NORTHWESTERN UNIVERSITY

Capabilities

Communicating the Science of Prosthetics and Orthotics

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Investigating the Effects of Surface Inclination and Prosthetic Alignment on the Biomechanics of Standing

Brian Ruhe, M. S.

Funds from the National Institute of Disability and Rehabilitation Research (NIDRR) of the Department of Education under Grant H133E030030 supported this work.

A prosthesis is an artificial device used to replace a missing or defective body part. Lower limb prosthetic devices attempt to restore the lost function of the anatomical feet, ankles, knees and/or hips, depending on the level of amputation. Restoring all of the anatomical lower limb's lost function with passive mechanical devices is an extremely difficult engineering problem. The average lower limb prosthesis adequately restores the ability to ambulate, however, with certain costs. Compared to able-bodied individuals, persons who walk with lower limb prosthetic devices typically demonstrate a decrease in walking speed; increase in energy consumption; and altered joint kinematics [1-3]. These results reflect studies performed in controlled environments. In uncontrolled environments, such as sloped surfaces, the muscular and energy demands are thought to increase.

Anecdotal evidence indicates that when standing and walking on sloped surfaces, persons with amputation experience difficulty retaining upright balance while maintaining their body center of mass (COM) over their base of support. Because current prostheses do not adjust adequately to inclines/declines, amputees maintain upright posture and stable balance by employing compensatory postural changes through their most distal anatomical joint. Walking on sloped surfaces may require increased muscle load and energy consumption because of postural changes.

The increased difficulty that amputees experience when walking on sloped surfaces may be associated with the mechanical properties of prosthetic components and prosthetic alignment. According to Schmalz et al. [4], persons with amputation walking on level surfaces showed changes in joint moments and trends toward increased energy consumption after altering prosthetic alignment. This suggests that changes in prosthetic alignment also can affect the biomechanics of standing and walking on slopes.

Typically, the prosthesis is assembled and aligned by a prosthetist in his/her clinic. Alignment of the prosthesis is performed in a controlled environment, on a smooth, level surface; therefore, the prosthesis will perform best on level surfaces. Component selection and their mechanical properties also can affect the performance of the prosthesis on sloped surfaces. Most prostheses are assembled without an articulating ankle. It has been shown that the mechanical properties of the prosthetic foot can simulate the effect of the anatomical foot/ankle complex during walking on level surfaces [5]. More advanced, passive, mechanical, prosthetic feet and ankles are designed with increased compliance, allowing the prosthetic foot to conform to uneven surfaces through the use of spring-like bumpers. It is believed that achieving foot flat will increase stability [6], which would benefit persons with amputation. Although the prosthetic foot may reach foot flat on sloped surfaces, the loaded spring-like bumpers generate forces that attempt to return the foot to its aligned position. These additional forces have to be managed by the user.

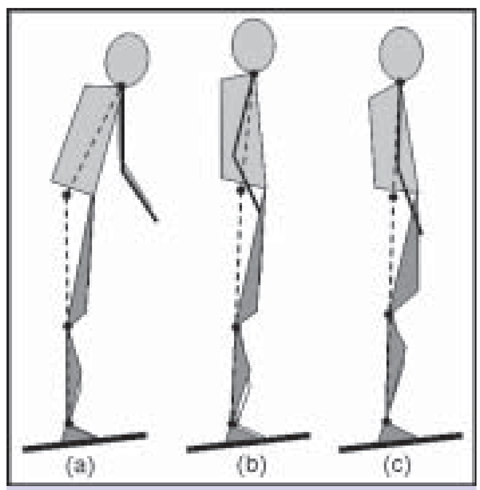

Figure 1: Simplified Link Segment Model of different body postures standing on a 7.5º slope. (a) Male with transfemoral amputations with no alignment change; (b) male with transfemoral amputations with prosthetic foot alignment changed in the sagittal plane to match the incline of the ramp; (c) able-bodied male subject. Dots represent shoulder, hip, knee and ankle joints. Segmented lines show the difference in postures.

The purpose of this investigation will be to determine the underlying biomechanical factors that

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contribute to static stability in persons with lower limb amputations. This study will evaluate the compensatory actions and the resulting costs of those actions that persons with unilateral transfemoral amputation use to stand safely on level, inclined and declined surfaces. Gaining a better understanding of these compensatory actions is necessary for the development of a control algorithm for a smart prosthetic foot/ankle.

Preliminary data from an able-bodied person and a person with transfemoral amputations were collected and analyzed. Kinematic data show that the person with amputations uses sagittal plane hip, pelvic and trunk modifications to adapt to the surface, whereas the able-bodied person uses sagittal plane ankle and knee adaptations to accommodate the incline (Figure 1). Data from the person with amputations and with no change in prosthetic feet or alignment showed a 54% increase in the rate of oxygen consumption when standing on a 7.5 degree inclined surface compared to standing on the level surface. After a change in prosthetic alignment to allow the feet to match the surface inclination, his rate of oxygen consumption increased by only 9%, compared to standing on the level without alignment change. The able-bodied subject's rate of oxygen consumption increased 6% while standing on an incline compared to level ground.

Results from this preliminary study were used to establish a protocol that will be implemented in a proposed, subsequent study. Subjects with unilateral transfemoral amputation will be tested in the VA Chicago Motion Analysis Research Laboratory. Subjects who can stand on uneven terrain for approximately 10 minutes at a time and currently use a multi-axial prosthetic foot will be recruited to participate in this study. Sagittal plane kinematic data, center of pressure data, EMG data and oxygen consumption data will be collected and analyzed. Subjects will be asked to stand on five different sloped surfaces wearing their current prosthesis. Subsequently, they will be fit with a rigid foot/ankle combination aligned for each surface and the protocol will be repeated.

It is anticipated that the results from this study will indicate that a prosthetic ankle device that adapts appropriately to the surface will improve posture and decrease the effort needed to stand and walk in real world environments. Also, these data will help to develop an algorithm to control an active ankle mechanism.

References

1. Boonstra, A.M., Fidler, V. and Eisma, W.H., 1993. Walking speed of normal subjects and amputees: Aspects of validity of gait analysis. *Prosthetics and Orthotics International*. 17:78-82.

2. Huang, C.T., Jackson, J.R., Moore, N.B., Fine, P.R., Kuhlemeier, K.V., Traugh, G.H., and Saunders, P.T., 1979. Amputation: Energy cost of ambulation. *Archives of Physical Medicine and Rehabilitation*. 60:18-24.

3. Michaud, S.B., Gard, S.A., Childress, D.S., 2000. A preliminary investigation of pelvic obliquity patterns during gait in persons with transtibial and transfemoral amputation. *Journal of Rehabilitation Research and Development*. 37:1, 1-10.

4. Schmalz, T., Blumentritt, S., Jarasch, R., 2002. Energy expenditure and biomechanical characteristics of lower limb amputee gait: The influence of prosthetic alignment of prosthetic alignment and different prosthetic components. *Gait and Posture*. 16:255-263.

5. Hansen A.H., Childress D.S., Knox E.H., 2000. Prosthetic foot roll-over shapes with implications for alignment of trans-tibial prostheses. *Prosthetics & Orthotics International*. 24(3):205-15.

6. Perry, J., 1992. *Gait Analysis, Normal and Pathological Function*. SLACK Incorporated, Thorofare, NJ.

NURERC NEWS

Visitors

NURERC hosted new and returning visitors. **Jack Uellendahl**, CPO, returned from Arizona to visit in April. **Rafael Bundoc**, M.D., Ph.D., Eisenhower Fellow from the Philippines, visited on April 17, 2007.

Susan and **Mike Rokosz** and their daughter, **Alexandra**, visited NURERC on May 11, 2007. Mrs. Rokosz is a member of the **Da Vinci Foundation** that honored **Dudley S. Childress**, Ph.D., with the Da Vinci Award for Lifetime Achievement (2005). After visiting NURERC, Mrs. Rokosz spoke at the Kellogg School of Management.

(From left) Dudley S. Childress, Susan Rokosz, Alexandra Rokosz and Mike Rokosz.

Kellie Lim, M.D., former NU bioengineering student and laboratory graduate, visited NURERC on May 9, 2007, prior to beginning her medical residency in pediatrics at UCLA. She likes to help children and looks forward to taking on more responsibilities. Recently, Dr. Lim was featured on ABC World News Tonight as "Person of the Week" and on NBC Nightly News.

Awards

Lexyne L. McNealy, M.S., was a winner in the 2007 AAAS Student Poster Competition in the Science and Society category. Ms. McNealy's poster, "Prosthetic Ankle Motion in Bilateral Transfemoral Amputees" was recognized in the April 20, 2007 issue of *Science*. Access her work at www.aaasmeeting.org. She received a cash prize, a framed award certificate and a one-year subscription to *Science*.

Prosthetic Foot and Ankle with Mechanical Adaptation for Inclined Surfaces

Ryan Williams, B.S.

Funds from the National Institute of Disability and Rehabilitation Research (NIDRR) of the Department of Education under Grant H133E030030 supported this work.

Walking on sloped surfaces is a demand faced by most people every day. While able-bodied individuals easily accomplish this task, persons with lower-limb amputations may find it more difficult. Most currently available prosthetic feet do not have an ankle joint; are aligned for walking on smooth, flat surfaces; and do not adapt to changes in the surface inclination. Therefore, such feet must rely on material deformation in order to simulate ankle motion.

In the 1950s and 60s, Hans Mauch developed a hydraulic prosthetic foot and ankle (FA) mechanism that adapted to the walking surface on each and every step. The mechanism simulated the physiological FA complex and its users preferred it for walking on ramps [1]. The product eventually failed due to leakage of hydraulic fluid, but its initial success indicates the need for a "smart" prosthetic foot, capable of automatically adapting to the walking surface with every step.

We sought to design, develop and test a prosthetic FA mechanism capable of automatic adaptation, and we evaluated its benefits to the users. We attempted to simulate the behavior of the physiological FA complex. It has been shown that the able-bodied ankle joint operates at two different levels of stiffness during a gait cycle: 1) a low stiffness during early stance phase as the foot "finds" the walking surface; and 2) a high stiffness during the remainder of stance phase [2].

The mechanism designed in this investigation achieved automatic adaptability, offering stiffness control for the ankle joint by switching back and forth between a high- and a low-stiffness mode. Furthermore, the mechanism established its set-point with **each step**, properly aligning with the walking surface by switching between stiffness modes at foot flat. Thus, the mechanism adapted to the walking surface with each step and provided the proper amount of ankle stiffness throughout every gait cycle. No currently available prosthetic feet can automatically adjust to slope on the first step. Also, our mechanism relies on the user's body-weight to activate a mechanical system and therefore requires no electronics or computerized components.

We tested this FA mechanism on three individuals with unilateral, transtibial amputations. After completing an Institutional Review Board (IRB) approved consent process, they walked on a level surface and on ramped surfaces using their usual prostheses and then again using our mechanism. All subjects acclimated to the mechanism for five to ten minutes before testing. This training time appears to have been inadequate and two of the three subjects walked more cautiously than they did with their usual prostheses. However, the third subject appeared very comfortable walking with the mechanism. His subjective feedback was positive for walking on the ramps with the mechanism.

The ankle-foot (AF) roll-over shape is a measurement of the effective rocker to which the ankle-foot complex conforms during the stance phase of walking. The AF roll-over shapes obtained for the third subject while using the mechanism (Figure 1) show an adaptation to the

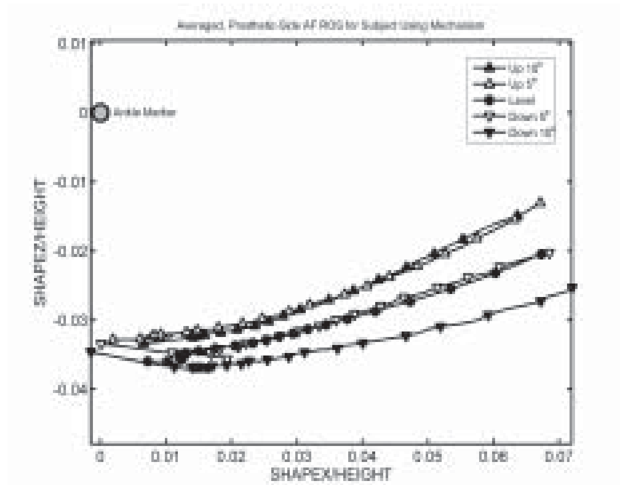

Figure 1: Averaged, single-limb-stance, ankle-foot roll-over shapes (ROS) for the prosthetic side of a single individual walking on our experimental foot and ankle mechanism on a level surface as well as on ramped surfaces with inclinations of +10, +5, -5, and -10 degrees. The x and y axes give coordinates of the shapes normalized by the user's height .

walking surface that is not seen in his roll-over shapes when he walks on his usual prosthesis (Figure 2). Figure 1 shows that while walking on the mechanism, the subject's roll-over shapes on the five- and ten-degree inclines are similar to each other, but are different from his roll-over shapes when walking on the level surface. The roll-over shapes on the ten-degree decline shifted distinctly to the opposite direction from the roll-over shapes on the level surface, while those for the five-degree decline are similar to those for the level surface. Figure 2 shows that while walking on his usual prosthesis, his roll-

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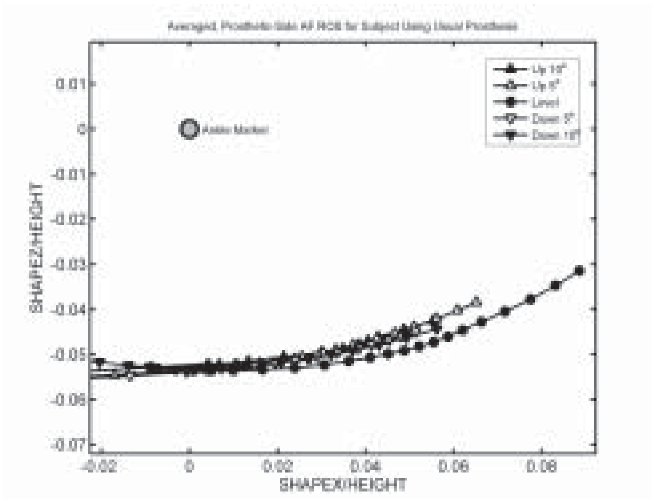

Figure 2: Averaged, single-limb-stance, ankle-foot roll-over shapes (ROS) for the prosthetic side of a single individual walking on his usual prosthesis on a level surface as well as on ramped surfaces with inclinations of +10, +5, -5, and -10 degrees. The x and y axes give coordinates of the shapes normalized by the user's height .

over shapes are very similar for all five walking surfaces. More analysis is required, but these results appear to show that our FA mechanism better simulates the behavior of the physiologic FA complex [3] than does this subject's usual prosthesis. Currently, we are working to enhance the FA mechanism for long-term usage.

References

1. Sowell, T.T. (1981). A preliminary clinical evaluation of the Mauch hydraulic foot-ankle system. *Prosthet Orthot Int, 5* (2), 87-91.

2. Hansen, A.H., Childress, D.S., Miff, S.C., Gard, S.A., and Mesplay, K.P. (2004a). The human ankle during walking: implications for design of biomimetic ankle prostheses. *J Biomech, 37* (10), 1467-74.

3. Hansen, A.H., Childress, D.S., and Miff, S.C. (2004b). Roll-over characteristics of human walking on inclined surfaces. *Hum Mov Sci, 23* (6), 807-21.

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Editor: **R. J. Garrick, Ph.D.**

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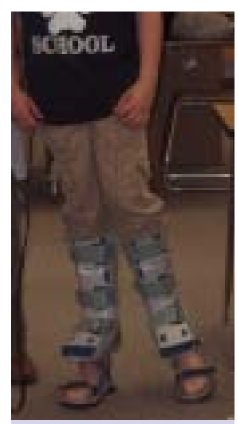
Eager Students Attend NURERC's Outreach Program

R. J. Garrick, Ph.D.

Steven A. Gard, Ph.D. (Director of NURERC), and **Brian Ruhe**, M.S., (doctoral candidate in Biomedical Engineering) conducted a hands-on demonstration about prostheses for 5th graders at a suburban elementary school on April 27, 2007. Dr. Gard showed slides and demonstrated how prostheses work. Eager students learned new words such as *shank* and *pylon*, while examining different prostheses and components. Mr. Ruhe put a personal face on the session by speaking about his experience using bilateral prostheses (See page 5).

Dr. Gard (left) and Mr. Ruhe (center) securely strap a student's legs into prosthetic boots.

Dr. Gard and Mr. Ruhe helped each student to wear boots attached to 4-inch pylons and prosthetic feet. The children took turns and learned to walk in the prosthetic boots. No one stumbled or fell. Mr. Ruhe asked them how it felt to walk in prosthetic boots. The children reported that it was difficult, but they "got used to it." Similar to amputees who must adapt, the children also learned a new way to walk.



Student practices walking in prosthetic boots.

Teachers and children alike reported that Dr. Gard's teaching, coupled with Mr. Ruhe's personal reflections, and the students' experiences walking on prostheses made NURERC's outreach activity particularly meaningful and memorable.

NURERC wishes to appreciate **College Park Industries** for lending the prosthetic boots for this outreach activity.

Brian Ruhe: Mind, Body, Spirit

R. J. Garrick, Ph.D.

Admiring photos of Mr. Ruhe who played sledge ice hockey at the 2002 Salt Lake City Paralympics, students enthusiastically held the gold medal that he won. Appropriately, the medal is inscribed: *Mind, Body, Spirit*.

Mr. Ruhe spoke to the children about prostheses from his own experience, summarizing the automobile accident that resulted in the amputation of both his legs. Briefly, he explained his medical history, how he recovered, learned to walk again and returned to university. Mr. Ruhe's friendly demeanor and frank talk broke the ice as he candidly answered the students' questions.

Mr. Ruhe answered questions about prosthetics and Paralympic competition. The background image shows him competing in the 2002 Paralympics.

Q: Does it hurt to wear prostheses?

BR: *It's uncomfortable, like wearing a pair of really bad shoes for 8 to 14 hours each day.*

Q: Can you run?

BR: *My pace is more like a jog, but it is not fast or stable, so I don't pursue it.*

Q: Do you sleep with your prostheses on?

BR: *No. Wearing prostheses is like wearing shoes. When you get home, you take them off to feel comfortable.*

Q: How long did it take you to learn to walk with prostheses?

BR: *It took weeks to stand, months to walk around in the hall, and even more time to walk outside. It took at least a week to learn to flex the prosthetic knees properly. Learning to work with the technology was a challenge. Then, getting up from chairs, carrying things, walking on uneven surfaces all took extra time to learn. Even now it takes more energy and stamina to walk outside on rough surfaces.*

Q: How far can you walk?

BR: *It depends on the surface, but I can walk about a mile on a flat surface. It requires greater concentration to walk on uneven or sloped surfaces.*

Q: How do the prostheses affect your height?

BR: *That is a very good question. Initially, prosthetists lowered my overall height to 5'9" thus lowering my center of mass (COM). But, when sitting in a chair, the reduced shank length made it impossible for my feet to touch the floor. Eventually, different prostheses returned my height to 6'2" making my COM higher. Remember, if you fall from a higher COM, you land harder, possibly resulting in broken prostheses. Also, taller prostheses make it more difficult to get up from a sitting position.*

Later, Mr. Ruhe reflected that the children had asked two particularly evocative questions: *"When you found out that you were alive, how did you decide what to do with your life?"* and *"After that tragedy, what makes you yourself?"* Although it is difficult to revisit the terrible automobile accident that resulted in his bilateral amputation, he answered the children directly and openly. He explained that six weeks after the accident he regained consciousness and learned that he had survived a devastating accident. He recognized that he had been given a second chance at life. He dedicated the rest of his life to work for a greater good.

The children responded to Mr. Ruhe's sincerity with words of encouragement and appreciation as in the following messages:

"Thank you for sharing your story with us. I thought it was great that after your accident you got up and put your life back together. Thanks. OEG"

"Thank you for everything you told us and for us~whether it was letting us try on your gold medal, or helping us into the prosthetic feet, or honestly answering all of our personal questions. Thanks again! RM"

"Thank you for coming in to talk to us about your experiences. It was very inspiring to hear you talk! Thanks. RG"

Mr. Ruhe's Paralympic gold medal for sledge ice hockey. The reverse is inscribed: *Mind, Body, Spirit*.

Mr. Ruhe's outreach activities promote education related to bioengineering; prosthetics and orthotics; and the lives of those living with a disability. His dedication to work for a greater good embodies the words inscribed on his gold medal: *Mind, Body, Spirit*.

NEWS FROM THE DEPARTMENT OF VETERANS AFFAIRS

Wounded Warrior Care at The Center for the Intrepid

Joseph Sadowski, CPO

As an ongoing partnership between the Department of Defense (DOD) and the Department of Veterans' Affairs (VA), The Center for the Intrepid (CFI) began operations in February 2007 on the Brooke Army Medical Center campus at Fort Sam Houston, Texas. Active duty military, along with federal and contract health care clinicians, provide state-of-the-art care for the wounded with amputation, moderate to severe burns, and those undergoing limb salvage procedures. Seven VA employees stationed at the CFI offer service members who choose to retire a seamless transfer of medical services. These VA personnel provide benefit counseling, case management, prostheses, occupational therapy, physical therapy, social work, and vocational rehabilitation counseling. Thus, by the time veterans complete their rehabilitation at the CFI, they are fully integrated into the continuum of care available in the VA Health Care system.

The CFI offers a thorough complement of rehabilitative care to both active and retired military service members. CFI is a National Armed Forces Physical Rehabilitation Center, so members from the Army, Marines, Air Force, Navy and Coast Guard may receive treatment in this 65,000 sq/ft facility. Medical intervention begins with Physical Medicine and Rehabilitation. Typically, patients are seen as outpatients after being discharged from Brooke Army Medical Center (BAMC). **Jennifer Menetrez**, M.D., Army Physiatrist, skillfully coordinates care with BAMC physicians from various departments, including orthopedic surgery and the burn unit. Each Monday, Dr. Menetrez holds a multi-disciplinary staffing and clinic to review the status of current and newly transferred patients. VA staff advises Army medical personnel about treatment progress, equipment updates and coordination of services for retirement. The multi-disciplinary teams discuss treatment options while creatively resolving issues related to ongoing care and continuing access to medical assistance. Also, team members meet with patients and their families to review medical progress, address concerns, solve problems collectively and allay anxiety about long term outcomes.

Behavioral Medicine intervention is critical in the early stages of care. Attention to cognitive and emotional recovery is paramount to help patients maximize their potential. Numerous injured individuals returning from Operation Iraqi Freedom and Operation Enduring Freedom have suffered traumatic brain injury (TBI) due to combat trauma and service related accidents. Treatment at CFI is multi-faceted and begins with cognitive assessment, medications, individual and group therapy sessions, and family support meetings. Patients' families are included in behavioral health intervention. For example, specialists can identify children's issues and arrange appropriate counseling. Thus, CFI endeavors to meet both the veteran's and his/her entire family's behavioral health needs. Evaluation and treatment occur at CFI, but several other clinics in the San Antonio area also offer care.

CFI's mission is to provide rehabilitation for service members with amputation, limb salvage and burns; therefore, most of the four floors are designated for prosthetics, occupational therapy and physical therapy. The prosthetics fabrication lab occupies the majority of the 2nd floor. The department's goal is to assure one-day or even same-day delivery of test socket fittings. To achieve this quick turn around, the VA prosthetist, technician team and contractors maintain close communication and a tight production schedule. Fabrication is accomplished in a communicative team atmosphere that emphasizes efficiency through daily adjustment of production priorities. Selective use of Computer Aided Design and Manufacture expedites early fittings. Prosthetic limb fittings occur on CFI's third floor in a large, fitting/adjustment room or in a private, individual treatment room. The prosthetics section is divided into an open lower extremity treatment room, upper extremity treatment room, a machine room, and two private treatment rooms.

At CFI amputees learn self sufficiency in many ways. One area is designed to allow patients to adjust their own artificial limbs. Throughout the third floor, parallel bars, lift tables, and exercise equipment allow safe training while wearing prosthetic devices. The third floor Physical Therapy gym allows both prosthetists and therapists to monitor and assist patients, facilitating instant collaboration on issues such as socket fit and alignment. This inter-disciplinary approach enhances rapid competency in the artificial limb wearer.

Many devices help diversify training in the use of artificial limbs. An example is the "Treadwall," which resembles a vertical treadmill with hand and foot holds and a two story rock climbing tower. The basketball court and indoor running

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track augment agility drills, gait training and recreation. The natatorium consists of a six lane pool that allows patients to swim, practice pre-running exercises, or play cardio basketball, torpedo soccer, water polo and water volleyball. The Flowrider machine enhances the aquatic program by producing a constant wave that patients may ride while lying or kneeling on a boogie board. This provides an enjoyable way to improve trunk strength and balance.

Occupational Therapy, located on the 4th floor, makes their motto: *Skills for the job of living and soldiering.* Work capacity evaluations, an Activities of Daily Living apartment, and a driver training simulator let patients regain their skills in a safe environment. Occupational Therapists lead patients on community outings that improve their coping strategies; increase their public interaction while decreasing their sense of isolation; and help individuals practice new skills required for living with a disability. Activities range from attending movies to playing paintball and laser tag. Patients may use the Firearms Training Simulator to practice firing techniques in multiple settings with a variety of weapons, helping individuals to qualify for weapon systems common to the military.

Finally, the Military Performance Lab (MPL) provides data about human motion that physicians, prosthetists and therapists use to improve patient function, enhance prosthetic design and adjust treatment plans. The gait lab utilizes up to 26 cameras to track body position, providing information that can be analyzed to calculate joint angles. Ground reaction forces are measured in three planes to calculate torque through a patient's limb or prosthesis. In conjunction, electromyography monitors timing and intensity of electrical activity during muscle contraction. Gait lab data allow CFI staff to optimize each artificial limb design and improve patients' performance.

The purpose of The Center for the Intrepid is to serve our severely wounded military heroes. CFI's state-of-the-art technology and compassionate professionalism provide the best rehabilitative care to our service men and women. The Department of Veterans Affairs, in a joint venture with the Department of Defense, is providing veterans with world class specialty care and a smooth transition from military to civilian life.

Capabilities appreciates Robert M. Baum for facilitating this article. Mr. Baum is Program Manager of Prosthetics and Clinical Logistics at the VA Central Office (10FP) in Washington, D. C. 20420.

NURERC NEWS

Publications

Fatone, S. and Hansen, A. "Effect of an Ankle Foot Orthosis on Roll-over Shape in Adults with Hemiplegia." *Journal of Rehabilitation Research & Development*, Vol. 44, No. 1, pp.76-87.

Fatone, S. and Gard, S. A. (eds.) (2007) "P&O Research: Are We Addressing Clinically Relevant Problems?" Report on the State-of-the-Science Meeting in Prosthetics and Orthotics, February 28, 2006. Northwestern University Rehabilitation Engineering Research Center in Prosthetics and Orthotics, Feinberg School of Medicine, Northwestern University, Chicago, IL. http://www.medschool.northwestern.edu/depts/repoc/sections/publications/papers/sos_reports/SOS_2006report.pdf

Defenses

Regina J. Konz, Ph.D., successfully defended her doctoral dissertation entitled "The Role of the Spine in Human Walking: Studies of Able-bodied Persons and Individuals with Spine Pathologies" on March 20, 2007. Congratulations!

NIDRR Award Honors Dudley S. Childress

Dudley S. Childress, Ph.D., was invited to speak about the history and development of NIDRR and Rehabilitation Engineering Research Centers (RERC) at the March 15, 2007 RERC Directors' Meeting in Washington, D. C.

At the meeting, **Robert Jaeger**, Ph.D., Executive Director of The Interagency Committee on Disability Research (ICDR) at NIDRR, expressed his appreciation with friendly humor and reviewed Dr. Childress' many contributions to rehabilitation engineering. **Steven J. Tingus**, M.S., C.Phil., Director of NIDRR, personally presented to Dr. Childress a career recognition award from NIDRR. Etched into the award are the words: *In Recognition of Dudley S. Childress, Ph.D., For His Contributions to NIDRR's Rehabilitation Engineering Research Center Program.*

Dudley Childress, Ph.D. (left), received a career recognition award from NIDRR (See inset below).

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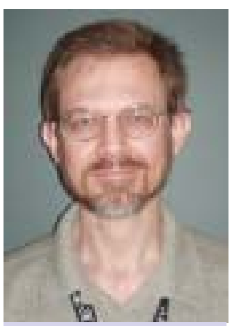

Tom Most

Tom Most has volunteered his skills at NURERC since December 2006. A recent graduate of NUPOC's Orthotics Program, currently Mr. Most is enrolled in NUPOC's Prosthetics Program. During his service at NURERC, he completed his orthotic and prosthetic clinical hours while assisting **Stefania Fatone**, Ph.D., with the fabrication of orthoses. Mr. Most also assisted **Andrew Hansen**, Ph.D., and **Brian Ruhe**, M.S., with the fabrication of Shape&Roll prosthetic feet and cosmetic covers.

With a BFA (1983) from the University of Illinois (Urbana) where he specialized in sculpture, Mr. Most parlayed his interest in 3-dimensional modeling and special effects into the field of prosthetics and orthotics. He observed, *"People may think that special effects and P&O are unrelated, but I use similar materials and processes in both fields. Only the clients and end applications are different."*

Mr. Most specializes in rapid prototyping, urethane casting, mold making, sculpting, color matching, painting and pattern finishing and he is a member of the Association of Professional Model Makers (APMM). He plans a local residency where he can incorporate rapid prototyping techniques into P&O. In his spare time, he and his certified Therapy Dogs, Rudy and Ariel, visit hospital patients.

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