



Capabilities

Communicating the Science of Prosthetics and Orthotics

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Edward Pennington-Ridge Visits NURERC

By R. J. Garrick, Ph.D. and Andrew Hansen, Ph.D.

Mr. **Edward Pennington-Ridge**, President of *Elegant Design and Solutions Ltd.*, located in Wales, UK, visited the Northwestern University Rehabilitation Engineering Research Center (NURERC) from April 24 through 28, 2006. An inventor and active proponent of developing affordable prostheses for amputees in developing countries, he presented a weeklong practicum, demonstrating to NURERC researchers **Andrew Hansen, Ph.D., Margrit Meier, Ph.D., Craig Heckathorne, M.S., and Dudley Childress, Ph.D.**, the process of fabricating realistic cosmetic shells for artificial hand and foot components. In particular, he demonstrated how to fabricate a silicone shell for the Shape&Roll Foot. For use in developing countries, Ed favors prosthetic designs that use accessible technology, as well as materials that are affordable and locally available. His philosophy is consonant with



Silicone cosmetic cover next to functional components. (Photograph courtesy of E. Pennington-Ridge)

the goals of the Shape&Roll Foot and its fabrication system that were developed at NURERC, with the collaboration of the Center for International Rehabilitation (CIR).

In addition to the workshop, Ed presented a slide review of his work in Sierra Leone, Bosnia, Slovenia, Cambodia and



Transtibial prosthetic components built from locally available materials. (Photograph courtesy of E. Pennington-Ridge)



Cosmetic shell (left) fabricated from silicone and Shape&Roll Foot core (right). (Photograph courtesy of E. Pennington-Ridge)

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Edward Pennington-Ridge Visits NURERC

Afghanistan where he has assisted many persons with limb loss by fabricating highly functional, durable, affordable and cosmetically appealing prostheses. Ed develops prosthetic components for transradial prostheses, flexible ankle joints and transtibial / transfemoral prostheses that can be fabricated on site from local materials, such as wood, bolts and tire rubber.

For example, while in Sierra Leone, he experimented with glass fiber reinforced PVC for use as prosthetic sockets, but found it lacking as a substance. Always searching for a better material from an easily accessible source, Ed discovered quantities of discarded 50-gallon polyethylene drums that had been used to transport sherry from England. He cut up the sherry drums, allowing John G. Craig, CPO, to thermoform them over positive models of people's residual limbs to make sockets.

Over the years, Ed created many functional prosthetic components, but acceptable cosmetic appearance still eluded him. Rubber molds provide a nominal cosmetic improvement, but the appearance of rubber is stiff; moreover, it deteriorates under harsh conditions and ultraviolet rays. Through experimentation, Ed developed hand and foot cosmetic shells made from industrial silicone (i.e., caulking material). The results are very realistic in appearance. The substance can be impregnated with pigment to approximate any skin tone and can be reinforced with inexpensive and readily available materials. The texture is relatively light, flexible, warm and lifelike. Covers can have unobtrusive zippers that allow ease of donning and doffing over the prosthetic mechanisms. Also, these shells are durable in exposure to UV light, moisture, heat and cold. Users favor these cosmetic covers.

The weeklong interaction with Ed was rewarding and suggested possible, future projects. We will continue to communicate with Mr. Edward Pennington-Ridge to determine specific projects that would lend themselves to collaboration between NURERC and *Elegant Design and Solutions Ltd.*

Landmine Devastation

Every year landmines cause thousands of deaths, blindness and amputations in men, women and children who are pursuing daily activities such as farming, collecting firewood or water. The International Committee of the Red Cross estimates that every 20 seconds another landmine amputation occurs somewhere in the world.



Landmines cause wanton and grievous injuries among civilian populations. (Photograph courtesy of E. Pennington-Ridge)

Many strife-torn countries have vast acreages of treacherous minefields, making the land inaccessible and untillable. In countries no longer at war, landmines sometimes wash down into areas considered safe. Frequently, the victims are children who tread on them while working or playing. Or, attracted by the bright, plastic housing, children may pick one up, only to lose the use of limbs and eyesight. The wounded may be days from basic medical care; and most landmine victims bleed to death. Survivors require transfusions, infection control and multiple, complex operations beyond available resources.

The Landmine Survivors Network (www.landminesurvivors.org) estimates that more than 80 million landmines are buried in more than 80 countries worldwide. Their source states that more deaths have occurred due to landmines than from nuclear, chemical and biological weapons combined. Each year, landmines and unexploded ordnance cause 20,000 new casualties. More than 80% of landmine victims are civilians living in poverty. At least 25% of landmine victims are children. Fewer than 10% of landmine victims have access to medical care and rehabilitation services. Less than 25% of landmine amputees are fitted with proper prostheses. Landmines can be manufactured for a mere three dollars (\$3) apiece, but removal of a single landmine costs one thousand dollars (\$1000).

Edward Pennington-Ridge: Solving Problems with Elegant Designs

By R. J. Garrick, Ph.D.

Edward Pennington-Ridge has been interested in solving problems since childhood. Curious to learn how things work, he often deconstructed, fabricated and improved items. He attributes his practical, problem-solving approach to the influence of his father who provided Ed with access to machines and materials for plastics fabrication. Educated in England, Ed pursued chemistry, physics, biology and zoology, eventually choosing to use his designs and innovations to solve problems in prosthetics.



Mr. Edward Pennington-Ridge during his visit to NURERC.

Prosthesis became his focal point through a series of convergent experiences. He taught in Zimbabwe where he gained familiarity with the needs and wishes of people living in a struggling economy. Upon his return to England, Ed designed and improved many items; however, his interest in prosthetic design was stimulated further when he improved the prosthesis of a local man who had lost his leg in a motorcycle accident. Because this individual disliked the leg prescribed to him by the National Health Service, Ed designed and built a new prototype that better suited him.

In 1996, Princess Diana spotlighted the tragedy of landmine survivors, bringing their needs to international awareness. This global call to action resonated with Ed. Recognizing the needs of vast numbers of amputee civilian noncombatants, Ed resolved to make meaningful contributions to that cause. He actively developed designs and established links with non-governmental organizations (NGOs) that assisted landmine survivors.

In 2001 he began his prosthetics work in Sierra Leone, a land savaged by brutal, marauding militias that hack off the arms of men, women and children. These intentional mutilations prevent the victims from productivity or subsistence. In spite of significant danger to himself, Ed worked with persons with limb loss who were being fitted with “out-of-the-box” prostheses for transradial amputations.

Working in Sierra Leone gave him insight to the plight and poverty of those who sought prosthetic assistance. Ed perceived that the divergent levels of amputation and conditions of the residual limbs made it difficult to fit “out-of-the-box” prosthetic limbs. Moreover, the cost of providing and repairing these prostheses depended on the policies and funding of certain non-governmental organizations (NGOs). He recognized that persons with limb loss objected to the unnatural appearance of split hooks, even with highly functional components; and they wished for prostheses with a more naturalistic appearance. Ed began to innovate and experiment with design options that would allow prosthetic repairs using materials readily available at low cost. He experimented with designs and fabrications of visually attractive and affordable prostheses.

Currently, he is affiliated with Adopt-A-Minefield (www.landmines.org.uk) as a Landmine Survivor Assistance Consultancy. We wish Mr. Pennington-Ridge continued success as he makes significant contributions with his innovative designs and activities that assist amputees who live in war-torn countries.

Results of the Northwestern University Online Survey and Forum on Prosthetics and Orthotics Research

By Stefania Fatone, Ph.D.

The Northwestern University Rehabilitation Engineering Research Center (RERC) in Prosthetics and Orthotics (P&O) held a State of the Science (SOS) Meeting in Prosthetics and Orthotics on February 28, 2006 in Chicago. In anticipation of this meeting, we conducted an online Survey and Forum to elicit the opinions of the P&O community about directions that P&O research should take during the next 5-10 years. We compiled the results of the Survey and Forum for presentation and discussion at the SOS Meeting and also at the American Academy for Orthotists and Prosthetists (AAOP) Annual Meeting held in Chicago from March 1-4, 2006.

Summary of Survey Results

From November 21 to December 30, 2005, we made the Survey available online at <http://www.medschool.northwestern.edu/depts/repoc/>. We advertised the Survey on the oandp-1 list server (which had 3300 subscribers during that period), the Clinical Gait Analysis (CGA) list server, and the Amputee Coalition of America amp-1 list server and their web site <http://www.amputee-coalition.org/>. Additionally, we sent e-mail invitations to a number of colleagues in the field.

We received a total of 224 responses, and 172 (77%) respondents provided their name and e-mail addresses. The majority of respondents (78%) were aged 30-59 years (**Figure 1**) and 60% identified themselves as

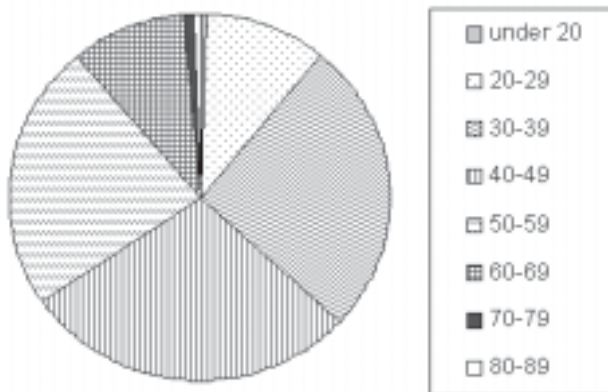


Figure 1 Survey: Age of Respondents.

Certified Prosthetists (CP), Certified Orthotists (CO) or Certified Prosthetist / Orthotists (CPO) (45.5% CO; 49.6% CP) (**Figure 2**).

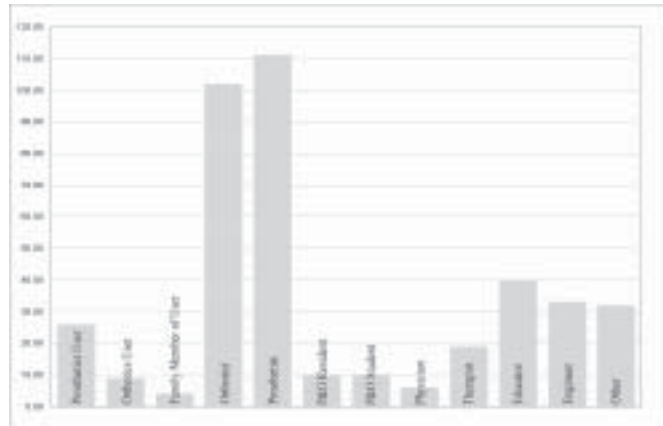


Figure 2 Survey: Respondents' Role in P&O.

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Fifty-four percent of respondents indicated that they do not conduct research in P&O, while 44% (98) indicated that they do conduct research and also specified a percentage of time they devote to research. (*Throughout this article the number in parentheses indicates the number of responses, unless otherwise indicated.*) The majority of prosthetists and / or orthotists who conduct research spend less than 20% of their time on research. Those respondents who spend more than 80% of their time on research tended to identify themselves as engineers.

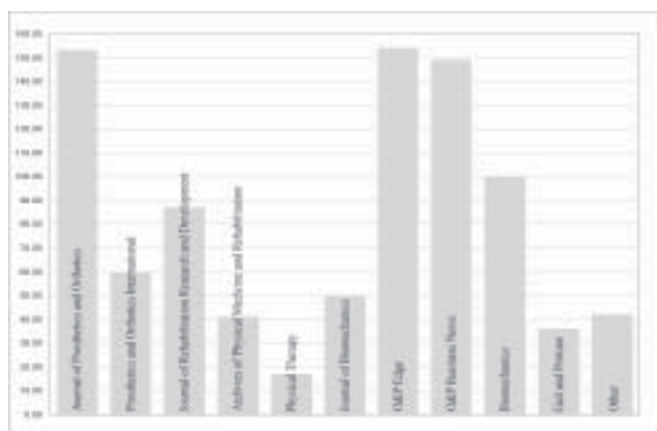


Figure 3 Survey: Journals Read by Respondents.

When asked to identify journals they read regularly to stay current with P&O-related research, 66-68% of respondents named *O&P Edge*, *Journal of Prosthetics and Orthotics*, and *O&P Business News* (**Figure 3**). An additional 33 sources were cited as “Other,” most only once. Sources cited more than once included: *O&P Almanac* (6), *InMotion* (4), *Challenge (Disabled Sports/USA)* (2), *Alignment* (a Canadian magazine) (2), *ADVANCE for Directors of Rehabilitation* (2), *Journal of Bone and Joint Surgery* (2), *Journal of Pediatric Orthopedics* (2), *Developmental Medicine and Child Neurology* (2), *Clinical Biomechanics* (2), and the internet (2). Almost all respondents (98.2%) answered that research is important. In answer to whether a sufficient amount of research is being conducted in the field of P&O and whether the emphasis of current P&O research is appropriate, 79.9% answered that they believe the quantity of research is inappropriate.

Eighty percent (80%) of respondents indicated insufficiency in the following areas: outcomes / evidence / efficacy (56); orthotics research (16); funding (15); statistically significant studies with strong design (12); objectivity / independence of research (7); time to do research (6); quantity of research being conducted (6); quality of research being conducted (5); and involvement of prosthetists and orthotists in research (5).

Sixty-one percent (61%) of respondents identified the following areas as requiring greater research emphasis: outcomes / evidence based practice (23); funding (11); study design and size (11); orthotics research (8); contribution to research by prosthetists and orthotists (5); time to conduct research (4); and cost effective P&O solutions (4).

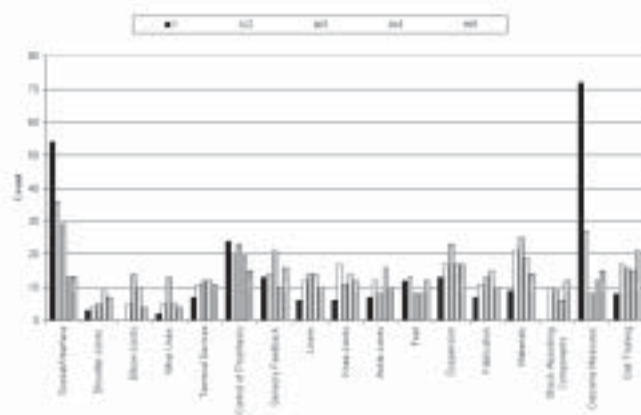


Figure 4 Survey: Areas for Future Prosthetics Research, Ranked by Order of Importance.

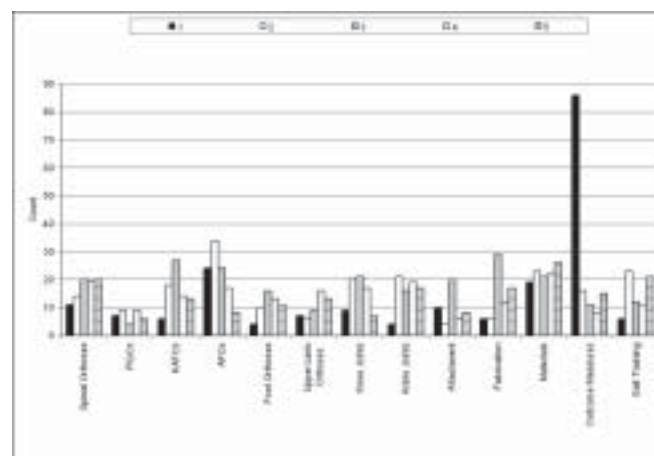


Figure 5 Survey: Areas for Future Orthotics Research, Ranked by Order of Importance

More than 78% of respondents indicated that they had identified areas that need further study but lacked the ability and resources to conduct research. Of the total, 74.6% responded that insufficient funding prevents more research.

Given a selection of topics, respondents ranked the top five most important P&O research areas from 1 to 5 (with 1 being the most important). See **Figure 4** for prosthetics results and **Figure 5** for orthotics results.

In prosthetics, respondents ranked “outcome measures” and “socket / interface” number one. At each level, the topics ranked most often were: 1) outcome measures; 2) and 3) socket / interface; 4) control of prosthesis and 5) suspension. “Other” topics included clinical decision-making (5), alignment (5), education (4), and practitioner accuracy / precision (4).

In orthotics, most respondents ranked “outcome measures” the number one topic. At each level, the topics ranked most often were: 1) outcome measures; 2) Ankle Foot Orthoses; 3) fabrication; 4) and 5) materials. “Other” topics included prescription principles (6), comfort (4), and alignment (4).

The open ended question “What do you consider to be the three most important questions to be addressed by prosthetics and orthotics research in the next five to ten years?” elicited the following most common topics:

- Outcome Measures with emphasis on efficacy of P&O service, evidence-based practice
- Cost-benefit analysis of P&O services / technologies
- Develop low cost alternatives
- Development of materials for P&O applications
- Develop light-weight components
- Develop fabrication processes for ease and quality
- Develop prescription principles for better decision making, e.g. component and device choice
- Long term and real-world functional analyses with applicability to P&O
- Interface / socket design and comfort
- Development of control options for prostheses
- Education and qualifications: standards, continuity, quality

Summary of Forum Discussion

The online Forum opened at <http://www.medschool.northwestern.edu/depts/repoc/> on

November 21, 2005 and was advertised in the same manner as the Survey. As of February 16, 2006, 108 members had registered. Although the Forum remains open, since mid-January few comments have been posted. Of the users who posted comments, most posted less than ten. Topics that attracted the most posts were “Lower-limb Prosthetics: Sockets and Liners” and “Research and Development Wish-list: ‘Lack of Science in P&O’.” Overall, prosthetic topics attracted greater discussion than orthotic topics.

From the Forum, we identified more than 70 potential research questions, most of which were kindled by two topics: 17 issues derived from “Research Desires” and 14 related to “Sockets and Liners.” Suggestions in “Research Desires” sought to determine function and efficacy of different technologies, to improve current technologies and to develop new ones. Most suggestions regarding Upper-limb Prostheses focused on the improvement of function through reductions in weight and weight distribution, improvement of control processes and sensory feedback. Most suggestions regarding Lower-limb Prostheses focused on improving function, particularly in real world conditions; developing better prescription principles; improving and better understanding alignment; establishing the cost-benefit of new technologies; and improving understanding of the socket-limb interface and its effects on tissue health. Additional suggestions focused on the efficacy and function of orthoses; the role of CAD / CAM in P&O; and improvements in the selection criteria and determination of the life span of materials and components used in P&O.

Conclusion

Overall, the State of the Science Meeting, online Survey and Forum generated many important recommendations for future research directions in P&O. By involving P&O clinicians, we believe we have identified clinically relevant topics that should be the focus of short- and long-term research endeavors. We intend to use this information to help us develop new research projects. A report summarizing these findings will be publicly available in late summer of 2006.

A “Baker’s Dozen” for Summer Reading

Dudley S. Childress, Ph.D., was invited to be keynote speaker at the **2006 Pros-TH-otics Congress** held in Wellington, New Zealand, from March 24-26, 2006 where he presented “Shape: The Portal of Entry to Function” and “Books for a Busman’s Holiday.” In the latter talk, he reflected on some memorable books. Some of these books never were best sellers and others may be difficult to obtain, but their message has the power to inspire and transform us.

Perhaps you have your own list of unforgettable books. Do you recall a particularly memorable book about courage, perseverance, hope and fulfillment? Did it contain experiences or ideas that stayed with you for days or longer? Such a book may have influenced you so deeply that it changed your view of your own life or the lives of others. Here is a “baker’s dozen” of books that you may enjoy reading:

1. “The Iron Hand” by Johann Wolfgang von Goethe, (1771 and 1773)

2. *Reach for the Sky: the story of Douglas Bader, legless ace of the Battle of Britain* by Paul Brickhill (N. Y., Norton, 1954)

3. *Michael Lapsley, Priest and Partisan: a South African journey* by Michael Worsnip (N. Y., Talman, 1996)

4. *The Long Road Home: one step at a time, a Doonesbury book* by Gary B. Trudeau, (Kansas City, MO, Andrews McMeel, 2005)

5. *Living with a Below-Knee Amputation: a unique insight from a*

***prosthetist / amputee* by Richard Lee Riley, (Thorofare, N. J., Slack Inc., 2005)**

6. *Enabling Lives: biographies of six prominent Americans with disabilities* ed. by Brian T. McMahon and Linda R. Shaw (Boca Raton, FL, CRC Press, 2000)

7. *A Leg to Stand On* by Oliver W. Sacks (N. Y., Simon & Schuster, 1984)

8. *Let Yourself Be Loved: the life and letters of Will Jenks* by William J. Kane (Minneapolis, MN, Syren Book Co., 2004)

9. *My Left Foot* by Christy Brown (N. Y., Simon & Schuster, 1955)

10. *Down All the Days* by Christy Brown (N.Y., Stein & Day, 1970)

11. *The Diving Bell and the Butterfly* by Jean-Dominique Bauby (trs. by Jeremy Leggatt, N. Y., Knopf, 1997)

12. *When Walking Fails* by Lisa I. Iezzoni (Berkeley, CA, University of California Press, 2003)

13. *Between a Rock and a Hard Place* by Aron Ralston (N. Y., Atria Books, 2004)

Take the time to read some of these books and you, too, may be moved by their message. Share these books and their insights about the human condition; you can expand their power to engender hope and determination in others.



NEWS FROM THE DEPARTMENT OF VETERANS AFFAIRS

VHA Polytrauma System of Care Enhances Amputation Care for Combat Injured Veterans

By

**Micaela Cornis-Pop, Ph.D., CCSLP, and Gretchen Stephens, MPA, OTR/L
National PM&R Program Office**

VHA is developing a Polytrauma System of Care to meet the rehabilitation needs of a new generation of veterans with injuries from current combat operations in Iraq and Afghanistan. Blasts are the most common cause of recent combat injuries. The term polytrauma, a new word in the medical lexicon, now is being used to describe the injuries to multiple body parts and organs that occur as a result of exposure to blasts. Traumatic brain injury (TBI) frequently occurs in polytrauma in combination with other disabling conditions such as amputation, auditory and visual impairments, spinal cord injury (SCI), post-traumatic stress disorder (PTSD), and other medical problems. Due to the severity and complexity of their injuries, service members and veterans with polytrauma require an extraordinary level of coordination and integration of clinical and other support services.

VHA Polytrauma System of Care currently includes four Polytrauma Rehabilitation Centers (Level 1/ regional), which provide acute comprehensive medical and rehabilitation care for complex and severe polytraumatic injuries and twenty-one Polytrauma Rehabilitation Network Sites (Level 2/VISN), which manage post-acute sequelae of polytrauma and coordinate life-long rehabilitation services. Levels 3 and 4 of the Polytrauma System of Care are under development and they will involve designating

Polytrauma Facility Teams or Polytrauma Points of Contact at each VHA facility. The VHA Polytrauma System of Care is designed to integrate and coordinate specialized rehabilitation services along a continuum of care that includes acute inpatient rehabilitation, outpatient services, transitional living, long-term care, community re-entry, and vocational rehabilitation. Care is provided at the participating facility that is closest to the patient's home and has the expertise to manage the specific rehabilitation, medical, or mental health needs of the veteran or service member. Polytrauma Case Managers and Points of Contact at each facility ensure access to the appropriate level of polytrauma care and coordinate services and community resources to meet patient and family needs. A Polytrauma Telehealth Network links Level 1 and 2 polytrauma centers and provides opportunities for videoconferencing and consultations among specialists so that optimal care is available at a location close to the patient's home.

In coordination with the development of the Polytrauma System of Care, VA is enhancing the care for the combat injured veterans with amputation, including interdisciplinary amputation clinic teams, prosthetic and orthotic laboratories, and Preservation-Amputation Care and Treatment Programs (PACT).

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Enhancements include addition of staff, advanced specialized training for staff, utilization of advanced prosthetic devices, equipment, and techniques in the rehabilitation process, and pro-active case management. The interdisciplinary teams at the polytrauma centers include physicians, nurses, physical therapists, occupational therapists, prosthetists, case managers, psychologists, speech therapists, recreation therapists, and blind rehabilitation specialists. The teams have received specialized training in polytrauma care for the combat injured and are prepared to provide amputation care services as a single impairment as well as in the context of polytrauma. Amputation rehabilitation for the combat injured recognizes the fact that these individuals are younger, previously active and healthy, and have high expectations and goals for life after

amputation. Advances in amputation care occur in coordination with the Polytrauma System of Care as combat injured veterans with amputation may have other blast and non-blast related conditions and can benefit from an integrated and coordinated approach to care across the life span.

Capabilities appreciates Robert M. Baum for making this article possible. To request future articles or to express interest in VA developments in prosthetics, contact:

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Richard F. ff. Weir, Ph.D., Invited Speaker at Senate Committee

On April 27, 2006, **Richard F. ff. Weir, Ph.D.**, (Research Scientist, Jesse Brown VA



Dr. Weir encourages Senator Craig in skillful use of the myoelectric prosthetic hand.

Medical Center, and Research Associate Professor, Department of Physical Medicine and Rehabilitation, and Biomedical Engineering Department, Biomedical Engineer, Prosthetics Research Laboratory and Rehabilitation Engineering Research Program) was invited to speak to the U. S. Senate Committee on Veterans Affairs in Washington, D.C. The Committee actively encourages and promotes new research in prosthetics that can benefit U.S. veterans.

Demonstrating a myoelectric prosthetic hand that he designed using VA funds, Dr. Weir explained to the Committee the concepts and goals for his prosthetics research project. Chairman of the Committee, Senator Larry Craig (R-Idaho), allowed electrodes to be attached to his forearm, enabling him to manipulate the myoelectric prosthesis and hold a glass of water.

Dr. Weir specializes in the fields of neural Engineering, biomechanics and rehabilitation, particularly implantable bioelectric sensors, artificial arm/hand systems, manipulators, robotics and their control. His ongoing research aims to develop new prosthetic hands.



Dr. Weir demonstrated and explained to United States Senators about some of the prosthetic hands he has designed.

Neural Control of Movement

By A. Bolu Ajiboye, M.S.

In May I attended the 16th annual meeting of the Neural Control of Movement Society held in Key Biscayne, FL. Co-chaired by **Barry W. Peterson, Ph.D.** (Professor of Physiology, Institute for Neuroscience, Northwestern University) and **Peter L. Strick, Ph.D.** (Professor and Co-director of the Center for the Neurological Basis of Cognition, University of Pittsburgh), this conference highlighted recent research in topics of neuromotor control, such as cortical control of spinal cord plasticity, the role of biomechanics in neural control, neural mechanisms of limb coordination, and methods of motor learning.

Invited speakers included **Eric J. Perreault, Ph.D.**, and **Matthew C. Tresch, Ph.D.**, both Assistant Professors of Biomedical Engineering, Northwestern University. In one of the two poster sessions, I presented “Analysis of Shared and Specific Neuromuscular Synergies of Hand Prehension Patterns at Varying Force Levels” where I described my research about the use of muscle coordination patterns for controlling the many degrees-of-freedom of the hand to produce various grasping postures. The goal of my work is to design a control method for multifunctional transradial myoelectric prostheses based upon these coordination patterns for electromyographical (EMG) pattern recognition. My two-fold objectives were 1) to determine if muscle coordination patterns are invariant to grasp force within a specific hand posture, and 2) to investigate to what extent these coordination patterns are shared between, or are specific to, common hand postures. My experiments showed that the coordination patterns used for hand posture construction are the same at different grasp force levels, with some patterns being shared across multiple postures.

Other interesting posters featured studies about how the neuromotor system may prevent falling by using muscle coordination patterns in automatic response to sudden postural changes; and how the neuromotor system may modularly organize the control of force and position. Overall, this conference produced stimulating discussions and engendered new ideas.

Margrit Meier, Ph.D., Accepts New Position

Margrit Meier, Ph.D., CPO, accepted a position as Director of Research at the National Center for Training and Education in Prosthetics and Orthotics at the University of Strathclyde, Glasgow, Scotland. In 2000, Dr. Meier joined NURERC. During her six years in our laboratory, she completed a post-doctoral program and subsequently was promoted to Research Assistant Professor. She taught, advised students, developed and conducted important research projects and published their results. A vigorous and methodical scientist with certification in prosthetics and orthotics, she brought a clinician’s perspective to her work.



Celebrating Dr. Meier with good fellowship, poetry and the carol of American songbirds.

Originally from Zurich, Dr. Meier was educated in Switzerland, Scotland, Canada and the U.S.A. Her international and multi-lingual background, as well as her outgoing, cheerful personality, contributed to her effectiveness in prosthetics work, both in the U.S.A. and abroad. Most recently, Dr. Meier and her associates wrote and published the English, French and Spanish versions of the three field manuals (*Manual 1, Fabrication of a Compression Lever Mold*; *Manual 2, Fabrication of the Core*; and *Manual 3, Fabrication of a Cosmetic Cover* [forthcoming]) that will accompany the Shape&Roll Foot and its fabrication system as it is disseminated to countries throughout the world.

We believe that Dr. Meier will influence positively the field of prosthetics and orthotics with her innovative and trenchant projects. We hope that we may look forward to future collaborative communications and projects with Dr. Meier and her European colleagues. NURERC wishes Dr. Meier continued success. She will be missed.

NURERC News

George Bertos, Ph.D., completed and successfully defended his Ph.D. dissertation entitled “Identification of the Mechanical Impedance of the Human Locomotor System Based on Steady-state Analysis and Shock Absorption Quantification: With Applications to Prosthetics.” Congratulations!

Devjani Saha, M.S., completed and successfully defended her master’s thesis entitled “The Effect of Trunk Flexion on Standing and Walking.” Congratulations!

Dudley S. Childress, Ph.D., was an invited speaker at Dartmouth’s Thayer School of Engineering.

Stefania Fatone, Ph.D., and **Andrew H. Hansen, Ph.D.**, authored “Effect of Ankle Joint Misalignment

on Calf Band Movement in Ankle-Foot Orthoses” and it has been accepted for publication in *Prosthetics Orthotics International*.

Stefania Fatone, Ph.D., authored “A Review of the Literature Pertaining to KAFOs and HKAFOs for Ambulation” to be published in *Journal of Prosthetics and Orthotics*.

Andrew H. Hansen, Ph.D., was an invited speaker at the Center for Applied Biomechanics and Rehabilitation Research lecture series at The Catholic University of America, Washington, D. C. He presented “Physiologic Ankle-Foot Roll-Over Shapes: Implications for Design and Evaluation of Prosthetic Feet.”

David Simpson Passes

Emeritus Professor of Orthopedic Bioengineering at the University of Edinburgh, **David Simpson** (85), died on May 15, 2006. His friends and colleagues remember him as a talented medical physicist and productive professional. He was a Fellow of the Royal Society of Edinburgh and of the Royal College of Physicians of Edinburgh; also, he participated in the International Federation for Medical and Biological Engineering.

Demonstrating innovation in the nascent combination of medicine and engineering, he constructed a multi-channel recorder to monitor patient condition during surgery. In the 1960s he began designing gas-powered upper limbs for children born with amelia due to Thalidomide embryopathy. He developed control systems for upper limb prostheses and is remembered for developing the concept of Extended Physiological Proprioception (EPP) and applying EPP to prostheses. EPP posits that a person’s awareness of the position of their body can be used to control the position of the prosthesis. By 1963 he directed the powered prosthetic unit at the Princess Margaret Rose Hospital. From 1977 until he retired in 1980, he was executive dean of the Faculty of Medicine at Edinburgh University.

A longtime friend and admirer of Mr. Simpson is Dr. Dudley S. Childress, Emeritus Director of NUPRL. A

proponent of Simpson’s bioengineering ideas, Dr. Childress was invited in October 1998 to present dedication remarks at the opening of the David C. Simpson Library at the Princess Margaret Rose Orthopedic Hospital in Edinburgh, Scotland.



David Simpson (Photograph courtesy Dr. D. S. Childress.)

Professor Simpson was active in areas beyond bioengineering and medicine, including horticulture, maps and the history of Edinburgh. Recently, Mr. Simpson wrote poetry about his war experiences from 1939-1945 as a Highland Light Infantryman. His first volume was *Interesting Times* (The Ramsay Head Press) followed by *A Private World* (Hollybush House, 2005). The service organization “Combat Stress” published Mr. Simpson’s second volume of poetry and used it to educate the public about Post Traumatic Stress Disorder (PTSD).

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