

2009

Nebraska Biomechanics Core Facility 2008 Annual Report, Issue 7

Nebraska Biomechanics Core Facility
University of Nebraska at Omaha

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Nebraska Biomechanics Core Facility

Strive for Excellence

Director's Message

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 in 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.

Isacson Professor and Director of the Nebraska Biomechanics Core Facility



Contents

Announcements2
Featured News3
Nonlinear Workshop ..5
Projects6
Collaborations13
Visitors14
Awards16
Publications17
Support20



Multiple Sclerosis



Virtual Reality



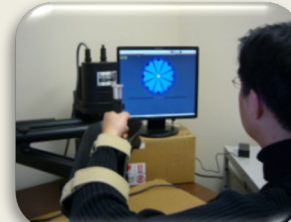
Gait & Cognition



Infant Sitting



Robotic Surgery



Stroke Rehabilitation

Nebraska Biomechanics Core Facility faculty and personnel have established a strong network at a local, national and international level. Supporters of our endeavors for excellence include local and national foundations, institutes and associations that have granted us 14 awards for a total of **\$6,626,549** 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 four-year award of **\$389,917** for the construction of a portable device (gait-o-gram) that serves as a prognostic and diagnostic tool for people with walking impairments (2004-2008), a two-year award of **\$538,000** for the construction of a novel wireless mobility monitoring system (2008-2010), 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) and a four-year award of **\$1,185,852** for constructing and testing new robotic surgical tools for minimal access surgery (2004-2008). Dr. Stergiou serves as PI for the first two Nebraska Research Initiative grants, while he is a co-investigator for the latter three. The last grant that is associated with robotic-assisted surgery comes from the University of Nebraska Medical Center for a four-year award of **\$769,698** granted to the Center for Advanced Surgical Technology (2005-2008).

Our leading project is related with our first lifetime milestone – sitting. 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 Monroe-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 four-year award of **\$450,000** to investigate the dynamics of development of sitting in children with cerebral palsy (2004-2008), and a new 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 Career Development Scholars award granted to Dr. Jason Johanning from the **American Geriatrics Society** to evaluate walking abnormalities in individuals with peripheral arterial disease (**\$150,000**; 2006-2008), and 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).

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).

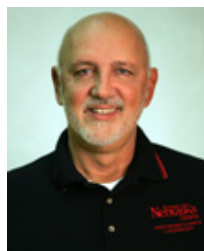


Back Row (left to right):

Panos Koutakis,
 Jeff Kaipust,
 Dimitrios Katsavelis,
 Nick Stergiou,
 Dan Blanke,
 Sara Myers,
 Jessie Huisinga,
 Jenna Yentes.

Front Row (left to right):

Mukul Mukherjee,
 Mira Momcilovic,
 Anastasia Kyvelidou,
 Irene Suh,
 Leslie Decker,
 Joseph Siu.



Dr. Blanke, founder of the Nebraska Biomechanics Core Facility Laboratory and Director of the School of Health, Physical Education and Recreation, helped to initiate and launch the Master of Public Health Program in 2000. He now chairs the Department of Health Promotion, Social and Behavioral Health within the College of Public Health at the Medical Center. Both Drs. Blanke and Stergiou have interviewed and recruited numerous faculty for the new college. They also participate in various committees that create new graduate majors and doctoral programs as well as developing needed courses. They held a retreat to strengthen existing collaborations, build new intercampus collaborations, and generally solidify the new college.

Dr. Stergiou continues to hold his primary appointment at University of Nebraska at Omaha (UNO) and has a special appointment with the College of Public Health. In addition, he continues to hold appointments with the UNO Psychology Department, the Department of Pediatrics and Surgery from the University of Nebraska Medical Center, 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.



Reappointment to the Isaacson Professorship for a second three-year term.

Internships – Internships – Internships – Internships – Internships – Internships – Internships – Internships – Internships

Internship opportunities in our lab!!!

The following students performed their internship in NBCF laboratory during 2008-2009.

- Jeff Kaipust (BS in Exercise Science at UNO).
- Katy Renahan (MS in Neuroscience and Applied Cognitive Science at University of Guelph, Canada)
- Jake Riggle (BS in Biological Systems Engineering at UNL)
- Kenneth Swantek (BS in Biotechnology at UNO)
- John Ernst (BS in Biotechnology at UNO)

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



NEW PERSONNEL

Jenna Yentes



Jenna - an Omaha-born doctoral candidate - received her Bachelor of Science in Kinesiology from the University of Northern Colorado (2000) and her Master of Science in Kinesiology from California State University at Fullerton (2006). Over the past year Jenna gained experiences by being involved with the majority of our projects. She also submitted a doctoral student proposal to the National Institute of Health and a tobacco proposal to study motor patterns in patients with chronic obstructive pulmonary disease. She is currently helping with the PAD and gait & cognition projects, while she is also responsible for projects that are related with our instrumented staircase. For her doctoral dissertation, she is planning to investigate motor behavior during dual motor task performance.

Mira Momcilovic



Mira received her Bachelor of Science in Exercise Science from Belgrade, Serbia (2008). She joined our program last Fall and she helps with data collections and analysis. She is currently assigned to work with projects that are related with our instrumented staircase. She also teaches the laboratory section of Anatomy and Physiology.

Jeff Kaipust

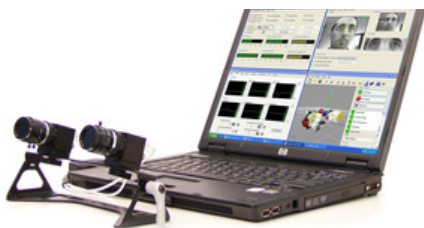


Jeff was born and raised in Omaha. He received a Bachelor of Science in Exercise Science from UNO (2008). He is currently working on his master thesis, which is dealing with how rhythmic aspects of music can affect the way we walk. He also helps with data collections and analysis for the MS and PAD projects and he teaches the laboratory section of Biomechanics.

The Nebraska Biomechanics Core Facility laboratory is fully equipped with key biomechanical research technologies and can provide services of consultation, data analysis, data collection, and software training, to the entire University of Nebraska 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 University 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)
- Force platforms (Kistler & AMTI).
- Instrumented treadmill (Bertec).
- Instrumented staircase (custom-made).
- Computerized Dynamic Posturography (Neurocom)
- Two electromyographic devices (Delsys & Bangoli)
- 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 system II & III)
- Multi-screen virtual reality system (custom-made).
- Stroke therapy robot for upper extremities (InMotion).
- Computerized Speech Lab (KayPentax).
- Two motorized treadmills.



EYE-TRACKING SYSTEM



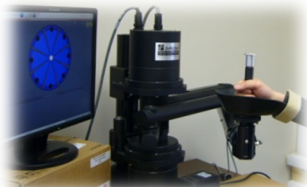
WIRELESS EMG



ELECTROGONIOMETERS



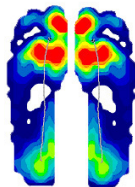
STRIDE ANALYZER



STROKE THERAPY ROBOT



EIGHT-CAMERA MOTION CAPTURE SYSTEM



PRESSURE INSOLES



Gait-O-Gram



DYNAMIC POSTUROGRAPHY



INSTRUMENTED TREADMILL



INSTRUMENTED STAIRCASE



WEIGHT-BEARING DEVICE

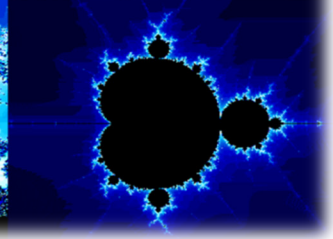
The Nebraska Biomechanics Core Facility laboratory offers a five-day nonlinear analysis workshop. The purpose of this workshop is to introduce research scientists, clinicians, educators and students to a variety of mathematical methods for the analysis of biological time series. Instructors will use class discussions and hands-on practice to facilitate understanding of the material covered in the lectures. Participants with varied backgrounds are welcome.

For more information, please, check our website:



<http://nbcf.unomaha.edu/nonlinear09.php>

Nonlinear Summer Workshop
August 3-7, 2009



TESTIMONIALS FROM PARTICIPANTS

I am very pleased with my experience in the NBCF Nonlinear workshop in 2008. I found the facilities and personnel to be quite hospitable and accommodating, but nothing compared to the quality of information that was disseminated during the lecture and hands-on sessions.

The knowledge I gained from Dr. Stergiou and his lab group bolstered my confidence in using nonlinear analysis techniques in the design of new studies, and prompted me to re-visit some of my older work to find underlying results that had previously gone unnoticed!

I can say with certainty that this experience was a corner-stone in my research career. I left with a great exposure to nonlinear analysis techniques and the experience of working with these analysis tools in both Matlab and CDA under the guidance of proven experts.

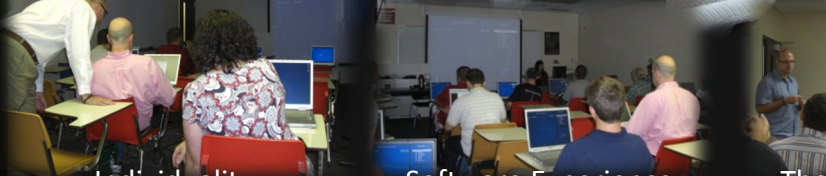
This experience is unmatched in quality, hospitality, and information versus any other experience that I have had. I would highly recommend this workshop to anyone interested in nonlinear analysis!

CLASS 2008



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

Daniel Russel	Reading, PA
Dwight Waddell	Oxford, MS
Joshua Haworth	Oxford, OH
Jose Algaba del Castillo	Seville, Spain
Juan Garbalosa	Hamden, CT
Maria Lebedowska	Washington D.C.
Mathias Hieronymus	Oxford, OH
Orlando Fernandes	Lisbon, Portugal
Stacey Dusing	Richmond, VA



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 the medical intervention is limited to the treatment and prevention of complications arising from CP's effects. However, because infants with symptoms of CP are not



R. Harbourne, PT

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.

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

Status: Recently, we completed the first part of this project (US Department of Education, National Institute of Disability and Rehabilitation Research; **NIDRR, 2004-2008**), and determined how reliable our methodology was, described the progression of sitting in typically developing infants and tested the efficacy of two different early intervention protocols in infants with developmental delay or diagnosed with CP. In this \$450,000 four-year study which ended in December 2008, we learned that stages of sitting can be reliably defined using biomechanical tools. We also learned that the progress and strategies of an infant with developmental motor delays is different from that of a typical infant learning to sit. These differences can be clearly demonstrated using biomechanical tools. We have also verified that the effectiveness of different types of treatment for infants with developmental motor delays, such as CP, can be objectively measured to a greater degree with biomechanical tools, than by the tools clinicians and physical therapists presently use. As part of this grant, our team launched a new website:



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

We have recently had a new grant proposal (**NIDRR, 2008-2011**) funded, and the goal is to test the efficacy of other treatments used in early intervention of moderate to severe cerebral palsy children aged between 2 and 6 years, a group of children who have been neglected in previous intervention studies.

Dr. Stergiou is now in year four of 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**. In this project, we determined how infants that are born prematurely differ in the development of sitting from term infants. We demonstrated that term infants develop differently in the front-to-back and side-to-side direction than premature infants, which is very helpful for therapeutic interventions and especially in targeting different aspects of sitting development.

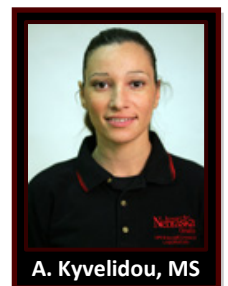
We have also received a new grant from the **Nebraska Research Initiative** to build the Balance-o-Gram, which is a portable force platform that can be carried to different locations, such as patient's home, clinical office or laboratory to collect biomechanical data from an infant's body sway. This biomedical device will help in the detection of early balance impairments during sitting development in infancy.

In collaboration with Dr. Stacey Duising, we have 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. Duising is an assistant professor at the Virginia Commonwealth University.



Dr. S. Duising

Our collaboration with the Boys Town National Research Hospital for the research study proposed by our doctoral candidate Anastasia Kyvelidou is still going strong and we have almost completed the data collection with the typically developing infants. This study is based on our current research on the sitting control of infants and we are interested in the contribution of three kinds of stimuli on the sitting control in typically developing infants and 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, in 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.



A. Kyvelidou, MS

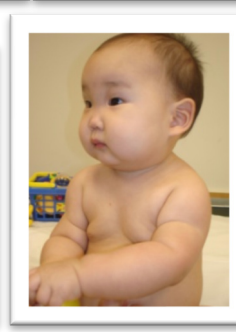
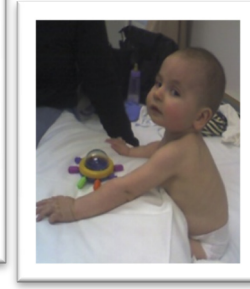
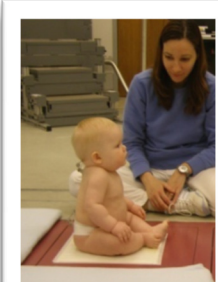
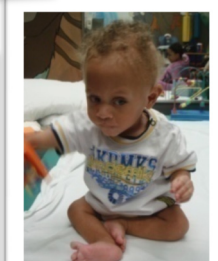
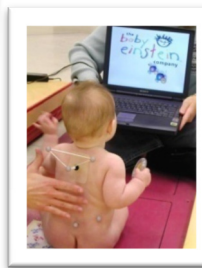
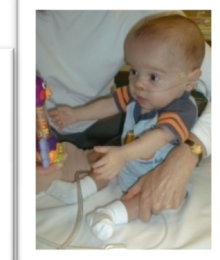
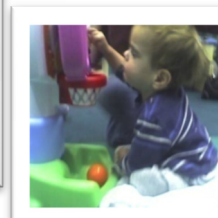
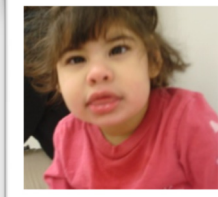
Future goals: In the future, the project will continue to expand the investigation of rehabilitation options for developmentally delayed infants and children by developing and evaluating new treatment protocols. Additionally, the project will seek to explore new technologies which may be applied to diagnose 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 these grants. Anastasia Kyvelidou is currently funded by the **Bukey and MacDonald Fellowship** from the University of Nebraska Medical Center and with a Regents Tuition fellowship.

People involved: Dr. Nick Stergiou, Dr. Joseph Siu and graduate student Anastasia Kyvelidou are the Nebraska Biomechanics Core Facility laboratory personnel working on this project. Anastasia Kyvelidou received her BS in Physical Education from the Aristotle University of Thessaloniki, her MS in Exercise Science from UNO, and is currently pursuing her doctorate through the University of Nebraska Medical Center. In addition, Jenna Yentes assists with data collection and analysis, as well as lab volunteers. Regina Harbourne and Sandy Willett from the Munroe-Meyer Institute at UNMC have extensive experience working with this clinical population. They provide clinical support and patient recruitment on this project. Other collaborators include Lisa Kelly-Vance and Bridgette Ryalls from the Psychology Department at UNO.



The Stars



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.

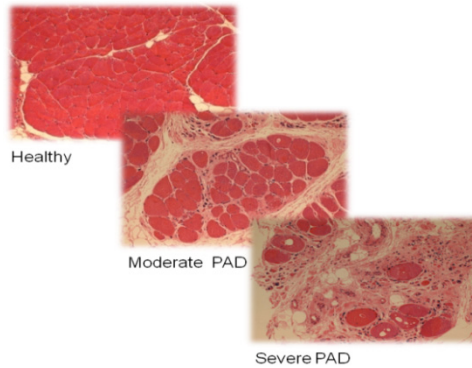
General goal: To determine the limitations caused by the disease and also to decide which treatments are best for the PAD patients.

Status: A total of 95 PAD patients and 31 controls have been tested and analyzed since 2004. Results from this project have shown that patients with PAD have problems walking compared to healthy controls. Specifically, the ankle is not able to push the body forward like it should. We have also established that patients with PAD have more variable move-

ment patterns at the ankle, knee and hip as compared to healthy controls. This could possibly make PAD patients less stable and more likely to fall. 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.

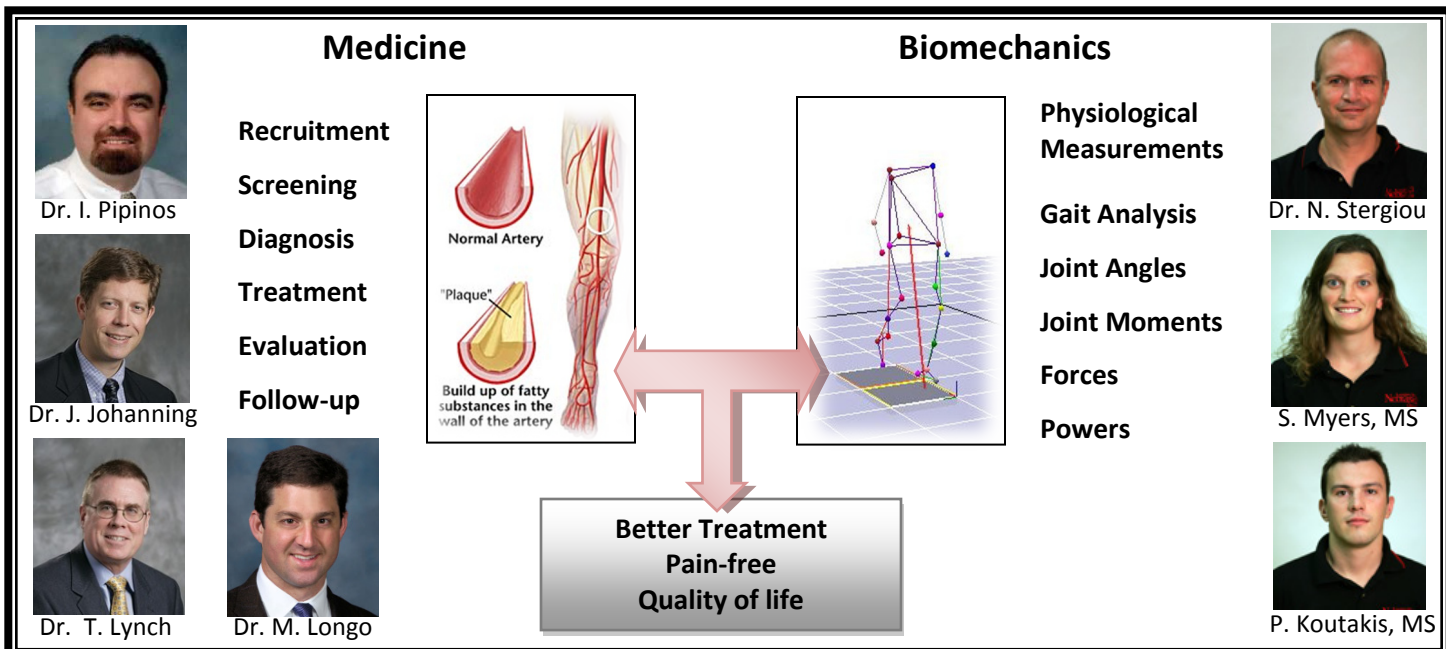
Future goals: Modify treatment strategies based on results of our studies. Develop devices for screening, assistance and rehabilitation for patients with PAD.

Funding: The research team concluded the last year of a three-year grant from the **American Geriatric Society** awarded to Dr. Johanning. Other funds include the **American Society of Biomechanics** and **NASA** awards that have been awarded to Sara Myers.



Muscle tissue from healthy and PAD patients.

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 Omaha Veterans Affairs Nebraska-Western Iowa Health Care System. Dr. Nick Stergiou, and graduate student Sara Myers are the NBCF laboratory personnel working on this project. Sara Myers received her BS and MS in Exercise Science from UNO, and is currently pursuing her doctorate through the University of Nebraska Medical Center. In addition, Panagiotis Koutakis, Jenna Yentes and Jeff Kaipust assist with data collection and analysis, as well as lab 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.

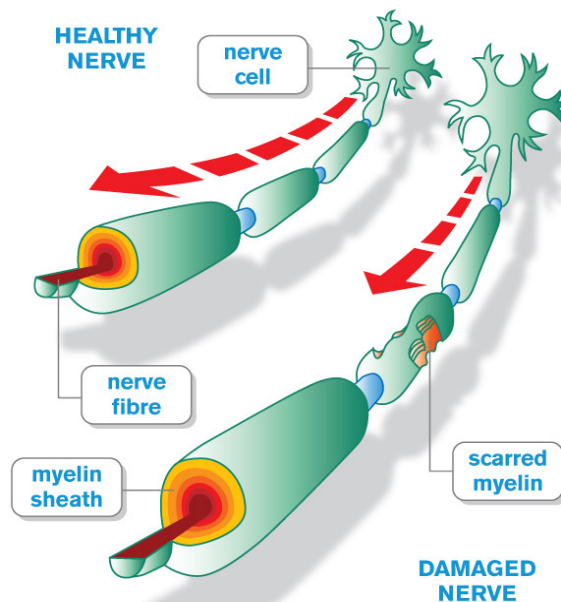
Status: There are two ongoing studies within the scope of the MS project. In the first study, we assess the effectiveness of resistance training in improving walking and balance parameters. Over the past two years 29 patients with MS completed six months of training and three gait assessments, while 6 patients are currently in training. Results from study have been presented at four different national conferences, whereas 5 manuscripts are in progress.

In the second study, we assess the effectiveness of elliptical training in improving walking parameters as a result of neuroadaptive mechanisms. The study has been recently approved by the Institutional Review Board and we have collected five pilot subjects. Currently, eleven are enrolled with more being actively recruited.

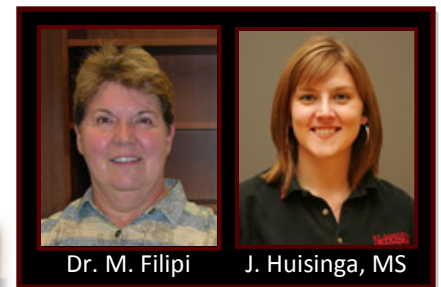
Future goals: In the future, the project will continue to expand the investigation of rehabilitation options for MS patients by developing and evaluating new treatment protocols. Additionally, the project will seek to explore new technologies which may be applied to monitor the health status of MS patients.

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 student Jessie Huisinga are the NBCF laboratory personnel working on this project. Jessie Huisinga received her BS in Biomedical Engineering from the University of Iowa, her MS in Exercise Science from UNO and is currently pursuing her doctorate through the University of Nebraska Medical Center. In addition, Jenna Yentes and Jeff Kaipust assist with data collection and analysis, as well as lab volunteers and interns. 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



Dr. M. Filipi

J. Huisinga, MS

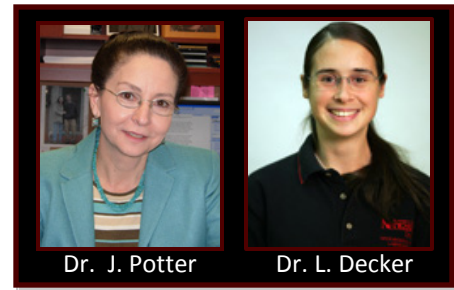


Rationale: Risk of falls may be related to changes in certain aspects of brain function. This research seeks to develop tools to identify older people at risk for falls. Walking under dual-task conditions could be helpful in detecting walking disorders at a preclinical stage and planning targeted therapeutic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

General goal: To investigate the relationship between walking variability and cognitive tasks relying exclusively on language and auditory modalities.

Status: We have collected a total of 35 young adults and 14 healthy elderly (non-fallers). Results showed that 1) high-demanding cognitive tasks result in more “robotic” looking and rigid walking patterns in healthy young adults, 2) subjects performing first the cognitive tasks and then cognitive tasks while walking, are more prone to cope with dual-tasks than subjects in the reverse order, 3) the dichotic listening test, which measures auditory attentional capacities, had a greater effect on stride width and than verbal tasks in healthy young adults, 4) modulation of attention to the right ear seems to affect principally the motor control of the left side of the legs in the elderly (results have been interpreted within the framework of brain laterality reorganization in aging), and 5) difficulty of the cognitive task is important in shaping the relationship between cognition and gait control. This preliminary work resulted in the acceptance of two peer-reviewed abstracts for Neuroscience 2008, one peer-reviewed abstract for Gait and Clinical Movement Analysis Society (GCMAS) 2009, and one peer-reviewed abstract for the International Association of Gerontology and Geriatrics (IAGG) World Congress of Gerontology and Geriatrics 2009.

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.



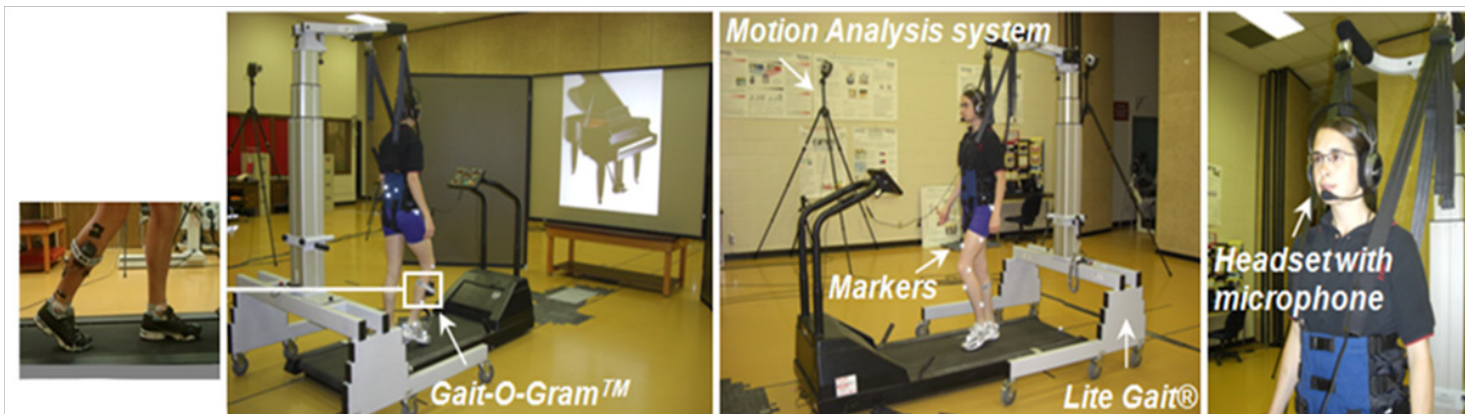
Dr. J. Potter

Dr. L. Decker

Funding: The project is currently funded by the **Nebraska Geriatric Education Center** grant awarded to Dr. Potter. Additional funding includes a **NASA** award that have been granted to Sara Myers and 2 grants from the Nebraska Research Initiative.

People involved: Dr. Nick Stergiou, Dr. Leslie Decker and graduate students Sara Myers, Jenna Yentes, Dimitrios Katsavelis and Mira Momcilovic are the NBCF laboratory personnel working on this project. Dr. Decker, a post-doctoral research associate, received her BS in Kinesiology and Exercise Science, her MS in Physiology and Biomechanics and her PhD in Biomechanics from the University of Pierre & Marie Curie in Paris, France. We have collaborators from the Computer and Electronics Engineering Department at the University of Nebraska-Lincoln (Dr. Song Ci, Assistant Professor, and Dr. Lim Nguyen, Associate Professor), 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) and the Pittsburgh Claude D. Pepper Older Americans Independence Center (Dr. Stephanie Studenski).

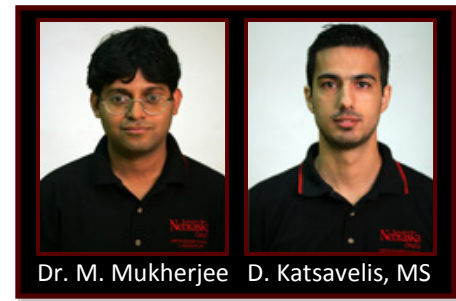
Dr. Jane Potter (Chief of the Section of Geriatrics, Department of Internal Medicine at UNMC) provides clinical support and patient recruitment on this project.



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. With VR 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 a 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. Preliminary results from this study were presented at the Neuroscience Conference. 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. The third is a preliminary study from Dimitrios' doctoral work. Dimitrios has conducted two experiments in a single-screen VR environment trying to identify walking stability in different optic flow conditions. He has developed the algorithms for our VR environment and he is currently working with Dr. Dan Cliburn, a computer scientist from the University of the Pacific, to expand the VR environment onto three screens.

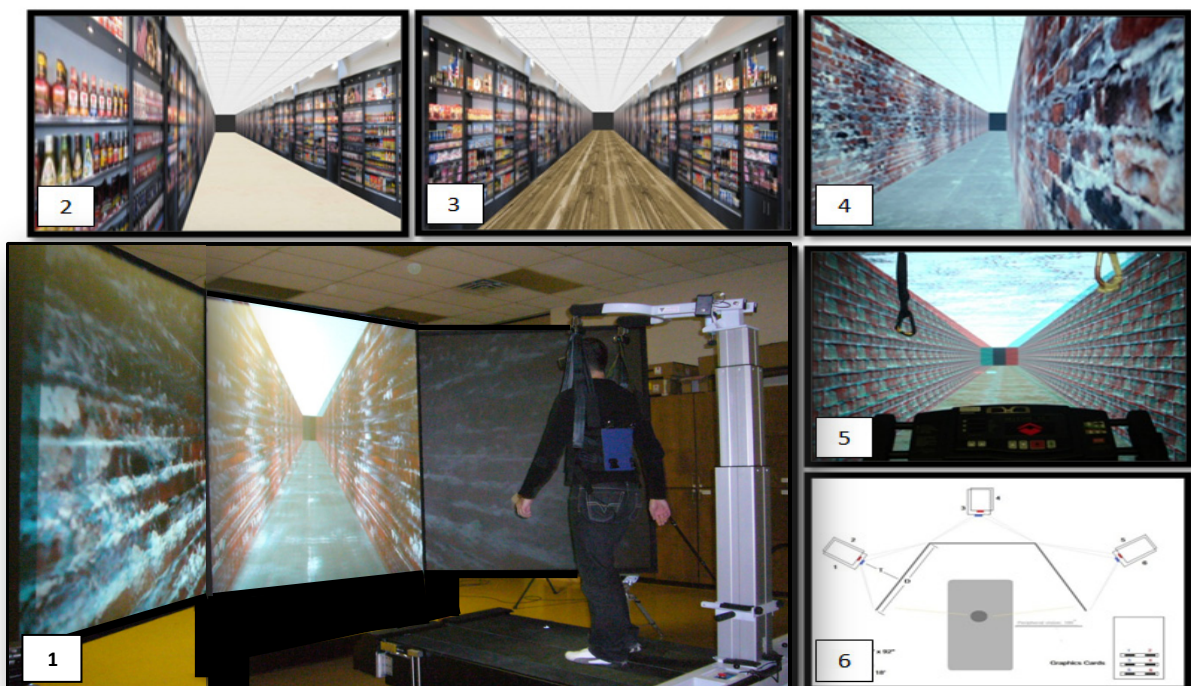


Future goals: Collect data from healthy young and older adults, as well as from clinical populations. Studies will include simple and complex VR environments of various optic flows and dimensions.

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 student Dimitrios Katsavelis 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 components. 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).



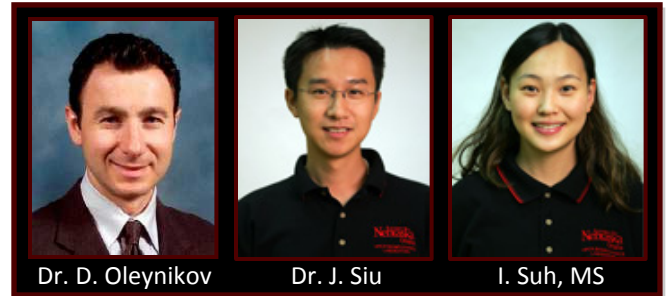
Rationale: Robotic surgery is a form of minimally invasive surgery performed by a surgeon who controls a specialized robot like the daVinci™. With the advancement of medical developments of new technology, it is now more challenging to learn surgical techniques, requiring more experience and practice 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 new surgical techniques using a surgical robot.

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 training module with the daVinci™ surgical robot to learn fundamental surgical skills. 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 a portable, cost-effective training simulator for robot-assisted surgery.



Our vRAMIST® simulator



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. Nick Stergiou, Dr. Joseph Siu, Dr. Mukul Mukherjee, and graduate student Irene Suh are the NBCF laboratory personnel working on this project. Dr. Siu, a post-doctoral research associate, received his BS in physical therapy from Taiwan and his PhD in Human Physiology from the University of Oregon. Irene received her BS in

Computer Science and her MS in Mathematics from UNO. She is currently pursuing her doctorate through the Medical Science Inter-departmental Area (MSIA) Graduate Program through the University of Nebraska Medical Center. 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.

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

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

ROBOTIC REHABILITATION IN STROKE PATIENTS

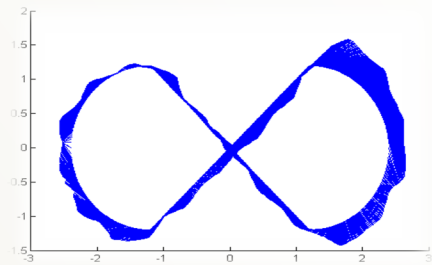
Dr. Mukherjee is a post-doctoral research associate, who has received a grant from the American Heart Association. His project deals with the effect of augmented sensory feedback in motor learning of upper limb movements in chronic stroke survivors. The main goal of the project is to determine whether 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 accuracy during reaching movements. Dr. Mukherjee is working closely with Dr. Nick Stergiou and he also collaborates with Dr. Pierre Fayad, department chair of Neurological Sciences at the University of Nebraska Medical Center. Results from this study will further the understanding of sensorimotor control of reaching movements in stroke subjects and may provide a new direction for stroke rehabilitation.



PATH INTEGRATION & SPACE NAGIVATION

Panagiotis Koutakis just finished his Master Thesis under the guidance of Dr. Nick Stergiou. He explored how young healthy adults navigate in space after having visual or somatosensory feedback. Participants performed either a simple task (circle) or a complex task (figure-eight). Furthermore, each participant was allowed to either visually inspect the selected pathway or was guided through it while blindfolded. Participants were then asked to walk blindfolded through the pathway. Results showed that while somatosensory feedback is more dominant during simple tasks, visual feedback becomes more important as the complexity of the task increases.

Panagiotis has received funding from the Alexandros Onassis Public Benefit Foundation. He will continue working with Dr. Stergiou during his doctorate.



Directional error between the ideal and the actual trajectory during a figure-eight pathway.



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 – Pulmonary Care

Department of Neurological Sciences

Pierre Fayad, MD – Chair

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

Brigette Ryalls, PhD – Cognitive Psych.

Dora Matache, 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 College of Engineering

Song Ci, PhD – Computer Engineer

Hamid Sharif, PhD – Computer Engineer



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, MS – Physical Therapist
Sandy Willett, PhD – Physical Therapist

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



IOANNINA MEDICAL CENTER – GREECE

Over the past 10 years, 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 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>



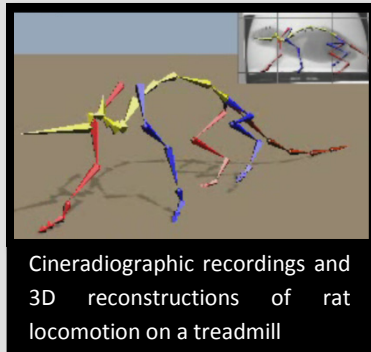
OSMCI members and visitors (2008).



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. duck and quail models, 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



People Involved: Dr. Leslie Decker, Dimitrios Katsavelis and Ken Swantek.
Collaborators: Drs. Jean-Pierre Gasc, Anick Abourachid, Marc Herbin and Rémi Hackert

COGNITION IN ELDERLY – NORWAY

Dr. Claudia Rodriguez-Aranda is a Professor in Psychology at the University of Tromsø and specializes in cognition in the elderly. Sharing a common interest in studying the relationship between cognitive and motor functions, Dr. Rodríguez and our lab personnel designed experimental procedures using dual-task paradigms to understand how cognitive demands, especially those related to attention, affect gait. We commenced these experiments during Dr. Rodríguez stay in our laboratory with healthy populations. Our laboratory continues the experimental protocol with healthy elderly and fallers.



NATIONAL COLLABORATORS

UNIVERSITY OF MICHIGAN

Beverly Ulrich, PhD – Professor in Movement Sciences and Director of the Developmental Neuromotor Control Lab
 Beth Smith, MS – Physical Therapist, Doctoral Candidate.
 Research interests: Infants, Down Syndrome, Parkinson's Disease.

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 CALIFORNIA, BERKELEY

David Anderson, PhD
 Research interests: Optic Flow, Infant Development.

UNIVERSITY OF THE PACIFIC

Dan Cliburn, PhD – Assistant Professor in Computer Science
 Research Interests: Virtual Reality, Visualization.

UNIVERSITY OF NEVADA, LAS VEGAS

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

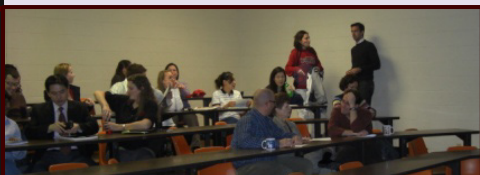


Below are listed special visitors, who came to look at our laboratory and get information with respect to our ongoing research projects. Each project group set up posters and provided a quick overview of the experimental procedures, the purpose of their study and the current important findings. All visitors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

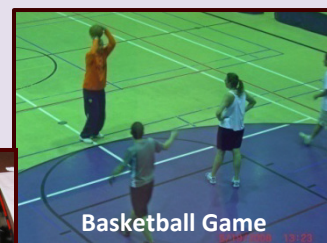
- Emily Dank, TCF Prosthetic Representative Trainee
to complete her internship at VA Nebraska-Western Iowa..... March 2008
- Sarah Pullen Senator Hagel’s Defense staffer..... March 2008
- Dr. Shane Farritor’s Class UNL-Mechanical Engineering..... April 2008
- Dr. Mary McDermott Northwestern University..... April 2008
- Michael Brzica & 2 staffers Rep..... May 2008
- Dr. Richard Hoffman..... Executive VP and Provost..... May 2008
- Dr Jennifer Larsen..... UNMC Director of Diabetes Center..... August 2008
- Dr. Teten..... UNO Psychology..... August 2008
- Dr. Timothy Broderick..... DOD-TATRC..... August 2008
- Mike Peter..... UniMed..... September 2008
- Drs. Hynes, Conway & Edick..... UNO Administration..... November 2008
- Glenn Wragge with PT & OT students from Millard Public Schools..... January 2009
- National Multiple Sclerosis Society representatives..... February 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 at (402) 554-3075.

SOCIAL EVENTS



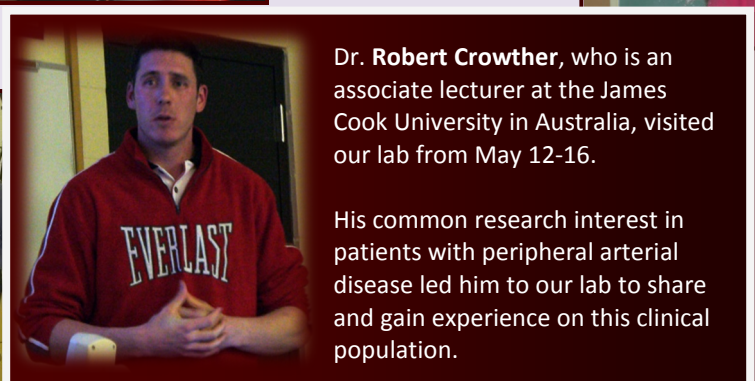
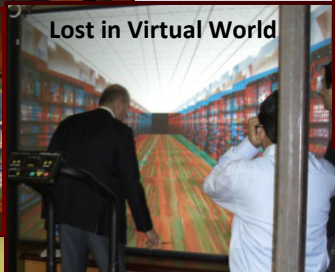
NBCF members and visitors/guests always enjoy intellectual discussions, interaction and food!!!



Basketball Game



Halloween Party →



Dr. Robert Crowther, who is an associate lecturer at the James Cook University in Australia, visited our lab from May 12-16.

His common research interest in patients with peripheral arterial disease led him to our lab to share and gain experience on this clinical population.

Dr. Petra Hauf

Professor in the Department of Psychology at St. Francis Xavier University. Nova Scotia, Canada. Presented: Baby Do – Baby See – Baby Learn: Action Understanding during infancy.



Dr. Nicholas Smith

Director of the Perceptual Development Laboratory at Boys Town National Research Hospital, Omaha, Nebraska.



Dr. Daniela Corbetta

Associate Professor in the Department of Psychology at the University of Tennessee, Knoxville. Presented: Motor Development, Complexity & Sensorimotor Experience.



Dr. Debra Romberger

Professor and Vice Chair of research in the UNMC Department of Internal Medicine and associate Chief of staff research and development at the Omaha Division of the Veterans Affairs Nebraska-Western Iowa Health Care System



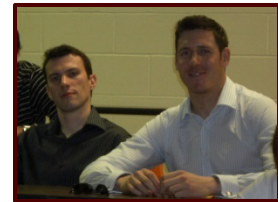
Dr. Tony Wilson

Assistant Professor in the Department of Neurological Sciences at the University of Nebraska Medical Center.



Dr. Robert Crowther

Associate lecturer and manager of the Movement Analysis Laboratory at the James Cook University, Australia.



Dr. Kalpana Padala

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



AWARDS

1. Nick Stergiou, Ph.D. Honored at the 2008 Research Innovation Awards hosted by the University of Nebraska Medical Center and the UNeMed Corporation for his recent invention the Balance-o-Gram.
2. Nick Stergiou, Ph.D. Reappointment to the Isaacson Professorship for a second three-year term. (2008-2011).
3. Anastasia Kyvelidou, MS: Sensory Information and Sitting Postural Control of Infants. UNMC. McDonald and Bukey Fellowships for 2008-2009.
4. Anastasia Kyvelidou, MS: Sigma Xi Grant-in-Aid of Research 2008.
5. Jennifer Yentes, MS: Chronic Obstructive Pulmonary Disease and Gait. NASA. 2008.
6. Jessie Huisinga, MS: Classification of movement characteristics of multiple sclerosis patients following an exercise intervention. American Society of Biomechanics Grant-in-Aid 2008-2009.
7. Jessie Huisinga, MS: Nonlinear posture assessment in multiple sclerosis patients as a model for measurement of functional alteration in astronauts. NASA, 2008.
8. Dimitrios Katsavelis, MS: The effect of virtual reality on movement variability. UNMC. Fellowship for 2008-2009.
9. Panagiotis Koutakis, BS: Scholarship, Alexandros Onassis Public Benefit Foundation. 2007-2009.
10. Panagiotis Koutakis, BS: Impact of resistance training on balance in Multiple Sclerosis patients. University Committee on Research and Creative Activity. 2008-2009.
11. Sara Myers, MS: NASA Nebraska Space Grant Scholarship for Service. 2008.
12. Sara Myers, MS: The effect of aging and vascular occlusion on variability in gait patterns. American Society of Biomechanics Grant-in-Aid. 2008-2009.
13. Sara Myers, MS: The interaction between cognitive and gait function in healthy young. NASA.
14. Sara Myers, MS: The effect of aging and vascular occlusion on gait variability. AAHPERD Research Grant Program. 2009
15. Erin Fosnaugh, BS: NASA Nebraska Space Grant Summer Internship. Summer 2008.
16. Jeff Kaipust, BS: NASA Nebraska Space Grant Summer Internship. Summer 2008.
17. Anastasia Kyvelidou, Dimitrios Katsavelis, Sara Myers & Panagiotis Koutakis. Awarded at the University of Nebraska at Omaha Centennial Celebration Research Fair. March 2009.

ARTICLES – REFEREED JOURNALS

1. Volkman KG, Stergiou N, Stuberger W, Blanke D, Stoner J. (2009) Factors affecting functional reach scores in youth with typical development. *Pediatric Physical Therapy*. 21(1):38-44.
2. Harbourne RT, Stergiou N. (2009) Perspective on movement variability and the use of nonlinear tools: Principles to guide physical therapy practice. *Physical Therapy*. 89(3):1-15.
3. Suh IH, Siu KC, Mukherjee M, Monk E, Oleynikov D, Stergiou N. (2009) Consistency of performance of robot-assisted surgical tasks in virtual reality. *Studies in Health Technology and Informatics*. 142:369-73.
4. Mukherjee M, Siu K-C, Suh IH, Andrew K, Oleynikov D, Stergiou N. (2009) A virtual reality training program for improvement of robotic surgical skills. *Studies in Health Technology and Informatics*. 142:210-14.
5. Chouliaras V, Ristanis S, Moraiti C, Tzimas V, Stergiou N, Georgoulis AD. (2009) Anterior cruciate ligament reconstruction with a quadrupled hamstrings tendon autograft does not restore tibial rotation to normative levels during landing from a jump and subsequent pivoting. *Journal of Sports Medicine & Physical Fitness*. 49(1):64-70.
6. Potach DH, Katsavelis D, Karst GM, Latin RW, Stergiou N. (2009) The effects of a plyometric training program on the latency time of the quadriceps femoris and gastrocnemius short-latency responses. *Journal of Sports Medicine & Physical Fitness*. 49(1):35-43.
7. Judkins TN, Oleynikov D, Stergiou N. (2009) Electromyographic response is altered during robotic surgical training with augmented feedback. *Journal of Biomechanics*. 42(1):71-6.
8. Judkins TN, Oleynikov D, Stergiou N. (2008) Enhanced robotic surgical training using augmented visual feedback. *Surgical Innovation*. 15(1):59-68.
9. Celis R, Pipinos II, Scott-Pandorf MM, Myers SA, Stergiou N, Johanning JM. (2009) Peripheral arterial disease affects kinematics during walking. *Journal of Vascular Surgery*. 49(1):127-32.
10. Judkins TN, Oleynikov D, Stergiou N. (2009). Objective evaluation of expert and novice performance during robotic surgical training tasks. *Surgical Endoscopy*. 23(3):590-7.
11. Harbourne RT, Deffeyes JE, Kyvelidou A, Stergiou N. (2009) Complexity of postural control in infants: Linear & Nonlinear features developed by principal component analysis. *Nonlinear Dynamics, Psychology and Life Sciences*. 13(1):123-44.
12. Kyvelidou A, Kurz MJ, Ehlers JL, Stergiou N. (2008) Age and partial body weight support affects gait variability. *Journal of Neuroengineering Rehabilitation*. 5(1):22.
13. Houser JJ, Decker L, Stergiou N. (2008) Stepping over obstacles of different heights and varied shoe traction alter the kinetic strategies of the leading limb. *Ergonomics*. 7:1-13.
14. Chen SJ, Pipinos II, Johanning J, Radovic M, Huisinga JM, Myers SA, Stergiou N. (2008) Bilateral claudication results in alterations in the gait biomechanics at the hip and ankle joints. *Journal of Biomechanics*. 41(11):2506-14.
15. Myers SA, Johanning JM, Stergiou N, Lynch TG, Longo GM, Pipinos II. (2008) Claudication distances and the Walking Impairment Questionnaire best describe the ambulatory limitations in patients with symptomatic Peripheral Arterial Disease. *Journal of Vascular Surgery*. 47(3):550-5.
16. Katsavelis D, Siu K-C, Brown-Clerk B, Lee IH, Lee YK, Oleynikov D, Stergiou N. (2008) Validated robotic laparoscopic surgical training in virtual reality environment. *Surgical Endoscopy*. 23(1):66-73.

PRESENTATIONS - ORAL

1. Huisinga JM, Filipi ML, Stergiou N. Resistance Training Alters Joint Moments and Powers in Multiple Sclerosis Patients Independent of Disease Severity. Presented at the 14th Annual Meeting of the GCMAS. Denver, Colorado. March 2009.
2. Koutakis P, Yentes J, Myers S, Kaipust J, Johanning J, Pipinos II, Stergiou N. Lower extremity joint kinetics are altered in patients with unilateral peripheral arterial disease. Presented at the 14th Annual Meeting of the GCMAS. Denver, Colorado. March 2009.
3. Dusing SC, Kyvelidou A, Mercer VS, Stergiou N. Movement Variability in Pre-Term and Full-Term Infants at Term Age. Presented at the APTA meeting. Las Vegas, Nevada. February 2009.
4. Katsavelis D, Rickertsen B, Stergiou N. Nano Legends: an interactive virtual reality game induces high level of physical activity. Presented at the 17th MMVR Annual Meeting, Long Beach, California. January 2009.
5. Mukherjee M, Siu K-C, Suh IH, Andrew K, Oleynikov D, Stergiou N. A Virtual Reality Training Program for Improvement of Robotic Surgical Skills. Presented at the 17th MMVR Annual Meeting, Long Beach, California. January 2009.
6. Suh IH, Siu K-C, Mukherjee M, Monk E, Oleynikov D, Stergiou N. Consistency of Performance of Robot-Assisted Surgical Tasks in Virtual Reality. Presented at the 17th MMVR Annual Meeting, Long Beach, California. January 2009.
7. Ristanis S, Siarava E, Stergiou N, Georgoulis AD. An in-vivo examination of the effect of femoral tunnel placement during ACL reconstruction on tibial rotation. Presented at the 4th NACOB annual meeting, Ann Arbor, Michigan. August 2008.
8. Deffeyes JE, Kochi N, Harbourne RT, Kyvelidou A, Stuberger WA, Stergiou N. Nonlinear detrended fluctuation analysis of sitting center-of-pressure data as an early measure of motor development pathology in infants. Presented at the SCTPLS Convention, Richmond, Virginia. August 2008.

9. Filipi M, Leuschen P, Stergiou N, Huisinga J, Agawral S, Schmaderer L, Kucera D. Impact of Resistance Training on Balance in Multiple Sclerosis. Presented at the 19th *International Nursing Research Congress focusing on Evidence –Based Practice*. Singapore. July 2008.
10. Myers SA, Stergiou N, Pipinos II, Johanning JM, Blanke D, Chen S-J. Gait variability is altered in peripheral arterial disease patients prior to the onset of pain. Presented at the 16th *Congress of the European Society of Biomechanics*. Lucerne, Switzerland. July 2008.
11. Johanning JM, Myers SA, Longo GM, Lynch TG, Koutakis P, Celis R, Stergiou N, Pipinos II. Persistent gait deficits following successful revascularization in patients with peripheral arterial disease. Presented at the *Vascular Annual Meeting*. San Diego, California. June 2008.
12. Kochi N, Stergiou N, Cavanaugh JT. Detrended Fluctuation Analysis and Entropy Rate reveal motor control strategies in the variability of step activity data. Presented at the *NASPSPA Conference*. Niagara Falls, Ontario, Canada. June 2008.
13. Kyvelidou A., Harbourne RT, Deffeyes JE, Stuberger WA, Shostrom VK, Stergiou N. Changes of COP variability across development of sitting posture in typically developing infants. Presented at the *NASPSPA Conference*. Niagara Falls, Ontario, Canada. June 2008.
14. Katsavelis D, Decker L, Kochi N, Stergiou N. Effects of optic flow produced by virtual reality on gait variability. Presented at the *NASPSPA Conference*. Niagara Falls, Ontario, Canada. June 2008.
15. Huisinga J, Filipi M, Stergiou N. Balance in Multiple Sclerosis patients is affected by resistance training. Presented at the *NASPSPA Conference*. Niagara Falls, Ontario, Canada. June 2008.
16. Deffeyes JE, Harbourne RT, Kyvelidou A, Stuberger WA, Stergiou N. Entropy based assessments of developmental delay in infants learning to sit. Presented at the *NASPSPA Conference*. Niagara Falls, Ontario, Canada. June 2008.
17. Smith BA, Stergiou N, Ulrich BD. Development of gait periodicity in new walkers with Down syndrome: a mathematical perspective. Presented at the *NASPSPA Conference*, Niagara Falls, Ontario. Canada. June 2008.
18. Lee IH, Siu K-C, Mukherjee M, Oleynikov D, Stergiou N. A Novel Training Program for Learning Robot-Assisted Surgery. Presented at the *International Student Forum*. Omaha, Nebraska, June 2008.
19. Johanning JM, Celis RI, Myers SA, Pipinos II, Radovic M, Stergiou N, Chen SJ, Keller BK, Potter JF. Significant reduction in performance of timed up and go in both young and elderly patients with symptomatic peripheral arterial disease: Implications for research and clinical practice. Presented at *AGS Annual Meeting*. Washington, D.C. April 2008.

PRESENTATIONS - POSTER

1. Kyvelidou A, Harbourne RT, Stuberger WA, Stergiou N. Sitting postural control in developmentally delayed infants: A stochastic or deterministic process? Presented at the *Annual Meeting of the GCMAS*. Denver, Colorado. March 2009.
2. Yentes, J., Koutakis, P., Myers, S., Kaipust, J., Pipinos, I., Johanning, J., Stergiou, N. Unilateral intermittent claudication affects joint kinematics during gait. Presented at the *Annual Meeting of the GCMAS*. Denver, Colorado. March 2009.
3. Katsavelis D, Mukherjee M, Decker L, Stergiou N. Lower extremity joint kinematic variability as produced by virtual reality during backward walking. Presented at the *Annual Meeting of the GCMAS*. Denver, Colorado. March 2009.
4. Kyvelidou A, Harbourne RT, Stuberger WA, Stergiou N. Reliability of COP measurements during sitting in developmentally delayed infants. Presented at the *APTA meeting*. Las Vegas, Nevada. February 2009.
5. Decker LM, Rodríguez-Aranda C, Myers SA, Stergiou N. Cognitive performance on high-demanding tasks affects gait variability in healthy young adults. Presented at *Neuroscience*. Washington, D.C. November 2008.
6. Deffeyes JE, Harbourne RT, Kyvelidou A, Stuberger WA, Stergiou N. Largest Lyapunov exponent shows infant sitting postural sway is chaotic. Presented at *Neuroscience*. Washington, D.C. November 2008.
7. Mukherjee M, Katsavelis D, Stergiou N. The effect of virtual reality on locomotor adaptation. Presented at *Neuroscience*. Washington, D.C. November 2008.
8. Rodríguez-Aranda C, Decker L, Myers SA, Stergiou N. Interplay between gait and attention: The unfavorable effects of walking on learning and cognitive performance of high demanding tasks. Presented at *Neuroscience*. Washington, D.C. November 2008.
9. Lee HI, Siu K-C, Mukherjee M, James E, Oleynikov D, Stergiou N. Examination of a novel robot-assisted surgical training program by comparing subjective and objective evaluations. Presented at the *ACS annual clinical congress*. San Francisco, California. October 2008.
10. Koutakis P, Myers SA, Johanning JM, Pipinos II, Stergiou N. Bilateral intermittent claudication affects joint powers during gait. Presented at the 4th *NACOB annual meeting*. Ann Arbor, Michigan. August 2008.
11. Myers SA, Pipinos II, Johanning JM, Stergiou N. Induced lower extremity vascular occlusions affects gait variability. Presented at the 4th *NACOB annual meeting*. Ann Arbor, Michigan. August 2008.
12. Huisinga JM, Filipi M, Stergiou N. Resistance training alters joint powers in Multiple Sclerosis patients. Presented at the 4th *NACOB annual meeting*. Ann Arbor, Michigan. August 2008.
13. Kochi N, Decker LM, Katsavelis D, Stergiou N. The minimum number of data points required to compute approximate entropy for gait data. Presented at the 16th *ESB congress*. Lucerne, Switzerland. July 2008.
14. Lee IH, Siu K-C, Mukherjee M, Oleynikov D, Stergiou N. A Novel Training Program for Learning Robot-Assisted Surgery. Presented at the *NASPSPA Conference*. Niagara Falls, Ontario, Canada. June 2008.

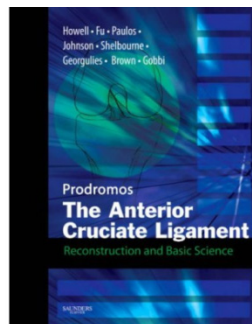
15. Myers SA, Stergiou N, Pipinos II, Johanning JM, Blanke D, Chen SJ. Nonlinear measures indicate gait variability is altered by Peripheral Arterial Disease Presented at *NASPSA Conference*. Niagara Falls, Ontario, Canada. June 2008.
16. Harbourne RT, Kyvelidou A, Deffeyes JE, Stergiou N. The Effect of Stochastic Noise to Improve Sitting Postural Control in Infants with Moderate to Severe Cerebral Palsy. Presented at *NASPSA Conference*. Niagara Falls, Ontario, Canada. June 2008.
17. Lee IH, Siu K.C, Katsavelis D, Oleynikov D, Stergiou N. Nonlinear Analysis Quantifies Learning in Robot-Assisted Laparoscopic Surgery. Presented at the *SAGES Annual Meeting*. Philadelphia, Pennsylvania, April 2008.
18. Stergiou N, Deffeyes J, Harbourne RT, DeJong SL, Kyvelidou A, Stuberger WA. Nonlinear analysis of sitting postural sway indicates developmental delay in infants. Presented at the *XVIth Biennial ICIS*. Vancouver, Canada, March 2008.
19. Kyvelidou A, Harbourne RT, Deffeyes JE, Stuberger WA, Sun J, Stergiou N. Reliability of body sway measurements during infant sitting posture development. Presented at the *XVIth Biennial ICIS*. Vancouver, Canada, March 2008.
20. Harbourne RT, Deffeyes JE, DeJong SL, Kyvelidou A, Stuberger WA, Willett S, Stergiou N. Efficacy of a Perceptual-Motor Intervention for Sitting Postural Control in Children with Moderate to Severe Cerebral Palsy Using Measures of Complexity. Presented at the *XVIth Biennial ICIS*. Vancouver, Canada, March 2008.

KEYNOTE SPEAKER

1. Stergiou N. Human Movement Variability From A Motor Development Perspective. *Invited lecture at the University of Ioannina Medical Center, Thessaloniki, Greece, April, 2008.*
2. Stergiou N. Tibial Rotation and ACL Reconstruction. Invited presentation at the South Central American Society of Biomechanics Annual Meeting, Odessa Texas, March 2008.

CHAPTER & SECTIONS

1. Stergiou N, Ristanis S, Moraiti C, Georgoulis A. (2008). Gait Analysis in ACL Deficient and Reconstructed Knee. In: Prodromos, C. *The Anterior Cruciate Ligament: Reconstruction and Basic Science*. Saunders Company/Elsevier. (1st edition) pp. 615-624.



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