2019

University of Nebraska at Omaha Department of Biomechanics Annual Report Spring 2019

Department of Biomechanics, University of Nebraska at Omaha

UNIVERSITY OF NEBRASKA AT OMAHA

DEPARTMENT OF BIOMECHANICS

ANNUAL REPORT **SPRING 2019**

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RETHINK THE IMPOSSIBLE

Five years ago, when I walked into the Biomechanics Research Building (BRB), I made a promise to the Scott family that I would make them very proud of their amazing gift. Both my staff and I worked very hard towards this goal and we have had many successes such as the largest research grant in the University of Nebraska at Omaha (UNO) history, the first department of biomechanics in the world that provides degrees in biomechanics, the first center for research in human movement variability in the world, and many others.

The result of these successes was the need for more space. "Give me space and I will move the earth," my grand grand-father Archimedes used to say. And again, the Scott family delivered another miracle.

With this miracle, they brought along some additional angels: George Haddix and Susan Nemer-Haddix and family; Allan and Dianne Lozier and family; Robert Braun and Mary Heng-Braun and family; Dottie and Stan Truhlsen and family; John and Mary Wilson and family; Kim and Derek Yungtum and family; Mogens and Cindy Bay and family; the late A. Gordon Lozier who is watching us from above and his family down here; Tim Daugherty, his family, and the late Robert Daugherty who is watching us from up above.

The BRB will expand by 30,000 squarefeet. The $11.6 million addition to our building has a scheduled move-in date of September 2019 with an official grand opening in October 2019. This expansion will more than double our physical size and will enhance our momentum to continue the amazing growth trajectory we are on. New laboratories, new research capabilities, new pieces of equipment; biomechanics at its best. You can read more in this annual report about this tremendous development and many others.

The "Biomaha Field of Dreams," where we always rethink the impossible, since nothing seems truly impossible anymore, is unfolding before your eyes.

Thank you,
Dr. Nick Stergiou

MAKING HISTORY AGAIN

NEW ACADEMIC PROGRAMS

Previously, UNO Biomechanics has made history through the BRB, creation of the Department of Biomechanics, Center for Research in Human Movement Variability, and last year establishing the Division of Biomechanics and Research Development. Although we are well known for our world-renowned research, we are also making history with our academic programs. We now offer a Master of Science in Biomechanics and an undergraduate Minor in Biomechanics.

MASTER OF SCIENCE IN BIOMECHANICS

The Master of Science in Biomechanics is a degree program designed to enable students to develop research skills and competencies in biomechanics. A degree in biomechanics will prepare students for a career in robotics, prosthetics, rehabilitation, sports, sports medicine, military performance, research and design of athletic apparel, and performance enhancement. The master's degree is also a great option for those wishing to seek their Ph.D. or teach undergraduate courses in biomechanics.

Admission Requirements include:

- GPA of 3.0 in undergraduate program
- GRE Score
- Written statement of goals and rationale for entering the graduate program
- Two letters of recommendation
- Official transcripts from previous institutions
- For applicants whose native language is not English, minimum total score of 80 on the internet based TOEFL, with at least 20 in all categories (listening, reading, writing, and speaking)

MINOR IN BIOMECHANICS

In addition to the Master of Science in Biomechanics, the department also now offers the undergraduate Minor in Biomechanics. The minor is designed to offer a formal biomechanics course load to students interested in applying their primary discipline to biomechanics.

Possible disciplines that complement the Minor include:

- Biology
- Chemistry
- Computer Science
- Neuroscience
- Physical Education
- Physics
- Psychology

Students from all majors are welcome to enroll. The minor is a great opportunity for anyone to learn more about the field of Biomechanics through coursework such as Introduction to Biomechanics, Ethics of Scientific Research, Analytical Methods in Biomechanics, Human Physiology and Anatomy I, and many more.

MACHINING AND PROTOTYPING CORE FACILITY

The Machining and Prototyping Core Facility involves the use of three major facilities within the UNO BRB: The Machine Shop, Electronics Workshop, and the 3D Printing Laboratory (pictured at right).

The most basic function of the Machining and Prototyping Core Facility is to provide services that utilize these spaces and their personnel and equipment. These services are for professionals in the University of Nebraska system, the local area, but also to people outside our state to progress their research or other projects.

The Machining and Prototyyping Core Facility can design, prototype, manufacture and repair, maintain, or install a wide range of devices and instrumentation.

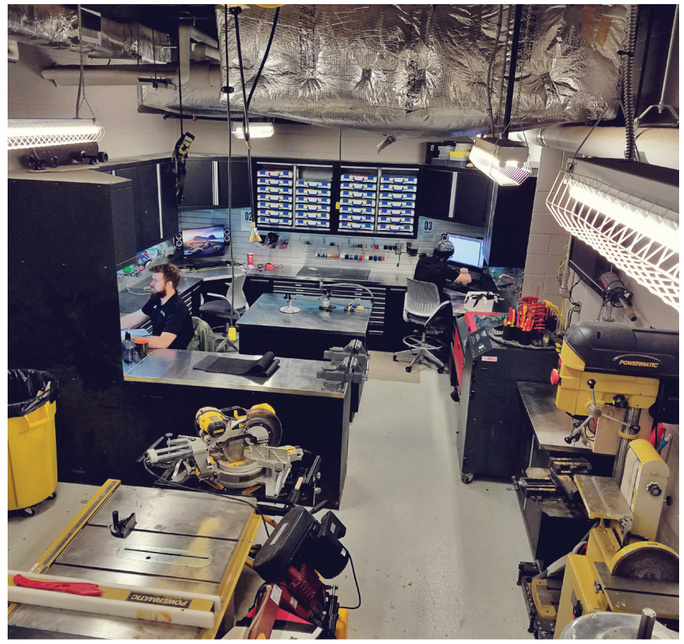
CORE STAFF

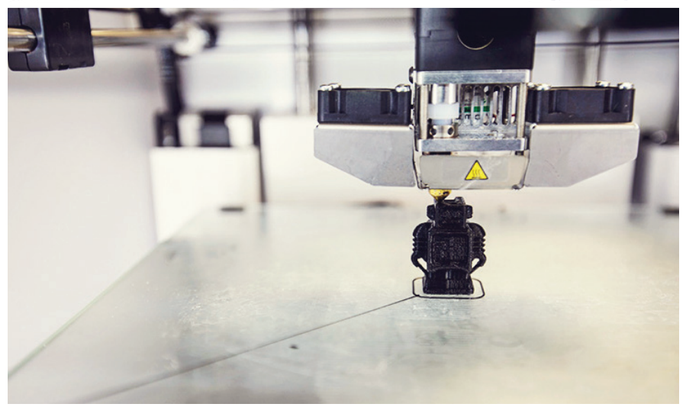
Dr. Brian Knarr
Core Facility Director

Mr. Travis Vanderheyden
Research Development Engineer

Those interested in utilizing the Machining and Prototyping Core Facility are encouraged to email

bmchmpcore@unomaha.edu





MACHINE SHOP

The 500 square foot Machine Shop is equipped with both traditional and advanced machinery that allows for the construction and fabrication in woods, metals, plastics, and unique composite materials. Equipment in this space includes a wide assortment of hand tools, a traditional knee mill, metal lathe, 3-Axis CNC milling machine, vertical band saw, table saw, compound miter saw, drill press, belt/disc sander, bench grinder, laser cutter, and a high-resolution 3D scanner. In addition to the tooling, several design workstations running the Autodesk Suite, Adobe Creative Cloud, and Solidworks are used by staff and student engineering technicians. The machine shop and adjacent washroom (8 feet by 15 feet) were also designed for typical prosthetics casting with a plaster modification area with grated, recessed flooring, and an oversized fume hood for carbon fiber lamination.

ELECTRONICS WORKSHOP

The Electronics Prototyping Workshop boasts a well-maintained inventory of prototyping supplies that allow for a drastic reduction in lead time for projects requiring complex electrical system components that include Arduino, Raspberry Pi, and embedded systems. This 200 square foot workshop contains an electrostatic dissipative workstation equipped with an Oscilloscope, Digital Power Supply, Soldering Station, Reflow Oven, Dedicated Programming Workstation, and a CNC PCB Milling Machine.

3D PRINTING LABORATORY

The 3D printing Laboratory is a 300 square foot room equipped with an industrial PolyJet 3D printer, two semi-industrial 3D printers, a stereolithography liquid resin printer, eight desktop 3D printers, four high resolution dual extrusion printers, a large format printing workbench, one selective laser sintering printer, and a new direct metal laser sintering machine that adds aluminum, titanium, and stainless steel alloys to our wide range of material options.

$442,693

amount awarded

MAIN GOAL OF STUDY

Understand scientifically and quantifiably how post-stroke individuals are using assistive devices to help them walk.

STUDENT RESEARCH TEAM

LED BY DR. BRIAN KNARR

Sheridan Parker

Tyler Hamer

Russell Buffum

Abderrahman (Alex) Ouattas

Namwoong Kim

Pictured top left, listed left to right, Dr. Knarr in center

CO-INVESTIGATORS

Samuel Bierner, M.D.
Professor and Chair, UNMC Department of Physical Medicine and Rehabilitation

Kendra Schmid, Ph.D
UNMC Campus Director of Assessment; Assistant Dean, Graduate Studies

Dacy Reisman, PT, Ph.D.
Academic Director of Neurologic & Older Adult Clinic; Professor and Associate Chair, Department of Physical Therapy, University of Delaware

DR. KNARR'S R15

BIOMECHANICS PROFESSOR RECEIVES NEARLY $500K NIH GRANT TO STUDY ROLE OF ASSISTIVE DEVICES IN STROKE RECOVERY

Written by Mimi Boswell, Communications Specialist, College of Education

Assistant Professor of Biomechanics Dr. Brian Knarr was recently awarded a competitive National Institutes of Health (NIH) R15 research grant for $442,693.

An R15 grant, also known as an Academic Research Enhancement Award (AREA), supports small-scale research projects proposed by faculty members to expose undergraduate and/or graduate students to meritorious research projects, and strengthens the research environment of the applicant institution, according to the NIH website.

Over the next three years, Dr. Knarr and his research team will study the role of assistive devices during stroke recovery.

"The main goal of our study is to understand scientifically and quantifiably how post-stroke individuals are using assistive devices to help them walk," explains Dr. Knarr. "For example, if they are using a cane and it seems to be helping them walk, why is it helping and what are the underlying components of biomechanics at work? We hope to determine how individuals are using different tools to change their biomechanics and help them walk post-stroke."

For the study, a research cane and a specially-designed set of treadmill handrails will serve as the core measuring devices. The research cane is an everyday walking cane retrofit with load cell instrumentation to measure the amount of load, or force, on the device. When research participants use the cane or handrails during the data collection stage, the devices will send information to motion capture software. Dr. Knarr and his team will then use this data to build descriptive computer models of each person's movement.

"Computer models will give us the ability to better describe how individuals are using the devices. We want to use that information to advise clinicians on how to train post-stroke survivors to best use their assistive devices to enhance rehabilitation outcomes," explains Dr. Knarr.

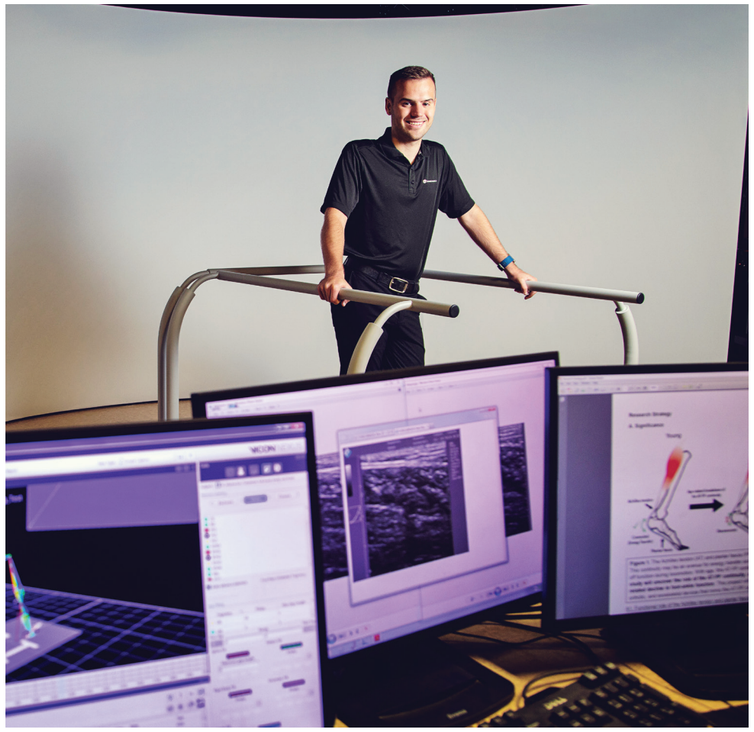
> **"We hope this study will inform more effective rehabilitation techniques. Currently, stroke survivors' recovery experience often includes rehab on a treadmill with handrails used for balance and support. Because the use of handrails hasn't been well-measured, clinicians are guessing on how to use them best."**

The research will formally begin with data collections in January 2019. Co-Investigators involved with the grant include:

- Samuel Bierner, M.D., Professor and Chair, UNMC Department of Physical Medicine and Rehabilitation
- Kendra Schmid, Ph.D., UNMC Campus Director of Assessment; Assistant Dean, Graduate Studies
- Darcy Reisman, PT, Ph.D., Academic Director of Neurologic & Older Adult Clinic; Professor and Associate Chair, Department of Physical Therapy, University of Delaware

Dr. Nick Stergiou, founding chair of UNO's Department of Biomechanics, explains why this type of federal funding is significant to the department and its researchers, many of whom are early in their careers,

> **"Receiving this award is a wonderful achievement for Dr. Knarr who is only in his second year as an assistant professor. It highlights the quality of talent we attract to our team. On a department and institution level, it demonstrates how effectively UNO's Center for Research in Human Movement Variability (MOVCENTR) can foster the development of our young scientists."**



> “WHAT WE’RE GOING TO BE DOING IS USING ULTRASOUND TO ACTUALLY LOOK AT THE CONNECTION BETWEEN THE ACHILLES TENDON AND THE PLANTAR FASCIA

BIOMECHANICS STUDENT
RECEIVES F31 GRANT

Written by Nolan Searl, University Communications

A UNO student is hoping to provide researchers with some critical information about what exactly happens to the muscles and connective tissue in our ankles and feet as we age.

Jeff Patterson, a doctoral candidate in UNO’s Department of Biomechanics, received an F31 grant from the National Institute of Health (NIH) that will allow him to look at human ankles in a unique way.

“What we’re going to be doing is using ultrasound to actually look at the connection between the Achilles tendon and the plantar fascia,” Patterson said. “The idea is that as you get older that connection gets worse.”

Patterson will look at real time footage of the gastrocnemius, the calf muscle, and the Achilles tendon as patients walk on various levels of incline. He hopes to look at the data from 72 healthy and physically fit patients aged 19 to 79.

Using ultrasound in this capacity is a new and developing technique in the field of biomechanics, Patterson says. Ultimately, the study will paint a clearer picture of what is happening when we walk and how that changes over time.

“(As you age), you’re not able to translate as much of the force that you have in your calf muscles down into your foot,” Patterson said.

Older adults have issues generating propulsive power at their ankle and into their foot, which leads to less toe clearance and walking speed. Less toe clearance can lead to trips and falls, and slower walking speed can lead to a less active lifestyle.

“If we can identify this as a problem, future research could target that as an intervention to prevent degradation, or exoskeletons could be developed,” Patterson added.

NSF BODY MODELS

Pictured: The first cohort of teachers and students participated in the biomechanics summer professional development workshop in Summer 2018.

In collaboration with the Department of Teacher Education, UNO Biomechanics was awarded a National Science Foundation Innovative Technology Experiences for Students and Teachers grant totaling $1.2 million over three years.

This grant, titled BODYMODELS (Biomechanics to Offer Diverse Young Minds Opportunities to Develop, Explore, and Learn STEM), works with local third to sixth grade teachers to develop biomechanics centered activities to utilize in their classrooms.

Biomechanics as a discipline is adaptable to all STEM (science, technology, engineering, and mathematics) making it an ideal pathway to teach STEM in a variety of different classrooms. Additionally, giving the opportunity for students to use their body for these different experiments can lead to more engaged and sustained learning. This project is lead by Dr. Neal Grandgenett (TED) in collaboration with doctors Amelia Lanier, Kota Takahashi, Michelle Friend, and Anne Karabon.

Over the next three years this team will develop a number of activities. Each year a cohort of 20 teachers will participate in a summer professional development workshop that explores biomechanics content, technology available to teachers, career opportunities connected to biomechanics and STEM, and a student academy where teachers can practice their lessons. This cohort will work with the research team throughout the school year to refine their work to be implemented in their classrooms.

This project is currently ongoing and will continue into Summer 2020. It has led to a number of community collaborations including Omaha’s Henry Doorly Zoo and Aquarium, the Omaha STEM Ecosystem, and the Omaha Children’s Museum. Through this work, UNO Biomechanics is connecting directly with Omaha area students and teachers to show them how exciting and fun biomechanics can be.

UPDATES FROM THE

CENTER FOR RESEARCH IN HUMAN MOVEMENT AND VARIABILITY

PHASE II SUBMISSION

The Centers of Biomedical Research Excellence (COBRE) Phase II application was submitted in September 2018. This application brings together four new variability projects while continuing research in variability and motor disorders. Doctors Jorge Zuniga, Nate Hunt, Philippe Malcolm, and Vivien Marmelat have all put together research project applications. The applications will continue to fund pilot projects, expanding the research capabilities of the MOVCENTR. The Phase II application would provide another five years of research funding for approximately $10 million.

The Phase II application will also include core facilities. The core facilities will be the first of their kind with a fee for service structure at UNO. Three core facilities were proposed: The Machining and Prototyping (MAPRO), the Movement Analysis Core (MOVAN), and the Nonlinear Analysis Core (NONAN).

The MAPRO core involves the use of three major facilities within the UNO BRB: The Machine Shop, Electronics Workshop, and the 3D Printing Laboratory. The most basic function of the Core is to provide services that utilize these spaces and their personnel and equipment. This core can design, prototype, manufacture and repair, maintain, or install a wide range of devices and instrumentation.

The MOVAN core will enable our investigators to measure behavioral function and movement analysis in order to use human movement variability research to treat and prevent motor related disorders. This will help centralize measurement and training for clinically based research. The NONAN core will use nonlinear analysis to examine data and build a leading resource for UNO, the state of Nebraska and the Great Plains IDEA-CTR network.

THIRD ANNUAL CONFERENCE IN HUMAN MOVEMENT VARIABILITY

The Third Annual Conference in Human Movement Variability took place at the Scott Conference Center on May 17, 2018.

Dr. Jeffrey Hausdorff, the Director for the Center for the Study of Movement, Cognition, and Mobility at Tel Aviv Sourasky Medical Center in Israel was the Barry T. Bates keynote speaker. Dr. Karl Newell from the University of Georgia was the Honorary Barry T. Bates keynote speaker. The two were joined by guest speakers, Dr. Janet Dufek from the University of Nevada, Las Vegas, Dr. Evangelos Christou from the University of Florida and Dr. Jesse Dean from the Medical University of South Carolina.

Graduate student, Mr. James Pierce received an award for outstanding oral presentation. Outstanding poster presentations went to graduate student, Ms. Jenny Kent, first place, undergraduate student, Mr. Anthony Arellano, second place and graduate student, Mrs. Jordan Wickstrom, third place.

Pictured: Dr. Nick Stergiou with the 2018 Barry T. Bates Keynote Speaker, Dr. Jeffrey Hausdorff

NEW PILOT AWARDEES

AARON LIKENS, PH.D.

Dr. Aaron Likens comes to us from Arizona State University where he completed Ph.D. and postdoctoral work. He was awarded a pilot project to investigate the role that known principles of visual perception play in rhythmic forms of motor coordination.

LUIS SILVA, PH.D

Dr. Luis Silva came to us from the University of Lisboa, Portugal where he completed his Ph.D. Before coming to UNO, he collaborated with the Laboratory of Motor Behavior in the College of Human Movement at the University of Lisbon. He was awarded a pilot project to investigate how external visual cueing can be used for gait rehabilitation in older adults.

JUNIOR INVESTIGATORS UPDATE

MENTORING RESEARCH PROJECTS UPDATES

FOOT BIOMECHANICS AND THERMOREGULATION IN PERIPHERAL ARTERY DISEASE AND DIABETES

DR. KOTA TAKAHASHI

Protecting the health of our feet is important for maintaining our quality of life and independence. Considering that we spend all day on our feet, whether it's standing, walking, or running, it is not surprising that the tissue surrounding the foot is prone to damage and infection. In individuals with abnormal physiology, such as diabetes and peripheral artery disease, tissue breakdown in the feet could lead to an ulcer formation. When left untreated these foot ulcers can often result in an amputation that would significantly affect mobility and activities of daily living.

Our research team is currently conducting ongoing studies to identify risk factors for foot ulcer formation in persons with diabetes and peripheral artery disease. We are combining various in-vivo analyses to examine foot tissue health, including biomechanics-based analysis of the foot joints/segments, as well as a thermography-based analysis of tissue surrounding the foot.

In particular, we are testing a theory that abnormal biomechanics can lead to excessive heat production in the foot, and this impaired temperature regulation could compromise tissue health. We envision that our research could inform early diagnosis of ulcer formation in diabetes and peripheral artery disease.

Pictured: Dr. Takahashi's research team

Pictured: Dr. Mukherjee and his research team

UPDATE ON THE RESEARCH PROJECT IN THE VIRTUAL REALITY LABORATORIES

DR. MUKUL MUKHERJEE

The overall goal of this research proposal is to investigate the impact of visual perception of self-motion during motor adaptation to a novel locomotor task in stroke survivors and healthy age-matched controls. In general terms, visual feedback through virtual reality is hypothesized to improve locomotor adaptation in stroke survivors. First, in the presence of information from multiple senses, visual input is given precedence. Second, augmented visual inputs during training can help to remove sensory conflicts that commonly exist during gait rehabilitation.

With the support of our collaborator, Dr. Pierre Fayad in the Department of Neurological Sciences at UNMC, we have completed several studies. Our next line of projects have received funding from the American Heart Association (AHA). I have received the AHA AIREA award for studying perceptual abilities in stroke survivors and our doctoral student, Mr. Zach Motz, has received an AHA fellowship to study inter-limb coordination in stroke survivors. Mr. Takashi Sado, master's student, received a GRACA award to investigate how exoskeletal devices could enhance gait adaptation.

All of these projects are investigating the importance of variability as a sensitive biomarker for balance control and physical activity. Data from the research project has resulted in several spin-off projects that have received grants (NASA award for developing modular robotic devices), start new projects, and enhance collaboration (e.g., University of Michigan, UNMC, UNL and NASA).

CLINICAL CHARACTERIZATION OF MOVEMENT VARIABILITY IN TOTAL KNEE ARTHROPLASTY

DR. BRIAN KNARR

Over 700,000 people undergo total knee arthroplasty (TKA) surgery, more commonly referred to as a knee replacement, every year. While many people report an improved quality of life and less pain after having a knee replacement, current rehabilitation and prevention strategies do not effectively prevent long-term functional deficits in individual's post-TKA. Dr. Knarr and his team, along with his clinical collaborator, Dr. Kent Boese from Miller Orthopedics Specialists, and others around Omaha, use a combination of biomechanics, engineering, and clinical measurements to help understand walking ability and outcomes after a knee replacement.

Our research is focused on the use of wireless sensors to understand how movement in the real world differs from movement in a clinic or laboratory. To do this, we use a combination of clinical measurements and engineering to collect biomechanics data in Elmwood Park, directly across the street from the BRB. In particular, we are interested in examining how a person's movement may change when exposed to real world surfaces such as a bumpy sidewalk or grass.

We believe that traditional clinical assessments are missing key information about an individual's ability to walk by not including the daily challenges that are experienced when walking in the real world. Our study aims to establish relationships between non-linear analyses and clinical measures in individuals undergoing TKA. It is also the first to evaluate gait performance and variability in real-world environments. Our team is working with collaborators in Computer Science at UNO to develop a method for obtaining a longer-term, community evaluation of recovery following TKA. By understanding how the real world differs from a rehabilitation clinic, we hope to help clinicians and physical therapists design new ways of improving recovery after surgery.

Dr. Knarr's research team

Dr. Yentes' research team

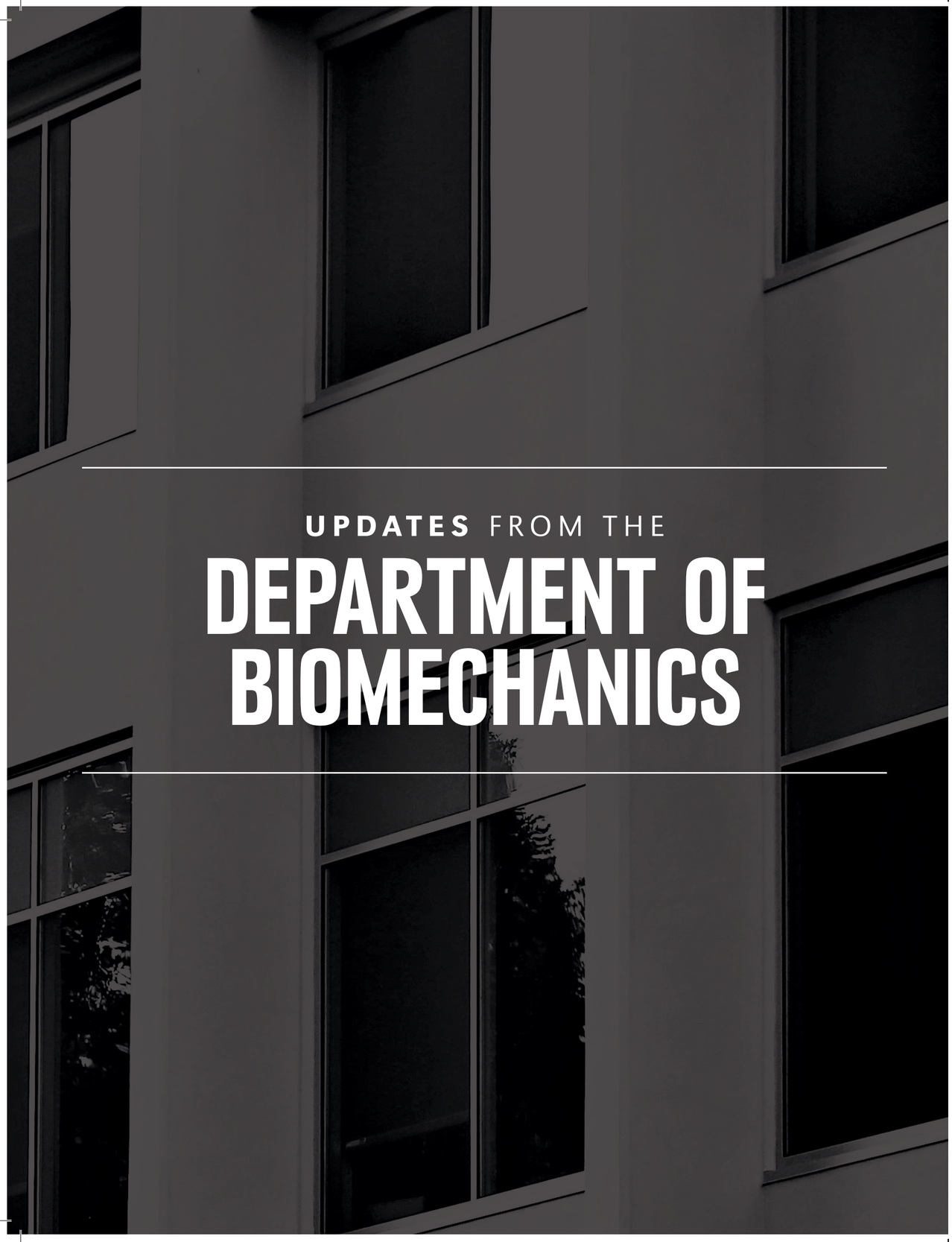
BREATHING AND WALKING COUPLING VARIABILITY IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

DR. JENNA YENTES

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death in the U.S. and is a disease of the entire human body, not just the lungs. Roughly 15 million people in the U.S. have been diagnosed with COPD and a similar number of people are thought to be undiagnosed. Previously, our work has shown that those with COPD have a slightly different walking pattern and that their balance starts to deteriorate at a much earlier age. Our recent work has started to expand this work into other pulmonary disorders such as asthma.

Early diagnosis of an individual at risk will have immediate clinical impact by allowing for early intervention and potentially preventing hospitalization and disability that would increase healthcare costs. We have created a patent-pending device that may be able to objectively detect the onset of an exacerbation. This device was used in a multi-site trial and an updated prototype was developed, all within the past year. Further, we have begun a new collaboration to expand the user interface with a faculty member from the College of Information Science & Technology (IS&T).

We have also been working on the investigation of how breathing and walking couple with each other. Our preliminary data has shown that patients with COPD demonstrate more rigid and less variable coupling than healthy controls due to abnormal breathing rhythms. We have tried to replicate these findings in healthy young adults while breathing through a tube that restricts their ability to exhale. We are continuing to gather more information on the coupling between breathing and walking by performing research with individuals with COPD and aged-matched controls. Through the combination of the team's hard work and assistance from participants and collaborators we are working towards improving the quality of life in those with COPD and other pulmonary diseases.



UPDATES FROM THE

DEPARTMENT OF BIOMECHANICS

Pictured: Dr. Stergiou (center) receiving the Innovator of the Year Award for the Department of Biomechanics

UNeMed, UNO & BIOMECHAINCS

Joe Runge, M.S., J.D.

At the end of 2017, UNeMed officially became the technology transfer office for UNO and the Department of Biomechanics. What had become an ongoing collaboration over the last decade was formalized under an established contract. Although the day to day operation of the reporting, protecting, and commercializing biomechaincs' inventions seemed the same as it ever had been, the relationship was dramatically different.

Foremost, UNeMed can now patent UNO inventions more easily. Instead of a process that involved authorization from departmental and administrative levels, UNeMed can file patent protection for UNO inventions based on the advice of its internal review.

Second, it allows the dedication of more time to UNO inventions—including Biomechaincs. As the campuses grow closer, UNeMed can help facilitate commercial and even academic collaborations that involve Biomechaincs.

Finally, the collaboration has opened a wellspring of innovation from UNO. In 2018, UNO submitted 27 new invention notifications. Biomechanics made up the bulk of those inventions and shows how working together as one university UNeMed, UNO, and Biomechanics can help propel innovation and commercial opportunity in Omaha and throughout the world.

BIOMECHANICS IN ACTION: QLI

A COLLABORATION BETWEEN THE DIVISION OF BIOMECHANICS AND RESEARCH DEVELOPMENT AND NONPROFIT QUALITY LIVING, INC. (QLI)

QLI is a post-hospital center for brain and spinal cord injury rehabilitation. This collaboration has led to three initiatives which are benefitting individuals recovering from traumatic injuries and strokes.

Written by Mimi Boswell, Communications Specialist, College of Education

QLI resident Boston Bieler (left) with Coordinator of PT/OT Services and Physical Therapist Brad Dexter. During his rehab, Bieler benefited from a QLI-prototyped, Biomechanics-revised mobile arm support device. Photo credit: Jon Pearson, QLI.

"I've always been a fighter, and I'm still a fighter, I'm fighting to get back all I can," explains QLI resident Boston Bieler.

Bieler, who suffered a severe spinal cord injury from a gunshot wound in March, has been able to regain greater use of his arms with help from an assistive device—a QLI prototype—that was redesigned and improved upon in the Biomechanics Research Building (BRB).

"When I first got to QLI, I was completely paralyzed. The mobile arm support helped me strengthen my arms. It's kind of like a crane—it held my arm up in a sling so I wasn't fighting gravity. I could move left or right, side-to-side depending on the tightness. I could lift my arm up and push down. As I got stronger, I found different ways to angle it to work my arms. Now, I no longer have to use the mobile arm support. It has allowed me to be more independent. Without it, I'd need someone to go with me everywhere."

200+

devices and accessories have been developed in the BRB Machining and Prototyping Core Facility over the past year

Machining and Prototyping Core Facility is the first service center on UNO's campus

Biomechanics received a $10.1 million COBRE Phase I grant

coe.unomaha.edu/cobre

CUSTOM DEVICES AND ACCESSORIES

Bieler's mobile arm support is one of over 200 devices and accessories that have been developed—with QLI's involvement—in the BRB's Machining and Prototyping Core Facility over the last year. Through this initiative, assistive devices and accessories are custom designed and fabricated in the BRB's machine shop based on the unique needs of QLI's residents, therapists, and clinicians. Broken components are also replaced and new tools are designed and created to enable more effective treatment. QLI pays UNO for these services.

The Machining and Prototyping Core Facility, run by Assistant Professor and Core Director, Dr. Brian Knarr, and machinist, Travis Vanderheyden, with support from UNO student workers, is the first service center on the UNO campus. A service center is an area that charges for services to support internal or external research objectives.

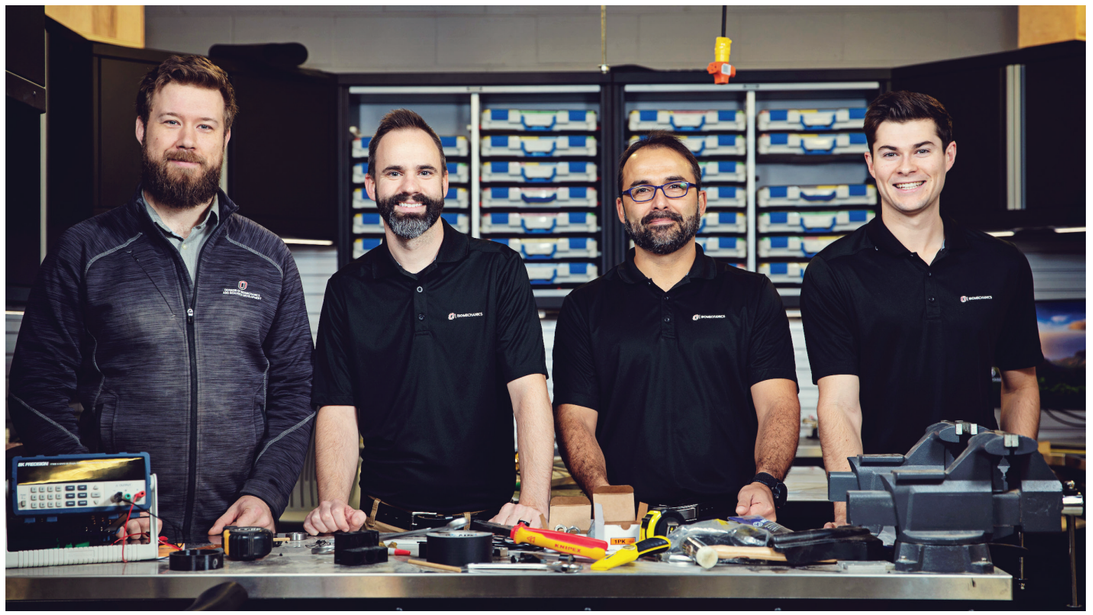
Establishment of this service center was a component of the recent submission for the National Institutes of Health's (NIH) Centers of Biomedical Research Excellence (COBRE) Phase II grant funding. Additional support for the service center has been provided by the Nebraska Research Initiative.

Read more about the Biomechanics $10.1 million NIH COBRE Phase I grant funding and the Center of Research in Human Movement Variability (MOVCENTR) at **coe.unomaha.edu/cobre**.

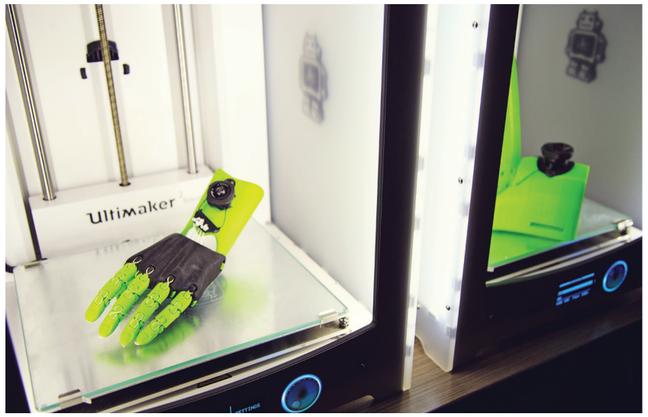
Robust collaborations with regional research communities—like the partnership with QLI—will help the Core achieve its goal of independent financial sustainability.

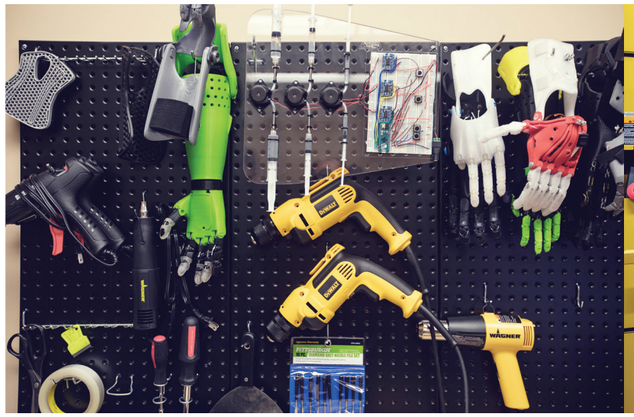
"Our hope is that the Machining and Prototyping Core Facility is a resource for UNO and the community through our development of new and innovative devices to treat and prevent movement related disorders," according to Dr. Knarr

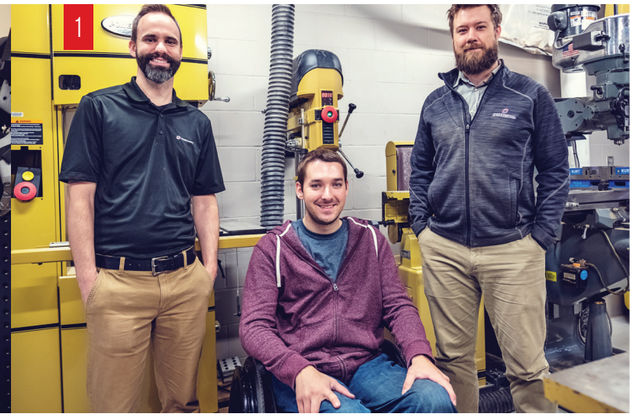
The QLI-prototyped, Biomechanics-revised mobile arm support device being assembled by Todd Schmitz, QLI's Adaptive Repair Technician. Photo credit: Jon Pearson, QLI. The QLI-prototyped, Biomechanics-revised mobile arm support device being assembled by Todd Schmitz, QLI's Adaptive Repair Technician. Photo credit: Jon Pearson, QLI.



In the machine shop | Machinist Travis Vanderheyden, Assistant Professor of Biomechanics and Machining and Prototyping Core Director Dr. Brian Knarr, Assistant Professor of Biomechanics Dr. Jorge Zuniga, and Graduate Assistant Drew Dudley are part of the interdisciplinary UNO team working closely with nonprofit rehab facility QLI and their residents.







UPPER ARM STROKE REHABILITATION RESEARCH

The partnership between the Biomechanics team and QLI began in 2016 when a donor with an interest in stroke recovery reached out to Dr. Knarr and connected him with QLI. Dr. Knarr used his background in stroke rehabilitation research to assemble a team of specialists who began work on their very first initiative: an affordable and accessible upper arm stroke rehabilitation tool.

The interdisciplinary team, guided by Dr. Knarr, is developing this rehabilitation tool with input from the occupational therapists (OT) at QLI. Efforts to expand the collaboration to clinicians at CHI Health Immanuel Rehabilitation Institute and Madonna Rehabilitation Hospitals are underway. The tool consists of two components: an exoskeleton hand utilizing 3D-printed prostheses technology from Assistant Professor Dr. Jorge Zuniga and collaborator Jean Peck, OT at CHI Health, and a virtual reality (VR) system developed by Assistant Professor Dr. Brian Ricks' team in UNO's Department of Computer Science.

Dr. Knarr explains, "In the BRB, we are designing a 3D printed exoskeleton to help stroke patients extend their affected hand. Many exoskeletons can be difficult to acquire or are unable to leave the lab they were built in. This exoskeleton is inexpensive, custom made for each patient, and is easily accessible as it is 3D printed in the BRB. The exoskeleton uses elastics to extend the patient's hand and has dials to tighten or loosen the tension."

"The goal is that this exoskeleton will help the patient use their affected hand in their own environment to grasp objects and improve mobility of their affected hand over time.

For the VR system, Dr. Ricks' team has designed several games for stroke patients, translating the rehabilitation experience into a virtual world. These exciting virtual settings mimic real-world situations and provide variation of traditional rehab methods. Benefits of gaming-style VR environments for stroke recovery patients include positive feedback of performance and assessment allowing for real-time adjustment, and a reward system which increases engagement and motivation.

Eventually, the two components will work together, allowing for a totally customized experience for stroke recovery patients. According to Dr. Knarr, "This is a system to be used by clients and therapists. During the research development phase, it's important to have a dialogue with our end users so we don't develop in a bubble. We have clients using prototypes of our exoskeleton hand and VR environment in both academic and therapy settings, and we are improving our designs based on the clinical feedback. Once we systematically understand all the components, we will put all the pieces together to get a better rehab tool in the hands of clinicians and their patients."

VOCATIONAL REHABILITATION TRAINING

Coordinator of PT/OT Services and Physical Therapist, Brad Dexter, is one of the Biomechanics team's main partners at QLI. As Dexter became aware of the tremendous resources and expertise in the BRB, he suggested another initiative to help engage QLI residents with backgrounds in engineering and manufacturing: vocational rehabilitation training.

The BRB has welcomed five QLI residents over the past year who supplemented their traditional therapy with vocational rehab training. Participants visited 2-3 times a week, accompanied by a therapist, and their tasks included guided work with Vanderheyden in the machine shop on computer aided design (CAD), microcontroller programming, electrical circuit design, and physical fabrication.

"Through this initiative, the Machining and Prototyping Core provides an environment for QLI residents who have industrial or engineering backgrounds. These individuals gained new experience and honed existing skills to help them acclimate back into the workforce after their injury," explains Dr. Knarr.

A few weeks into his 4-month residency at QLI for a spinal cord injury, Shane Hultine started vocational rehab therapy at the BRB. His therapist knew of Hultine's industrial engineering degree and suggested CAD training to supplement traditional rehab.

"It was a place where I could apply my skills in a work-like setting. It was a more authentic experience than physical therapy, and my first 'real life' activity outside of physical rehabilitation," says Hultine.

"Previously, I was an assistant manager at a production plant, and I had a maintenance role. I'd crawl into the machine and troubleshoot it, but I'm not able to do that now. Now I'm on the design end."

After graduating from QLI in late 2017, Hultine moved back to Illinois, but has since returned to Omaha. He plans to look for a job in the CAD field but wants to gain more experience first. In early Oct., he returned to the BRB as a volunteer. "It will keep me up on the different software and methods for rapid prototyping."

After suffering a traumatic brain injury from an industrial accident, Jeff McEvoy spent five months at QLI, and is currently in outpatient treatment. He is also back to work part-time at his employer for over 20 years, a bearing factory in Atlantic, Iowa. Like Hultine, he has an engineering degree and came to the BRB for vocational rehab training a few weeks into his rehab at QLI.

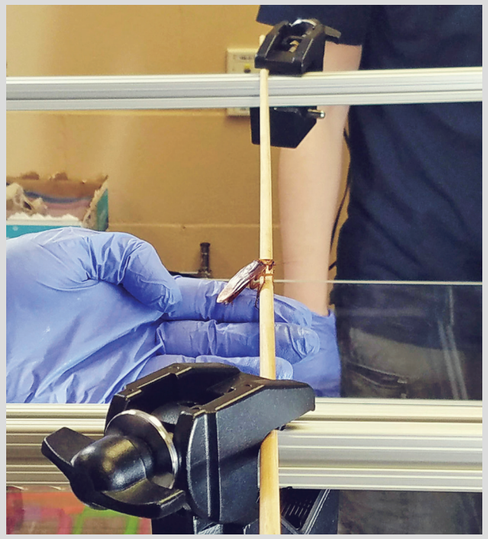
"It really helped me to get back to work," says McEvoy, who builds tools and machine parts with a computer-controlled mill and lathe and makes repairs to the factory production line. "After the accident, my recall was difficult—designing a part, the names of things. Vocational rehab at the BRB helped bring that back.

"I loved the UNO part of my therapy. The technology at the BRB was amazing, and I was impressed with their engineering projects. Travis was really easy to talk to and work with—he did whatever it took for me to understand. And I did whatever I could to stick around!"

Dexter is enthusiastic about the partnership and looks forward to what the future holds, "Travis and Brian have been great partners to QLI over the last several years. We appreciate their enthusiasm, creativity, and willingness to jump in to help find a solution to everyday problems that exist in our world of rehabilitation. Thanks to our collaborative relationship the devices that we've been able to produce with the help of UNO's Biomechanics research team have enabled the individuals we serve to access their environment more independently, have given them a new sense of freedom, or, in some cases, have provided them additional safety. We're looking forward to continuing to work with UNO's Department of Biomechanics to help make some of our ideas reality!"

1) Vocational Rehab Training participant Shane Hultine (center) with Dr. Brian Knarr (left) and Travis Vanderheyden (right). Photo credit: Jon Pearson, QLI.

WHAT'S NEW IN THE BRB?



A cockroach in the lab arena during an experiment.

NEW LABORATORIES

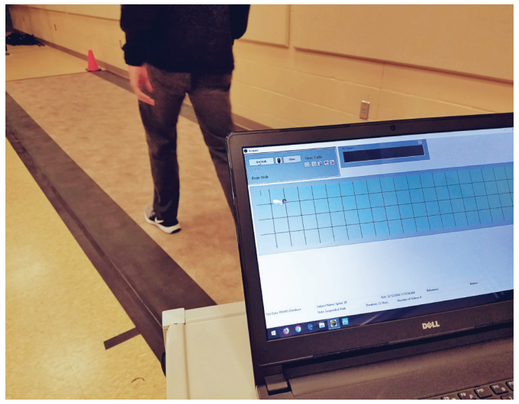
INSECT LAB

The Insect Lab is a recent conversion of the Acoustics Lab into a space for research on insects and robotics. This work is primarily headed by Dr. Nate Hunt and his research team. The lab has specialized containers for cockroaches. These insects have relatively simple nervous systems, however, their movements are very stable, whether it's running across a branch, the floor or avoiding getting squashed. Because of this they have become a popular subject for bio-inspired designs and robotics. The research team has also built an arena to contain the insects during experiments. While traversing simulated branches, their movement is recorded hundreds of times per second with three HD digital video cameras. The lab also includes a powerful computer dedicated towards processing these images. The Insect Lab is also a space where Dr. Hunt's students work on other bio-inspired robots and shoe designs.

NEW EQUIPMENT

ZENO WALKWAY

This 20 foot instrumented walkway allows the measurement of spatiotemporal measures from uninstrumented subjects. It samples 46,080 1.6 in 2 sensors up to 120 Hz. Because the subjects do not need to wear any sensors, it can greatly reduce experiment time for those calculating measures such as step lengths and stride times. It will be primarily used by Dr. Carolin Curtze in Parkinson's research.



PROCESSING COMPUTER

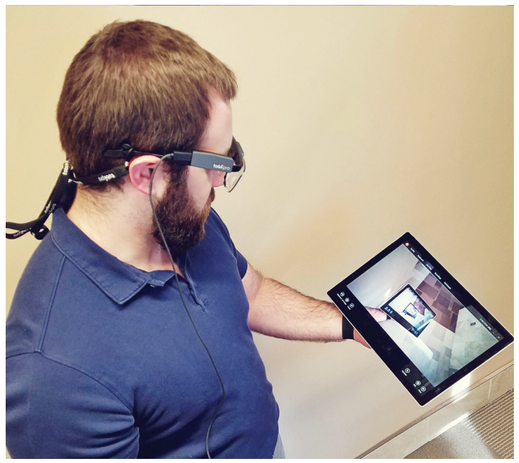
For processing high speed digital images the BRB has acquired a high performance computer. It includes an Intel i9 processor, 128 GB of RAM, 3 GeForce GTX 1070 8GB graphics cards and 7 TB of hard drive space. The images it will process will be mostly from Dr. Nate Hunt's research into cockroach, squirrel, and human motion capture.

APDM

The APDM is a markerless motion capture suit that uses IMU technology strapped across the sternum, wrists, ankles, and waist. The portable design allows researchers to perform up to 720 hours of research outside the BRB. It will be primarily used by Dr. Carolin Curtze in Parkinson's research.

TOBII

This head-mounted eyetracker records gaze and the field of view by the wearer at 100 Hz. It can be used both inside and outside the BRB, and will be especially useful with our GRAIL and CAREN virtual reality systems. With these systems especially, the interaction of the subject with the virtual environment is important. This equipment will be used across a number of labs and research teams.



PURSUING A B.S. IN BIOMECHANICS

DECIDING TO PURSUE MY DEGREE IN BIOMECHANICS HAS CHALLENGED ME AND FORCED ME OUT OF MY COMFORT ZONE.

As cliché as it sounds, I did not choose biomechanics, but rather biomechanics chose me. As a third-year transfer student, I wanted to pursue my interests in human anatomy and athletic performance in the exercise science program. Instead, I enrolled in the Biomechanics program for the sole reason of graduating early, but my experience in the biomechanics degree program has provided me with so much more than a diploma.

Deciding to pursue my degree in biomechanics has challenged me and forced me out of my comfort zone. Because of my network within the biomechanics department at UNO, I was able to engage in an undergraduate research assistant role at UNMC.

I currently work with Dr. Elizabeth Wellsandt in the Clinical Movement Analysis Laboratory (CMOVA) at UNMC studying movement patterns of ACL-injured human subjects. The combination of my lab experience and courses at UNO have created the perfect storm for me to delve into my interests with a scientific state of mind. Choosing to participate in research as an undergraduate has been an invaluable supplement to my education; it allows the application of concepts and use of equipment discussed in classes in a hands-on and educational setting.

After graduating with my Bachelor of Science in Biomechanics, I plan to pursue my Doctor of Physical Therapy degree as well as a Ph.D. in Patient-Oriented Research with a concentration in biomechanics. Without making the connections and building my network in the biomechanics department, I would be unaware of all the opportunities and modes of education available to me. I began the program with little knowledge of the field, but I will graduate in May 2019 with a passion for biomechanics research.

ALYX FLIPPIN
UNDERGRADUATE STUDENT, BIOMECHANICS

WHY CHOOSE BIOMECHANICS?

THE BIOMECHANICS RESEARCH BUILDING IS MORE THAN JUST A RESEARCH LAB, IT IS A COMMUNITY OF SCIENTISTS, STUDENTS, AND RESEARCHERS CONSTANTLY ANSWERING THE HARD QUESTIONS OF HOW, WHY, AND WHAT CAN WE DO.

When I started my undergraduate career in biomedical engineering at the University of Delaware I knew that I wanted to help people, but wasn't sure what that would look like. It wasn't until two years later that I discovered biomechanics as a field and suddenly everything I had studied in engineering and what I wanted to do became clear.

I dove straight into biomechanics research fascinated by the cutting-edge and novel concepts and processes. I assisted in many different projects as an undergraduate, including studying the healing mechanics of Achilles tendon rupture, determining the appropriate electromyography normalization needed for an injured population, and developing an instrumental walking boot. I developed a passion to understand and apply engineering concepts to biomechanics in order to improve people's lives. When it came time to graduate, I wanted to continue learning and working in the field of biomechanics and I found the UNO BRB.

When I toured the BRB I was impressed and motived by the wide breadth of research happening. The way cutting-edge technology and concepts are applied to innovative research was so inspiring I quickly accepted the opportunity to work at the BRB.

My goal is to do research that explores the intersection between rehabilitative research and engineering for the purpose of improving rehabilitative protocols and devices. I was given the incredible opportunity to work on a project with Dr. Knarr where we developed a wireless system to predict falls in the elderly. Dr. Knarr has mentored me and helped me gain the skills necessary to receive an internal grant and become a principle investigator of my own project.

The BRB is an amazing place with such high caliber faculty, staff, and students working on projects that tackle the hard to answer questions of biomechanical research. I chose the BRB because of the multiple opportunities the building has to offer to give back to the community. The BRB is more than just a research lab, it is a community of scientists, students, and researchers constantly answering the hard questions of how, why, and what can we do to help improve biomechanical research.

SHERIDAN PARKER
GRADUATE STUDENT, BIOMECHANICS

WHERE ARE THEY NOW?

ALEK DIFFENDAFFER, M.S.
SPORTS BIOMECHANIST, AMERICAN SPORTS MEDICINE INSTITUTE

Currently, I am the Sports Biomechanist at the American Sports Medicine Institute (ASMI) in Birmingham, Alabama. ASMI is a 501(c)(3) not-for-profit sports medicine research and education foundation started in 1987 by world renowned orthopaedic surgeon Dr. James R. Andrews. The mission of ASMI is to improve the understanding, prevention, and treatment of sports-related injuries through research and education. My career goal has always been to work with athletes in some facet. At ASMI I get the opportunity to tie together athletic performance and biomechanical research, which gives me the best of both worlds. Reaching this career goal was due largely to the education, guidance, and training I received during my time at the BRB.

After graduating from Hastings College with my bachelor's degree, I had two options: continue my education or enter the work force. I read some of the research being done by Dr. Stergiou and others at the BRB and became interested in seeing if this would be a good fit for graduate school.

After getting accepted, and prior to starting, my wife and I visited and met with Dr. Stergiou to discuss school, courses, and the possibility of me working as a graduate assistant. It was then I knew what I was getting myself into as Dr. Stergiou looked at my wife and said, "Your husband will work harder than he ever has in his life... Are you sure you want him to do this?" Dr. Stergiou's statement that day was true, as I dove head first into my master's program as a part of the BRB. From early 7 A.M. mornings of Doctoral Seminar to late night data collections in the lab, I still to this day can say that I have never worked harder. The work ethic and drive that was ingrained in me through Dr. Stergiou and the "BRB Family" is a character trait that I will always be grateful for.

At ASMI we are a leading research center in sports biomechanics, with particular expertise in baseball. Our primary goal at ASMI is to reduce the number of injuries occurring across the world through our biomechanical and clinical research. In my time at ASMI I've had the opportunity to publish nearly ten peer-reviewed journal articles, one book chapter, and work on a multitude of projects which has helped me grow professionally as a scientist.

In addition to research, we also provide biomechanical evaluations for baseball pitchers of all levels (youth to professional). This portion of my job is very rewarding because I am able to provide feedback to reduce an individual's injury risk, improve their performance, and hopefully prolong their career. There is nothing more satisfying than seeing a pitcher improve overtime due to my biomechanical recommendations. My success in the world of biomechanics reminds me of where I began, under the direction of my mentors and advisors, Dr. Stergiou, Dr. Myers, and Dr. Yentes at the BRB.

NEW HIRES IN THE DEPARTMENT

Dr. Carolin Curtze, assistant professor in Biomechanics, joined the UNO and our center as a faculty member in Fall 2018. Originally from Germany, she earned her Ph.D. in Rehabilitation Medicine from the University of Groningen, The Netherlands, exploring the neuromechanics of movement in lower limb amputees. Carolin completed her postdoctoral fellowship in the Department of Neurology at Oregon Health & Science University, studying balance and gait impairments in people with Parkinson's disease. Her overall research goal is to improve everyday functional mobility and prevent falls by investigating the pathophysiology of motor impairments and objectively characterizing them with new technologies.

DID YOU KNOW?


2018-2019 Faculty and Staff photo

34
students enrolled in the B.S. in Biomechanics

36,400
downloads of the 236 papers currently listed in the UNO Digital Commons database

Jeff Kaipust, building coordinator, was promoted to Assistant Director

737
followers in 2017

791
followers as of December 2018

440
followers in 2017

653
followers as of December 2018

11 *faculty members*
19 *undergraduate research assistants*
11 *masters graduate assistants*
7 *staff members*
5 *postdoctoral research associates*
9 *doctoral graduate assistants*

BIOMECHANICS UNITED

is a student-led group created in August 2018. The group has organized a professional development seminar as well as social outings for Biomechanics students.

Facts are as of December 2018 unless otherwise noted

EXCITING EVENTS

GROUNDBREAKING DINNER

On May 21, 2018 we hosted a Groundbreaking Dinner to celebrate construction beginning on the BRB expansion. Attendees included univiersity administration and donors that contributed to the expansion. Interactive demonstrations were stationed in each of the labs for attendees to experience the technology involved in biomechanics research. Dinner was hosted in the Gait Lab and attendees were given a small shovel and 3D printed figurine that contained dirt from the groundbreaking to take home.

INNOVATION, DEVELOPMENT, AND ENGAGEMENT AWARD (IDEA)

On May 1, 2018, Dr. Nick Stergiou received the University of Nebraska Innovation, Development, and Engagement Award (IDEA) for his hard work and dedication to the field of biomechanics. Dr. Stergiou's goal is to have biomechanics and Nebraska synonymous, and thanks to his perseverance we are almost there. The IDEA honors members of the University of Nebraska faculty who have extended their academic expertise beyond the boundaries of the university in ways that have enriched the broader community.

EXPANSION

The BRB expansion is fully enclosed as of December 2018 and the project is on track for September 2019 completion. There have been many changes to the project as the department has been successful in acquiring new equipment and recruiting new faculty. Additional space has been added for a Metal 3D Printer lab, underwater treadmill lab, and cardiovascular biomechanics lab. These spaces, added to what was originally designed, help to make Omaha the destination for biomechanics.

BEYOND OUR BORDERS

CHILE

Our 3D printed prosthetic designs have restored function to more than 3,000 children from the U.S. and several other countries, including Chile, Argentina, Colombia, Brazil, Peru, Panama, Mexico, Canada, Singapore, Nepal, Egypt, and many others.

In 2014, the NIH 3D Print Exchange and the world's largest 3D printing community "Thingiverse," published files of our upper extremity prosthesis to make this design available to other medical and research institutions in the U.S. and worldwide. The files of this design have been downloaded by more than 60,000 people and modified and used by 19 different educational and medical institutions around the world. eNABLE, a worldwide non-profit organization, not only uses our prosthetic designs, but makes them available to people all around the world.

The nature of this project represents a shift in the current paradigm of how prosthetics and orthotics are designed, manufactured, and used. Currently, we provide technical support to U.S. academic institutions such as Children's Mercy Rehabilitation Hospital in Kansas City, Missouri; Regional West Medical Center in Scottsbluff, Nebraska; Children's Hospital in Omaha, Nebraska; and Chilean rehabilitation institutions such as Teleton (Santiago and Concepcion) and Hospital del Trabajador in Santiago, Chile.

Dr. Zuniga's scientific work in the development of low-cost 3D printed upper-limb prostheses provided through digital platforms has changed the current paradigm in prosthetic rehabilitation and disrupted the prosthetic industry. The Cyborg Beast was named one of the Best Inventions of 2014 by MSN.com. Dr. Zuniga's Cyborg Beast hand prosthesis has been featured in several media outlets including *The New York Times*, *CNN*, *The Guardian*, 3D Printing Industry and many others.

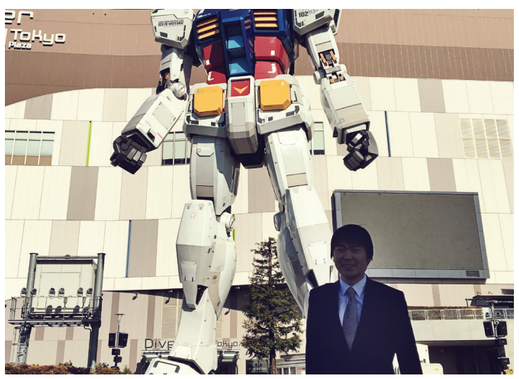
Due to his international collaborations and scientific impact of his work, Dr. Zuniga was selected by the U.S. Department of State as the 2018 "Runner Up" for the APEC (Asia-Pacific Economic Cooperation) Science Prize for Innovation, Research, and Education ("ASPIRE"). Dr. Zuniga is the only researcher in the state of Nebraska that has ever received such an honor.

JAPAN

Dr. Takahashi was an invited presenter at the International Forum on Biomechanics of Running-specific Prostheses in Tokyo, Japan. After the conference, Dr. Takahashi got to enjoy two of his favorite activities: discussing science with other biomechanists, and enjoying authentic Japanese ramen. Dr. Takahashi also made a brief stop next to a giant robotic statue in Odaiba to get inspiration for the next generation of exoskeleton designs.

Invited presenters at the International Forum on Biomechanics of Running-specific Prostheses in Tokyo, Japan (February, 2018)

Dr. Takahashi enjoying authentic ramen noodles in Tokyo with biomechanists from around the world.



Dr. Takahashi visiting a robotic exoskeleton statue in Odaiba.

EUROPE

DR. STERGIOU VISITS FOUR EUROPEAN COUNTRIES

FRANCE

Dr. Stergiou visits EuroMov (European Centre for Research on Human Movement) in Montpellier, France in April 2018. (1,2)

GERMANY

Dr. Stergiou gives a keynote presentation at the 5th International Autumn School on Movement Science in Berlin.

- Stergiou with collaborator Peter Raffalt in Berlin (3)
- Dr. Stergiou site seeing in Berlin (4)

GREECE

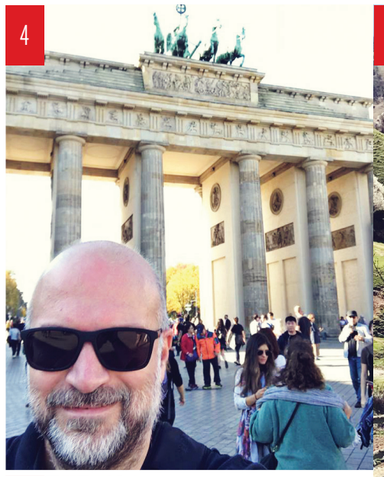
Dr. Nick Stergiou continues to have multiple speaking engagements and collaborations in his home country of Greece.

- Dr. Stergiou discussing "Brain Drain" at the 10th International Congress of Sports Medicine (5)
- Dr. Stergiou representing UNO Biomechanics on a trip home to Greece (6)
- Dr. Stergiou speaking at the 27th Conference of the Greek Armed Forces (7)

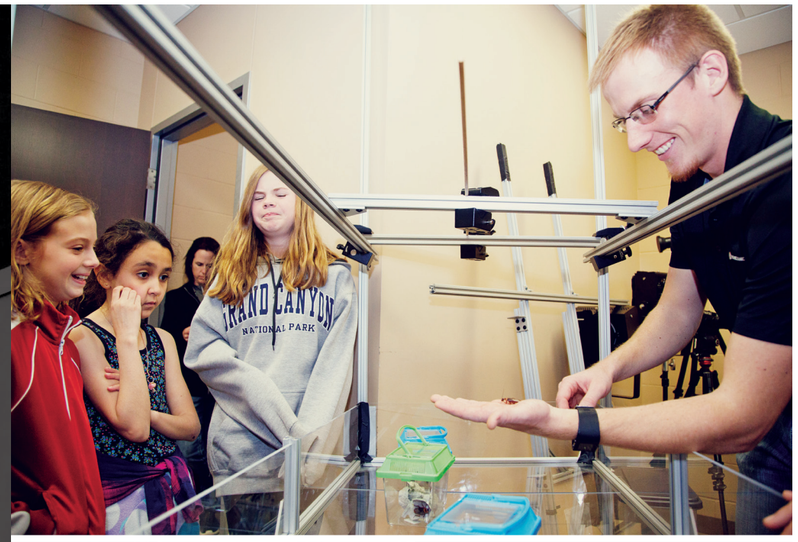
IRELAND

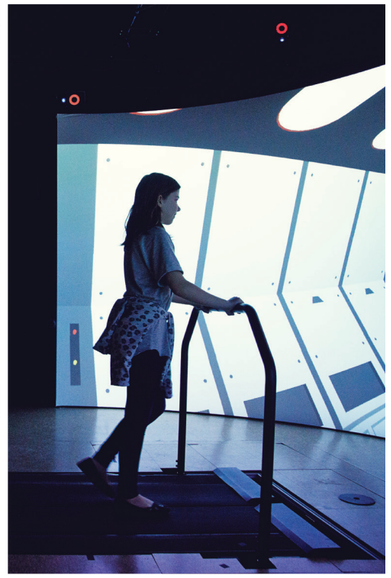
Dr. Nick Stergiou presented at World Congress in Biomechanics in Dublin, Ireland.

- Dr. Stergiou pictured with fellow presenters during his session at World Congress (8)



OUTREACH





NATIONAL BIOMECHANICS DAY

National Biomechanics Day is an international event sponsored by the American Society of Biomechanics that celebrates biomechanics for students and teachers.

On this day, biomechanics research labs across the country open their doors to students and teachers in an effort to show them how exciting and innovative biomechanics research can be!

Over the past two years biomechanists have hosted over 20,000 students and 800 teachers across the world! This past year the UNO Department of Biomechanics hosted over 75 students and five teachers. Visitors came from a variety of Omaha Public Schools including Omaha North High School, Omaha Central High School, and Omaha South High School. Additionally, we were lucky enough to host a local girl scout troop and their families.

Visitors for this years event participated in many different activities. A small group of high achieving high schoolers were invited to participate in a small scale motion capture data collection. Other groups competed in an animal robot obstacle course highlighting the work of Dr. Nate Hunt, tested 3D printed prosthetic simulators highlighting the work of Dr. Jorge Zuniga, and tested their strength and balance highlighting the work of Dr. Brian Knarr, in addition to a number of other activities.

Students and teachers were also able to explore all lab spaces in the BRB. We are looking forward to hosting students each year for National Biomechanics Day!

Participants of the Perry Initiative perform mock surgeries with Orthopedic Surgeons and Biomechanists.

PERRY INITIATIVE

In 2018 UNO and UNMC hosted the second annual joint Perrry Initiative Outreach program. This year's program was located on UNMC's campus at the Lauritzen Outpatient Centered and hosted by faculty from UNO Biomechanics and UNMC Orthopaedic Surgery and Rehabilitation.

The Perry Initiative Outreach program is focused on introducing high school females to career opportunities in medicine, engineering, biomechanics, and STEM through hands on surgical demonstrations and interaction with professionals currently in the field. In 2018 we hosted 40 local high school females, a packed event.

Dr. Susan Scherl, an orthopaedic surgeon, and Dr. Amelia Lanier, a biomechanist, presented on their professional lives and how they got there. Current biomechanics undergraduate and graduate students volunteered for the event and assisted the participants as they completed six different surgeries throughout the day. The mock surgeries included suturing, fracture casting, knee reconstruction, and fracture plating, among many others.

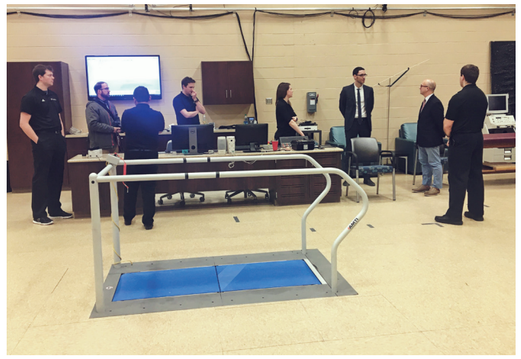
This one day event hopes to introduce young women to previously unknown career fields that historically see few women in an effort to increase diversity. UNO Biomechanics is excited to host this event again next year in the newly expanded BRB.

LIGHTS ON AFTER SCHOOL

Faculty, staff, and students once again attended the Lights on After School event hosted at UNO on October 6, 2018. The purpose of this event is to highlight after school programs and their significance in helping children learn.

TOURS

Faculty, staff, and students lead and participate in tours every single week at the BRB. Tours include politicians, educational groups, potential students, and community members.



Counsel General from France

STEM Ecosystem

GIRLS INC.

GIRLS INC. EUREKA STEM! AND EXTERNSHIPS

Each summer the Department of Biomechanics works with Girls Inc. to provide unique and exciting STEM opportunities to local young women. In the past year our department was able to support Girls Inc. in two unique ways: through Eureka! STEM camp and the Girls Inc. summer externship program.

Girls Inc. is a nonprofit organization serving girls across the country by providing them safe spaces and enriching support. Locally, Girls Inc. hosts Eureka! STEM camp where 8-10th grade girls spend a month on the UNO campus experiencing different STEM opportunities.

For one of those weeks, girls explored the BRB to learn about our exciting research. Campers learned how to build mechanical hands in the Machine Shop, tested out different environments in the Virtual Reality Lab, and tested their balance in the motion capture lab, among many other activities.

In addition to Eureka! STEM Camp, our department welcomed two externs for four weeks during the summer. The two externs were local high school students who expressed interest in biomechanics and STEM. Our externs were able to shadow all the faculty members during their visit learning the ins and outs of research. They attended team meetings, observed data collections, assisted with equipment testing, and helped with projects in the Machine Shop.

At the end of their externship, Girls Inc. hosted a presentation night where all the Girls Inc. externs presented their summer projects. It is easy to say UNO Biomechanics had a busy summer working with Girls Inc.

HIGHLIGHTS

AWARDS, GRANTS, AND SCHOLARSHIPS

Students, staff, and faculty's dedication is apparent with the numerous grants, scholarships, and awards they receive. Much of the research performed in the BRB would not be possible without these grants, scholarships, and awards.

Fuse Grants

Walker Arce
Anthony Arellano
Russell Buffum
Daniel Jaravata
Will Picken
Andrew Walski
Henamari Ybay

URCA Grants

Joao Casaca de Rocha Vaz
Nathaniel Hunt
Henamari Ybay

GRACA Grants

Prokopios Antonellis
Drew Dudley
Farahnaz Fallah Tafti
Tyler Hamer
Erica Hedrick
Jenny Kent
Todd Leutzinger
Zachary Motz
Nikolaos Papachatzis
Corbin Rasmussen
Douglas Rowan
Takashi Sado
Keaton Young

2018-19 NASA Nebraska Space Grant Fellowship

James Pierce
Drew Dudley
Keaton Young
Erica Hedrick
David Salazar
Christopher Copeland
Walker Arce
Claudia Cortes Reyes
Zachary Motz

2018 Office of Research and Creative Activity Awards

Outstanding Undergraduate Oral Presentation
Zachary Meade

Meritorious Undergraduate Student Oral Presentation
Alyssa Averhoff

Outstanding Undergraduate Poster Presentation
Lauren Wehrle

Honorable Mention Undergraduate Poster Presentation
Henamari Ybay

Best Graduate Oral Presentation
Keaton Young

Best Graduate Poster Presentation
James Pierce

2017-18 Department of Biomechanics Awards

Outstanding Undergraduate Student
Emma Leone

Outstanding Graduate Student
Jenny Kent

2018 Human Movement Variability Conference Awards

Outstanding Oral Presentation
James Pierce

Outstanding Poster Presentation - 1st Place
Jenny Kent

Outstanding Poster Presentation - 2nd Place
Anthony Arellano

Outstanding Poster Presentation - 3rd Place
Jordan Wickstrom

Barry Goldwater Scholarship

Samantha Sack

Vaya Stergiou Distinguished Scholarship in Biomechanics

Claudia Cortes Reyes

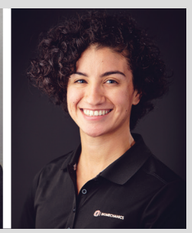
INNOVATIVE STUDENT FELLOWSHIP

Congratulations to Claudia Cortez Reyes, an undergraduate biomechanics major that received the "Innovative Student Fellowship." The overall goal of the "Innovative Student Fellowship" is to provide funding to support a UNO student working in the 3D printing laboratory at the BRB under the supervision of Dr. Jorge M. Zuniga.

Specific objectives of the "Innovative Student Fellowship"

- Expose UNO undergraduate or graduate students to the research and clinical applications of 3D printing working in laboratory and clinical settings
- Increase the student's technical and clinical knowledge about the different applications of 3D printing in the prosthetic industry to facilitate future employment
- Promoting collaborations between Innovative Prosthetic & Orthotics and the 3D printing laboratory at the UNO BRB for the development of grants and scientific literature

JENNY KENT
2017-18 Presidential Graduate Fellowship



CLAUDIA CORTES REYES
2017 Vaya Stergiou Distinguished Scholarship in Biomechanics winner

THESIS AND DISSERTATION PROPOSALS AND DEFENSES

THESIS PROPOSALS AND DEFENSES

ROBERT BARBER

Proposal: November 30, 2017
Defense: April 16, 2018
Balance in Smokers Versus Never Smokers

KATLYN NIMTZ

Proposal: December 8, 2017
Defense: March 30, 2018
The Relationship Between Linear and Nonlinear Analysis in Activity Data and how they Relate to Clinical Measures in Older Adults

JAMES PIERCE

Proposal: October 11, 2017
Defense: June 8, 2018
Prosthetics and Motor Function: Implications for Coordination and Brain Activity

DREW DUDLEY

Proposal: February 12, 2018
Defense: November 2, 2018
Acute Effects of Using a 3D Printed Hand Exoskeleton in Stroke Patients

CORY FREDERICK

Proposal: February 16, 2018
Defense: August 27, 2018
The Effects of Outsole Geometry on the Biomechanics of Walking Using Modular Shoes

ABDERRAHMAN OUATTAS

Proposal: December 15, 2017
Defense: June 27, 2018
Knee Joint Proprioception: Its Effect on Inter-Limb Joint Asymmetry & Dynamic Stability in Post-Total Knee Arthroplasty Patients

AUSTIN DUNCAN

Proposal: January 30, 2018
Defense: June 22, 2018
Bridging the Gap: Individual Relationships between Long Range Correlations and Dexterity in Walking

JOEL SOMMERFELD

Proposal: December 11, 2018
Isolating Aspects of Gait Through The Use of Pacing Signals

DOUGLAS ROWAN

Proposal: December 10, 2018
Cortical Activity During Walking with Variable Metronomes

TYLER HAMER

Proposal: December 4, 2018
The Effects of Aging and Knee Arthroplasty on Joint Angle Variability Across Terrains

CORBIN RASMUSSEN

Proposal: November 27, 2018
Characterizing Diverse, Unconstrained Slips and Recovery Reactions during Curvilinear Walking

DAVID SALAZAR

Proposal: December 4, 2018
Development and Validation of a Low-Cost and Rapid Methodology for the Development of 3D Printed Anatomical Models for Surgical Planning and Clinical Education

KEATON YOUNG

Proposal: November 21, 2018
3D Prosthetics Effects on Standing Posture in Unilateral Upper Limb Deficient Children

SHANE MELTZ

Proposal: October 4, 2018
Effect of Dual-Task Walking on Long Range Correlations in People with Parkinson's Disease

BLAKE BEIER

Proposal: September 28, 2018
Effects of a Passive Dynamic Knee-Ankle-Foot Exoskeleton on Healthy Adults During Walking

TODD LEUTZINGER

Proposal: August 30, 2018
Walking Adaptations to an Ankle Foot Orthosis in Individuals with Peripheral Artery Disease

ERICA HEDRICK

Proposal: June 1, 2018
How Prosthetic Ankle Stiffness Affects Metabolic Energy Expenditure During Walking with Added Loads in Non-amputees

DISSERTATION PROPOSALS AND DEFENSES

JENNY KENT

Proposal: October 4, 2017
Defense: August 30, 2018
The Implications of Lower Limb Impediment for our Ability to Walk on Uneven Terrain

BRYON APPLEQUIST

Proposal: January 9, 2017
Defense: November 20, 2017
The Development of Gait Dynamics and Gait Coordination in Children

TROY RAND

Proposal: December 2, 2016
Defense: June 18, 2018
The Effect of Multisensory Perturbations on Postural Entrainment to a Moving Room and Support Surface Translations.

JORDAN WICKSTROM

Proposal: December 5, 2016
Defense: June 22, 2018
Investigating the Interaction between Social and Motor Processes in Infants At-Risk for Autism

JESSICA FUJAN-HANSEN

Proposal: December 8, 2017
Defense: July 19, 2018
The Impact of Age on Gait Asymmetry Post-Stroke

SEMINAR SERIES FALL 2018–SPRING 2019

DR. FRED CHOOBINEH

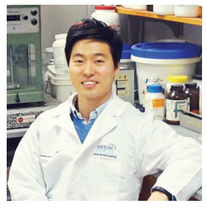
Nebraska EPSCoR
August 25, 2017

EPSCoR Opportunities

DR. JAMES VAN ETTEN

UNL
September 1, 2017

Fifty Years of Fun Being a Scientist



DR. SONG-YOUNG PARK

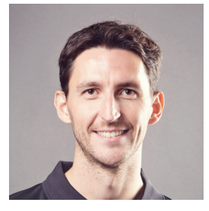
UNO
September 8, 2017

Attenuated Oxygen Transport Capacity and Vascular Mitochondrial Dysfunction in Aging and Disease

DR. SARA MYERS

UNO
September 15, 2017

Peripheral Artery Disease, Productivity, and Priorities"



DR. VIVIEN MARMELAT

UNO
September 22, 2017

A Journey Through Complexity: Healthy Behavior is Not Normal

DR. FRED HAMEL

Veterans Affairs
September 29, 2017

Doing Research at the VA Nebraska-Western Iowa Health Care System

DR. SCOTT TASHMAN

University of Texas-Health
October 6, 2017

Dynamic Joint Function Assessment for Enhancing Understanding and Treatment of Musculoskeletal Injury and Disease

DR. JULIE LISS

Harvard Medical School
October 13, 2017

Tracking Speech Motor Control as a Window to Neurological Health

DR. PANAGIOTIS ARTEMIADIS

Arizona State University
October 20, 2017

Advanced Human-Robot Control and Interaction Interfaces

DR. LI-SHAN CHOU

University of Oregon
October 27, 2017

Attention and Gait: Dual-Task Gait Paradigms

DR. JORGE ZUNIGA

UNO
November 3, 2017

The Development of 3D Printed Prostheses and Anatomical Models for Children

DR. PHILIPPE MALCOLM

UNO
November 10, 2017

Exoskeleton Actuation Inspired By and Informing Biomechanics

DR. MUKUL MUKHERJEE

UNO
November 17, 2017

Sensory Contributions to Human Movement Control and Learning in Health and Disease

DR. STEFANIA FATONE

Northwestern University
December 1, 2017

"The NU-Flexsivsocket: Development, Research, and Dissemination"

DR. CATHERINE LANG

Washington University
January 12, 2018

Dose in Stroke Rehabilitation: The Value of Explicit Hypothesis Testing

DR. NATE HUNT

UNO
January 19, 2018

Cognitive Biomechanics of Arboreal Locomotion

DR. MARCO SANTELLO

Arizona State University
January 26, 2018

A New Model of Sensorimotor Control

DR. JENNA YENTES

UNO
February 2, 2018

Breathing and Walking Coupling in Pulmonary Disease

MR. JOHN TENCER

Nebraska Strategic Research Institute
February 9, 2018

National Strategic Research Institute

DR. CHRISTOPHER BURCAL

UNO
February 16, 2018

Sensorimotor Activity in Patients with Chronic Ankle Instability

DR. JEFFREY DRIBAN

Tufts Medical Center
February 19, 2018

Characterizing Accelerated Knee Osteoarthritis

DR. JENNIFER LARSEN

UNMC
February 23, 2018

Promoting Your Science: The Art of the 'Elevator Pitch'

DR. LORI LEIBOLD

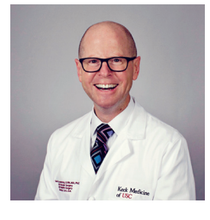
Boys Town National Research Hospital
March 9, 2018

Research Findings from the Center for Perception and Communication in Children: A Centers of Biomedical Research Excellence at Boys Town National Research Hospital

DR. KOTA TAKAHASHI

UNO
March 16, 2018

Biomechanical Design of the Human Foot and Ankle: Engine, Transmission, and Radiator



DR. DAVID ARMSTRONG

University of Southern California, Keck School of Medicine
March 30, 2018

The Diabetic Foot in Remission: A Marriage of Team, Technology, and Tenacity

DR. REBECCA WACHS

UNL
April 6, 2018

Natural Materials and Antioxidants to Treat Low Back Pain

DR. ELIZABETH STEGEMOLLER

Iowa State University
April 13, 2018

Music and Neuroscience in Parkinson's Disease

DR. BRIAN KNARR

UNO
April 20 2018

Applying Research Across Populations: How Stroke and Total Knee Replacement Are the Same, Yet Different

DR. ADAM BOSEN

Boys Town National Research Hospital
April 27, 2018

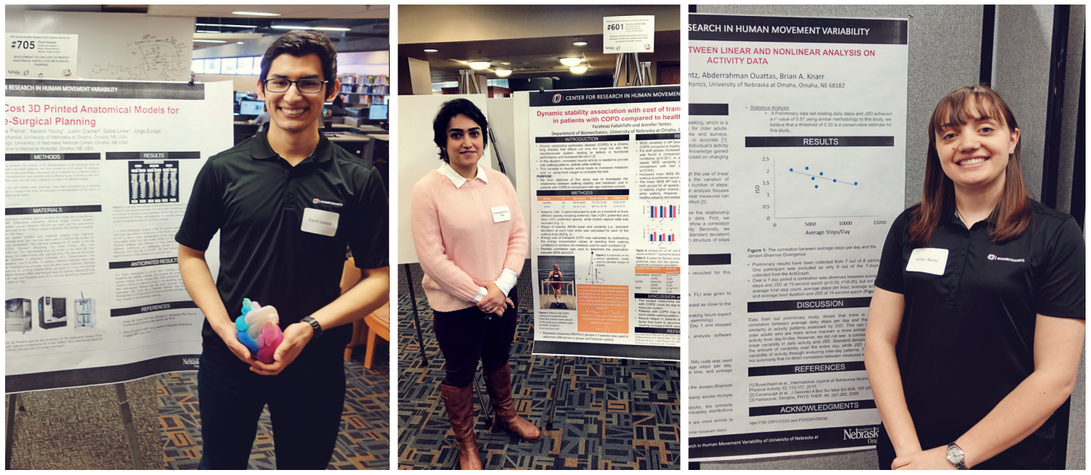
Sensory and Cognitive Interactions in Speech Recognition in Listeners with Cochlear Implants

CONFERENCES, MEETINGS AND WORKSHOPS

UNO STUDENT RESEARCH AND CREATIVE ACTIVITY FAIR

MARCH 2, 2018

The Research and Creative Activity Fair is an annual showcase of student-centered scholastic endeavors and achievements. We had 44 students participate in the 2018 research fair with a Biomechanics faculty mentor for their research!



Students from the Department of Biomechanics present their research at the Annual UNO Student Research and Creative Activity Fair.

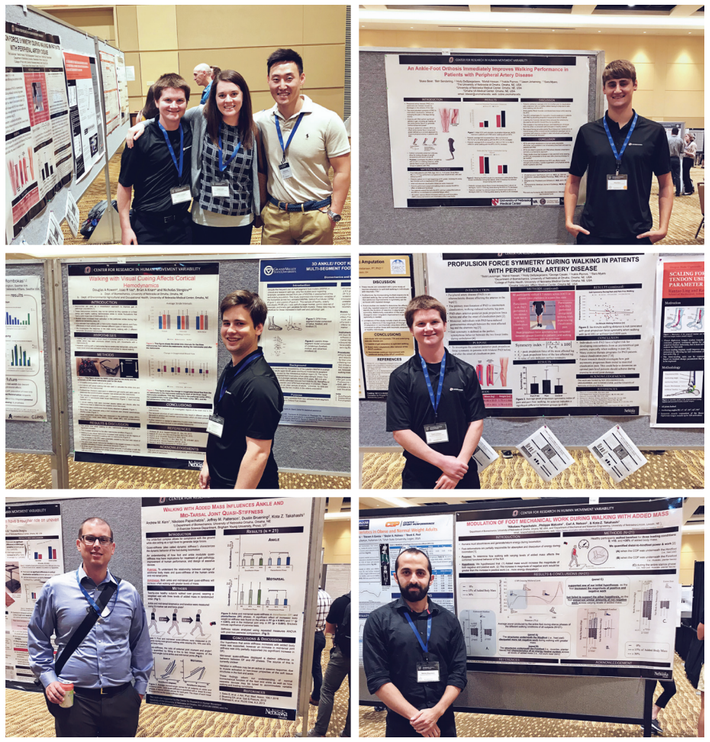
2018 NONLINEAR ANALYSIS WORKSHOP

OMAHA, NE

Every summer the Division of of Biomechanics and Research Development hosts the Nonlinear Analysis Workshop on the UNO campus. The workshop introduces research scientists, clinicians, educators, and students to nonlinear analysis methods of biological time series data.

2018 AMERICAN SOCIETY OF BIOMECHANICS ANNUAL MEETING

AUGUST 8–11 | ROCHESTER, MN

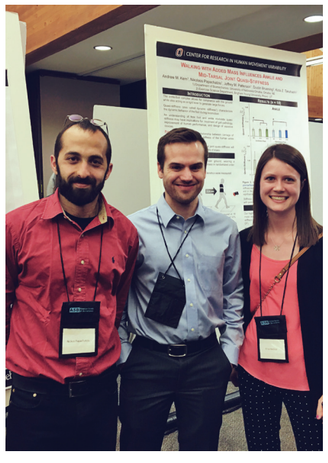


WORLD CONGRESS OF BIOMECHANICS

GAIT AND CLINICAL MOVEMENT ANALYSIS SOCIETY MEETING

2018 ROCKY MOUNTAIN AMERICAN SOCIETY OF BIOMECHANICS ANNUAL MEETING

ESTES PARK, CO



FUN STUFF

IN THE OFFICE

Dr. Mukul Mukherjee received tenure (1)

Staff at the College of Education (COE) Holiday Party (2)

Dr. Nick Stergiou on Halloween (6)

COMMENCEMENT

Faculty members with the Bachelor of Science in Biomechanics graduates at May 2018 Commencement (3)

Faculty and Doctoral Students at December 2018 Commencement (4)

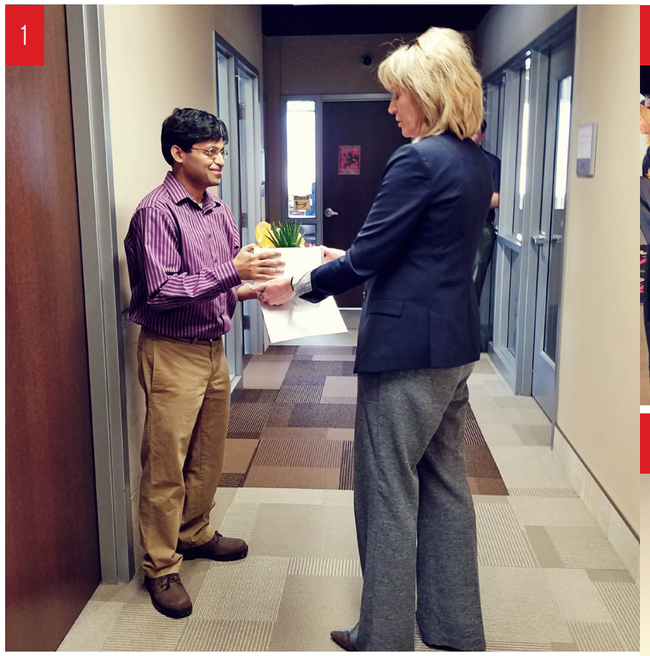
Doctoral student, Troy Rand, with Dr. Mukherjee (5)

Undergraduate student, Claudia Cortes Reyes, and Dr. Stergiou at December 2018 Commencement (7)

The first graduate of the Master of Science in Biomechanics program, Drew Dudley, with Dr. Stergiou (8)

Doctoral student, Jenny Kent, with Dr. Stergiou (9)

1



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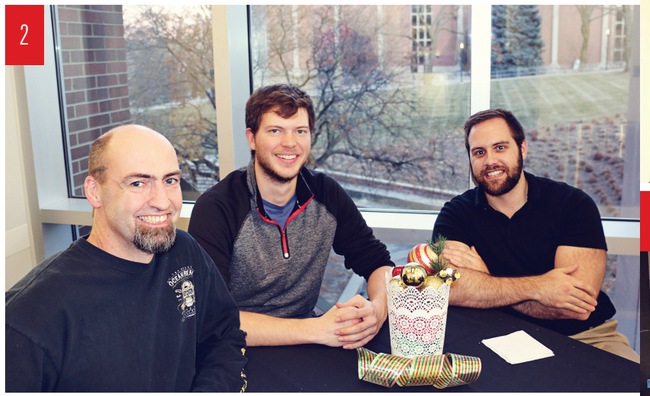

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BRB FACULTY, STUDENTS, AND STAFF

Research reported in this annual report was supported by the National Institute Of General Medical Sciences of the National Institutes of Health under Award Number P20GM109090. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Front Row (L-R): Angela Collins, Laura Rotert (Campbell), Henamari Ybay, Jenny Maun, Farahnaz Fallah Tafti, Claudia Cortes Reyes, Monica Barajas, Amelia Lanier Knarr, Daniel Jaravata, Mahdi Hassan, Arash Gonabadi

Second Row (L-R): Mukul Mukherjee, Anthony Arellano, Todd Leutzinger, Deepak Kumar, Jorge Zuniga, Carolin Curtze, Gabriela Garaycochea, Thallon Pitchure, Nikolaos Papachatzis, Andrew Walski

Third Row (L-R): Maddisen Mohnsen, Jenna Yentes, Kyle Doerr, Erica Hedrick, Sheridan Parker, Douglas Rowan, Chenggong Zhang, Benjamin Senderling, Jeffrey Patterson, Greg Faber, Davis Salazar, Takashi Sado

Fourth Row (L-R): Jeff Kaipust, Ryan Meidinger, Kota Takahashi, Andreas Skiadopoulos, Namwoong Kim, Christopher Copeland, Will Gwoe, Abderrahman Ouattas, Tyler Keller, Hemachandra Ghanta, Alex Dzewaltowski, Nick Jaton, Joel Sommerfeld, Zachary Motz

Fifth Row (L-R): Brian Knarr, Andrew Kern, Charles Ian Sloan, Philippe Malcolm, Drake Bell, Vivien Marmelat, Keaton Young, Nate Hunt, Coleman Westerby, James Pierce, Tyler Hamer, Luis Silva, Blake Beier, Sara Myers, Travis Vanderheyden, Nick Stergiou, Kyle Brozek, Prokpios Antonellis, Aaron Likens

CAMPAIGN for NEBRASKA

UNIVERSITY of NEBRASKA FOUNDATION

For over 25 years, the revolutionary research taking place at UNO's Biomechanics Research Building (BRB) has led to a new understanding of human movement – how we stand, walk, and physically interact with our environment.

The only facility of its kind in the world, BRB has earned an international reputation for excellence in basic and clinical research. For example, its research in cerebral palsy and peripheral arterial disease has influenced the treatment and therapy options available to persons living with these disabilities. BRB has patented the wireless Gait-O-Gram, a biomedical instrument designed to measure an individual's walking parameters. Current research efforts are underway in the areas of robotic assisted surgery, chronic obstructive pulmonary disease, Autism, stroke and mobility issues facing elderly populations.

These achievements bring additional opportunities to advance biomechanics research in ways that aren't even known today. However, this continued growth requires private support beyond what State of Nebraska funding can provide.

Private support for new equipment, student scholarships/fellowships and faculty support is critical to continue building upon the work taking place at BRB. Your gift to any of the areas indicated on the corresponding pledge card will help advance these efforts now and into the future.

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.

☐ My check for $_____ is enclosed, payable to the University of Nebraska Foundation.

☐ Please charge $_____ to my: ☐ VISA ☐ MasterCard ☐ Discover ☐ AmEx

Card Number:_____Exp. Date:_____

☐ I'd like to fulfill my pledge of $_____ payable over _____ years (not to exceed five years) beginning _____ (month) of _____ (year).

_____

Signature (for credit card payment or to establish a pledge) Date

Name _____

Address _____

City _____ State _____ Zip_____

Phone_____ Email_____

☐ My company, _____, will match this gift. (If you, or your spouse, are employed by a company with a matching gift program, your gift could be increased. Contact your employer's personnel office for more information.)

☐ I have already included the Foundation in my estate plans through my will, trust or life insurance.

☐ Please send information about making a planned gift. You may also call 1.800.432.3216 to speak with a planned giving professional.

PLEASE RETURN TO:

University of Nebraska Foundation
2285 South 67th Street, Suite 200
Omaha NE 68106

For more information, call **800.432.3216** or visit our website **nufoundation.org**.

Since 1936, the University of Nebraska Foundation has played a significant role in the success of the University of Nebraska. As a nonprofit, independent corporation, the University of Nebraska Board of Regents designated the Foundation as the primary fundraiser and manager of private gifts to the university. The Foundation exists to raise and manage gifts to further advance all campuses of the University of Nebraska.

University of Nebraska Omaha

Connect with the University of Nebraska at Omaha Biomechanics Research Building

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unobiomechanics@unomaha.edu 402.554.3228 /unobrb /unobrb @UNOBiomechanics /uno_biomechanics