



# Capabilities

Communicating the Science of Prosthetics and Orthotics

NORTHWESTERN  
UNIVERSITY

A quarterly publication sponsored by the National Institute on Disability and Rehabilitation Research (NIDRR) of the United States Department of Education

Volume 17, Number 4, Autumn 2009

## NURERC Education and Outreach: Making a Difference

This issue of *Capabilities* summarizes public education and outreach activities about rehabilitation engineering for prosthetics and orthotics (P&O) that NURERC personnel have conducted during the immediate past quarter. In compliance with the mandate issued by the NIDRR grant that supports our work, all NURERC researchers and graduate students conduct multi-faceted public education activities, including informative presentations and didactic tours of the laboratory. Herein, *Capabilities* reports NURERC efforts to teach new audiences about rehabilitation engineering for P&O.

Scientific publications and presentations at professional meetings represent a primary way to educate others about NURERC research. Dr. Fatone presented "Barriers to Dissemination of Research Results" at a Chicago meeting hosted by AAOP; Dr. Hansen presented "Prosthetic Foot Technologies and a Search for the 'Right' Tech" at the Asian Prosthetic and Orthotic Scientific Meeting in Hong Kong; Dr. Gard presented information about developments in adaptable foot-ankle mechanisms in a special session at the national RESNA meeting; and NURERC staff are preparing to present their research at the 2010 national Academy meeting.

In addition to core research and presentations, throughout the year NURERC research staff offers informative tours of the laboratory. During the summer quarter, NURERC welcomed physicians, engineers, manufacturers, researchers, students, and others. The ability to communicate bioengineering concepts makes these interactions meaningful and fruitful to visitors. Some NURERC graduate students have burnished

their teaching skills in the Graduate Teaching Certificate Program, and they will effectively educate others about NURERC research. This summer, NURERC welcomed researchers from Germany, Taiwan, and Korea, as well as local groups from the Chicago Museum of Science and Industry, the National Youth Leadership Forum, and the Rush University School of Nursing.

Some visitors are knowledgeable specialists while others encounter rehabilitation engineering and P&O for the first time. Regardless of a visitor's level of expertise, NURERC researchers adjust the content of their orientations, summaries, and overviews to match the understanding of the individuals and groups.

Public dissemination of information about research in rehabilitation engineering for P&O is crucial to the mission of NURERC. While outreach activities do not contribute directly to new research, NURERC believes that its public education activities can provide unexpected opportunities for both the giver and the receiver. Outreach and dissemination activities at NURERC expand public knowledge about rehabilitation engineering, develop potential collaborative relationships with foreign and domestic researchers, and generate career interest among young students and professionals.

Please enjoy this issue of *Capabilities* and share it with someone who may become interested in the field of rehabilitation engineering for prosthetics and orthotics.

R. J. Garrick, PhD  
*Capabilities*, Editor

## Inside This Issue:

◆ Editor's Preface: NURERC Education and Outreach .....	Page 1
◆ Teaching Skills Boost NURERC Outreach .....	Page 2-3
◆ P&O Careers Attract Youth; Science Minors Focus on P&O .....	Page 4
◆ Fatone Tackles Barriers; P&O Outreach to Nursing .....	Page 5
◆ Final Farewells to Max Näder and Kevin O'Hagan .....	Page 6
◆ NURERC at 2010 AAOP Meeting in Chicago .....	Page 7
◆ Koehler Awarded OPERF Grant .....	Page 7
◆ Ruhe Defends Doctoral Dissertation .....	Page 8
◆ NURERC Welcomes International Visitors: Dr. Chang and Dr. Park .....	Page 9
◆ Dr. Schneider Visits; NURERC at RESNA; Hansen Speaks in Hong Kong. .	Page 10
◆ NURERC NEWS; Hansen Promoted .....	Page 11
◆ Final Patent Applications; Read <i>Capabilities</i> On-line .....	Page 12

## Excellent Teaching Skills Boost NURERC Outreach

R. J. Garrick, PhD, with Sara Koehler, MS, Lexyne Jackson, MS, and Angelika (Kiki) Zissimopoulos, MS

NURERC graduate students contribute significantly to all laboratory work by conducting research, presenting their results in professional meetings and also by educating the public about the science of prosthetics and orthotics (P&O).

Graduate students **Sara Koehler, MS, Lexyne Jackson, MS, and**

**Angelika (Kiki) Zissimopoulos, MS**, adapt their explanations so that people from diverse backgrounds can understand the sometimes difficult or unfamiliar concepts that underlie rehabilitation engineering.

Adding to their demanding schedules, these students make a difference in many lives as tutors for inner-city science students, judges at science fairs, and teachers of prosthetic design in the NU-sponsored program, **Get-a-Grip!** (See *Capabilities*, Volume 16, Number 2, Spring 2008, pages 4, 5 and 8). To augment their instructional skills, Ms. Koehler, Ms. Jackson and Ms. Zissimopoulos are completing requirements for their teaching certificate through the **Graduate Teaching Certificate Program (GTCP)** offered by the Searle Center for Teaching Excellence at Northwestern University. As biomedical engineers, proficiency in teaching will enhance their professional qualifications and will contribute to NURERC's educational outreach activities.

Created in 2003, GTCP systematically prepares advanced graduate students to teach at the university level. During the 12-month program Ms. Koehler, Ms. Jackson and Ms. Zissimopoulos participated in three integrated components: 1) Skills Development, 2) Practice Teaching, and 3) Critical Reflection. The three engineers honed their instructional skills by working individually, in small groups, and with faculty mentors. BME faculty mentors provided discipline-



(From left) Kiki Zissimopoulos, MS, Lexyne Jackson, MS, and Sara Koehler, MS, are completing their Graduate Teaching Certificate Program this year.

specific feedback and evaluated each GTCP participant. In Skills Development Ms. Koehler, Ms. Jackson and Ms. Zissimopoulos applied theory to practice in course design, teaching methods, and assessment of student learning. The Critical Reflection component emphasized growth and documentation of teaching achievements.

Ms. Koehler, Ms. Jackson and Ms. Zissimopoulos articulated her respective teaching experiences in bi-quarterly discussions and workshops. Each also wrote topic essays about educational research, course design and methodology, evaluation of student learning, teaching effectiveness, and mentorship.

To fulfill the teaching practicum, each constructed an independent teaching project that was selected from among several formats: co-teach a class with a faculty member; design and teach a portion of an existing course; or design and teach a new course. In winter and spring quarters 2009, Kiki Zissimopoulos, MS, co-taught a section of Engineering Design and Communication (EDC), a required course for all freshman engineering majors. Approximately 16 students attend each section, which is team-taught by faculty from the McCormick School of Engineering and Applied Science and the Weinberg College of Arts and Sciences Writing Program. This course integrates instruction in effective communication with a user-centered design process. In the class, student teams build a project that solves engineering design challenges. Ms. Zissimopoulos acknowledged, *"I enjoyed the challenge of teaching this course, which could be unpredictable, depending on the specific project or team. I valued the opportunity to apply in a classroom setting the instructional methods that I learned in the GTCP, such as active learning,*

Continued on page 3

## Teaching Skills Boost NURERC Outreach

*service learning, team-teaching strategies, and evaluation techniques.*” She enjoyed multidisciplinary team teaching with, **Kathleen Carmichael**, PhD (Lecturer, WCAS Writing Program), **Leslie A. Fischer**, MA (Adjunct Lecturer, WCAS Writing Program) and other EDC faculty; and also appreciated the opportunity to work with faculty mentor and EDC instructor **Suzanne Olds**, PhD (Assistant Chairperson, Department Biomedical Engineering).

The GTCP helped Lexyne Jackson develop a teaching philosophy and practice techniques that she will use to support an active learning classroom. Ms. Jackson crafted example-driven lectures and taught a full course of Differential Calculus to freshman engineering students.

Her faculty and teaching mentor, **Eric Perreault**, PhD (Associate Professor, Department Biomedical Engineering), provided regular evaluations and practical suggestions. Ms. Jackson noted, *“Traditionally, Differential Calculus is taught with lectures, a passive approach to learning. I challenged my students to take an active role by using examples and deconstructing real-world applications. I encouraged them to teach each other. Initially, the students resisted this style of teaching, but they adjusted. I believe they appreciated active participation in the learning process.”* Ms. Jackson reviewed her GTCP experience. *“I gained insights by discussing the scholarship of teaching and learning with graduate students and post-docs from various disciplines. It was invaluable to teach Differential Calculus to freshmen. As an educator, I will use these skills to provide an innovative and student-centered learning environment.”*

In winter 2009, Sara Koehler, MS, co-instructed with **Wendy M. Murray**, PhD (Assistant Professor, Department Biomedical Engineering), a required course for all biomedical engineering students, Introduction to Biomechanics (BME 271). This core course introduces sophomores to basic concepts in rigid body mechanics. *“Co-instructing BME 271 was a rewarding experience, especially because I collaborated with experienced faculty members like Dr. Murray and faculty mentor, Yasin Dhaher, PhD,*

*who gave me regular feedback and support as I developed my teaching skills,”* reflected Ms. Koehler. She incorporated various teaching methods into her weekly lectures, including group work, classroom demonstrations, and challenge-based learning. Also, she used a Personal Response System (PRS), commonly called “clickers.” This innovative, electronic polling system allows students to respond immediately to an instructor’s questions, enhances student engagement, and monitors their understanding of specific concepts. Ms. Koehler reported,

*“Teaching BME 271 was an opportunity to tackle the challenges of teaching a large, introductory engineering course. I had to engage a diverse group of learners, create an interactive learning environment, and develop assessment tools that applied fundamental engineering concepts to real-world scenarios.”*

At NURERC, Ms. Koehler, Ms. Jackson and Ms. Zissimopoulos are poised to apply the skills they learned in GTCP to teach NURERC lab visitors the concepts of rehabilitation engineering for prosthetics and orthotics. In the future, these engineers will continue to articulate the science of prosthetics and orthotics to professionals, students, and the wider public. By effectively communicating their knowledge, they will foster interest and understanding in rehabilitation engineering, thus creating a positive difference in many lives.



(From left) **Kiki Zissimopoulos**, MS, and **Sara Koehler**, MS, communicate the science of rehabilitation engineering for prosthetics and orthotics to people who have different levels of expertise. Above, they judge student-designed, experimental prostheses in a science class at Bateman School, Chicago (April 2008).



## P&O Careers Attract National Youth Leadership Forum

R. J. Garrick, PhD

Twenty participants in the **National Youth Leadership Forum (NYLF) Medical Group** (Chicago) visited the **Northwestern University Prosthetics Orthotics Center (NUPOC)** on July 23. Ready to enter their junior year in high school, these students are examining careers in medicine. NYLF visited NUPOC where they learned how prosthetists and orthotists make a significant difference in the lives of others.

**Chris Robinson, MBA, CPO, ATC**, led the NYLF group through "Orientation to Careers in P&O Practice." Appraising career opportunities in P&O, Mr. Robinson reviewed educational requirements, training, residency and certification, as well as practice opportunities. As he reflected on the variety and rewards of his P&O career, Mr. Robinson also showed videos that featured interviews with P&O students, practitioners and end users.

**Stefania Fatone, PhD, BPO(Hons)**, presented "Research Initiatives in P&O" that focused on P&O with respect to rehabilitation engineering research. Dr. Fatone described the biomechanical effects that certain P&O devices may exert



**Stefania Fatone, PhD**, speaks to NYLF-Medical Group about P&O research initiatives.

on the wearer's residual limb, mobility and quality of life; and how these devices can be improved through scientific inquiry and evidence based outcomes. Dr. Fatone summarized motion analysis, identifying vertical, oblique, and rotation as three measurable dimensions, and illustrated its application to postural and gait studies that are conducted at NURERC.

NYLF students learned that P&O careers are interdisciplinary, requiring skills that include, but are not limited to, mathematics, medicine, engineering, communication, and an aptitude for tools, problem-solving, analytical skills, business acumen, patience, and compassion.

NYLF student feedback included these comments, "*This really made me think about going into biomedical engineering and prosthetics. This stuff is awesome!*" and "*It was very cool to see how they made the prosthetic limbs and how orthoses help people.*" The NYLF group toured NUPOC, the NU Physical Therapy and Human Movement Science Program, and the Rehabilitation Institute of Chicago.

## MSI Science Minors Focus on Prosthetics

R. J. Garrick, PhD

On July 22, twenty-five Science Minors from the **Chicago Museum of Science and Industry (MSI)**, accompanied by their Education Coordinators **Charles Brass** and **Steven Willis**, attended talks presented by NURERC staff and students. **Stefania Fatone, PhD, BPO(Hons)**, greeted the group, summarized the work conducted at NURERC and introduced the laboratory's graduate students **Eric Nickel, BS, Charles Wang, MS**, and **Erin Boutwell, MS**.

The group listened with keen interest as Mr. Nickel presented "Walking for the Real World: an Adaptive Prosthetic Ankle." He explained how normal and prosthetic ankles adapt to slopes. Mr. Wang presented "Understanding Walking, Swaying and Standing of Able-bodied Persons," explaining the adaptive role of the ankle with respect to different rocker radii of shoes and the effective Roll-over Shape. Ms. Boutwell



**Erin Boutwell, MS**, explains pressures within prosthetic sockets to MSI Science Minors.

presented "Effect of Liner Thickness on Peak Pressure within the Transtibial Prosthetic Socket." She explained the relationship between the thickness of gel liners and potentially harmful pressures on the residual limb. NURERC talks generated enthusiastic response and relevant questions. After the question and answer session, Mr. Nickel reflected, "*I always enjoy being able to inspire curiosity and cultivate understanding. I wish I had more time so that I could have thoroughly covered the fundamentals and given them more foundation.*"

Science Minors are students aged 14 to 17 who have taken a 10-week training program and serve as docents demonstrating MSI exhibits to patrons. The program increases students' knowledge of science and develops their job skills by interacting with MSI staff and visiting laboratories, university science departments, and other science museums.

## Fatone Tackles Barriers to Disseminating P&O Research

R. J. Garrick, PhD

**Stefania Fatone**, PhD, BPO(Hons), was an invited speaker at the Great Barriers Meeting hosted by the **American Academy of Orthotists and Prosthetists (AAOP)** at the Rehabilitation Institute of Chicago on July 17 to 19. The meeting examined clinical and academic barriers to the profession of P&O and offered potential solutions.

Chaired by **John Michael**, MEd, CPO, prominent P&O professionals who attended the meeting were: **Stefania Fatone**, PhD, BPO(Hons); **Sam Phillips**, PhD, CP; **Geza Kogler**, PhD, CO; **Mark Geil**, PhD; **Mark Muller**, CPO; **Phil Stevens**, CPO; **Chris Morris**, MSc, DPhil; **Tim Bach**, PhD; **Don Katz**, CO; **Brian Hafner**, PhD; and **Chris Robinson**, MBA, CPO, ATC. **Kimber Nation**, grants administrator at AAOP, also attended the meeting.

The panelists considered the interrelationship between vast systems such as educational institutions and professional organizations and features that may



Attending the Great Barriers Meeting included (from left to right) **Geza Kogler**, PhD, CO, **Sam Phillips**, PhD, CP, and **John Michael**, MSc, CPO. Mr. Michael chaired the meeting.

impede the progress and development of P&O. Speakers identified barriers to: 1) the dissemination of research results; 2) the understanding and clinical application of evidence-based practice; and 3) the academic and clinical education of P&O faculty. They proposed potential solutions to academic and clinical barriers in P&O by recognizing the Internet as a

means of providing ready access to professional mentors, academic and clinical networks, and continuing specialty education as well as research.

Dr. Fatone presented “Barriers to Dissemination of Research Results” to the panel of P&O experts. Mr. Robinson (NUPOC) presented “Role of the Internet in Overcoming Academic & Clinical Barriers.” The meeting concluded with a synthesis of the discussions. The panel resolved to establish more interactive and supportive communications among P&O specialists and their educational and professional organizations.

## P&O Outreach to Nursing

R. J. Garrick, PhD

Nine first quarter nursing students from **Rush University School of Nursing** participated in a training rotation at the Rehabilitation Institute of Chicago (RIC), where they attended a detailed orientation and overview about Prosthetics and Orthotics (P&O) on August 20.

**Stefania Fatone**, PhD, BPO(Hons), (NURERC), discussed Orthotics Research at Northwestern University; and **Robert Lipschutz**, BSME, CP, (NUPOC and Neural Engineering, RIC),



NUPOC's **Christopher Robinson**, MBA, CPO, ATC, presented an overview of Orthotic Management to nursing students from the **Rush University School of Nursing**.

discussed Prosthetics Research at RIC with special emphasis on targeted muscle re-innervation.

NUPOC staff, **Ingrid Masterton**, MS, PT, presented an overview about patient populations that utilize prosthetic/orthotic interventions; **Tom Karolewski**, CP, FAAOP, Director of Prosthetics Education at NUPOC, presented an overview of Prosthetic Management; and **Christopher Robinson**, MBA, CPO, ATC, presented an overview of Orthotic Management.

## Otto Bock Group Bids Farewell to Max Näder

R. J. Garrick, PhD

**Max Näder** (1915-2009), senior executive of the Otto Bock Group, has passed away at the age of 94. Founded in 1919 by Otto Bock, the company grew into a world renowned multinational corporation under his name. This year marks Otto Bock's 90th year of operation. Originally established in Berlin as the *Orthopädische Industrie GmgH*, Otto Bock developed prostheses and fabrication systems to meet the needs of German World War I veterans.

Max Näder, husband of Otto Bock's younger daughter, Maria (d. 2005), began work at Otto Bock in 1935 as an orthopedic technician and sales representative. In 1953 he rose to the post of senior executive after the death of his father-in-law and corporate founder, Otto Bock. The entrepreneurial family-run corporation continued to be a successful, German-based company in spite of relocations caused by social and political upheaval and the partition of Germany during the Cold War. From 1953, the Otto Bock Corporation began to internationalize by establishing its first subsidiary in the USA. From 1990, Max Näder's son, **Hans Georg Näder**, has managed the family business. Today, **Otto Bock HealthCare** has 40 subsidiaries throughout the world and exports its products to more than 140 countries.



**Max Näder**, circa 1956.  
(Photo of Max Näder courtesy of OttoBock.com)

Max Näder was a respected humanitarian who fulfilled the Otto Bock vision, “enabling people to achieve the maximum possible mobility and independence.” He was recognized for his personal and corporate achievements in social responsibility with a doctorate from the Berlin Technical University (1985), the Commander's Cross of the Order of Merit of the Federal Republic of Germany (1994), and many others. In 1987 he formed the **Otto Bock Foundation** to promote orthopedic technology and interdisciplinary collaboration through continuing medical education for physicians, physical therapists, and orthopedic technicians. From 2002, the Foundation developed charitable activities that support domestic and international relief projects, such as victims of the 2002 German floods, the 2004 *tsunami* in Southeast Asia, and the 2008 earthquake in China.

Max Näder's humanitarian and scientific legacy continues with the June 16, 2009 opening of the **Otto Bock Science Center for Medical Technology** in Berlin. For the public, the Center features interactive exhibits about anatomy, biotechnology and human movement. For specialists in the field of rehabilitation sciences, the Center offers seminars about prosthetic prototypes and other practical, innovative medical applications for people who live with disabilities.

## Kevin O'Hagan Remembered

R. J. Garrick, PhD

**John Kevin O'Hagan**, CP, (59) passed away on July 8, 2009. He was proprietor of **Chicago Prosthetics** and immediate past president of the **Midwest Chapter of the American Academy of Orthotists and Prosthetists** (AAOP). Mr. O'Hagan was trained at the **Northwestern University Prosthetics Orthotics Center** (NUPOC), was licensed in the state of Illinois, and nationally certified through the **American Board for Certification Orthotics and Prosthetics** (ABC).



**Kevin O'Hagan**, CP  
(1950-2009)

An active member of AAOP, he encouraged other prosthetists to participate in and report findings of research studies that would enrich P&O professional knowledge and benefit patients. Prior to his death, Mr. O'Hagan was participating in the NIDRR-funded research study conducted collaboratively by **NURERC** with **Allen Heinemann**, PhD. Mr. O'Hagan will be missed as a productive prosthetist and a supportive colleague.



## AAOP Symposium Slated for Chicago in 2010

R. J. Garrick, PhD

The **American Academy of Orthotists and Prosthetists** (AAOP) has rescheduled its 36th Academy Annual Meeting and Scientific Symposium to meet in Chicago on February 24 to 27, 2010. NURERC will contribute to the scientific program and NUPOC will hold a dinner to raise funds for its proposed merger with NURERC. **Stefania Fatone**, PhD, BPO(Hons), is a member of the AAOP **Clinical Content Committee** and has helped plan the 2008, 2009 and 2010 meetings.

The **Thranhardt Lecture Series** is a highlight of the Annual Meeting. Two best presentations are recognized with \$500 honoraria, considered for inclusion in a future issue of the *Journal of Prosthetics & Orthotics*, and become an online course on the Academy's Paul E. Leimkuehler Online Learning Center. This year, Dr. Fatone has been selected to present a Thranhardt Lecture, "Randomized Cross-over Study of AFO Ankle Components in Adults with Post-stroke Hemiplegia." Co-authored with **Rebecca Stine**, MS, and **Steven A. Gard**, PhD, their study assesses the effect of different ankle components on the gait of adults with post-stroke hemiplegia who wore articulated AFOs. (This work was funded by the VA Merit Review #A3573R.) Twice selected as a finalist for the **Howard R. Thranhardt Lecture Award**, Dr. Fatone won the award in 2006 for work she conducted with **Andrew Hansen**, PhD. (As a member of the Clinical Content Committee that selected Thranhardt finalists, Dr. Fatone abstained from discussing her abstract due to conflict of interest.)

Other work by Dr. Fatone to be presented at the meeting include "The Role of Journal Club for Professional Development: Facilitating Knowledge Translation" co-



authored with **Christopher Robinson**, MBA, CPO, ATC (NUPOC); and "Use of Experimental Prosthetic Feet to Study Effects of Forefoot Flexibility and Effective Keel Length on Gait of Prosthesis Users" co-authored with **Andrew Hansen**, PhD, *et al.*

In addition to the above-mentioned paper, **Andrew Hansen**, PhD, will chair "Powered Lower Limb Prosthetics and Orthotics: Current Technologies and Future Directions." Participants include **Hugh Herr**, PhD, (Massachusetts Institute of Technology) and **Daniel Ferris**, PhD, (University of Michigan). This session will examine classification of devices based on their use of power; research about power and energy in physiologic systems that suggest a need for powered devices for certain tasks; and research and development

toward future powered lower limb prostheses and orthoses.

**Erin Boutwell**, MS, will present her paper, co-authored with **Steven A. Gard**, PhD, "Study of Residual Limb/Prosthetic Socket Compliance in Transtibial Amputees." Their paper focuses on shock absorption during walking among lower-limb prosthesis users. Use of a prosthetic gel liner that deforms under body weight and contributes to system compliance may attenuate shock and regulate pressure through the residuum. Authors hypothesized that 1) a thick gel liner would increase compliance at the limb-socket interface and create a more uniform distribution of peak pressure across the residual limb; and 2) this increased compliance would allow subjects to walk at a faster self-selected speed.

See an online calendar of P&O meetings where you can contribute to and stay abreast of current research. Visit: [www.oandp.com/calendar/](http://www.oandp.com/calendar/).

### Koehler Awarded OPERF Grant

**Sara Koehler**, MS, has been selected by the **Orthotic and Prosthetic Education & Research Foundation** (OPERF) to receive a **2009 OPERF Fellowship Award**. This award supports quality graduate education research and clinically-relevant research in P&O. Ms. Koehler is a doctoral candidate in biomedical engineering at Northwestern University and conducts research at NURERC. She will use the OPERF Fellowship Award in partial support of her doctoral research: investigating the influence of prosthetic alignment on the gait biomechanics of persons with transfemoral amputation.

The P&O profession is working within its

organizational base to develop a body of reliable, outcomes-based research. OPERF was established in 2008 as a 501(c)(3) nonprofit organization that promotes education and evidence-based research in P&O. The OPERF Board of Directors oversees the Research Committee and the Education Committee. To improve the quality of research, OPERF applicants' research proposals are evaluated through a peer review process. In addition to research funds, Ms. Koehler will receive complimentary registration to attend the 2011 AAOP National Meeting where she will present her research.

**Brian L. Ruhe**, PhD, successfully defended his doctoral dissertation, "Investigations of Standing Balance Efficiency on Sloped Surfaces in Persons with Transfemoral Amputation," on July 28, 2009. Dr. Ruhe summarizes his research for *Capabilities*.

## Investigations of Standing Balance Efficiency on Sloped Surfaces in Persons with Transfemoral Amputation

**Brian L. Ruhe, PhD**

This study investigated the effects of stiffness and alignment properties of prosthetic foot/ankle devices during quiet standing on sloped surfaces. The prosthetic foot/ankle stiffness and alignment are normally set by a prosthetist in a clinic on a level surface. Most prosthetic foot/ankle devices cannot dynamically change these properties; therefore, persons with amputation use proximal joint compensations to maintain balance. It was hypothesized that: (1) able-bodied persons adapt to sloped surfaces using their foot/ankle systems with no increase in oxygen consumption; (2) decreasing prosthetic foot/ankle stiffness (without changing alignment) will decrease proximal joint compensations and reduce oxygen consumption of prostheses users; and (3) using adapted prosthetic foot/ankle alignment on sloped surfaces produce oxygen consumption, joint kinematics, and kinetic data that are similar to standing on level surfaces.

Ten able-bodied persons quietly standing on sloped surfaces were studied to quantify their energy consumption, kinematic, and kinetic adaptations. Oxygen consumption was not significantly altered ( $p=0.098$ ). Able-bodied persons' proximal body segment kinematics ( $p=0.334$ ) and anterior/posterior center of pressure location ( $p=0.164$ ) did not change significantly while standing on sloped surfaces. These results suggest that the able-bodied foot/ankle realigns its sagittal plane orientation to match the surface slope.

Ten persons with unilateral transfemoral amputation were studied to quantify their energy consumption, kinematic, and kinetic compensations. These persons quietly stood on sloped surfaces with three prosthetic foot/ankle stiffness values and two prosthetic foot/ankle alignments. Prosthetic foot/ankle stiffness did not have a significant effect on oxygen consumption ( $p=0.220$ ); however, oxygen consumption was significantly



**Brian L. Ruhe, PhD**

increased for non-level standing trials ( $p=0.044$ ). The adaptable alignment prosthetic foot/ankle condition decreased oxygen consumption on inclined surfaces compared to standard alignment ( $p=0.034$ ). Realignment of the prosthetic foot/ankle device reduced sagittal plane hip compensations ( $p=0.005$ ) and improved posture.

The results from these studies suggest current approaches using a single stiffness and alignment for prosthetic foot/ankle devices were not energy efficient for quiet standing on non-level surfaces. It is believed that prosthetic foot/ankle devices that can dynamically

change stiffness and alignment for the task performed would have a positive impact on persons with lower limb amputation.

### New Horizons

**Brian Ruhe**, PhD, is enrolled in the **California State University Prosthetics Certificate Program** at the VA Long Beach Healthcare System (VALB)/CSU Dominguez Hills Center for Orthotics and Prosthetics. As a prosthetist, Dr. Ruhe will use clinical and fabrication skills to create the interface between a person with an amputation and a mechanical device. As a prosthesis user, Dr. Ruhe has an insider's understanding that the socket fit and prosthetic alignment can determine whether and how well a person with amputation will walk. Combined with his doctorate, a Certificate of Prosthetics will enable Dr. Ruhe to teach in graduate prosthetics programs, develop new prosthetic devices, and contribute significantly to the fields of rehabilitation engineering and prosthetics.



## NURERC Welcomes International Visitors

R. J. Garrick, PhD

### Liang-Wey Chang: Expanding Taiwan's P&O Infrastructure



Dr. Liang-Wey Chang

**Liang-Wey Chang**, PhD, CO, PE, visited NURERC on August 13 and 14. Dr. Chang is Associate Professor at the **Institute of Biomedical Engineering, National Taiwan University** and Deputy Director of **National Taiwan University Rehabilitation Engineering Research**

**Center (NTURERC).**

He presented an overview of the NTURERC program and explored potential educational exchange and collaborative research in P&O.

Dr. Chang obtained his doctorate in mechanical engineering at **Purdue University** (1984) and held faculty positions in the United States until 1992 when he returned to Taiwan to develop a national infrastructure for the education, research

and clinical practice of prosthetics and orthotics (P&O). Frequently returning to the USA to develop new areas of expertise, Dr. Chang attended NUPOC where he completed his orthotics education (1999) and his prosthetics education (2005). He conducted P&O research at NURERC in 2005 and again in 2006. This summer Dr. Chang spent two months at **Texas Scottish Rite Hospital for Children** (Dallas, TX) where he conducted research in pediatric orthotics and prosthetics.

With qualifications in rehabilitation engineering and P&O, Dr. Chang is committed to improving Prosthetics and Orthotics throughout Taiwan. Under his watch, the NTURERC has worked to establish clinical affiliates throughout the island nation. Currently, NTURERC has 12 students in the master's program and 4 students in the doctoral program. Through international exchange and collaboration, Dr. Chang aims to strengthen and expand P&O research, education, and clinical practice throughout Taiwan.

### Hyun Sub Park Visits from KITECH

**Hyun Sub Park**, PhD, Principal Researcher, Division for Applied Robot Technology, the **Korea Institute of Industrial Technology (KITECH)**, **Soo Jong Lee** (President, SMA Engineering Inc.), and **Jong Min Park** (Manager, SMA Engineering Inc.) Korea, visited the laboratory on July 15 to learn about NURERC research in prosthetics and orthotics; and to share their interest in rehabilitation robotics. **Steven A. Gard**, PhD, Director



NURERC Director **Steven A. Gard**, PhD (left) explains features of the Shape&Roll Prosthetic Foot to **Hyun Sub Park**, PhD (right).

of NURERC, welcomed the group, conducted a tour of the laboratory, and discussed our research projects. Dr. Park presented an overview of KITECH robotic projects directed toward translational use. Mr. Lee presented details about finite element analysis simulations and showed examples of robots already fabricated at SMA Engineering. The group discussed potential collaboration on future projects.

## Urs Schneider Visits from Fraunhofer

**Urs Schneider**, MD, Head of the Systems in Motion Department, **Fraunhofer Technologie-Entwicklungsgruppe** (Stuttgart, Germany) visited NURERC on July 14 and 15. **Brian Kaluf**, MS, a **Purdue University** biomedical engineering graduate who studied at Fraunhofer this year, visited NURERC with Dr. Schneider. Mr. Kaluf also visited NUPOC, where he may enroll in the prosthetics certification program.



(Left to right) **Brian Kaluf**, MS, **Urs Schneider**, MD, and **Andrew Hansen**, PhD.

NURERC researchers **Andrew Hansen**, PhD, **Dudley S. Childress**, PhD, and **Stefania Fatone**, PhD, BPO(Hons), and others met Dr.

Schneider and Mr. Kaluf to exchange updates on current prosthetics and orthotics projects. Dr. Schneider presented an overview of research at Fraunhofer and discussed “Terrain Detection and Adaptation.” Mr. Kaluf discussed ratite gait characteristics, specifically the biomechanics of the ostrich foot and ostrich gait with respect to metabolic cost

in the transition from walking to running. Discussions included mutual research goals, potential collaboration and opportunities for educational exchange.

### NURERC Represented at RESNA

**Steven A. Gard**, PhD, and **Stefania Fatone**, PhD, BPO(Hons), attended the 32<sup>nd</sup> Annual International Conference of the **Rehabilitation Engineering and Assistive Technology Society of North America** (RESNA) on June 23 to 27 in New Orleans, LA. They hosted an exhibit booth featuring prosthetics and orthotics research conducted at NURERC. Another NURERC collaborative partner, the **National AgrAbility Project**, also hosted a booth.

While at the RESNA conference on June 25, **Steven A. Gard**, PhD, participated in a special session hosted by the IEEE/EMBS on “Application of Assistive Technologies to Augment Independent Living in People with Disabilities: From Research to Practice.” Dr. Gard presented information about NURERC research and development projects pertaining to adaptable foot-ankle mechanisms in assistive technologies.

NURERC attended the meeting as one of 10 Rehabilitation Engineering Research Centers (RERC) that are funded by **NIDRR**. Ten of the 16 national RERCs attended the meeting. NIDRR representative, **Tom Corfman**, Project Officer, also attended the meeting.

### Hansen Invited Speaker in Hong Kong

**Andrew Hansen**, PhD, was invited to speak at the **Asian Prosthetic and Orthotic Scientific Meeting** held August 20 to 22 in Hong Kong. Dr. Hansen presented “Prosthetic Foot Technologies and a Search for the ‘Right’ Tech” at the symposium titled “Advanced Technology for Lower Limb Prosthetics Rehabilitation.” **Winson Lee**, PhD, (Institute of Biomedical Engineering, **National Yang-Ming University**) organized the symposium and also presented “Analysis and Design of Conventional and Osseointegrated Lower-Limb Prostheses.”

Dr. Hansen also attended the **Annual Meeting for the American Society of Biomechanics** held August 26 to 29 at the Pennsylvania State University. Co-authored with **Charles C. Wang**, MS, Dr. Hansen presented two posters: “Changes in Ankle Kinematics to Preserve an Invariant Roll-over Shape” and “Effective Rocker Shapes for Walking, Swaying, and Standing.”

## NURERC News

### Meetings and Presentations

**Craig Heckathorne**, MSc, and **Kathy Waldera**, MS, attended the **Farm Progress Show** on September 1 to 3 in Decatur, IL. The show featured many aspects of farm technology, including machines, safety, seeds, fertilizer, animal husbandry, irrigation, and alternative energy resources.

Mr. Heckathorne and Ms. Waldera manned a booth in the Health and Safety Tent where they displayed a poster, distributed issues of *Capabilities* and distributed recruitment flyers to encourage farmers with amputations to participate in NURERC research. **The National AgrAbility Project**, **Breaking New Ground Resource Center**, and the **University of Illinois Farm Safety Program** also sponsored booths in the same tent.

**Stefania Fatone**, PhD, and **R.J. Garrick**, PhD, represented NURERC on August 7 at a meeting of **UnLIMBited Potential**, the amputee support group at the Rehabilitation Institute of Chicago. Drs. Fatone and Garrick discussed NURERC research activities, educational outreach, and the potential for future collaborations. NURERC will help UnLIMBited Potential establish its own website, activities calendar, and blog space. NURERC looks forward to interacting further with the members of UnLIMBited Potential.

**Steven A. Gard**, PhD, attended the *Journal of Rehabilitation Research & Development* (JRRD) Editorial Board Meeting, held on July 23 in Baltimore, MD. Dr. Gard serves as an Associate Editor at the JRRD.

**Stefania Fatone**, PhD, BPO(Hons), represented NURERC as part of NUPOC's participation in the **National Youth Leadership** forum that was held at the RIC on July 23. Dr. Fatone presented information about NUPRL research and encouraged youth to examine careers in rehabilitation engineering research and in prosthetics and orthotics (See article, page 4).

**Stefania Fatone**, PhD, **Jodi Fox**, Director, Distance Education, NUPOC, and **Christopher Robinson**, MBA, CPO, ATC, participated in the **American Academy of Orthotists and Prosthetists** (AAOP) Great Barriers Meeting, held at the Rehabilitation Institute of Chicago, July 17 to 19. Dr. Fatone led a discussion session on

“Barriers to Dissemination of Research Results.” Mr. Robinson presented “The Role of the Internet as a Solution to Clinical, Research and Educational Barriers” and Ms. Fox presented “Overcoming Distance: How Technology Breaks Barriers” (See article, page 5).

**Kathy Waldera**, MS, attended the 2009 **Amputee Coalition of America National Conference** on June 18 to 21 in Atlanta, GA, as a representative of the **National AgrAbility Project**, a collaborative partner of NURERC. She handed out brochures about adaptive equipment and health resources available to people living in rural and agricultural areas; and also distributed flyers intended to recruit farmers, ranchers, and prosthetists to the NURERC-Agrability project.

**Steven A. Gard**, PhD, participated in a continuing education course about Evidence Based Practice at the **Midwest Chapter American Academy of Orthotists and Prosthetists** (AAOP) 2009 Annual Summer Session, held on June 12 to 13 in Lake Geneva, WI. Other NURERC presenters were **Stefania Fatone**, PhD, **Brian Ruhe**, PhD, **Erin Boutwell**, MS, and **Kathy Waldera**, MS.

**Christopher Robinson**, MBA, CPO, ATC, participated in a Resident Director Training Task Force to develop web-based curriculum for prosthetists and orthotists on June 1. This meeting was sponsored by the **American Academy of Orthotists and Prosthetists** (AAOP) and the **National Commission on Orthotic and Prosthetic Education** (NCOPE).

### Andrew Hansen Promoted

Congratulations to **Andrew H. Hansen**, PhD, who has been promoted to the rank of **Research Associate Professor** in the **Department of Physical Medicine and Rehabilitation** in the **Feinberg School of Medicine** at **Northwestern University**.



Andrew Hansen



## **Capabilities**

ISSN 1055-7156

Northwestern University

Prosthetics Research Laboratory and  
Rehabilitation Engineering Research Program

345 E. Superior Street, Room 1441

Chicago, IL 60611-4496

Phone Help Line: (312) 238-6524

FAX: (312) 238-6510

TTD: (312) 238-6530

E-mail: [reiu@northwestern.edu](mailto:reiu@northwestern.edu)

Web Site: [http://www.medschool.northwestern.edu/  
depts/repoc](http://www.medschool.northwestern.edu/depts/repoc)

**RETURN SERVICE REQUESTED**

**Non-Profit  
U.S. Postage  
PAID  
Northwestern University**

### **Read *Capabilities* On-line!**

You can read *Capabilities* on our website, [http://  
www.medschool.northwestern.edu/depts/repoc](http://www.medschool.northwestern.edu/depts/repoc).

*Capabilities* is free to those who request it and you may receive this publication by post or read all current and archived issues on-line.

If you read *Capabilities* on-line, or if you no longer wish to receive it by mail, please contact us to remove your name from the list of postal recipients.

E-mail: [reiu@northwestern.edu](mailto:reiu@northwestern.edu)

Phone: (312) 238-6524

FAX: (312) 238-6510

Northwestern University PRL & RERP  
345 E. Superior St., Room 1441  
Chicago, IL 60611  
USA

*Capabilities* (ISSN 1055-7156) is published quarterly by Northwestern University's Rehabilitation Engineering Research Center.

Director: Steven A. Gard, PhD

Director Emeritus: Dudley S. Childress, PhD

Editor: R. J. Garrick, PhD

Subscription is free by post or internet to all individuals interested in prosthetics and orthotics. All issues are available on our website, [www.medschool.northwestern.edu/depts/repoc](http://www.medschool.northwestern.edu/depts/repoc). Send subscription requests and address changes to: *Capabilities*, Northwestern University RERC, 345 E. Superior St., Room 1441, Chicago, IL 60611.

This work is funded by the National Institute on Disability & Rehabilitation Research (NIDRR) of the Department of Education under grant number H133E080009. The opinions expressed in this publication are those of the grantee and do not necessarily reflect those of the Department of Education.

Copyright 1997 Northwestern University Rehabilitation Engineering Research Center. All rights reserved. Reproduction by any means of the entire contents or any portion of this publication without prior written permission is strictly prohibited, except for limited copying for educational purposes.

## **Final Patent Applications**

**Andrew Hansen, PhD, and Dudley S. Childress, PhD.** "Bi-modal Ankle-foot Systems for Standing and Walking." Final application filed with the United States Patent and Trademark Office, July 31, 2009 (Serial #USSN 61/137,765).

**Andrew Hansen, PhD, and Dudley S. Childress, PhD.** "Prosthetic Foot with an Adjustable Flat Region." Final application filed with the United States Patent and Trademark Office, July 31, 2009 (Serial #USSN 61/137,746).