



# HERL Quarterly Newsletter

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WINTER EDITION  
DECEMBER 2004

## LETTER FROM THE EDITOR

I am proud to announce that the publication of this issue of the HERL newsletter marks the third complete year of its' circulation. When the first edition was released in Spring of 2002, we had about 500 readers. Now, over 1,400 people receive the HERL newsletter, and our distribution list is growing every day. We thank our many dedicated research participants and other newsletter readers for their interest, support, and contributions to this publication.



*Dr. Cooper, newly appointed FISA/PVA Endowed Chair for Rehabilitation Engineering, spoke at a VA/White House Forum on opportunities for people with disabilities in October*

Our faculty and students have merited several notable awards and achievements since our last update. HERL director Rory Cooper was appointed by the University of Pittsburgh to be the first holder of the Federation of Independent School Alumnae Foundation Paralyzed Veterans of America (PVA) - Chair for Rehabilitation Engineering. Dr. Cooper's appointment to this endowed Chair, one of the highest honors any

university can bestow, is the result of a dynamic career in the field of rehabilitation engineering and assistive technology.

In October Dr. Cooper was invited by VA Central Office to participate in a White House/VA conference entitled, "Emerging Technologies in Support of the New Freedom Initiative: Promoting Opportunities for People with Disabilities." The conference highlighted Federal support for disabilities, development in science and technology, and innovation leading to new products, businesses, and jobs. The conference also provided a forum for discussing ideas about support for future research and technology development.

This fall, Dr. Cooper accepted an invitation from the Hong Kong Polytechnic University to serve for a second two-year term as an Honorary Professor in their Jockey Club Rehabilitation Centre. He was also invited to be an adjunct professor of Xi'an Jiaotong University, China, for 4 years.

In the last newsletter we announced that HERL doctoral student Ian Rice would be competing in the Paralympic Games in Athens, Greece, September 17th - September 28, 2004. He competed in the 100m, 200m, 400m and 800m wheelchair races, finishing fourth in the 100 meter race and sixth in the 200 meter race. He was the first American to finish. On Oct. 9<sup>th</sup>, Ian placed first in the Chicago marathon, beating the 2<sup>nd</sup> place finisher by 45 minutes. He also placed first in the Detroit marathon on

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October 24<sup>th</sup>.

HERL's capacity to design and develop new assistive devices was strengthened this fall with the arrival of some new production equipment in our Design and Prototyping Laboratory. In October, a new Selective Laser Sintering (SLS) machine arrived. This revolutionary equipment will allow HERL to make 3D prototypes, molds, parts, and tools in as little as one day.



*HERL's new SLS machine*

As a final and somewhat personal announcement, there will be a feature-length article on our

10th anniversary and on the history of HERL appearing in the December issue of the magazine *Paraplegia News*. The article, written by myself and HERL research coordinator Paula Stankovic, provides a good overview of our facilities and research and what HERL holds in store for the future. I hope everyone will check out the article. If you are interested in subscribing to *Paraplegia News*, a publication of the Paralyzed Veterans of America, visit [www.pvamagazines.com/paraplegianews](http://www.pvamagazines.com/paraplegianews).

-Christine Heiner, editor

## CURRENT RESEARCH ABSTRACTS

### Preliminary Assessment of a Prototype Advanced Mobility Device in the Work Environment of Veterans with Spinal Cord Injury

Rory A. Cooper, Ph.D., Michael L. Boninger, M.D., Rosemarie Cooper, M.P.T., P.T., Shirley G. Fitzgerald, Ph.D., and Annmarie Kelleher, M.S., OTR/L, ATP  
Full article appeared in *Neurorehabilitation*, Vol 19, No. 2, pp. 161-170, 2004.

#### Purpose of the Work

The INDEPENDENCE™ 3000 IBOT™ Transporter (IBOT™) is an electronically stabilizing device for people with disabilities. The IBOT™ has unique features that provide the user with indoor and outdoor mobility, elevated height, the ability to climb stairs, and remote function to transport the device. The purpose of this study was to collect data on the potential for the IBOT™ to improve employment satisfaction of veterans who use wheelchairs to work.

#### Subjects/Procedures

This study was based upon observations by trained clinicians, and responses to a survey completed by four veterans with traumatic spinal cord injury, who worked in an accessible office environment. Each subject was trained on the use of the IBOT™ and had the opportunity to trial it for a half workday supervised by a trained physical therapist.

#### Results

The mean age of the subjects was  $52 \pm 8.8$  years. The subjects used the devices to hold eye-level discussions with colleagues, climb stairs, ascend steep ramps, and



The IBOT™

negotiate curbs. When subjects were asked to rate the ease of getting around in the IBOT™ compared to their personal wheelchairs, they responded with a mean of  $6.7 \pm 1.8$  on a 10-point visual analog scale. Values near 1 indicated poorest ease of function and values near 10 represented highest ease of function. The response to rating the overall function of the IBOT™ within their working environment yielded a rating of  $6.0 \pm 2.8$ . Half of the users felt that the IBOT™ would help them at work and all thought it should be made available to veterans who use wheelchairs. A larger study should be conducted to determine if the IBOT™ affects work performance and the ability to return to work.

#### Relevance to Wheelchair Users

The functions of the IBOT™ and its advanced features may increase the functional mobility of people who use wheelchairs, and may help to satisfy the desire to return to demanding work activities.

-Annmarie Kelleher, M.S., OTR/L

### Outcomes Of Wheelchair Systems Intervention With Residents Of Long Term Care Facilities

Elaine Trefler, Med, Shirley G. Fitzgerald, PhD, Douglas A Hobson, PhD,  
Thomas Bursick, MS, Robert Joseph, MS

Full article appeared in *Assistive Technology*, Vol. 16.1, pp. 18-27, Summer 2004.

**Purpose of work:** The goal of this study was to measure the effects of wheelchair seating systems that were individually fit to the user in a nursing home setting. The effects that were measured included posture, reach, mobility, quality of life and satisfaction with technology.

**Subjects/Procedures:** Thirty persons, 60 years of age or older who resided permanently in a long term care facility and who used seating and mobility systems for 6 hours or more each day were recruited for this project. Outcomes included timed independent mobility, forward and lateral reach, quality of life, and satisfaction with assistive technology. The participants were measured at three separate times. First, in the person's existing wheelchair, and a second time after participants

were provided with the individually fitted wheelchair. The final measurement was three months after the delivery of the individually fitted wheelchair.

**Results:** Results indicated that individually fitted wheelchair systems for elderly residents of long-term care facilities are beneficial. Participants had less trouble independently propelling their systems, and increases in reach, quality of life, and satisfaction with the new wheelchair technology.

**Relevance to Wheelchair Users:** For persons residing in nursing homes, individually fitted wheelchairs would be beneficial. The individual systems enhance elderly persons' mobility, reach, feeling of well-being and satisfaction with their assistive technology.

-Shirley Fitzgerald, Ph.D.

## CURRENT RESEARCH ABSTRACTS

### Analysis of Driving Backward in an Electric-Powered Wheelchair

Dan Ding, PhD, Rory A. Cooper, PhD, Songfeng Guo, PhD, Thomas A. Corfman, MS

Full article appeared in **IEEE Transactions on Control Systems Technology**,

Vol. 12, No. 6, pp. 934-943, November 2004.

**Purpose of the work.** The stability of an electric-powered wheelchair (EPW), especially reverse directional stability, is a well-recognized determinant of its user's risk for wheelchair related injury. This study was to examine the influences of caster orientations and driving speeds on the reverse directional stability of electric-powered wheelchairs.

**Procedures.** Kinematic and dynamic models of an EPW were developed to simulate wheelchair motion and conduct a parametric study of different factors on wheelchair reverse directional stability. The models were validated through an experiment, where wheelchair trajectories and ground reaction forces/moments for the front caster wheels and rear wheels were recorded when a wheelchair initiates reverse motions at six initial caster orientations and three desired driving speeds.

**Results.** The experimental and simulation results show agreement indicating that different caster orientations at the start of reverse driving introduce disturbances and the faster the intended speed, the less deviation of the wheelchair from its desired heading. The center of gravity was also found to be a dominant influence on the reverse directional stability of EPWs.

**Relevance to wheelchair users.** It is critical for wheelchair users to realize the factors influencing wheelchair reverse directional stability for greater safety. Better control algorithms for EPWs are needed to dampen the reverse instability and reject external disturbances introduced by caster orientations and other factors.

-Dan Ding, Ph.D.

### Relationship Between Nerve Health and Wrist Motion During Wheelchair Propulsion

Michael L. Boninger, MD; Bradley G. Impink, BSE; Rory A. Cooper, PhD; Alicia M. Koontz, PhD

Full article appeared in **Archives of Physical Medicine and Rehabilitation**,

Vol. 85, No. 7, pp. 1141-1145, July 2004.

**Purpose of the work:** Wheelchair users are at high risk for nerve injury at the wrist. The purpose of this study was to investigate the relationship between median and ulnar nerve health and wrist range of motion

#### Subjects/

**Procedures:** Thirty-five individuals with a spinal cord injury and paraplegia who used manual wheelchairs participated. Their average age was 38.9 years and their average time from injury date to test date was 12.2 years. Subjects propelled their own wheelchair on a dynamometer at 0.9 m/s (2 mph) and 1.8 m/s (4 mph). Left and right side propulsion data were collected using force and moment sensing pushrims and a motion tracking camera system. Left and right side nerve conduction studies were also completed.



HERL students Jen Mercer (L) and Ian Rice (R) demonstrate the biomechanics lab setup used in this study. As Jen propels, Ian collects her propulsion data from the motion tracking camera system.

**Results:** We found a significant, positive relationship between wrist flexion/extension range of motion and median and ulnar nerve function. We also found a significant, negative correlation between flexion/

extension range of motion and propulsion force and propulsion frequency.

**Relevance to Wheelchair Users:** Contrary to our expectations, subjects using a larger range of motion showed better nerve function than those subjects propelling with a smaller range of motion. Subjects using a larger range of motion used less force and fewer strokes to propel their wheelchair at a given speed. It is possible that using long, smooth strokes to propel one's wheelchair may be beneficial to nerve health at the wrist.

-Brad Impink



## HERL IN THE MEDIA



This University of Pittsburgh Medical Center full page color ad featuring the HERL device GAME<sup>Wheels</sup> ran in the September issue of Archives of Physical Medicine and Rehabilitation and in the Proceedings of the 2004 American Academy of PM&R Annual Assembly.

**ACRM Rehabilitation Outlook, Summer 2004, Page 6:**ACRM Member News: Rory Cooper Appointed to Distinguished Professor

**University of Pittsburgh School of Medicine: Excellence Revealed, 2004:** Brad DiCianno, M.D.

**VA Research Currents, September 2004, Page 2:** Recent HERL Publications and Presentations

**ORD Research Honors, October 2004, Page 2:** Rory Cooper appointed Distinguished Professor/

APS Excellence Award. [http://www1.va.gov/resdev/about/ord\\_research\\_honors/](http://www1.va.gov/resdev/about/ord_research_honors/)

**VA Research and Development Highlights, Oct. 19, 2004:** Dr. Rory Cooper Appointed First PVA Chair for Rehabilitation Engineering. [http://www1.va.gov/resdev/highlights/HighlightsArticle\\_cooper\\_1004.cfm](http://www1.va.gov/resdev/highlights/HighlightsArticle_cooper_1004.cfm)

**VA Research Currents, October 2004, Page 4:** Career Milestones: Rory Cooper Appointed First Chair for Rehabilitation Engineering

*If you know of a current event or have an ad that you would like to post in the HERL Quarterly Newsletter, please contact Christine Heiner at (412) 365-4854 or by e-mail at [heinerbcm@pitt.edu](mailto:heinerbcm@pitt.edu)*

Disability Rights Advocates (DRA), a non-profit law center in Oakland, California, is investigating complaints about Medicare's wheelchair and scooter coverage policies. *Please contact them* if Medicare denied you or a vendor you know reimbursement for a power wheelchair or scooter because the beneficiary:

- needed it for use **outside the home**
- was **able to walk short distances**, or
- could not prove **sufficient upper extremity weakness**.

*In addition, please contact them* if you know of beneficiaries who, for any of the reasons above,

- paid out-of-pocket** for a wheelchair or scooter.

## RECENT HERL PUBLICATIONS

Cooper RA, Bioengineering and Spinal Cord Injury: A Perspective on the State-of-the-Science, **Journal of Spinal Cord Medicine** (APS 50th Anniversary Issue), Vol. 27, No. 4, pp. 351-364, 2004.

Koontz AM, Boninger ML, What is the Best Way to Propel a Wheelchair?, **Canadian Adaptive Seating and Mobility Association Newsletter**, Number 2, 2004.

Ding D, Cooper RA, Guo S, Corfman TA, Analysis of Driving Backwards in an Electric-Powered Wheelchair, **IEEE Transactions on Control Systems Technology**, Vol. 12, No. 6, pp. 934-943, November 2004.

Chaves ES, Boninger ML, Cooper R, Fitzgerald SG, Gray D, Cooper RA, Assessing the Influence of Wheelchair Technology on Perception of Participation in Spinal Cord Injury, **Archives of Physical Medicine and Rehabilitation** (Model Systems Issue), Vol. 85, No. 11, pp. 1854-1858, November 2004.

Hunt PC, Boninger ML, Cooper RA, Zafonte RD, Fitzgerald SG, Schmeler MR, Demographic and Socioeconomic Factor Associated with Disparity in Wheelchair Customizability Among People with Traumatic Spinal Cord Injury, **Archives of Physical Medicine and Rehabilitation** (Model Systems Issue), Vol. 85, No. 11, pp. 1859-1864, November 2004.

Algood SD, Cooper RA, Fitzgerald SG, Cooper R, Boninger ML, Impact of Pushrim-Activated Power-Assisted Wheelchair on the Metabolic Demands, Stroke Frequency, and Range of Motion Among Subjects with Tetraplegia, **Archives of Physical Medicine and Rehabilitation** (Model Systems Issue), Vol. 85, No. 11, pp. 1865-1871, November 2004.

## CURRENT EVENTS

·were unable to get a wheelchair or scooter by any means.

Disability Rights Advocates  
449 15th Str., Suite 303  
Oakland, CA 94609  
[healthaccess@dralegal.org](mailto:healthaccess@dralegal.org)  
Phone: 510-451-8644 / Fax: 510-451-8511

They do not need supporting documentation at this time. DRA will treat all replies as confidential. They can only investigate claims for reimbursement dated October 1, 2002 or later.

## FEATURED HERL STUDENT: Eliana Chaves

Eliana Chaves joined the Human Engineering Research Laboratories in 2001 while pursuing her Masters Degree at the University of Pittsburgh. Eliana came to Pittsburgh from Brazil where she acquired her bachelor degree in Occupational Therapy. After receiving her degree, she completed her residency at AACD in Sao Paulo, Brazil. There she worked with adults and children with neurological and orthopedic problems, emphasizing the seating work. In December of 2003 Eliana graduated with her Masters Degree in Rehabilitation Science and Technology and is now working towards her Ph.D.



*Eliana Chaves*

and outcomes measure of assistive technology. Eliana has also helped in the improvement and development of the India wheelchair. Eliana has been awarded the Whitaker Student Paper Competition Award for her paper, "Clinical Evaluation of a Wheelchair Mounted Robotic Arm" (RESNA 2003). "Application of a Participation System to Assess the Influence of Assistive Technology on the Lives of People with Spinal Cord Injury" (Third Annual Clifford E. Brubaker Visiting lecture 2004) earned her the Rory Cooper and Dion Johnson Award Student Paper Award.

In her spare time, Eliana enjoys her Flamenco dance class. She speaks fluent Portuguese, English, and basic French. In the future, Eliana would like to go back to Brazil to help advance the Rehabilitation Science and Technology field.

*-Amie Struble*

Eliana has worked on many projects while she has been at HERL. These projects include the development of an isometric joystick, the clinical evaluation of a wheelchair mounted robotic arm,

## FEATURED STAFF MEMBER: Elizabeth Traynor

Elizabeth Traynor joined the Human Engineering Research Laboratories in July of 2004 as a Clinical Coordinator Assistant. She received her Bachelor of Science degree in Marketing from Robert Morris University in 1984. Elizabeth's devotion to helping people, along with a friend who participated in research studies at HERL, attracted her to this new career path. She is currently enrolled in the Master of Rehabilitation Counseling Program at the University of Pittsburgh.



*Beth Traynor*

She invented a dog feeder that attaches to a wall and allows people with high-level spinal cord injuries, and other disabilities that limit hand function, to feed their service dogs. She also installed X-10 modules on many of her lights and electronic devices, which now allows them to be controlled by a voice activated environmental control unit on a computer.

Elizabeth enjoys working in the research field. Once she completes her Masters degree, she hopes to work more 'hands-on' with test subjects. She also attends several service dog events each year, and is active in public education and advocacy for service dogs and their partners. Her favorite Susquehanna Service Dog is Nala.

*-Amie Struble*

Elizabeth's work at HERL includes: working with the National HERL Registry, along with writing consensus protocols, and maintaining IRB approvals. Although Elizabeth's major is in counseling, she has a special interest in assistive technical devices.

## 2004 TECH-LINK ROBOTICS COMPETITION

The third year of the annual Tech-Link Robotics competition is in full swing. In a mission to encourage youths with disabilities towards careers in science and engineering, Tech-Link, HERL, and Carnegie Mellon University are working together to mentor and prepare teams of middle-school children for the annual FIRST Lego League Competition. In this event, teams build a robot out of

LEGOs and program it to complete missions. The theme of this year's competition, "No Limits," is focused on assistive technology

and accessibility for people with disabilities. This year's competing robots will be programmed to complete tasks designed to assist people with disabilities.

Many HERL students and faculty have volunteered to organize and mentor the two Tech-Link



*Karl Brown (R) and Tech-Link children build a LEGO Robot together*

teams, consisting of sixteen 5th and 6th graders from several Pittsburgh middle schools. HERL student Karl

Brown organized and lead the kickoff on September 15th and the following weekly meets. Students Alex Bevly, Brad Impink, Jon Pearlman, and Garrett



*Alex Bevly (L) works with young Tech-Link team members to program their robot*

Grindle, as well as faculty members Diane Collins, Don Spaeth, and Dan Ding have all provided mentorship and assistance towards preparing the two teams for the upcoming Pittsburgh State tournament, which will take place on December 4th at the National Robotics Engineering Consortium at Carnegie Mellon University in Pittsburgh.

Since the competition will be taking place while this issue of the newsletter is going to press, look for the competition results in the March 2005 issue. Best of luck to the two Tech-Link teams!

*-Christine Heiner*



If you are 18 years of age or older and use a wheelchair or scooter for 75% of your mobility, we need you for our study:

### **Efficacy of Service Dogs as a Viable Form of Assistive Technology**

**You do NOT need to have a service dog to participate in our study**

The VA R&D Center of Excellence and the University of Pittsburgh are conducting a research study examining the effect of wheelchair service dogs. If you agree to participate, you will be asked to answer surveys over the phone or through the mail on five different occasions. The surveys will take 1 hour to complete and ask basic questions like age, gender, type of disability, education, occu-

pation, healthcare use, etc. You will also be asked about your level of happiness, life satisfaction, social life, ability to do everyday activities, etc. Your participation in this study is **strictly voluntary**. All answers will be kept **strictly confidential**. You will be reimbursed a small fee for your time each time you complete a survey.

If you would like to participate or have questions, contact: **Shirley G. Fitzgerald, PhD at 1-412-365-4840 -or- Diane Collins at 1-412-365-4844 or email Diane at: [dmcst84@pitt.edu](mailto:dmcst84@pitt.edu)**



## VISITING FACULTY PROFILE: Toru Furui, Ph.D.

Toru Furui is a visiting faculty member at the Human Engineering Research Laboratories from Japan. He has been with us since July 2004 and is a postdoctoral associate of the Department of Physical Medicine and Rehabilitation at the University of Pittsburgh.



*Toru Furui, Ph.D. (L) and the Furui Family: Tae, Toru, Noboru, Masayo, and Masaru*



individuals with disabilities in ADL and mobility in a changing environment. Collaborating with teachers and children's institutes, Toru accommodated some public schools and private kindergartens for children with dis-

abilities. He received his Japanese Physical Therapy License. He received his doctorate in Science, with a major in Physical Therapy, from Kobe University Graduate School of Medicine, Japan, in March 2004. He has also obtained a BA in Sociology majoring in Social Welfare.

Toru has a wife and three children ages 23, 24, and 25. He practiced Physical Therapy in Japan for 14 years and has done extensive work with people who have cerebral palsy. In Japan, people with CP were often segregated and targeted by bullies. After graduating in 1990, Toru got a local government position for a community-based practice. He specialized in finding better adaptation for

abilities. The Hiroshima Physical Therapist Association awarded Toru with the Physical Therapist Distinguished Service Award in 2001.

Toru's research has included the retrospective study of the secondary functional deterioration in socially active adults with cerebral palsy in Japan and postural control by ergonomic seating in severe neurological cases. He has also studied the regional community support system for homebound elderly persons in Japan.

*-Amie Struble*

### RECENTLY FUNDED GRANTS

"Enhanced Remote Data Logging for Power Wheelchairs." Principle Investigator: Dan Ding, Ph.D. Paralyzed Veterans of America Research Foundation, November 1, 2004-October 30, 2005, \$50,000.

"Enhanced Remote Data Logging for Electric Powered Wheelchairs." Principle Investigator: Dan Ding, Ph.D. NIDRR Switzer Research Fellowship Award, September 2004-August 2005, \$45,000.

"Spastic Cerebral Palsy and Electric Power Wheelchair Joysticks." Principle Investigator: Brad Dicianno, M.D. NIH K-12 Award, July 1, 2005-June 30, 2008, approx. \$300,000.

### News from the Department of Rehabilitation Science and Technology



DongRan Ha successfully completed her Ph.D. in Rehabilitation Science and Technology, University of Pittsburgh. Her dissertation title is "Pediatric Wheelchair Transportation Safety: Transit Manual Wheelchair Design Guidelines and Injury Risk of 6-year old children in a Frontal Motor Vehicle Impact"

Human Engineering Research Laboratories

Mailing Address:  
VA Pittsburgh Healthcare System  
7180 Highland Drive  
Building 4, 2nd Floor East Wing, 151R-1  
Pittsburgh, Pa, 15206

Phone: 412-365-4850  
Fax: 412-365-4858

E-mail any comments, corrections, or questions concerning  
the newsletter to the editor, Christine Heiner at:  
Email: [heinercm@pitt.edu](mailto:heinercm@pitt.edu)

VA Center Of Excellence For  
Wheelchairs and Associated  
Rehabilitation Engineering

University of Pittsburgh Model  
Center on Spinal Cord Injury

Rory A. Cooper, Ph.D.  
*Director*

Michael L. Boninger, M.D.  
*Medical Director*

Shirley G. Fitzgerald, Ph.D.  
*Associate Director of Research,*

Donald M. Spaeth, Ph.D., ATP  
*Associate Director of Engineering*

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all issues of the HQN are available on our  
website, [www.herlpitt.org](http://www.herlpitt.org).**



**ARE YOU INTERESTED IN WHEELCHAIR RESEARCH?**

The Human Engineering Research Laboratories is recruiting individuals interested in participating in research studies for the **WHEELCHAIR USERS REGISTRY**. If you would like to be notified of Wheelchair related Research Studies for which you may be eligible to participate, contact The Human Engineering Research Laboratories and join the Wheelchair Users Registry. This is an informational resource and notification of a study does not obligate you to participate. You do not need to be located in nor are you required to travel to Pittsburgh in order to participate in research studies. If you are at least 18 years of age, and use a wheelchair or scooter, please contact **Rosi** or **Annamarie** for more information.

VA PGH Healthcare System 7180 Highland Drive Pittsburgh, PA 15206  
**412-365-4850      [registry@herlpitt.org](mailto:registry@herlpitt.org)      [www.herlpitt.org](http://www.herlpitt.org)**