

2010

Nebraska Biomechanics Core Facility 2009 Annual Report, Issue 8

Nebraska Biomechanics Core Facility
University of Nebraska at Omaha

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Core Facility, Nebraska Biomechanics, "Nebraska Biomechanics Core Facility 2009 Annual Report, Issue 8" (2010). *Biomechanics Annual Report*. 6.

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Nebraska Biomechanics Core Facility

Strive for Excellence

Our annual report will give you a brief look at who we are, what we do and a quick update on our studies. We hope that after reading about us that you will want to come to the Nebraska Biomechanics Core Facility and visit us in person as well.

Following Nebraska and National initiatives, the laboratory is interdisciplinary in nature. Our thriving enterprise features engineers, mathematicians, scientists, surgeons, and clinicians exchanging ideas to gain additional insights on healthy and abnormal movement patterns. Using techniques from biology, engineering and mathematics, we have revolutionized the way we perceive how the neuromuscular system controls human movement. Our success often leads us to new opportunities to advance the laboratory's 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 you, also are 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,
- fund a laboratory addition to alleviate the current shortage of research and office space.

To learn more about how you can support the important work of the Nebraska Biomechanics Core Facility, turn to page 20. Your gift will make a difference — enhancing our scientific pursuits and ultimately helping improve the lives of those we serve and beyond.

Thank you for your consideration,



Nick Stergiou, Ph.D.



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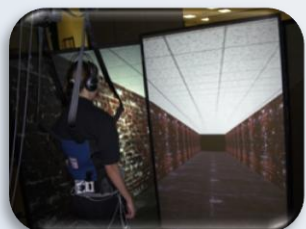
Gait Analysis



Infant Sitting



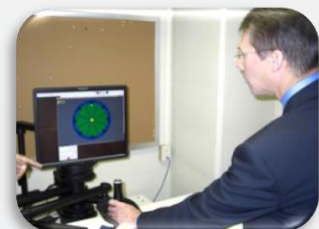
Elderly



Virtual Reality



Robotic Surgery



Stroke Rehabilitation

Nebraska Biomechanics Core Facility faculty and personnel have established a strong network at a local, national and international level. Supporters in our endeavors for excellence are several local and national foundations, institutes and associations that have granted to us 12 awards for a total of **\$3,248,493** during the last year!!!

The **Nebraska Research Initiative** has granted to Dr. Daniel Blanke (principal investigator; PI) a one-time award of **\$621,980** over a period of two years (2007-2009) for the purchase of equipment to facilitate collaborative research projects. Our laboratory is now a fully-equipped core facility that can provide services of consultation, data analysis, data collection, and software training to the entire University of Nebraska research community and its partners. Other Nebraska Research Initiative grants include a two-year award of **\$453,863** for the construction of a portable device (Balance-O-Gram) to evaluate sitting posture in infants (2008-2010), a two-year award of **\$538,000** for the construction of a novel wireless mobility monitoring system (2008-2010), and a two-year award of **\$681,057** to study the use of virtual simulators and robotic manipulators for the improvement of robotic surgical educational training (2008-2010). Dr. Stergiou serves as PI for the first Nebraska Research Initiative grant, while he is a co-investigator for the latter two.

New grants include an award from the **Alzheimer's Association** to study the effect of Wii-Fit on improving gait and balance in Alzheimer's dementia (**\$43,153**; 2009-2011), an award from the **UNMC Center for Clinical and Translational Research** (**\$19,835**; 2009) to study COPD and an award from **NASA Nebraska Space Grant** and **EPSCoR** to study the effect of physiological mechanisms on muscular strength and skeletal muscle performance (**\$33,995**; 2010).

Our leading and well-funded project is related with our first lifetime milestone – sitting up. Dr. Stergiou has received a K-25 research award of **\$577,182** from the **National Institute of Health** to examine postural functions in infants by utilizing advanced mathematical methods (2005-2010). Our ongoing collaboration with Munroe-Meyer Institute at UNMC has resulted in funding from the most prestigious national institutions. The **National Institute of Disability and Rehabilitation Research** has granted to our research group a three-year award of **\$600,000** to investigate interventions of sitting in young children with moderate to severe cerebral palsy (2008-2011). Dr. Stergiou serves as PI in all aforementioned projects propelling him to be considered an expert in infants' postural control during sitting. He also serves as a co-PI for a grant from the **American Physical Therapy Association** to explore the development of early postural interventions of sitting and reaching in preterm infants (**\$30,000**; 2009-2010).

In addition, Dr. Stergiou serves as a mentor for a two-year post-doctoral fellowship awarded to Dr. Mukherjee from the **American Heart Association** to study upper limb movements in chronic stroke survivors (**\$85,000**; 2008-2010) and for a three-year predoctoral fellowship (F31) awarded to Sara Myers from the **National Institutes of Health** to study the effect of aging and vascular occlusion on gait variability (**\$86,408**, 2009-2012).

Lastly, Dr. Stergiou serves as a co-investigator for a two-year award of **\$100,000** from the **MARS Foundation** to investigate the impact of resistance training on balance in multiple sclerosis patients (2007-2009).



Back Row (left to right): Erin Fosnaugh, Jenna Yentes, Elena Kokkoni, Dimitrios Katsavelis, Shane Wurdeman, Ka-Chun Siu, Nick Stergiou, Dan Blanke, Jeffrey Kaipust, Neil Huben, Sara Myers, Jessie Huisinga, Mira Momcilovic.

Front Row (left to right): Anastasia Kyvelidou, Irene Suh, Mukul Mukherjee, Joshua Haworth, Panos Koutakis, Jung-Hung Chien, Fabien Cignetti, Shi-Hyun Park, Leslie Decker.



Dr. Daniel Blanke

Dr. Blanke, founder of our laboratory and Director of the School of Health, Physical Education and Recreation, helped to initiate and launch the Master of Public Health (CoPH) Program in 2000 at the University of Nebraska Medical Center (UNMC). He is now working on developing an undergraduate degree in Public Health and oversees the expansion of our building. Last year, Dr. Ka-Chun (Joseph) Siu, who was a post-doctoral research fellow at NBCF with Dr. Stergiou, became an Assistant Professor in the College of Public Health, while he is also holding appointments with the Department of Surgery from UNMC and the College of Education at UNO. He will be in charge of Robotic Surgery research.

Drs. Stergiou and Siu were honored as New Invention Notification Contributors at the 2009 Research Innovation Awards hosted by the UNMC and the UNeMed Corporation for their recent Robotic Simulators invention.

Dr. Stergiou continues to hold his primary appointment at UNO and has a special appointment with the College of Public Health in the Department of Environmental, Agricultural, and Occupational Health at UNMC. He is also the Graduate Program Chair of this Department representing the department at the UNMC Graduate Council. He continues to hold appointments with the UNO Psychology Department, the Department of Pediatrics and Surgery from the UNMC, and the Physical Therapy Department at Creighton University. Dr. Stergiou is also the Chair of the Education Committee for the American Society of Biomechanics and Member of the Executive Board.



Dr. Ka-Chun (Joseph) Siu

NEW PERSONNEL



Shi-Hyun Park came to us from South Korea via Penn State. He received his BS and MS degrees from the DONG-EUI University in South Korea in Industrial and Management Engineering and his PhD from Penn State in Industrial and Manufacturing Engineering. His PhD research work was focused on hand biomechanics for the optimal handle size. Shi-Hyun is supported by a grant that Dr. Stergiou has from the Nebraska Research Initiative. He is currently working on our robotic surgery and staircase related projects.



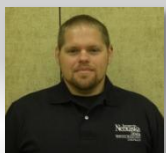
Fabien Cignetti came to us from France where he received a BS in Exercise Science from the University of Savoie, a MS in Bioengineering and ergonomics from the University of Jean Monnet at Saint-Étienne, and his PhD in Motor Control as a joint degree between the University of Savoie (France) and the University of Trent (Italy). His PhD was on the self-organization process in cross-country skiing. Fabien is supported by a grant that Dr. Stergiou has from the US Department of Education and he is working on our infant related projects.



Shane Wurdeman is supported by a College of Public Health first year Doctoral Student Fellowship to work with Dr. Stergiou on our gait related projects. He obtained his BS in Physics in 2003 from Creighton University with a health sciences focus. He received his MS in Prosthetics and Orthotics at Georgia Institute of Technology within the School of Applied Physiology. Shane went on to complete a clinical residency in prosthetics at the Shriner's Hospital in Los Angeles and is a board certified Prosthetist. He comes to the lab after working as a full-time prosthetist at the Veterans' Health Administration in Los Angeles.



Jung-Hung Chien is supported by a grant we have with the Nebraska Research Initiative to work as a Doctoral Research Assistant with Drs. Stergiou and Siu on our virtual reality and robotic surgery related projects. Jung received BS and MS degrees in Taiwan in mechanical engineering and an MS degree in Human Physiology from the University of Oregon (UO). He also has an associate degree in computer science from UO.



Joshua Haworth is supported by a College of Public Health first year Doctoral Student Fellowship to work with Dr. Stergiou on our infant and posture related projects. Joshua received his BS and MS degrees in Exercise Science from Miami University of Ohio. He came to us after serving as interim faculty at Penn State-Berks Department of Kinesiology where he taught Biomechanics and Introduction to Kinesiology.



Elena Kokkoni came to us from Greece where she earned her BS degree in Exercise Science from the Aristotle University in Thessaloniki. Elena is supported by a Nebraska Research Initiative grant to work as a Research Assistant with Dr. Stergiou on our infant related projects.

The Nebraska Biomechanics Core Facility is fully equipped with key biomechanical research technologies and can provide services of consultation, data analysis, data collection, and software training to the entire state of Nebraska and Western Iowa research community and its partners. We are able to provide biomechanical support for surgeons, physical therapists, biomedical engineers and other related professionals. We will continue fostering collaborative projects seeking to integrate modern biomechanical techniques with biotechnology related research activities. Our laboratory will promote the state of Nebraska as a leader in biotechnology and will enhance the economic development of the state via biotechnology-based industrial growth.

LIST OF AVAILABLE DEVICES:

- Eight-camera motion capture system (Motion Analysis)
- Active motion capture system (2 tubes; NDI) **NEW!!**
- Five force platforms (Kistler & AMTI)
- Portable force platforms (AMTI & custom-made) **NEW!!**
- Instrumented treadmill (Bertec)
- Instrumented staircase (custom-made)
- Vibration mat (custom-made) **NEW!!**
- Computerized Dynamic Posturography (Neurocom)
- Two electromyographic devices (Delsys)
- Insoles for temporal parameters (Stride Analyzer)
- Pressure insoles (Tekscan)
- Four electrogoniometers (Biometric)
- Eye-tracking system (FaceLab 5)
- Two weight-bearing devices (LiteGait & custom-made)
- Two isokinetic dynamometers (Biodex systems II & III)
- Multi-screen virtual reality system (custom-made)
- Stroke therapy robot for upper extremities (InMotion)
- Computerized Speech Lab (KayPentax)
- Two motorized treadmills
- Oxygen saturation meter (InSpectra) **NEW!!**



STROKE THERAPY ROBOT



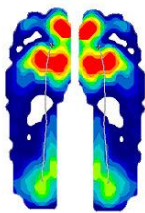
WIRELESS EMG



BALANCE-O-GRAM



3D INVESTIGATOR



PRESSURE INSOLES



GAIT-O-GRAM



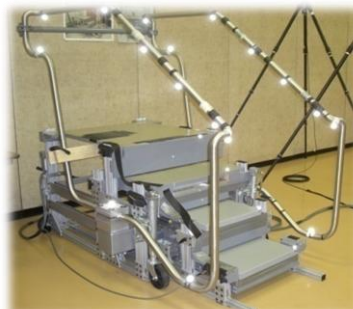
EIGHT-CAMERA MOTION CAPTURE SYSTEM



DYNAMIC POSTUROGRAPHY



INSTRUMENTED TREADMILL



INSTRUMENTED STAIRCASE



WEIGHT-BEARING DEVICE



HUGE SUCCESS FOR NBCF!!!

The NBCF is the recipient of the Chancellor's 2010 Strategic Planning Award for Academic Excellence at UNO! This award recognizes the NBCF as an academic, cross-disciplinary initiative that exemplifies a commitment to furthering UNO's strategic goals. This award affirms the NBCF Team as a student focused, academically centered, and community engaged unit. In addition, this award illuminates the NBCF's major role in increasing the stature of UNO as Nebraska's metropolitan university of scholarly excellence.

INTERNSHIP OPPORTUNITIES IN THE NBCF LABORATORY!!!

The following students completed their internship in the NBCF laboratory during 2009-2010.

- Krupa Savalia (UNMC; MD/PhD Scholars program).
- Emily Gentleman (UNL; BS in Nutrition, Exercise, and Health Sciences / Pre-physical Therapy)
- Kenneth Swantek (UNO; BS in Biotechnology / Pre-physical Therapy)
- John Ernst (UNO; BS in Biotechnology)



<http://www.unomaha.edu/biomech/also/intern.php>

NONLINEAR ANALYSIS WORKSHOP

The Nebraska Biomechanics Core Facility laboratory offers a five-day nonlinear analysis workshop. The purpose of this workshop is to introduce research scientists, clinicians, educators and students to a variety of mathematical methods for the analysis of biological time series. Instructors use class discussions and hands-on practice to facilitate understanding of the material covered in the lectures. Participants with varied backgrounds are welcome. If you are interested in our upcoming workshop, please, contact Dr. Nick Stergiou (phone: 402-554-3247 or email: nstergiou@mail.unomaha.edu)

CLASS 2009

The following participants successfully completed our second nonlinear analysis workshop. Congratulations and thank you for your participation!!!

- | | |
|-------------------|-----------------|
| Amit Sethi | Gainesville, FL |
| Andrew Sawers | Seattle, WA |
| Angela DiDomenico | Hopkinton, MA |
| Kathleen Thomas | Norfolk, VA |
| Peter Federolf | Calgary, Canada |
| Robert Catena | Cambridge, MA |
| Vipul Lugade | Eugene, OR |



Individuality

Software Experience

Theoretical Lectures

Intellectual Discussions

Rationale: Cerebral palsy (CP) is a term used to describe a group of chronic conditions affecting body movements and muscle coordination. It affects 2 to 3 children per 1,000 live births and is caused by damage to one or more specific areas of the brain, usually occurring during fetal development or infancy. It also can occur before, during or shortly following birth. Children with CP may not be able to walk, talk, eat or play in the same ways as most other children. So far, there is no known cure for CP, thus medical interventions are limited to the treatment and prevention of complications arising from CP's effects. However, because infants with symptoms of CP are not always diagnosed in the early months after birth, they miss the opportunity of early intervention services. Early intervention protocols are crucial for a child's motor development because the nervous system is very pliable in infancy and can be "re-shaped" based on the treatment.



Dr. R. Harbourne

General goal: To develop and evaluate innovative rehabilitation interventions in order to improve movement deficits, related to sitting balance present in CP children.

Status: We have been awarded another grant (**NIDRR, 2008-2011**) to examine the efficacy of other treatments used in early intervention of children with moderate to severe cerebral palsy, between 18 months and 6 years, a group of children who have been neglected in previous intervention studies. Specifically, we will investigate the addition of stochastic mechanical vibrations to the support surface, a treatment that has been shown effective in improving standing postural performance in adults suffering from stroke, diabetic neuropathy, and other balance deficits.

Dr. Stergiou has now completed his K-25 Mentored Quantitative Research Career Development Award from the National Institute of Child Health and Human Development of the National Institutes of Health. **We should mention that in 2005 this was the first K25 awarded in the state of Nebraska!** In this project, we demonstrated that term infants develop differently in the front-to-back and side-to-side direction during sitting than premature infants, which is very helpful for therapeutic interventions and especially in targeting different aspects of sitting development.



<http://www.unomaha.edu/infant/>

We are continuing with our grant from the Nebraska Research Initiative to build the Balance-o-Gram (BoG),

which is a portable force platform that can be carried to different locations, such as a patient's home, clinical office or laboratory, to collect biomechanical data from an infant's body sway. This biomedical device will help in the detection of early balance impairments during sitting development in infancy. As part of this project, we have been developing a software package that will be used to analyze postural performance in real-time, making this device extremely useful for therapists during at-home visits and maximizing the early detection of postural deficits.

In collaboration with Dr. Stacey Dusing, we have currently received a grant from the **American Physical Therapy Association** to explore how early postural intervention can affect sitting balance or reaching in infants born preterm (2009-2010). Dr. Dusing is an assistant professor at the Virginia Commonwealth University.



Dr. S. Dusing

Our senior doctoral candidate, Anastasia Kyvelidou, is still going strong and she has completed the data collections for her dissertation. Her study is based on our current research on the sitting control of infants. She is interested in the contribution of three kinds of stimuli on the sitting control in typically developing infants and eventually comparing it to the sitting control of infants with hearing loss. These infants may have damage to the hearing nerve in both ears and it is usually accompanied with deficiencies in the vestibular apparatus, which is the center of the brain controlling balance. Currently, there are no diagnostic tools that can identify early, within the first year of life, infants that have vestibular problems. Thus, there is a missed opportunity for early intervention services. By studying the effect of sight, hearing and balance we hope to find an early identification method for finding infants with potential hearing and vestibular problems.

In addition, our newest doctoral student, Joshua Haworth, has extended this work to investigating the sensorimotor coordination in developing infants; resultant from the observation of the behavioral performance of a model. To do this, the infant will be seated atop a force platform with the video image of a model infant performing the target behavior of healthy upright sitting. Eye tracking equipment will be used to determine eye movement behavior and the force platform will allow for direct measurement of the postural performance of the viewing infant. The project will investigate the interactive role of vision and attention on sitting postural performance, and determine whether vestibular dysfunction influences the utility of these systems.



A. Kyvelidou, MS

Dr. F. Cignetti

J. Haworth, MS

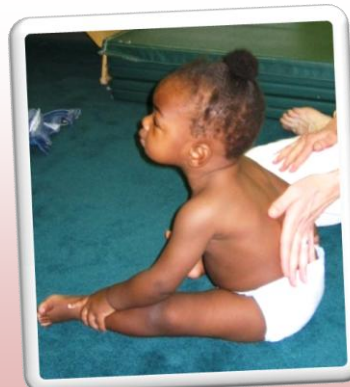
E. Kokkoni, BS

Future goals: In the future, the project will continue to expand the investigation of rehabilitation options for developmentally delayed infants and children by developing and evaluating new treatment protocols. Additionally, the project will seek to explore new technologies which may be applied to diagnose and monitor the health status of this population.

Funding: This project is currently funded by US Department of Education, National Institute of Disability and Rehabilitation Research, the National Institutes of Health, and the Nebraska Research Initiative. Dr. Stergiou is the principal investigator on all of these grants. Anastasia Kyvelidou is currently funded by the **Bukey and MacDonald Fellowship** from the University of Nebraska Medical Center and a Regents' Tuition fellowship. Drs. Stergiou and Harbourne submitted an R01, as well as a multi-site R01 with Dr. Galloway, and Dr. Stergiou also served as a collaborator for an R21 submission by Dr. Dusing.

People involved: Dr. Nick Stergiou, post-doc Dr. Fabien Cignetti and graduate students Anastasia Kyvelidou, Joshua Haworth and Elena Kokkoni are the Nebraska Biomechanics Core Facility laboratory personnel working on this project. Fabien has brought to us additional invaluable expertise in nonlinear dynamics. He is working on developing theoretical models about how information from different sensory systems affects the control of posture in various positions (i.e. sitting, standing). In addition, he is exploring how different algorithms affect the way we measure variability in human movement. Anastasia received her BS in Physical Education from the Aristotle University of Thessaloniki, her MS in Exercise Science from UNO and anticipates completing her doctorate through the University of Nebraska Medical Center this summer. Joshua Haworth is beginning his doctoral studies, funded by a Graduate Research Fellowship from the College of Public Health at the University of Nebraska Medical Center. He comes to us with both a BS and MS in Exercise Science, from Miami University (OH). Elena Kokkoni earned her undergraduate degree in Exercise Science from the Aristotle University in Thessaloniki. She will be pursuing her Master's degree and is supported by our grant from the Nebraska Research Initiative.

Our collaborators from the Medical Center include Dr. Reggie Harbourne and Sandy Willett. Reggie is the heart of our infant related research work and she is the one who encouraged Dr. Stergiou to get involved in this research almost a decade ago! This last year she received her doctorate. **Congratulations to Dr. Harbourne!!!** Drs. Harbourne, Stergiou, Dusing and Cavanagh presented an excellent tutorial on the usage of nonlinear analysis for physical therapy related problems in the APTA Combined Section Meeting at San Diego this last February. Other collaborators include Drs Lisa Kelly-Vance and Bridgette Ryalls from the Psychology Department at UNO.



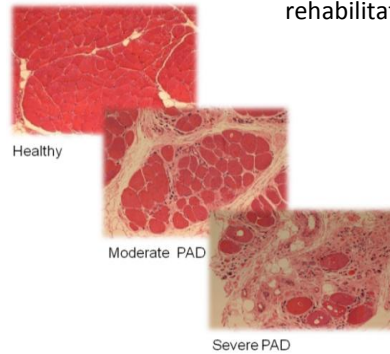
Rationale: Peripheral arterial disease (PAD) is a debilitating disease affecting 8 to 12 million people in the United States. The most common characteristic of this disease is the hardening and narrowing of the arteries in the legs. PAD patients develop increased pain in their legs when they walk for more than a block or even up a slight incline. As they walk, their leg muscles need more blood. Since their blood vessels are partially blocked, oxygen doesn't reach their working leg muscles which results in pain. Persons with PAD experience limitations of daily activities including impaired balance, high risk of falls, poor health outcomes and physical dependence. These limitations are more pronounced in the elderly leading to falls, nursing home placement and subsequent loss of functional independence. Vascular procedures to treat these patients constitute the third most common group of operations performed in the Veterans' Affairs hospitals nationwide. With the expected increases in our elderly population, PAD is fast becoming one of the most significant causes of morbidity and mortality for our nation's veterans.

General goal: To determine the limitations caused by the disease and also to decide which treatments are best for the PAD patients.

Status: Results show patients with PAD have weaker muscular responses at the ankle, which is not able to push forward like it should during walking. 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 the 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. Our team is currently working to find out if blood flow, muscular changes or another mechanism is responsible for mobility problems in these patients. We are also working to determine if patients' walking patterns improve following pharmacological and surgical treatments.

Future goals: Modify treatment strategies based on results of our studies. Develop devices for screening, assistance and rehabilitation for patients with PAD.

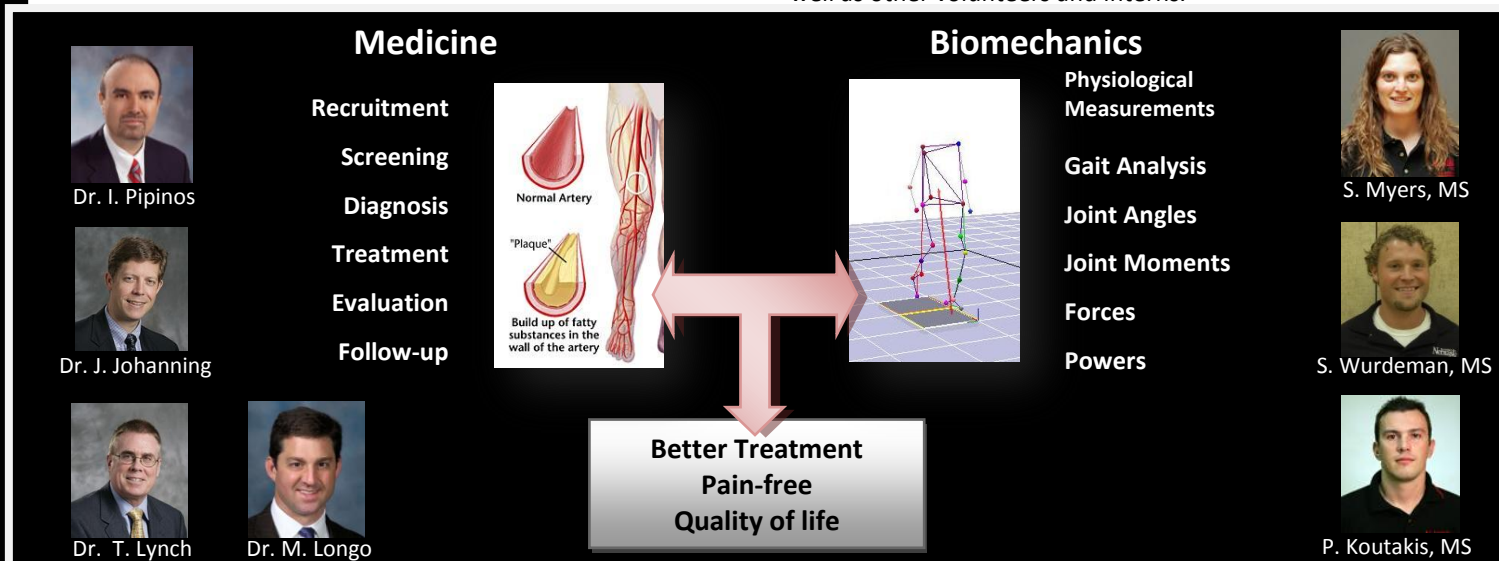


Muscle tissue from healthy and PAD patients.

Funding: The project is currently supported by several grants. Doctoral student Sara Myers was awarded this year a **NIH Ruth Kirschstein National Research Pre-Doctoral Fellowship (F31)** for her work surrounding PAD. In addition, other funds include the **AAHPERD** and the **American Society of Biomechanics** awards that have been awarded to Sara Myers and the **NASA** awards that have been awarded

to Sara Myers, Neil Huben and Shane Wurdeman. Furthermore, **Dr. Pipinos scored a perfect score of 10 in a current R01 submission. Congratulations Dr Pipinos!!!**

People involved: Dr. Jason Johanning, along with Dr. Iraklis Pipinos, Dr. Thomas Lynch and Dr. Matthew Longo are collaborators from the Department of Surgery at UNMC and the Veterans' Affairs Nebraska-Western Iowa Health Care System. Dr. Jane Potter from the Department of Internal Medicine at UNMC is also a clinical collaborator. Dr. Nick Stergiou, and graduate students Sara Myers, Shane Wurdeman, and Panagiotis Koutakis are the NBCF laboratory personnel working on this project. In addition, Neil Huben and Jeff Kaipust assist with data collection and analysis, as well as other volunteers and interns.



Rationale: Multiple Sclerosis (MS) is a disease of the central nervous system that affects approximately 400,000 Americans and is the most common progressive neurological disease in young adults. The disease generally attacks the myelin sheath that covers nerve cells which leads to a breakdown in communication between the brain and the muscles. As a result, people with MS have inconsistent movement patterns, poor balance, and a long list of possible other problems. This disease varies in severity with some patients only experiencing mild muscle weakness while others may be confined to a wheelchair. Current treatment varies according to individual symptoms, though medication and physical therapy are popular options.

General goal: To develop and evaluate innovative rehabilitation interventions in order to slow disease progression and improve movement deficits, related to both balance and walking, present in MS patients.

Status: There are three ongoing studies within the scope of the MS project. In the first study, we assess the effectiveness of resistance training in improving walking and balance parameters.

Results from this study have been presented at several national conferences, while manuscripts are under review or in progress. In the second study, we assess the effectiveness of elliptical training in improving walking parameters as a result of neuroadaptive mechanisms. Early results indicate that significant improvements in muscular responses and their contributions of the lower extremities occur as a result of training. Finally, we have embarked on a new balance assessment and training study. The goal of this study is to evaluate the balance of MS patients during different sensory input conditions and to create a balance training protocol to improve any balance deficits. This study was recently approved by the Internal Review Board and pilot testing is currently being performed.

Good balance is vital for multiple sclerosis patients

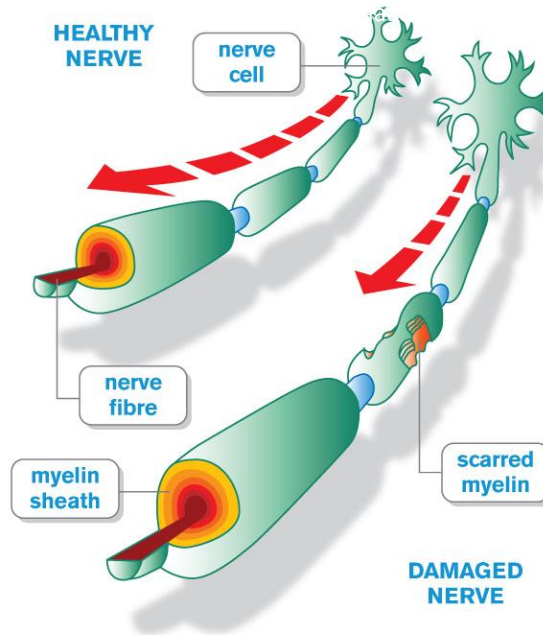


Future goals: In the future, the project will continue to expand the investigation of rehabilitation options for MS patients by developing and evaluating new treatment protocols. Additionally, the project will seek to explore new technologies which may be applied to monitor the health status of MS patients.

Funding: The project is currently funded by the **MARS Foundation** (Ames, IA). Dr. Mary Filipi is the principal investigator of this grant, while Dr. Stergiou and Jessie Huisinga are listed as co-investigators. Additional funds include the **American Society of Biomechanics** and the **NASA** awards that have been granted to Jessie Huisinga.

People involved: Dr. Nick Stergiou, and graduate students Jessie Huisinga and Shane Wurdeman are the NBCF laboratory personnel working on this project. In addition, Jeffrey Kaipust, Mira Momcilovic Ryan Hasenkamp and Neil Huben assist with data collection and analysis, as well as lab volunteers and interns. **Jessie recently received and accepted a post-doctoral position with Dr. Fay Horak at the Oregon Health Sciences University. This position is sponsored by the National Multiple Sclerosis Society. Congratulations Jessie!** Dr. Mary Filipi from the College of Nursing at

UNMC has extensive experience working with this clinical population. She provides clinical support and assists in patient recruitment on this project.



Multiple Sclerosis Disease Schematic



Rationale: Risk of falls may be related to changes in certain aspects of brain function. This research seeks to develop tools to identify older people at risk for falls. Walking under dual-task conditions could be helpful in detecting walking disorders at a preclinical stage and planning targeted therapeutic interventions to prevent falls.

General goal: To develop screening tools for early identification of future fall risk in the elderly and to evaluate new therapeutic interventions that would counteract the underlying pathological process.

Status: Young adults, elderly non-fallers and fallers are assessed with cognitive tasks involving different levels of difficulty and challenging various cognitive abilities. In the first phase of this project, participants are tested with auditory and linguistic cognitive tasks with and without walking on the treadmill. We predict that fallers who are more “centrally” impaired (e.g., decline in specific cognitive domains) would show different walking profiles than fallers who are more “sensory” impaired (e.g., neuropathy, decline in sensory systems). During the second phase, elderly fallers will be assigned to either walking training alone or a dual-task training combining walking and cognitive tasks. We predict that the latter training will be better than the former one in defining fall-risk profiles and developing therapeutic strategies that are relevant to specific cognitive deficits. In addition, a brain imaging study using magneto-encephalography will be conducted to gain insights into the neural correlates of dual-task performance.

Future goals: Our ultimate goal is to design and test new therapeutic interventions that will effectively target dual-task decrements during walking, hence reducing falls and improving functional status and quality of life in elderly.



Dr. J. Potter

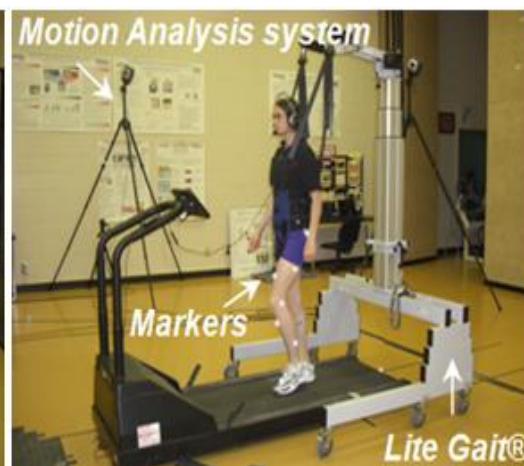
Dr. L. Decker



Funding: The project is currently funded by the various grants awarded to Dr. Stergiou. Additional funds include a **NASA** award that has been granted to Jenna Yentes. **Dr. Decker’s Pathway to Independence Award (K99/R00) has received an exceptional score of 16 by the NIA!!!**

People involved: Dr. Nick Stergiou, post-doc Dr. Leslie Decker and undergraduate and graduate students Jenna Yentes, Dimitrios Katsavelis, Nate Hunt, Mira Momcilovic, Erin Fosnaugh, and Ben Mawhiney are the NBCF laboratory personnel working on this project. **Dr. Decker recently accepted a faculty position with UNO that will start the Fall of 2011. Congratulations Leslie!** We have also intra-university collaborations from the Section of Geriatrics at UNMC (Dr. Jane Potter), the Department of Special Education and Communication Disorders at UNO (Dr. Mary Friehe and Dr. Amy Teten), the Department of Neurological Sciences at UNMC (Dr. Tony Wilson), national collaborations from the Pittsburgh Claude D. Pepper Older Americans Independence Center (Prof. Stephanie Studenski), and international collaborations from the Technical University of Lisbon, Portugal (Dr. Duarte Araújo).

Dr. Jane Potter (Chief of the Section of Geriatrics, Department of Internal Medicine at UNMC) provides invaluable clinical mentoring and patient recruitment on this project.



Rationale: It has been predicted that by 2020, chronic obstructive pulmonary disease (COPD) will be the third leading cause of death worldwide. Patients with COPD suffer extreme functional loss, even in mild COPD where lung function is almost normal. The specific mechanisms that contribute to functional loss in COPD patients are unclear, despite considerable research efforts. Attempts to attribute functional loss in COPD patients with levels of systemic inflammation have been inconclusive. However, inactivity due to breathlessness could be contributing to the problem. Investigating the biomechanics of walking, mechanical abnormalities in COPD can be identified. Identifying these mechanisms is vital to establishing proper rehabilitation and treatment protocols for COPD, as current pulmonary rehabilitation protocols are mildly successful.

General Goal: To determine if abnormal walking patterns are present due to COPD and whether or not these abnormalities are different for COPD patients with exercise intolerance due to breathlessness or due to muscular fatigue.

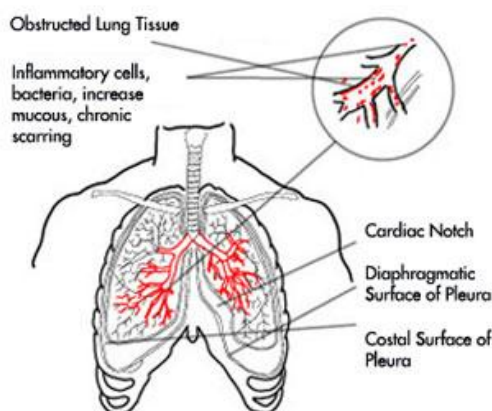
Status: One manuscript "Gait Abnormalities in COPD: An Investigation of the NHANES III Dataset" is currently under review. This investigation of a public use dataset from the Centers of Disease Control established preliminary evidence that gait abnormalities are associated with COPD and further, the level of severity of COPD. Further investigations of gait abnormalities are currently underway using sophisticated biomechanical analysis.

Preliminary results show COPD subjects to have altered gait patterns as compared to controls. The majority of these changes are at the knee and hip joints. Therefore, based on our preliminary research and the available literature, we propose that proximal muscles in COPD patients succumb to fatigue sooner than distal musculature.



Mary Carlson, NP, Dr. Jad Goraya, Dr. Stephen Rennard, Jenna Yentes, MS

Future goals: Continue enrollment of COPD patients. In addition, mild and moderate COPD patients will participate in a 6-week supervised training protocol. This will allow us to investigate the effect of increased physical activity on systemic inflammation and gait patterns in this population. Additionally, the project will seek to explore the changes associated with different interventions and treatments for COPD.



Funding: This project is currently funded by various grants awarded to Dr. Stergiou. Additional funding is provided by the **UNMC Center for Clinical and Translational Research Pilot Grant** program with Dr. Stephen Rennard as the principal investigator, while Dr. Stergiou and Jenna Yentes are listed as co-investigators. In addition, Jenna Yentes was able to acquire funds from the **Nebraska NASA Space Grant Foundation & EPSCoR**. She is aggressively pursuing funds from the NIH and several other sources.

People Involved: Dr. Nick Stergiou and graduate assistant, Jenna Yentes, are the NBCF laboratory personnel working on this project. Dr. Stephen Rennard from UNMC Department of Internal Medicine, Pulmonary, Critical Care, Sleep, & Allergy Section is the co-sponsor of this project and provides clinical support. In addition, Mary Carlson, NP and Deb Sumnick of the Pulmonary Clinical Studies Unit at UNMC have been instrumental in recruiting patients and assisting with the screening process. Students in the NBCF that have assisted with screening, data collections, and data analysis for this project are Jeff Kaipust, Mira Momcilovic, Erin Fosnaugh and Nate Hunt. Graduate student, Jon Carey, has been hired to assist with the exercise training protocol.



Rationale: 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 walk 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 and the scientific support for the application of these systems is limited.

General goal: To lay the foundation for the proper utilization of advanced biotechnology, such as virtual reality (VR) environment, on gait related disabilities.

Status: There are three ongoing studies that are being conducted in young healthy adults. The first study investigates the effect of VR on locomotor adaptation in healthy individuals adapting to a load attached to one of the lower limbs. Results from this study were presented at the Neuroscience Conference 2010 and a manuscript has been under review. The second study explores the effect of changes in the width and frequency of VR environments on walking strategies as reflected by step width and step frequency. Results from this study will be presented at the GCMAS 2010 conference. Lastly, the third study is coming from Dimitrios Katsavelis' doctoral work. Dimitrios has conducted two experiments in a single-screen passive stereo VR environment to identify walking stability in different visual conditions. Results from these experiments have been accepted for publication in the *Nonlinear Dynamics, Psychology, and Life Sciences Journal*.

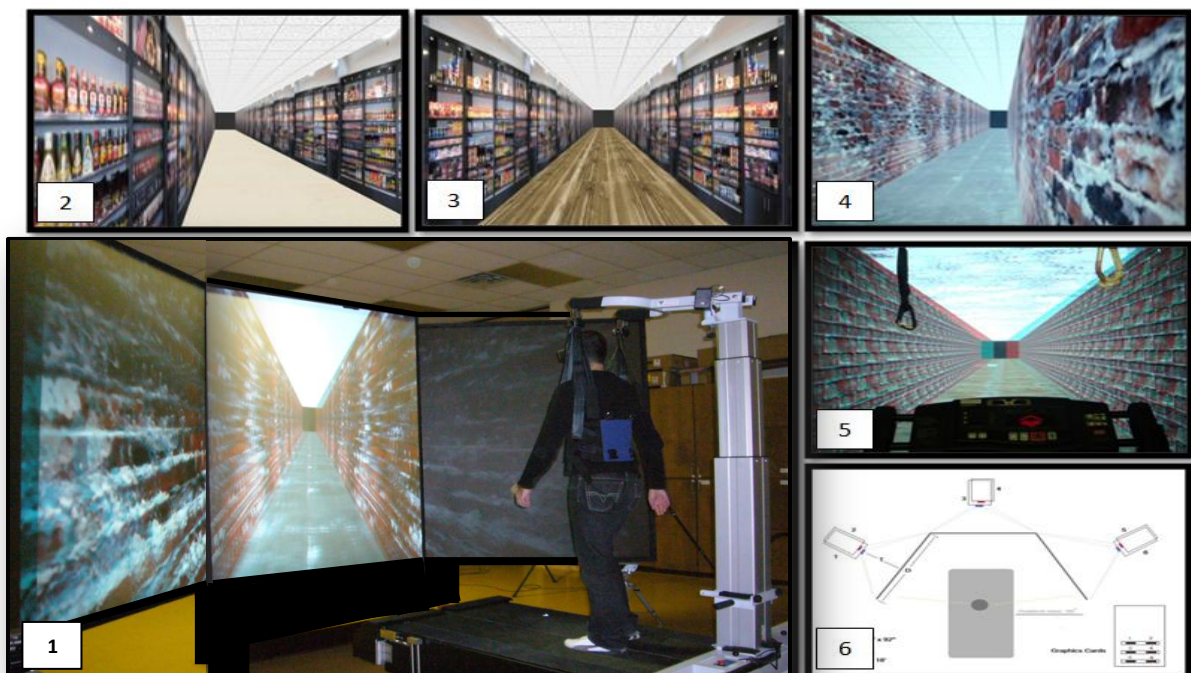


Future goals: Collect data from healthy young and older adults, as well as from clinical populations. Studies will include simple and complex VR environments with various optic flows and dimensions.

Funding: The project is currently funded by a grant from the **American Heart Association** awarded to Dr. Mukherjee, and a **research fellowship from UNMC** awarded to Dimitrios Katsavelis.

People involved: Dr. Nick Stergiou, Dr. Mukul Mukherjee, Dr. Joseph Siu and graduate students Dimitrios Katsavelis and Jung-Hung Chien are the NBCF laboratory personnel working on this project. Dr. Mukherjee, a post-doctoral research associate, received his BS in Physical Therapy from India and his PhD in Rehabilitation Sciences from the University of Kansas Medical Center. Dimitrios received his BS in Physical Education from the Aristotle University of Thessaloniki, his MS in Exercise Science from UNO, and is currently pursuing his doctorate through the Medical Science Inter-departmental Area (MSIA) Graduate Program through UNMC. Dr. Jane Potter (Chief of the Section of Geriatrics at UNMC) provides clinical support and patient recruitment.

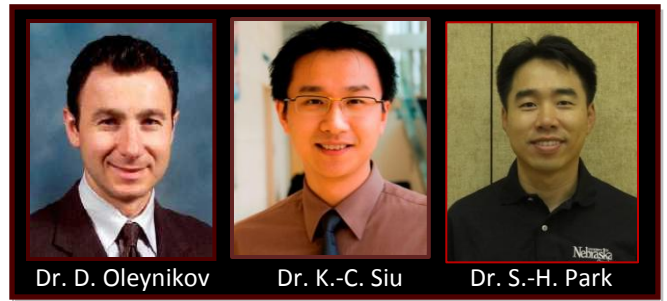
Set up of the 3D visualization system (1) and overhead configuration (6) of its compartments. Screenshots of the virtual reality environment (2) with different texture (3-5). The environment as seen from the user by using circular polarized glasses (4) and as seen by an observer (5).



Rationale: Robot-assisted surgery is a form of minimally invasive surgery performed by a surgeon who controls a medical robot like the daVinci™. With the advancement of medical developments due to new technology, it is now more challenging to learn surgical techniques, requiring more experience and practice to master them. This led us to consider alternative training environments outside the operating room. Virtual simulation has been increasingly implemented in medical education. Training in virtual simulation provides a risk-free and low-cost environment for surgical trainees to learn robotic surgery.

General goal: To implement an effective, quantifiable and cost-efficient training environment for surgical trainees. The implementation of a training program using simulation will provide trainees an optimal opportunity to learn robot-assisted techniques independently and effectively.

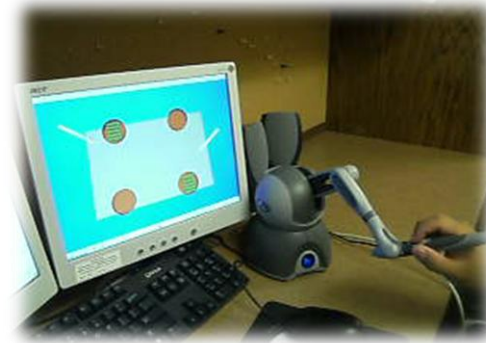
Status: There are three ongoing studies that are being conducted in this project. One study is developing a portable, cost-effective training simulator for robot-assisted surgery. The second one is exploring whether concurrent cognitive distractions affect the performance of robotic surgical tasks, and investigating whether feedback enhances the performance of robotic surgical tasks when cognitive distractions are present. The third study is developing an adaptive training framework with the daVinci™ surgical robot to learn fundamental surgical skills.



Future goals: The long term goal is to develop a training program for surgical trainees in robotic surgery that will be located at UNMC.

Funding: The project is currently funded by the **Nebraska Research Initiative (2008-2010)** and the **Center for Advanced Surgical Technology, University of Nebraska Medical Center.**

People involved: Dr. Ka-Chun Siu, our post-doc Dr. Shi-Hyun Park and graduate students Irene Suh and Jung-Hung Chien are the NBCF laboratory personnel working on this project. In addition, Dr. Dmitry Oleynikov, a robotic surgeon, from the University of Nebraska Medical Center and Dr. Song Ci, a computer engineer, from the University of Nebraska-Lincoln are the collaborators in this project.



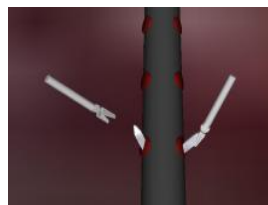
Our vRAMIST® simulator



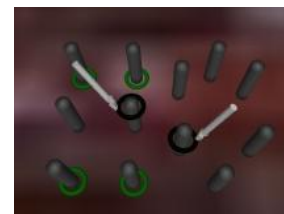
<http://www.unmc.edu/cast/>



Insite® Vision System:
Stereoscopic 3d vision



Animate surgical tasks



Endowrist® instruments :
reproduce hand movements



Hand manipulators with eight
-degree of freedom motion



Da Vinci Surgical System: 1) surgeon's console, 2) image processing equipment, and 3) surgical arm cart.



Foot pedals for Dvss navigation,
magnification, and reorientation

ROBOTIC REHABILITATION IN STROKE PATIENTS

In the NBCF, a strong collaborative team lead by Dr. Mukherjee is performing several research studies looking at the usefulness of robots for stroke rehabilitation. Dr. Mukherjee is working closely with Dr. Nick Stergiou and collaborating with Dr. Pierre Fayad, the chairman and Dr. Tony Wilson, Assistant Professor and Magnetoencephalography (MEG) scientist in the Department of Neurological Sciences at the University of Nebraska Medical Center. We initiated these studies with a fellowship from the **American Heart Association** and are continuing them with support from the **Nebraska Research Initiative**. Several extramural proposals are under review at the National Institute of Neurological Disorders and Stroke/National Institute of Health.



Dr. Fayad, M.D.



Dr. Wilson, Ph.D.



Dr. Mukherjee, Ph.D.

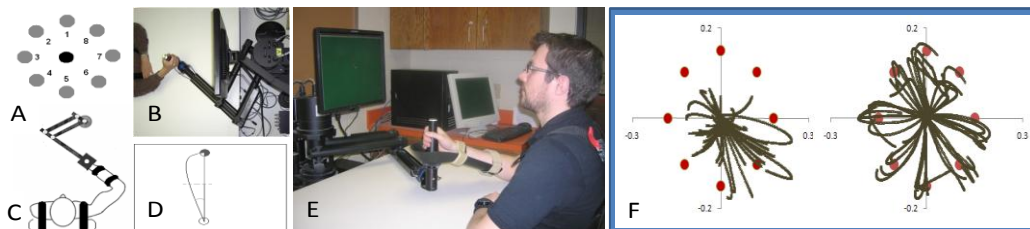


Learn and LiveSM



Nebraska Research Initiative

The figure below shows schematics, displays and the rehabilitation robot used in the following study: "The Effect of Augmented Sensory Feedback in Motor Learning of Upper Limb Movements in Chronic Stroke Survivors." The goal of the project was to determine whether training with visual feedback enhances the learning process of a new environment in chronic stroke survivors and to apply this training to examine the effect on the accuracy during reaching movements. Results from this study (shown in the figure below) will demonstrate the effectiveness of our techniques to improve motor learning in stroke survivors. Ongoing studies are investigating the mechanisms of these changes through innovative brain imaging technologies that will bring to light the correlates of these changes in the brain. These experiments will further the understanding of neural control of abnormal movements in stroke subjects and will provide a new direction to stroke rehabilitation.



STATE COLLABORATIONS

UNIVERSITY OF NEBRASKA MEDICAL CENTER

Department of Surgery

Iraklis Pipinos, MD – Vascular Surgeon
 Jason Johanning, MD – Vascular Surgeon
 Thomas Lynch, MD – Vascular Surgeon
 Dmitry Oleynikov, MD – General Surgeon

Department of Internal Medicine

Jane Potter, MD – Chief of Geriatrics
 Brenda Keller, MD – Section of Geriatrics
 Kalpana Padala, MD – Section of Geriatrics
 Steven Rennard, MD - COPD

Department of Neurological Sciences

Pierre Fayad, MD – Chair
 Tony Wilson, PhD – MEG Scientist

College of Nursing

Mary Filipi, PhD – Neuroscientist

College of Public Health

Kendra Schmid, PhD – Biostatistician



UNIVERSITY OF NEBRASKA AT OMAHA

College of Education

Jennifer Huberty, PhD – Health Promotion
 Elizabeth Leader-Janssen, PhD – Special Education and Communication Disorders
 Amy Teten, PhD – Special Education

College of Arts & Sciences

Jeffrey French, PhD - Psychobiologist
 Lisa Kelly-Vance, PhD - Psychologist
 Brigitte Ryalls, PhD – Cognitive Psych.
 Dora Matache, PhD – Mathematician
 John Konvalina, PhD - Mathematician
 Jack Heidel, PhD – Chair in Mathematics

College of Information Science & Tech.

Hesham Ali, PhD – Dean
 Jon Youn, PhD – Computer Scientist
 Raj Dasgupta, PhD – Computer Scientist
 Bastola Dhundy, PhD – Computer Scientist



UNIVERSITY OF NEBRASKA AT LINCOLN

Song Ci, PhD – Computer Engineer
 Hamid Sharif, PhD – Computer Engineer
 Brenda Wristen, PhD – Music and Dance



CREIGHTON UNIVERSITY

Joseph Threlkeld, PhD – Physical Therapist



MADONNA REHABILITATION HOSPITAL

Judith Burnfield, PhD – Physical Therapist



BOYS TOWN INSTITUTE

Michael Gorga, PhD – Director of the Human Sensory Physiology Laboratory.



MUNROE-MEYER INSTITUTE

Wayne Stuberg, PhD – Physical Therapist
 Regina Harbourne, PhD – Physical Therapist
 Sandy Willett, PhD – Physical Therapist

Shelley Smith, PhD – Molecular Geneticist
 Max Kurz, PhD - Biomechanist



IOANNINA MEDICAL CENTER – GREECE

Over the past decade, the NBCF laboratory has established a successful collaboration with the Orthopedic Sports Medicine Center of Ioannina (OSMCI). The OSMCI is a contemporary research laboratory that belongs to the Orthopedic Surgery Department of the University of Ioannina. Anastasios D. Georgoulis, Professor of Orthopedic Surgery, is the founder and director of the OSMCI. The experience of the personnel from OSMCI ranges from medical students and residents, to physical therapists, exercise physiologists and biomechanists. For more information, please visit:

<http://www.osmci.gr/en/home>



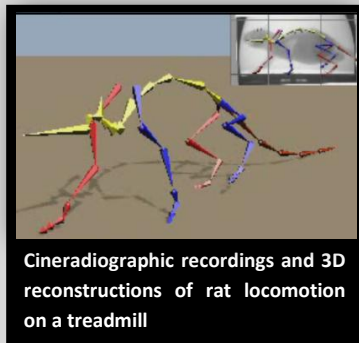
OSMCI members and visitors (2008).



We have several ongoing experiments to identify the best way to reconstruct the Anterior Cruciate Ligament (ACL). Dr. Stergou is currently the Scientific Consultant of OSMCI, who designs almost all ongoing experiments at this laboratory. He also helps with the organization and structure of OSMCI. He visits Ioannina at least three times a year to ensure that all projects progress smoothly.

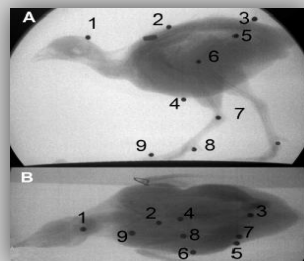
VARIABILITY IN ANIMAL LOCOMOTION – FRANCE

In collaboration with the team "Locomotion" located at the National Museum of Natural History of Paris (France), we have determined experimental protocols to investigate movement variability in small vertebrates (e.g. bird models such as duck and quail, dog models, rat and mouse models with Parkinson's disease) using advanced mathematical methods.



Cineradiographic recordings and 3D reconstructions of rat locomotion on a treadmill

UNO undergraduate students Nate Hunt and Benjamin Mawhiney are exploring gait variability in various animal models (e.g., myopathy mice, dog breeds). In collaboration with Dr. Stephen Bonasera (Section of Geriatrics, UNMC), our doctoral student Jung-Hung Chien is investigating patterns of ambulatory activity in older mice by examining the complexity of daily time series. Measures derived from nonlinear dynamics are applied on long-term kinematic data (collected on miniature treadmills using the technology of cineradiography) and center of pressure data (collected on low load miniature force platforms).



A. Side view and B. overhead view of our duck model

People Involved: Dr. Leslie Decker, Dimitrios Katsavelis, Jung Hung Chien, Nate Hunt, and Benjamin Mawhiney.
Collaborators: Drs. Jean-Pierre Gasc, Anick Abourachid, Marc Herbin and Rémi Hackert, and Bonasera.



NATIONAL COLLABORATORS

UNIVERSITY OF MICHIGAN

Beverly Ulrich, PhD – Professor in Movement Sciences and Director of the Developmental Neuromotor Control Lab
 Research interests: Infants, Down Syndrome, Parkinson's Disease.
 Daniel Ferris, PhD – Associate Dean of Research and Associate Professor at the University of Michigan (School of Kinesiology)
 Research interests:

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Kevin Guskiewicz, PhD, ATC – Professor and Department Chair of Exercise and Sport Science.
 Darin Padua, PhD, ATC – Associate Professor and Director of the Sport Medicine Research Laboratory.
 Research interests: Sport-related Concussion, ACL Injury.

UNIVERSITY OF DELAWARE

Cole Calloway, PhD – Associate Professor in Physical Therapy
 Research interests: Motor Behavior, Infant Development.

UNIVERSITY OF NEW ENGLAND

Jim Cavanaugh, PhD – Assistant Professor in Physical Therapy
 Research interests: Ambulatory Activity, Parkinson's Disease.

UNIVERSITY OF MARYLAND

John Jeka, PhD – Professor in Kinesiology
 Research interests: Motor Control, Sensorimotor Integration.

VIRGINIA COMMONWEALTH UNIVERSITY

Stacey Dusing, PhD – Assistant Professor in Physical Therapy
 Research interests: Preterm Infants, Pediatric Physical Therapy.

UNIVERSITY OF TENNESSEE, KNOXVILLE

Daniel Corbetta, PhD – Associate Professor in Motor Development
 Research: Perceptual & Motor Development.

UNIVERSITY OF KANSAS MEDICAL CENTER

Randolph Nudo, MD - Director of the Landon Center on Aging
 Research interests: Stroke, Neural Mechanisms.

UNIVERSITY OF NEVADA, LAS VEGAS

Janet Dufek, PhD – Associate Professor
 John Mercer, PhD – Associate Professor
 Research interests: Aqua Locomotion, Forensic Biomechanics.



Listed below are the names of special visitors, who came to look at our laboratory and get information with respect to our ongoing research projects. Each project group set up posters and provided a quick overview of the experimental procedures, the purpose of their study and the current important findings. All visitors expressed their pleasure of receiving a personal review of the work we do in the laboratory.

- Dr. Mary Filipi & National Multiple Sclerosis Society Health Practitioners..... March 2009
- Dr. Lau & Dr. Lee.....May 2009
- Dr. Woldstad..... May 2009
- Accorda Pharmaceuticals.....May 2009
- Questcare.....June 2009
- Dr. Leuschen & Dr. Meyer.....August 2009
- Mary Hawkins and Annette WilesNovember 2009
- MARRS magnet school.....December 2009

In addition, we regularly give tours to interested class groups such as high school biology classes, faculty and student candidates and interested collaborators. If you are interested in a tour, please, make arrangements by calling (402) 554-3075.

SOCIAL EVENTS



Moving day

NBCF members and visitors/guests always enjoy intellectual discussions, interaction and **food!!!**



That's why we love him!!!!



Halloween: Dr. Stergiou's wannabes.....

Who loves Dr. Stergiou?



Poor kids



Dr. Song Ci

Assistant Professor of Computer Engineering at the University of Nebraska at Lincoln.
Presented: An e-Healthcare Platform for small clinics using markerless human motion tracking techniques and nonlinear data analysis.



Dr. Daniel Ferris

Associate Dean of Research and Associate Professor at the University of Michigan School of Kinesiology.
Presented: Robotic lower limb exoskeletons for studying human locomotion.



Dr. Jason Johanning

Chief of Vascular Surgery and Associate Professor at the Department of Surgery, University of Nebraska Medical Center.
Presented: PAD: evidence based?



Dr. Randolph Nudo

Director of the Landon Center on Aging and Professor in the Department of Molecular and Integrative Physiology. University of Kansas Medical Center.
Presented: Brain machine interfaces for modulating recovery after stroke.



Dr. Jacob Sosnoff

Assistant Professor at the Department of Kinesiology and Community Health. University of Illinois at Urbana-Champaign.
Presented: Aging and motor variability: What are the underlying mechanisms?



Dr. Tom Buchanan

Deputy Dean at the College of Engineering and Professor at the Department of Mechanical Engineering, University of Delaware.
Presented: Biomechanics of ACL deficit knee.



Dr. Stephen Rennard

Professor of Medicine in the Pulmonary and Critical Care Medicine section, Department of Internal Medicine at the University of Nebraska Medical Center.



Dr. Teresa Wilcox

Associate Professor at the Department of Psychology, Texas A&M University.
Presented: Object processing in infants: Brain and Behavior.



Dr. Pierre Fayad

Reynolds Centennial Professor, Chairman at the Department of Neurological Sciences and Medical Director of Neurology University of Nebraska Medical Center.



Dr. David Vaillancourt

Associate Professor at the Department of Kinesiology and Nutrition, University of Illinois at Chicago.
Presented: Structural and functional neuroimaging in health and Parkinson's disease.



Dr. Stephen Bonasera

Assistant Professor at the Department of Internal Medicine, University of Nebraska Medical Center.



AWARDS

1. **UNO Strategic Planning Award in the area of Academic Excellence, 2010.**
2. Nick Stergiou, Ph.D. Reappointment to the Isaacson Professorship for a second three-year term (2008-2011).
3. Anastasia Kyvelidou, MS: NASPSPA Graduate Student Research Award, Motor Development Section, 2009.
4. Anastasia Kyvelidou, MS: *Reliability of COP measurements during sitting in developmentally delayed infants*. UNO Centennial Celebration of Student Research and Creative Activity, 3rd Place Graduate Poster Presentation, 2009.
5. Anastasia Kyvelidou, MS: Sensory Information and Sitting Postural Control of Infants. UNMC McDonald and Bukey Fellowships, 2009-2010.
6. Anastasia Kyvelidou, MS: UNMC Regents Tuition Fellowship, 2009-2010.
7. Dimitrios Katsavelis, MS: The Effect of Virtual Reality on Movement Variability, UNMC fellowship, 2009-2010.
8. Dimitrios Katsavelis, MS: *Nano Legends: An interactive virtual reality game induces high level of physical activity*. UNO Centennial Celebration of Student Research and Creative Activity, Honorable Mention Graduate Oral Presentation, 2009.
9. Jeffrey Kaipust, BS: *The effect of auditory stimulation on gait variability*, NASA, 2010.
10. Jeffrey Kaipust, MS: NASA Travel mini-grant to attend the Society of Neuroscience 39th Annual Meeting, 2009.
11. Jennifer Yentes, MS: NASA Travel mini-grant to attend the Society of Neuroscience 39th Annual Meeting, 2009.
12. Jennifer Yentes, MS: *The effect of dual motor tasking on gait variability*, NASA, 2010.
13. Jessie Huisinga, MS: *Balance training in Multiple Sclerosis patients*, NASA, 2010.
14. Jessie Huisinga, MS: NASA Travel mini-grant to attend the Society of Neuroscience 39th Annual Meeting, 2009.
15. Mira Momcilovic, BS: *Reliability test of handrail force during stair negotiation*, UNO University Committee for Research and Creative Activity Research Grant program, 2009.
16. Mukul Mukherjee, PhD: *The effect of augmented sensory feedback in motor learning of upper limb movements in chronic stroke survivors*, American Heart Association Midwest Affiliate Postdoctoral Fellowship, 2008-2009.
17. Neil Huben: 2nd Place Undergraduate Poster, 2009 Nebraska Physiological Society 12th Annual Meeting, 2009.
18. Neil Huben: Dr. Barbara Hayhome Memorial Undergraduate Scholarship, 2009-2010.
19. Neil Huben: Golden Key Research Grant, 2009.
20. Neil Huben: Honors thesis scholarship, UNO College of Arts and Sciences, 2009.
21. Neil Huben: *Locomotion mechanisms of rocker bottom shoes*, Nebraska Academy of Sciences research grant, 2009.
22. Neil Huben: Student Organizations and Leadership Programs *Who's Who*. 2009.
23. Neil Huben: *The effect of Masai Barefoot Technology (rocker bottom) shoes on joint kinematics and kinetics*, NASA, 2010.
24. Neil Huben: UNMC Summer Undergraduate Research Program, 2009.
25. Neil Huben: UNMC Summer Undergraduate Research Program, 2010.
26. Panagiotis Koutakis, MS: Alexandros Onassis Public Benefit Foundation, 2010-2013.
27. Sara Myers, MS and Panagiotis Koutakis, MS: *Induced lower extremity vascular occlusion affects gait variability*. UNO Centennial Celebration of Student Research and Creative Activity, 2nd Place Graduate Poster Presentation, 2009.
28. Sara Myers, MS: American Alliance for Health, Physical Education, Recreation, and Dance Ruth Abernathy Presidential Scholarship, 2010.
29. Sara Myers, MS: NASA Travel mini-grant to attend the Society of Neuroscience 39th Annual Meeting, 2009.
30. Sara Myers, MS: National Institutes of Health Ruth L. Kirschstein NRSA Individual Predoctoral Fellowship (F31), 2009-2012.
31. Sara Myers, MS: *The effect of muscular ischemia on strength*, NASA, 2010.
32. Sara Myers, MS: *The effect of aging and vascular occlusion on gait variability*, American Alliance for Health, Physical Education, Recreation, and Dance Graduate Student Grant in Aid, 2009-2010.
33. Shane Wurdeman. *Externally powered orthosis to supplement ankle torque in elderly*, NASA, 2010.



Sara Myers was recently awarded an \$86,408 F31 research training award from the National Institutes of Health for her dissertation study entitled "The effect of aging and vascular occlusion on gait variability". Sara is the first doctoral student from a UNO research laboratory to receive this training award. Interestingly, Sara is from Hampton Nebraska and the sample size of her study is larger than the population of her town! Sara received her BS and MS from UNO and she is pursuing her PhD from UNMC in the MSIA program sponsored by the Department of Surgery under the mentorship of Drs. Pipinos and Johanning. She was a star athlete from UNO as an undergraduate and has a perfect 4.0 for all of her degrees! She is also an exceptional mother and a wife showing that she is successful in every aspect of her life!



Panagiotis Koutakis received funding this year from the Onassis Public Benefit Foundation (\$43,000, three years) to complete his PhD under the mentorship of Dr. Stergiou. He is exploring how we navigate in space and especially how information from different senses guides us as we move. His motivation arises from animal research and specifically from ant locomotion and pigeon flying. These animals, even though they travel far away from their homes, develop motor memory that they use to know exactly how to come back. The Onassis Foundation is a very prestigious scholarship that is the outcome of funds left by the late billionaire. Panagiotis is also working closely with our post-doc Dr. Mukherjee in expanding the aims of this project.

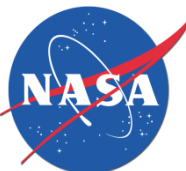


Anastasia Kivelidou received the NASPSPA Outstanding Student Paper award for her work "Differences of COP variability between full and pre term infants in the sitting position" that she presented at the North American Society for Psychology in Sports and Physical Activity. Austin, TX, June, 2009.

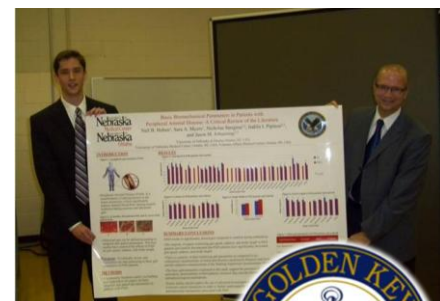


Six members of the NBCF laboratory have been funded from NASA to complete clinical-related projects. Congratulations to Jessie Huisinga, Jennifer Yentes, Sara Myers, Shane Wurdeman, Jeffrey Kaipust, and Neil Huben!!!

<http://ne.spacegrant.org/index.php?page=about>



The Golden Key International Honour Society recently selected University of Nebraska at Omaha student Neil Huben as the recipient of a 2009 Golden Key Research Grant valued at \$1,000. Each year, Golden Key awards more than \$600,000 in scholarships and awards. All Golden Key student members can apply for the Golden Key Research Grant, but only four outstanding students are selected to receive the honor for the fall semester. The grant will provide Neil with funding for travel to national conferences to present the results of his honors thesis study, "The effect of Masai Barefoot Technology (rocker bottom) shoes on joint kinematics and kinetics." His research explores the benefits of rocker bottom shoes in gait-impaired pathological populations, such as patients with peripheral arterial disease.



"It is an honor to present Neil with the Golden Key Research Grant," said John W. Mitchell, Golden Key's chief executive officer. "Our members are inspired and motivated not only to achieve exceptional academic accomplishments, but also to make a positive impact on our world through the society's commitment to service."



ARTICLES – REFEREED JOURNALS

1. Patras, K., Ziogas, G., Ristanis, S., Tsepis, E., Stergiou, N., Georgoulis, A.D. (2010) ACL reconstructed patients with a BPTB graft present an impaired vastus lateralis neuromuscular response during high intensity running. *J Sci Med Sport*. (Epub ahead of print).
2. Ziogas, G.G., Patras, K.N., Stergiou, N., Georgoulis, A.D. (2010) Velocity at Lactate Threshold and Running Economy Must Also be Considered Along With Maximal Oxygen Uptake When Testing Elite Soccer Players During Preseason. *J Strength Cond Res*. (Epub ahead of print).
3. Smith, B.A., Stergiou, N., Ulrich, B.D. (2010) Lyapunov exponent and surrogation analysis of patterns of variability: profiles in new walkers with and without down syndrome. *Motor Control*. 14(1):126-42.
4. Decker, L.M., Cignetti, F., Stergiou, N. (2010) Complexity and human gait. *Rev Andal Med Deporte*. 3(1):3-13.
5. Thigpen, C.A., Padua, D.A., Michener, L.A., Guskiewicz, K., Giuliani, C., Keener, J.D., Stergiou, N. (2010) Head and shoulder posture affect scapular mechanics and muscle activity in overhead tasks. *J Electromyogr Kinesiol*. (Epub ahead of print).
6. Siu, K.C., Suh, I.H., Mukherjee, M., Oleynikov, D., Stergiou, N. (2010) The impact of environmental noise on robot-assisted laparoscopic surgical performance. *Surgery*. 147(1):107-13.
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KEYNOTE SPEAKER

1. Stergiou N. Human movement variability in neurological sciences. *Grand rounds in neurology*. Omaha, UNMC, October 2009.
2. Stergiou N. Nebraska Biomechanics Core Facility. Collaborative *Research in Action. Clinical and Translational seminar*. Omaha, UNMC, August 2009.
3. Stergiou N. Research in the Nebraska Biomechanics Core Facility. *Biology Seminar Series*. Omaha, UNO, 2010.
4. Stergiou N. Human Movement Variability in Gait: examples for business related opportunities. *Creighton Business School Entrepreneurship Series*. Omaha, Creighton, 2009.
5. Stergiou N. Movement Variability and the Use of Nonlinear Tools: Principles to Guide Research in Human Movement. European Workshop on Movement Science. Lisbon, Portugal, 2009.
6. Katsavelis, D., Stergiou, N. Nonlinear analysis: Theoretical background and applications. *Invited lecture at the Winter School of Biomechanics*. Sao Paulo, Brazil, July, 2009.
7. Katsavelis, D., Stergiou, N. Movement variability and the use of nonlinear tools: From theory to applications. *Invited lecture at 13th Congress of the Brazilian Society of Biomechanics*. Sao Paulo, Brazil, July, 2009.
8. Katsavelis, D., Stergiou, N. Movement variability in the study of robot-assisted surgery and animal locomotion. *Invited lecture at 13th Congress of the Brazilian Society of Biomechanics*. Sao Paulo, Brazil, July, 2009.
9. Katsavelis, D., Stergiou, N. The future of biomechanics. *Invited lecture at 13th Congress of the Brazilian Society of Biomechanics*. Sao Paulo, Brazil, July, 2009.

Trip to Portugal

Dr. Nick Stergiou represented NBCF laboratory at the Technical University of Lisbon, Portugal. He was a keynote speaker at the European Workshop on Movement Science and he organized a one-day workshop on nonlinear analysis.



From right to left: Dr. João Barreiros, Dr. Nick Stergiou and Dr. Duarte Araújo.

Trip to Brazil

Dimitrios Katsavelis represented NBCF laboratory at the XIII Congress of the Brazilian Society of Biomechanics, Brazil. He was keynote speaker and also participated at the Winter School of Biomechanics.



From right to left: Dr. Paul Hodges, Dr. Joseph Hamill, Jeronimo and Dimitrios Katsavelis.

ROBOTIC EXPO

Dr. Joseph Siu, Dr. Shi-Hyun Park and doctoral student Jung-Hung Chien participated in the Nebraska Robotics Expo at the Strategic Air and Space Museum on January 30, 2010. They showcase our medical training simulator for about 500 local students, along with teachers, from 60 or more schools across Nebraska.



Neuroscience Conference at Chicago

ICIS Conference at Baltimore

Neuroscience Conference at Chicago

Nebraska Research and Innovation Conference

For more than 25 years, the revolutionary work of the Nebraska Biomechanics Core Facility (NBCF) Laboratory at UNO has led to a new understanding of human movement; such as how people stand, walk and physically interact with their environment. The laboratory 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 laboratory 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, multiple sclerosis, 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 laboratory addition, student scholarships and faculty support.

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