BA, Teulier C, Sansom J, Stergiou N, Ulrich BD. (2011). Approximate entropy values demonstrate impaired neuromotor control of spontaneous leg activity in infants with myelomeningocele. *Pediatr Phys Ther.* 23(3):241-7.
- Smith BA, Stergiou N, Ulrich BD. (2011). Patterns of gait variability across the lifespan in persons with and without down syndrome. *J Neurol Phys Ther.* 35(4):170-7.
- Stergiou N, Decker LM. (2011). Human movement variability, nonlinear dynamics, and pathology: Is there a connection? *Hum Mov Sci.* 30(5):869-88.
- Vallabhajosula S, Yentes JM, Momcilovic M, Blanke DJ, Stergiou N. (2012). Do lower-extremity joint dynamics change when stair negotiation is initiated with a self-selected comfortable gait speed? *Gait Posture.* 35(2):203-8.
- Wurdeman SR, Huisinga JM, Filipi M, Stergiou N. (2012). Multiple sclerosis alters the mechanical work performed on the body's center of mass during gait. *J Appl Biomech.* 2012 Aug 23. [Epub ahead of print]
- Wurdeman SR, Koutakis P, Myers SA, Johanning JM, Pipinos II, et al. (2012). Patients with peripheral arterial disease exhibit reduced joint powers compared to velocity-matched controls. *Gait Posture.* 36(3): 506-509.
- Wurdeman SR, Myers SA, Johanning JM, Pipinos II, Stergiou N. (2012). External work is deficient in both limbs of patients with unilateral PAD. *Med Eng Phys.* 2012 Feb 7. [Epub ahead of print]
- Wurdeman SR, Huisinga JM, Filipi M, Stergiou N. (2011). Multiple sclerosis affects the frequency content in the vertical ground reaction forces during walking. *Clin Biomech.* 26(2):207-12.
- Wurdeman SR, Huben NB, Stergiou N. (2012). Variability of gait is dependent on direction of progression: Implications for active control. *J Biomech.* 45(4):653-9.
- Wurdeman SR, Yentes JM, Huben NB, Stergiou N. (2012). An unstable shoe with a rocker bottom redistributes external work. *Footwear Science.* 2012 Apr 18. [Epub ahead of print]
- Yentes JM, Huisinga JM, Myers SA, Pipinos II, Johanning JM, Stergiou N. (2012). Pharmacological treatment of intermittent claudication does not have a significant effect on gait impairments during claudication pain. *J Appl Biomech.* 28(2):184-91.

# Travels

## GCMAS 2012

Several lab members, including Dr. Stergiou travelled to Grand Rapids, Michigan in May 2012 for the Gait and Clinical Movement Analysis Society Meeting. Here, Dr. Stergiou and Jenna Yentes presented a tutorial on nonlinear mathematics and their application to movement. In addition, Troy Rand received the Best Poster Award at the conference. Many others gave poster or oral presentations, too.



From left to right: Troy Rand, Whitney Korgan, Jon Carey, Ryan Hasenkamp, Eric Cutler, Nick Stergiou, Jenna Yentes

## SPAIN

In late March 2012, Dr. Stergiou travelled to Seville, Spain to participate and present as a Guest Speaker at the International Symposium on Nonlinear Dynamics and its application to Sport. This conference was organized by Dr. Jose Naranjo Orellana. Here he met Dr. Covadonga Lopez, who later visited the NBCF for two weeks, and Dr. Elena Sarabia Cachadiña, who is a new postdoc at the NBCF.



From left to right: Maria Zakinthinaki, Laura Guerrero Almeida, Jose Naranjo Orellana, Fernando Gutierrez Ortega, Dr. Jose Luis Terreros Blanco, Blanca de la Cruz Torres, Nick Stergiou and Elena Sarabia Cachadina

## ASB 2012

Several lab members, including Dr. Stergiou travelled to Gainesville, Florida in August 2012 to attend the American Society of Biomechanics Annual Meeting. At this meeting, a total of 18 posters, 4 oral presentations and 1 thematic poster were presented. This meeting will be held in Omaha next September. We hope to see you there!



From left to right: Amanda Fletcher, Jenna Yentes, Troy Rand, Jessica Renz, Whitney Korgan, Bryan Arnold, Austin Davidson, Jessie Huisinga, Sara Myers, Nick Stergiou

## NAK

In September 2011, Dr. Stergiou was inducted into the National Academy of Kinesiology. This meeting was held in Minneapolis, Minnesota. From left to right in the picture below: Dr. Thomas Stoffregen (nominator), Dr. Nicholas Stergiou, Dr. Maureen Weiss (President of NAK), Dr. Jane Clark (nominator) and Dr. Beverly Ulrich (nominator).



## NASPSA 2011 & 2012

Dr. Stergiou, and Josh Haworth traveled to Burlington, Vermont in 2011 and in 2012 Dr. Stergiou, Jeff Kaipust and Austin Davidson traveled to Honolulu, Hawaii for the North American Society for the Psychology of Sport and Physical Activity Meeting.



Austin Davidson at his poster (left) and Jeff Kaipust at his poster (above).

# Support

For more than 25 years, the revolutionary work of the Nebraska Biomechanics Core Facility (NBCF) at UNO has led to a new understanding of human movement; such as how people stand, walk and physically interact with their environment. The facility has earned an international reputation for excellence in basic and clinical research.



Our research in cerebral palsy and peripheral arterial disease, for example, has influenced the treatment and therapy options available to persons living with these disabilities. The facility has patented the wireless Gait-O-Gram, a biomedical instrument designed to measure an individual's walking parameters. Currently research efforts are also focused on robotic assisted surgery, chronic obstructive pulmonary disease, Alzheimer's, stroke and elderly populations.

These achievements bring opportunities to advance our program. But this growth requires funding beyond allocations provided by the state. Charitable gifts to the Nebraska Biomechanics Excellence Fund are needed to help advance the critical work occurring at NBCF. This funding will support new equipment, a facility addition, student scholarships and faculty support. **We feel so strongly about our facility and the work that we do that every one of our students, faculty and staff have contributed to the fund. The NBCF was the first entity in the University of Nebraska system to procure 100% support internally.** Join us in our efforts by making a gift today.

**Yes, I/we would like to support the Nebraska Biomechanics Core Facility with a gift to the Nebraska Biomechanics Excellence Fund # 01103240 by choosing one of the three options below.**

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