3-2006

HPER Biomechanics Laboratory 2005 Annual Report, Issue 4

Nebraska Biomechanics Core Facility
University of Nebraska at Omaha

HPER Biomechanics Laboratory

2005 Annual Report

March 2006 Issue 4

In This Issue

Message from the Director

HPER Biomechanics Lab Director, Nick Stergiou, PhD.

Our laboratory was established for the purpose of developing a new understanding of the dynamical aspects of human movement. The laboratory is a flourishing enterprise where engineers, scientists and clinicians get together to gain additional insights on healthy and abnormal movement patterns. The laboratory uses techniques from biology, engineering and mathematics to understand the complexity of the neuromuscular system. Such techniques have revolutionized the way we perceive how the neuromuscular system controls human movement.

Our laboratory has earned a national and international reputation of excellence in basic and clinical research. Several domestic and international visitors have toured our facilities and collaborated with our research team. Our annual report is designed to give you a brief look at who we are and what we do. We hope that after reading about us that you will want to come to the HPER Biomechanics Laboratory and visit us in person as well.

Nick Stergiou, PhD

Dr. Nick Stergiou
Isaacson Professor and
Director of the HPER Biomechanics Laboratory
University of Nebraska at Omaha
tel. (402) 554-3075 fax (402) 554-3693

Contact Us

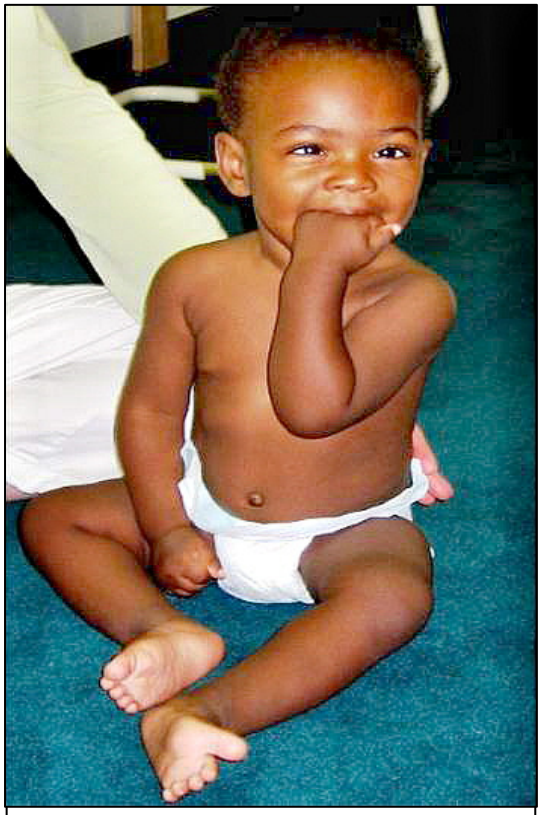
lholst@mail.unomaha.edu

http://www.unocoe.unomaha.edu/hper/bio/home.htm

Dr. Stergiou Receives a K25-Award from the National Institutes of Health

Dr. Nick Stergiou was awarded a coveted "Mentored Quantitative Research Career Development Award" from the National Center of Medical Rehabilitation Research. This center is located within the National Institute of Child Health and Human Development of the National Institutes of Health. This five year, $577,182 K25-award titled "Nonlinear analysis of postural function in infants" began in August of 2005. The purpose of this award is to help quantitative scientists like Dr. Stergiou become more focused on biomedical and behavioral research.

This award provides Dr. Stergiou with a five-year period of research and study. He will even receive focused coursework to learn about child motor development and clinical pediatrics. Towards this end, his frequent collaborator, Dr. Jeffrey French, University of Nebraska at Omaha-Psychology, will be his primary mentor. Dr. French will expose Dr. Stergiou to basic behavioral research. Dr. Bradley Schaefer, of the University of Nebraska Medical Center – Pediatrics, is his co-mentor. Dr. Schaefer is the Chief of Medical Genetics at the Munroe-Meyer Institute for Genetics and Rehabilitation. He serves as Dr. Stergiou's guide in applied clinical pediatrics. Dr. Stergiou will also receive pertinent instruction by his consultants Dr. John Jeka, University of Maryland, and Dr. Jack Heidel, University of Nebraska at Omaha. Dr. Jeka is the Director of the Cognitive Motor Neuroscience Laboratory. This laboratory has been investigating human postural control for the last 10 years. Dr. Heidel, a long time collaborator of Dr. Stergiou, is the chair of UNO's Mathematics Department. He will assist Dr. Stergiou in his efforts in applying chaos and nonlinear mathematics to clinical pediatrics. This excellent team of mentors and consultants will help him to focus his efforts in infant motor behavior and neurophysiology in a clinical setting. As a by-product of this interdisciplinary effort, there will be stronger collaborative ties between several departments at UNO and with the UNMC Pediatrics Department.

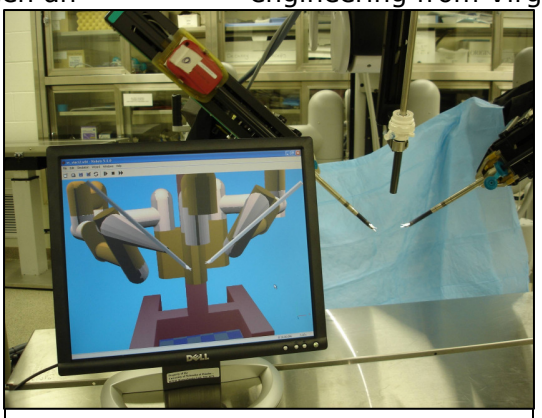


Infant in final sitting posture.

This NIH award compliments his award from the National Institute of Disability and Rehabilitation Research (NIDRR). Once again, the Monroe Meyer Institute, under the direction of Dr. Wayne Stuberg and with the support of their experienced physical therapists Regina Harbourne and Stacey DeJong, will facilitate his research experience. He will explore how typically developing infants develop the ability to sit upright. In the later years of the K25-award, Dr. Stergiou will also study infants having benign congenital hypotonia.

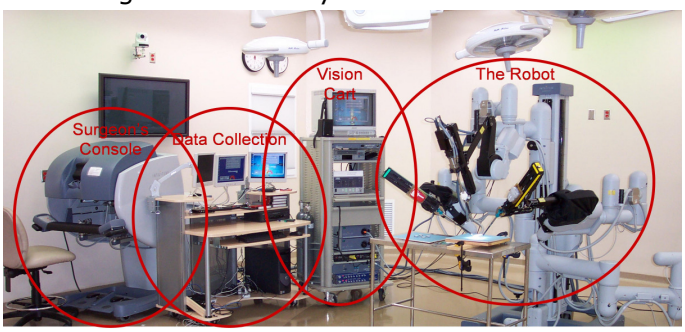
Training Methods to Improve Robotic Laparoscopic Surgery

Laparoscopy is a minimally invasive surgical technique that has been an invaluable tool for diagnosing abdominal pathology. It can be performed with manually operated graspers. It can also be performed with robotic surgical systems such as the daVinci™ Surgical System from Intuitive Surgical. The novel abilities of such systems in terms of precision and efficiency have recently received great attention. However, the best methods for training surgeons in robotic laparoscopy have not been established. This problem is addressed with various research projects performed by our laboratory, and in conjunction with medical doctors from the University of Nebraska Medical Center. We have been able to identify several parameters that can be used to judge proficiency in robotic surgery. In addition, we are in the process of developing feedback techniques to improve performance and a virtual reality training simulator. Our work is supported by funds from the Nebraska Research Initiative. Our ultimate goal is to develop an international certificate program for surgeons training in robotic laparoscopy administered here in Omaha.



Visual comparison of the actual and the virtual reality simulated da Vinci™ surgical robot.

Graduate student Tim Judkins is heading the laboratory's efforts toward this project. Tim has a BS degree in computer engineering from Virginia Tech and an MS in Biomedical Engineering from Marquette University. He is now pursuing his PhD in Biomedical Engineering under the direction of Dr. Stergiou. A multidisciplinary team of students is also contributing to the success of this research: Matthew Fiedler (Exercise Science, MS), Hitika Tanwar (Telecommunications, MS), Jason Alter (Exercise Science, BS), and Imran Khader (Biological Systems Engr, BS). Several of our research results have been presented at these national conferences: the American Society of Biomechanics, the Society for American Gastrointestinal and Endoscopic Surgeons, the IEEE Conference on Rehabilitation Robotics, and at the Medicine Meets Virtual Reality Conference. In addition, some of the research outcomes are in press or published in Surgical Endoscopy journals.



The da Vinci™ Robotic Surgical System with our data collection setup.

We are also participating in the Center for Advancement of Surgical Technology (CAST). CAST is a collaborative effort between UNO, UNMC, and the UNL to facilitate interaction and collaborative research between surgeons, physicians, life scientists, engineers, and computer scientists specifically interested in contributing to work on the advancement of surgical technology. Currently, this collaboration has resulted in several patent-pending technologies and work is continuing on other devices. Current CAST members are Dr. Dmitry Oleynikov (UNMC), Dr. Shane Farritor (UNL), Dr. Susan Hallbeck (UNL), Dr. Stephen Platt (UNL), Dr. Nick Stergiou (UNO), and administrator Marsha Morien (UNMC).

Progress Update for Federal Grant:

The Development of Sitting Posture in Children with Cerebral Palsy

Dr. Stergiou and his colleagues from the Munroe-Meyer Institute, Reggie Harbourne and Dr. Wayne Stuberg, are beginning the second year of a three year $450,000 grant from the US Department of Education and the National Institute on Disability and Rehabilitation Research. The title of the grant is the "Investigation of the dynamics of development of sitting postural control in infants with cerebral palsy". This collaboration has led to innovative ways to evaluate the development of sitting posture in children. This grant enables our research to move forward in establishing baseline data for the diagnosis of movement disorders and the examination of treatment efficacy. Our research team also develops clinical tools that can assist in determining effective treatments for children with movement dysfunction and early detection of disabilities. Reggie Harbourne and Dr. Stergiou presented our work at the IIIStep Conference last July. The Summer institute on Translating Evidence into Practice (STEP) is a multidisciplinary summer institute which is held approximately every twenty years. It is designed to advance physical therapy for people with movement dysfunction through the translation of movement science into effective clinical interventions. Our research received enthusiastic comments from many participants and it is also invited to appear as a scientific paper in the Journal of Neurologic Physical Therapy. It was a great honor to be included in this conference as it sets the tone for the research and clinical practice in physical therapy for the next 15 to 20 years.

The typical set up with researcher, infant and mother during data collection.

Graduate students Joan Deffeyes and Anastasia Kyvelidou are among the HPER Biomechanics Laboratory graduate students that work on this project. Joan received a MS in Mechanical Engineering from Stanford and she is currently pursuing her PhD in Psychobiology under the direction of Dr. Stergiou. Natasha received her BS in Exercise Science from the Aristotle University of Thessaloniki in Greece. She is currently pursuing her MS in Exercise Science.

For this project, we need infants developing typically (age 4 months) and infants who are at risk/diagnosed for cerebral palsy, ages 5 months to 2 years. If you know of a baby that falls in this category and would like to participate please contact Reggie Harbourne (559-6415 or rharbour@unmc.edu) or Lisa Holst (554-3075 or lholst@mail.unomaha.edu) for additional information.

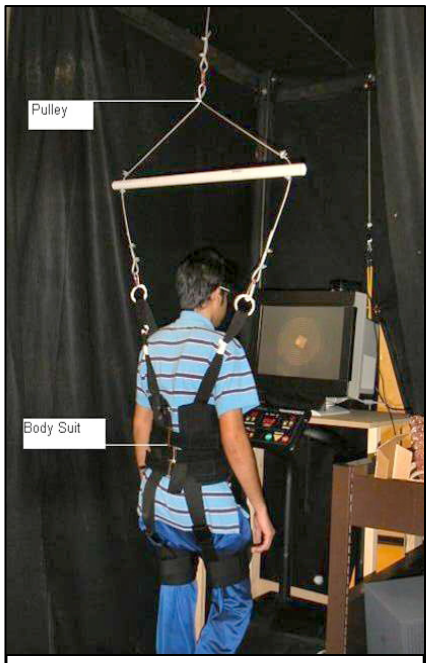
Pioneering Gait Analysis Research

Funds from the Nebraska Research Initiative have successfully developed the Gait-O-Gram© which is a portable wearable biomedical device that can provide a rapid assessment of the health of the neuromuscular system from gait data collected throughout the day. This device is for gait, what the Holter monitor is for the heart. The portable Holter provides the cardiologist with a rapid assessment of the heart's performance throughout the day. The data collected by the Holter is used by the cardiologist to diagnose a wide range of clinical disorders related to the performance of the heart. These disorders include chest pain, heart palpitations and pacemaker function. Similarly, the portable Gait-O-Gram© can be used by the physical therapist, the neurologist, the orthopedist and other clinicians to monitor walking patterns for 24 hours. This information can be used to provide prognostic and diagnostic measures of diseases such as Parkinson's and diabetic peripheral neuropathy. It can also be utilized for the clinical assessment of prosthetic alignment and the success of orthopedic interventions such as knee ligament reconstruction. A patent application has been filed for the Gait-O-Gram© which has also attracted venture capital interest.

We have also implemented the device with virtual reality simulations and a body weight support system. This additional biotechnology was developed with the ultimate goal of eventually packaging everything together and marketing it in the biomedical rehabilitation world.

Our bodyweight support system.

Furthermore, we have successfully completed a significant portion of the software that accompanies the Gait-O-Gram©. We are using mathematical algorithms from Chaos Theory to detect subtle differences in gait patterns.



Our Virtual Reality Environment.

This success resulted in the renewal of our grant with the Nebraska Research Initiative for a second year for $83,079. These funds are also helping us to develop the next generations of our prototype. Our associates Drs. Foster (UNL), Heidel (UNO), and Matache (UNO) also funded by this grant, are contributing their expertise in the further development of the device.

Graduate students Naomi Kochi, Hitika Tanwar and Janmejay Tanwar are among the HPER Biomechanics Laboratory personnel that work on this project. Naomi Kochi received her MS in Mathematics from UNO and is currently pursuing her PhD in Psychobiology under the direction of Dr. Stergiou. Hitika Tanwar received her BE in Electronics and Communication from the University of Rajasthan in India and is pursing her MS in Telecommunications from UNL. Janmejay Tanwar received his BE in Computer Engineering from the North Maharashtra University in India and is pursuing his MS in Computer Science from UNO.

COLLABORATIONS

Collaboration with UNMC Department of Surgery and VA Hospital:

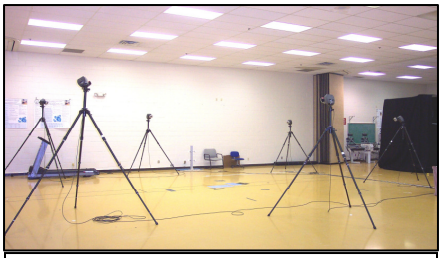
The Effects of Peripheral Arterial Disease on Gait

Peripheral arterial disease (PAD) is a debilitating disease affecting 8 to 12 million people in the Unites 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. During walking, they have to stop many times since the pain is unbearable. Staff from the HPER Biomechanics Laboratory, including graduate students Sara Myers, Jessie Huisinga and our new faculty member Dr. Shing-Jye Chen, in collaboration with Dr. Iraklis Pipinos, Dr. Jason Johanning and Dr. Thomas Lynch from the Department of Surgery at UNMC and the Omaha VA Hospital, are evaluating the effect that PAD has on gait. Sara Myers received her BS in Exercise Science from UNO. Jessie Huisinga received her BSE in Biomedical Engineering from the University of Iowa. They are both currently pursuing their MS in Exercise Science.

Participant in the PAD study.

The medical doctors run several diagnostic tests on patients at UNMC and VA hospitals to diagnose a PAD patient's condition. Then they treat them with a prescription of specific exercises, with medication, or even with surgery (i.e. angioplasty).

Unfortunately, research is lacking on the proper selection of the correct treatment. This is where the work conducted in our laboratory comes in. We evaluate the PAD patients walking before and after treatment. Our lab is equipped with infrared high speed digital cameras, force platforms and specific software so that even a slight change in the way they walk, can be measured. These measures can be used diagnostically to indicate if treatment has resulted in improvement in how the patient walks. Therefore, the results of this work help the medical doctors in their decisions.



Infrared digital cameras.

Eventually we will be able to provide definitive answers regarding the best type of treatment for these patients. This research is quite unique because no other laboratory has ever examined, in such detail, how these patients walk. Gait studies in other pathological populations have found altered walking patterns specific to the pathology and ways for improvement via surgical techniques and rehabilitation. However, such developments are not currently available for PAD patients. Our research work has been presented in several national scientific meetings receiving significant attention.

Sabbatical Strengthened Collaborations in Orthopedics

Dr. Stergiou was awarded a Faculty Development Fellowship or "sabbatical" for the Spring of 2005. He was able to conduct research at the Orthopedic Center in Sports Medicine (OCSM) for several weeks during the spring semester. The OCSM, with its director Dr. Tassos Georgoulis, is located at the Ioannina Medical Center in Greece. Dr. Stergiou holds the title of the OCSM Scientific Consultant. In his ongoing collaboration with OCSM, Dr. Stergiou works closely with orthopedic surgeons in a well equipped biomechanics laboratory. Last Spring's collaborative work resulted in several new manuscripts and several presentations. Their work has lead to some very important findings regarding the knee's anterior cruciate ligament reconstruction. They found that current surgical techniques fail to restore rotation of the lower leg during dynamic activities of every day life (i.e. turning). They also found that proper placement of the graft is essential for subsequent knee stability. Currently, they are working in identifying the best surgical techniques that can keep the knee stable during daily activities. They have also started exploring how osteoarthritis of the knee is related with ligament reconstruction.

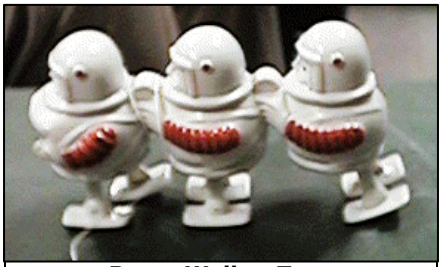
Drs. Stergiou & Georgoulis with the entire OCSM staff.

Biomechanics lab at the Ioannina Medical Center in Greece.

One of these studies was recently a finalist for the very prestigious international Y-ROBOTS Award which is given every year to the best orthopedic study in the world.

Computer Modeling with Dynamic Toys Reveals Human Gait Patterns

Toy stores contain many wonderful basic machines for our entertainment. Ramp Walkers are simple, easily made toys which use gravity to walk down a ramp. These "passive walkers" have no energy input or a nervous system to facilitate their gait. However, the most surprising thing about them is that this uncomplicated mechanism closely resembles a basic human gait. Robotic looking Ramp Walkers are being studied at several universities. Researchers can easily add or subtract a factor affecting gait, such as gravity, and study how the robot's gait is changed.



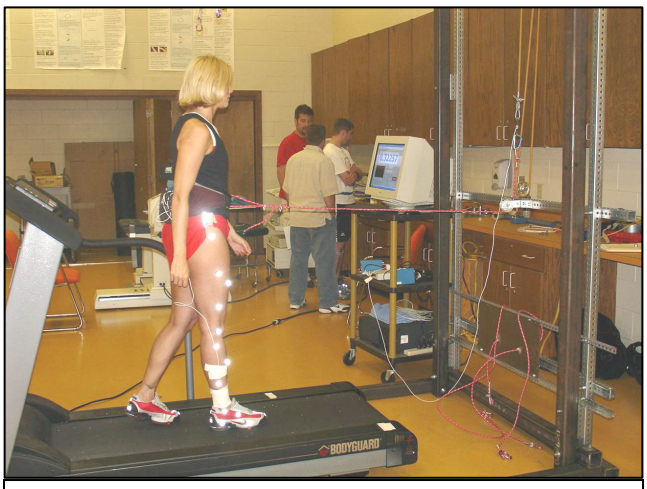
Ramp Walker Toys

Max Kurz and Dr. Stergiou were inspired by these simple robots to develop their own virtual passive walker. Using this model they were able to test their theories about the meaning of variations in human gait. They used mathematical algorithms from chaos theory to quantify changes in their model. Furthermore, they also tested these theories with human based experiments.

For these experiments, Max Kurz built apparatuses for reduced gravity and horizontal assistance. These apparatuses were used to study how changes in biomechanical variables influence walking patterns and to see if the computer simulations were a predictor of those gait changes. Max Kurz recently became a faculty member at the University of Houston. He facilitates our ties to NASA, and remains one of our closest associates.

One of our goals in future robotic models is to develop intelligent agents that utilize chaotic control. Toward this end, Max Kurz and Dr. Stergiou focused on how our hips react. They proposed that the nervous system may use well-timed joint actuations to switch to more stable gait patterns when unforeseen disruptions are encountered. They were able to develop an artificial neural network (ANN) to add to their passive dynamic bipedal model. The ANN simulates twenty-one neurons. It could be trained to select a hip stiffness that would transition between different gaits. Using this model, they showed that a robust chaotic control scheme can be facilitated by the nervous system to select the proper muscular contractions for a stable walk.

In their work, Max Kurz and Dr. Stergiou are collaborating with Dr. Jack Heidel, Chair of the UNO Math department, Dr. Terence Foster from UNL Engineering and with scientists from NASA.



Students using horizontal assistance apparatus.

Prestigious Awards to Dr. Stergiou

Dr. Stergiou obtained the rank of Full Professor this year. He was also awarded the Isaacson Professorship. This esteemed professorship is awarded on the basis of outstanding performance in research/creative activity. Appointments are made for a three-year period and have a yearly stipend.

Teachers Enriched During Final Year of Banneker 2000

During the final year of the Banneker 2000 Community of Excellence in Mathematics and Science (CEMS) program, K-12 teachers took courses, such as Biomechanics, from Dr. Stergiou. In addition to regular course work, these teachers wrote several lesson plans pertaining to the classes they teach. CEMS was part of a 5-year $4.9 million grant from the National Science Foundation. This work is in collaboration with Dr. Carol Mitchell from the Teacher Education Department of the College of Education at UNO. This program was geared toward getting High School students involved in Math and Science. The teachers working with Dr. Stergiou learned how to use biomechanics in their classrooms in order to explain difficult issues. For example, they can teach students about projectiles using examples from sports biomechanics rather than cannons! The teachers enthusiastically embraced the opportunity to present science using the unique viewpoint of Biomechanics.

New Staff Joins the HPER Biomechanics Laboratory

The HPER Biomechanics Laboratory has recently been blessed with two new positions. Shortly after being granted a sabbatical and receiving three grants in 2004, Dr. Stergiou needed a person to help him manage his increased responsibilities. He recruited an academic secretary from his office who had recently completed her Bachelors in General Studies. Lisa Holst joined the HPER Biomechanics staff at the end of 2004. As Project Assistant, her busy office maintains all budgets, edits and distributes our newsletter, assists in grant writing, and facilitates the management of an international staff of 12 graduate assistants and student workers.

After Dr. Stergiou received a K-25 award, he needed an exemplary person to step in, be his co-Director and teach his classes. Highly recommended by Dr. Stergiou's mentors from the University of Oregon, Dr. Shing-Jye Chen arrived at UNO, after completing his masters and doctorate there. He started teaching classes during the fall of 2005. Our HPER Biomechanics co-Director is a native of Taiwan. Dr. Chen is also supervising all technical aspects of the laboratory, heads the Peripheral Arterial Disease study, and assists in writing new grants.

Noteworthy Events

One of the members of our laboratory, **Anastasia Kyvelidou** MS, excels not only as a student-researcher but also as an athlete. She was recently honored as the University of Nebraska at Omaha Female Athlete of the Year. Anastasia was also named the NCAA II female track athlete of the year by the national track coaches association. Her heptathlon score of 5,780 ranks as the eighth best in the world.

Pictured with Anastasia is Dr. Daniel Blanke, the founder of the HPER Biomechanics faculty and the Director for the School of Health, Physical Education and Recreation.

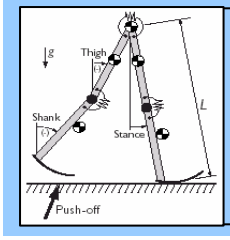
Dr. Daniel Blanke and Anastasia Kyvelidou.

Dr. Pipinos accepting this award.

Our collaborator, **Dr. Iraklis Pipinos**, received the William J. von Liebig (K08) Award from the American Vascular Association at the annual meeting held in Chicago. This particular award is offered jointly with the National Heart, Lung and Blood Institute (NHLBI) to provide supplemental funding to vascular surgeon scientists for their research careers. Dr. Pipinos works very closely with several members from our staff on our joint Peripheral Arterial Disease studies. His clinical expertise has been invaluable to the progress of this work.

Internationally Recognized Bioengineer Visited HPER Biomechanics Lab April 1

Robots can be used to test how humans control efficient and stable locomotion. Dr. Art Kuo, an internationally recognized bioengineer who specializes in passive dynamic locomotion demonstrated this theory in an event on April 1, 2005. His presentation "Control and Mechanics of Human Walking" addressed how passive dynamic walking robots are being used to understand the requisites of human locomotion. To rigorously test such theories, engineers must replicate the human body's morphology, gait appearance, energy consumption and organization of the nerves that control walking. Some of the most elaborate bipedal walking robots produce joint actuations that are more precise than humans, but have gait mechanics that are extremely less efficient. To overcome this problem, engineers and neurobiologists recently have started using a passive dynamic framework to model the lower extremity. His presentation included a wide variety of robotic legs from a simple child's toy, which walks down hill without winding up, batteries or springs, to several films of robotic legs developed and tested in his lab. During his visit, Dr. Kuo also consulted with our personnel on the research that we have been doing the last five years on the investigation of human movement variability during locomotion using passive dynamic walking models. Dr. Kuo, a professor from the University of Michigan, teaches in the areas of dynamics & vibrations, and systems & control. Dr. Kuo has been awarded several grants from the National Institutes of Health, the National Science Foundation and the Whitaker Foundation to support his exciting research work.



Passive Dynamic Walking Model

Dr. Kuo with Dr. Stergiou and doctoral students Kurz and Judkins discussing research on passive dynamic walking models.

Madonna Rehabilitation Center Researcher visits HPER Biomechanics Lab Nov. 4

Dr. Burnfield & Dr. Stergiou

Dr. Judith Burnfield visited us in November and gave a presentation entitled "Biomechanical Research Applications in the Rehabilitation Setting". Dr. Burnfield is the Director of the Movement Sciences Center of the Madonna Rehabilitation Hospital in Lincoln Nebraska. She is both a clinician, a physical therapist, and a researcher with a Ph.D. in biokinesiology. She is a national authority in gait analysis and especially on friction problems during locomotion and slips and falls in the elderly. In her talk she explained to us the function of her Lincoln based center which is a collaborative network of researchers, educators, clinicians, community innovators and students. This network focuses on enhancing the independence and quality of life for persons with and without disabilities. Dr. Burnfield and our staff spoke about a variety of ways to foster collaborations between our two institutions.

Other Exciting News

- Previous members of the HPER Biomechanics Lab received faculty appointments during the summer of 2005: Dr. Max Kurz at the University of Houston and Dr. Tracy Dierks at the University of Indiana at Indianapolis.
- During 2005, Dr. Stergiou strengthened his collaboration with several Universities; the University of Nevada at Las Vegas, the University of North Carolina at Chapel Hill and the University of Kansas Medical Center. Located under the auspices of the University of Kansas Medical Center, Dr. Stergiou has developed a rapport with Dr. Randy Nudo the Director of the Landon Center on Aging and several of their faculty. Dr. Stergiou will continue to exchange ideas with other researchers from around the world on topics that are under investigation in the HPER Biomechanics Laboratory.
- In August 2005, seven members of the HPER Biomechanics Laboratory staff attended the American Society of Biomechanics (ASB) conference held in Cleveland, Ohio. The lab presented current research topics they had been working on.
- Tim Judkins, Ph.D. candidate, was part of two patents filed. *"An Ergonomic Handle and Articulating Laparoscopic Tool"* and the *"EndoSense, Laparoscopic Haptic Grasper".*
- Dr. Nick Stergiou has been kept busy this fall with invited presentations at Kansas City, Washington D.C., and Las Vegas.
- Dr. Nick Stergiou received Professor Courtesy Appointments with the UNMC Departments of Surgery and Pediatrics.

Professional Journal Publications Since Our 2004 Annual Report

1. Hreljac, A., Stergiou, N. & Scholten, S.D. (2005) Joint kinetics of the ankle and knee when running over obstacles. *Journal of Sports Medicine and Physical Fitness* 45(4):476-82.
2. Narazaki, K., Oleynikov, D., & Stergiou, N. (2006) Robotic surgery training and performance: identifying objective variables for quantifying the extent of proficiency. *Surgical Endoscopy* 20(1):96-103.
3. Judkins, T.N., Oleynikov, D., & Stergiou N. (2005) Real-time augmented feedback benefits robotic laparoscopic training. *Studies In Health Technology and Informatics.* 119:243-8.
4. Ristanis, S., Stergiou, N., Patras, K., Basileiadis, H., Giakas, G., & Georgoulis, A.D. (2005). Excessive tibial rotation during high demanding activities is not restored by ACL reconstruction. *Arthroscopy* 21(11):1323-9.
5. Cavanaugh, J.T., Guskiewicz, K.M., & Stergiou, N. (2005) A nonlinear dynamic approach for evaluating postural control: New directions for the management of sport-related cerebral concussion. *Sports Medicine* 35(11):935-50.
6. Cavanaugh, J.T., Guskiewicz, K.M., Giuliani, C., Marshall, S., Mercer, V.S., & Stergiou, N. (2005) Detecting altered postural control after cerebral concussion in athletes without postural instability. *British Journal of Sports Medicine* 39(11):805-11.
7. Georgoulis, A.D., Ristanis, S., Moraiti, C., Mitsou, A., Bernard, M., & Stergiou, N. (2005). Three-dimensional kinematics of the tibiofemoral joint in ACL-deficient and reconstructed patients shows increased tibial rotation. *Operative Techniques in Orthopaedics*, 15(1):49–56.

8. Georgoulis, A.D., Ristanis, S., Papadonikolakis, A., Tsepis, E., Moraiti, C., & Stergiou, N. (2005). Electromechanical delay of the knee extensor muscles is not altered after harvesting the patellar tendon as a graft for anterior cruciate ligament reconstruction: Implications for sports performance. *Knee Surgery Sports Traumatology and Arthroscopy*. 13(6):437-43.
9. Kurz, M.J., & Stergiou, N. (2005). An artificial neural network that utilizes hip joint actuations to control bifurcations and chaos in a passive dynamic bipedal walking model. *Biological Cybernetics*. 93(3):213-21.

Selected Presentations and Published Abstracts

1. Wristen, B., Stergiou, N., Evans, S. (2005). Using three dimensional motion capture technology to describe and assess piano technique: A case study. *National Conference on Keyboard Pedagogy,* Oak Brook, Illinois.
2. Robinson, L., Scott-Pandorf, M.M., Stergiou, N., Johanning, J.M., Judkins, T.N., Lynch, T.G., & Pipinos, I.I. (2005). Claudication produces abnormal and inefficient gait patterns detectable by advanced biomechanical analyses. *Midwestern Vascular 2005, the 29th Annual Meeting of the Society*. Chicago, Illinois.
3. Judkins, T.N., Scott-Pandorf, M.M., Pipinos, I.I., Stergiou, N. (2005). The effect of peripheral arterial disease on gait: frequency response of ground reaction forces. *Progress in Motor Control V Convention*, State College, Pennsylvania.
4. Kurz, M.J., Stergiou, N., Markopoulou, E., Buzzi, U. (2005). An Inverted Pendulum Model Indicates that Parkinson's Disease results in Altered Neuromuscular Stiffness for Controlling Gait. *XXth Congress of International Society of Biomechanics and 29th Annual Meeting of the American Society of Biomechanics*, Cleveland, Ohio.
5. Miller, D., Stergiou, N., Kurz, M.J. (2005). An improved surrogate method for detecting the presence of chaos in gait. *XXth Congress of International Society of Biomechanics and 29th Annual Meeting of the American Society of Biomechanics*, Cleveland, Ohio.
6. Narazaki, K., Oleynikov, D., Pandorf, J.J., Stergiou, N. (2005). Training and performance of robotic laparoscopy: Electromyographic analysis to quantify the extent of proficiency. *XXth Congress of the International Society of Biomechanics and 29th Annual Meeting of the American Society of Biomechanics*, Cleveland, Ohio.
7. Hurt, C.P., Hreljac, A., Kurz, M.J., Stergiou, N. (2005). Is there a gait transition between run and sprint? *XXth Congress of International Society of Biomechanics and 29th Annual Meeting of the American Society of Biomechanics*, Cleveland, Ohio.
8. Judkins, T.N., Narazaki, K., Oleynikov, D., Stergiou, N. (2005). Electromyographic correlates of robotic laparoscopic training. *XXth Congress of the International Society of Biomechanics and 29th Annual Meeting of the American Society of Biomechanics*, Cleveland, Ohio.
9. Ryland, K., Wutzke, C., Stergiou, N. (2005) Nonlinear analysis of postural control in different positions and vision conditions. *XXth Congress of the International Society of Biomechanics and 29th Annual Meeting of the American Society of Biomechanics*, Cleveland, Ohio.
10. Stergiou, N. and Harbourne, R.T. (2005) Investigation of the dynamics of development of sitting postural control in infants with cerebral palsy. *III Step Conference*, Salt Lake City, Utah.

11. Judkins, T.N., Narazaki, K., Oleynikov, D., Stergiou, N. (2005). Electromyographic frequency response of robotic laparoscopic training. *IEEE 9th International Conference on Rehabilitation Robotics*, Chicago, Illinois.
12. Georgoulis, A., Ristanis, S., Patras, K., Moraiti, C., Tsepis, E., Stergiou, N**.** (2005) Motion analysis evaluation, 2 years after ACL reconstruction, shows that tibial rotation is not restored during high demanding activities. *51st Annual Meeting of the Orthopaedic Research Society*, Washington, D.C.
13. Moraiti, T., Stergiou, N., Giakas, G., Mitsou, A., Georgoulis, A. (2005) How does the ACL deficient knee behave in different walking speeds? *5th Biennial Congress of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS)*. Hollywood, Florida.
14. Ristanis, S., Stergiou, N**.**, Patras, K., Vasiliadis, H., Giakas, G., Georgoulis, A. (2005) Tibial rotation after ACL reconstruction during high demanding activities, even though anterior tibial drawer is diminished. *5th Biennial Congress of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS)*. Hollywood, Florida.
15. Georgoulis, A.D., Moraiti, T., Ristanis, S., & Stergiou, N. (2005) Nonlinear methods can be used as tests of dynamic functional knee stability during clinical gait analysis. *American Orthopaedic Society of Sports Medicine (AOSSM)*. Keystone, Colorado.
16. Narazaki, K., Oleynikov, D., Pandorf, J.J., Solomon, B.M., Stergiou, N. (2005) The effects of training on the performance of robotic laparoscopy: What are the objective variables to quantify learning? *Society of American Gastrointestinal Endoscopic Surgeons Annual Meeting*, Hollywood, Florida.
17. Narazaki, K., Oleynikov, D., DiMartino, A., Rentschler, M., Stergiou, N. (2005) Objective quantification of proficiency in robotic laparoscopy with bimanual inanimate tasks. *13th Annual Medicine Meets Virtual Reality Conference*, Long Beach, California.

2005 HPER Biomechanics Laboratory

Back Row: **Jessie Huisinga, Sara Myers, Dr. Dan Blanke, Dr. Nick Stergiou, Dr. Shing-Jye Chen, Matthew Fiedler, Jason Alter.**

Front Row: **Lisa Holst, Naomi Kochi, Jay Tanwar, Tim Judkins, Natasha Kyvelidou, Joan Deffeyes, Hitika Tanwar.**