



# HERL Newsletter

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## PerMMA Gen I: What's Next?



HERL Director Dr. Rory Cooper and graduate student Garrett Grindle show PerMMA Gen I to Army Surgeon General Lieutenant General Patricia D. Horoho, Pitt ROTC Commander Andy Loeb and Dan Fisher look on.

Regular readers of this newsletter will no doubt be familiar by now with PerMMA, the wheelchair with robotic arms. What's news is that the rest of the world is slowly becoming more familiar with it, too. Most recently, PerMMA was featured at the Consumer Electronics Show (CES) in Las Vegas, and the cable channel C-SPAN devoted part of an episode of its program "The Communicators" to PerMMA at CES. Maybe even more interestingly, PerMMA was considered for a role in an upcoming big-budget Hollywood film, due to its sleek, space-age look. VIP visitors to HERL - such as Army Surgeon General LTG Patricia Horoho - look forward to seeing PerMMA and controlling it remotely.

We're not content to rest on these laurels, however; there's still a lot we'd like to accomplish with PerMMA. First and foremost, we're continuing to make PerMMA even easier to use. We're currently looking at user data to find ways to improve the user interface, for both the wheelchair user and the remote operator. We conducted focus groups and found that the touch-screen interface was very popular, and we hope to make it even better. *(continued on page 7)*

## Research Update: The Personal Mobility and Manipulation Appliance (PerMMA)

## PerMMA Gen II: Facing Ambitious Tasks



HERL postdoctoral student Hongwu Wang sets up the PerMMA Gen II prototype. Note the large center driving wheels and the blue caster wheels that lift the center wheels off the ground when climbing.

Has this ever happened to you? You're all set for an outing, but as you open the door of your house to leave, you notice a huge ice sheet right in front of you, blocking your way. You're stuck inside.

Or maybe you're shopping and see exactly the product you want in a store window - but you can't get into the store because there's a step in front of the door.

Both of these dilemmas are scenarios that many of the 3.3 million Americans who use wheelchairs to get around have faced. But if researchers at HERL have their way, both of those problems could be solved with the second generation of PerMMA, which will tackle both steps and challenging terrain.

The secret is in the chair's six wheels. The large center driving wheels can reposition themselves to simulate front-, mid-, or rear-wheel driving. The four smaller caster wheels are controlled with compressed air and move up and down freely and independently. For climbing curbs, the front caster wheels lift up *(continued on page 7)*

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## CURRENT RESEARCH ABSTRACTS

### Effects of Computer Keyboarding on Ultrasonographic Measures of the Median Nerve

Toosi KK, Impink BG, Baker NA, Boninger ML  
Full article published in the *American Journal of Industrial Medicine*, pp. 826-833, Vol. 54, No. 11, November 2011.

**Purpose of the Work:** Carpal tunnel syndrome (CTS) is a common, costly problem in the general population and in manual workers. Several studies have found greater prevalence of carpal tunnel syndrome in workers with highly repetitive manual jobs. Keyboarding is a highly repetitive daily task, and its association with musculoskeletal disorders of the upper extremity has been a public health concern since the mid 1980s. The purpose of this study was to use ultrasonographic measurements to determine whether continuous keyboarding can cause acute changes in the median nerve.

**Subjects/Procedures:** Ultrasound images of the median nerve from twenty-one volunteers were captured prior to and following a one-hour keyboarding task. Changes in the median nerve ultrasonographic measures as a result of continuous keyboarding were evaluated.

**Results:** Acute changes in the median nerve following one-hour of keyboarding were detected. In particular, the median nerve cross-sectional area was significantly larger following the keyboarding task. Swelling ratio was also significantly greater after 60 minutes of keyboarding when compared to the baseline measures.

**Relevance to Wheelchair Users:** It is critical for clinicians and researchers to understand common injuries occurring in manual wheelchair users (MWUs), a population struck particularly hard by CTS. Carpal tunnel syndrome is poorly tolerated by this population because they rely on their arms for mobility, transfers and activities of daily living. Understanding the effects of repetitive manual tasks such as keyboarding may help provide insight into the pathophysiology of median nerve neuropathies such as CTS.

### Analyzing Wheelchair Mobility Patterns of Community Dwelling Older Adults

Karmarkar A, Cooper RA, Wang H, Kelleher AR, Cooper RM  
Full article published in *Journal of Rehabilitation Research and Development*, pp. 1077-1086, Vol. 48, No. 9, 2011.

The objective of this study was to determine wheelchair mobility patterns for community dwelling older adults. To identify whether age has any impact on wheelchair, or self-reported physical activities. Data were collected during National Veterans Wheelchair Games (Omaha, Nebraska) and participants' natural living environment using the wheelchair data logging devices, and Physical Activity Scale for Elderly (PASE). Participants using manual wheelchairs were significantly more physically active during the games as compared to when they used their wheelchairs at their homes, in terms of distance traveled and of the speed of propulsion. The trend was same for power wheelchair users, with a difference in the extent of use during games and that of use at home, with respect to distance, and to speed. Power wheelchair users reported to be engaged in levels of work-related activities that were higher than those reported by compared to manual wheelchair users. The difference in the level of participation, in the sporting event, for the manual and power wheelchair users, was not significantly different. An objective evaluation is important for understanding the factors associated with wheelchair use and for the development of strategies for improving wheelchair mobility, thus enhancing overall participation on the part of wheelchair users.

### Tuning Algorithms for Control Interfaces for Users with Upper Limb Impairment

Guirand AS, Dicianno BE, Mahajan H, Cooper RA  
Full article published in the *American Journal of Physical Medicine and Rehabilitation*, pp. 992-998, Vol. 90, No. 12, December 2011.

An estimated 4 million Americans use control interfaces to operate wheeled mobility devices. Approximately forty percent of these individuals cannot use these devices adequately due to diminished upper-limb motor control, sensory limitations, and cognitive impairments. Control interface customization to an individual has been shown to improve performance on computerized tracking tasks. This study uses data from several studies conducted at the Human Engineering Research Laboratories to examine the relationship between individuals with specific diagnoses of upper limb impairment and parameters used in customization. Identification of important parameter relationships may aid in the development of commercially available tuning software packages for individuals with various diagnoses.



# CURRENT RESEARCH ABSTRACTS

## International Mobility Technology Research: A Delphi Study to Identify Challenges and Compensatory Strategies

Jefferds AN, Pearlman JL, Wee J, Cooper RA

Full article published in *Assistive Technology*, pp. 232-242, Vol. 23, No. 4, Winter 2011.

**Purpose of work:** To identify logistical and ethical challenges to performing wheelchair-related research in low- and middle-income countries, and to generate a list of compensatory strategies to address these challenges. **Methods.** Thirteen individuals with experience in the field were engaged in an online multi-survey study (a Delphi study). The three surveys asked participants to select research challenges (such as time management and fundraising) from a list, suggest strategies to address the selected challenges, and critique each other's strategies based on personal experience.

**Results:** The results of the study indicated the existence of challenges in the use of research techniques appropriate for the studied individuals (whose culture may cause them to respond differently to tools such as numerical rankings), compensation for participation that does not result in the coercion of financially vulnerable people, oral and written translation of study materials into local languages, funding for research, collaboration with local professionals and populations, and the research tenet 'respect for persons'.

**Relevance:** Effective international mobility research requires time, cultural sensitivity, collaboration, and careful planning. An understanding of these requirements can allow researchers to anticipate and compensate for common pitfalls of their work, thus making the research more productive and beneficial to participants.

**Findings:** Overall there was an 8 percent body weight (% Body Weight= Force divided by persons body weight) reduction in vertical forces at the trailing hand (i.e. arm behind during move to new location) averaged over the HH techniques compared to the TU transfer technique. At the leading hand (i.e. hand reaching to the new surface), the vertical forces were reduced by 6.5% BW using the HH-A technique compared to the forces generated using HH-I (23.69% BW) and TU (24.77% BW) techniques. While both the HH techniques reduced superiorly directed forces at the shoulder, shoulder moments were significantly higher than that experienced when executing the TU transfer technique.

**Interpretation:** Varying the hand placement and trunk positioning during transfers changes the load distribution across all upper limb joints. The results of this study may be useful for determining a technique that best suits an individual and one that helps preserve upper limb function over time.

## Zack Mason is HERL's 2011 Employee of the Year



It was no surprise when HERL Engineering and Machine Shop Coordinator Zack Mason was announced as the Human Engineering Research Laboratories' Employee of the Year for 2011. We very literally would not have been able to move to our new space at Bakery Square without his efforts! Zack joins previous winners of the award such as Mark McCartney in 2010, Mary Goldberg in 2009, Michelle Oyster in 2008, and Emily Teodorski in 2007. Congratulations, Zack!





# LINKS AND RESOURCES FOR VETERANS

**United States Department of Veterans Affairs - <http://www.va.gov/>**

- Nationwide. For benefits information, call (800) 827-1000. To find a local facility, go to <http://www.va.gov/directory/>.

**Paralyzed Veterans of America - <http://www.pva.org/>**

- Nationwide. To find a local chapter, visit <http://www.pva.org/chapters>. Healthcare hotline: (800) 232-1782. Benefits hotline: (866) 734-0857.

**Keystone Paralyzed Veterans of America - <http://www.kpva.org/>**

- Pennsylvania. (800) 775-9323 or email [keystonepva@comcast.net](mailto:keystonepva@comcast.net).

**The Center for Assistive Technology - <http://is.gd/upmccat>**

- Pittsburgh, PA. Assistive technology evaluation and services to increase mobility, communication, and comfort. For more information, visit the website or call (412) 647-1310.

**Pennsylvania Veterans Foundation <http://www.paveteransfoundation.org/>**

- Pennsylvania. Founded 11/11/11. Email [admin@paveteransfoundation.org](mailto:admin@paveteransfoundation.org).

**Disabled American Veterans - <http://www.dav.org/>**

- Nationwide. For benefits information or to find an office or chapter, visit <http://www.dav.org/veterans/ContactUs.aspx> or call (877) I AM A VET (426-2838).

**Jobs2Vets - <http://www.jobs2vets.com/>**

- Enter your military title or job code to bring up a list of equivalent civilian job openings.



*Army Surgeon General LTG Patricia D. Horoho and Dr. Rory Cooper*



*LTG Horoho, MSG Mike Wilkinson, Cadet Kennedy Nye, and Joshua Chung*



*Shiv Hiremath with students from the Industrial College of the Armed Forces*



*Dr. Cooper shows ICAF students around the machine shop*



# JOB SHADOWING !

February 2, 2012



# AWARDS

HERL Director **Dr. Rory Cooper** received the **AAAS Mentor Award** from the American Association for the Advancement of Science on February 17 at the AAAS Annual Meeting in Vancouver, British Columbia.



HERL Medical Director **Dr. Michael Boninger** was elected president of the **Association of Academic Physiatrists**, assuming the office on September 1, 2011.



HERL Associate Medical Director **Dr. Brad Dicianno** and co-authors received the **Association of Academic Physiatrists' Ernest W. Johnson AAP Excellence in Research Writing Award**. Dr. Angie Garcia, Dr. Dicianno's fellow, was lead author.



HERL grad student **Nahom Beyene** has reached the final round of the **Fulbright Scholarship** and awaits the final award decision.



Following the annual Brubaker Lecture, given this year by Colonel James Ficke (*left*) of the San Antonio Military Medical Center, HERL grad student **Jorge Candiotti** was awarded the **Rory A. Cooper & Dion Johnson Award** for his outstanding RESNA paper.



## Online Now: Symposia, Volunteer Opportunities

Couldn't be at the latest State of the Science Symposium? Want to see if we're doing any research studies you can participate in? Visit our website to watch the symposium videos and photos and search for volunteering opportunities!

<http://herl.pitt.edu/>

Find us on  
**facebook**

See photos from the Consumer Electronics Show and catch up on the most up to date HERL news on our Facebook page!

<http://www.facebook.com/herlpitt>



# PerMMA Gen I: What's Next? *(cont. from p. 1)*

One problem we found during testing PerMMA was that although the remote operator can control both arms at the same time, the local user is only able to control one arm at a time. This will be fixed in future upgrades.

Another upgrade we plan to make is to improve the object recognition capabilities of the arms, in order to have the graspers automatically close once the target is identified. This will mean the user will have one less task to worry about when operating PerMMA.

Finally, one of the great things about PerMMA is how it's led to collaboration with all kinds of different groups. We have been using PerMMA to introduce students to commercialization and entrepreneurship through evaluation of PerMMA's commercial potential - and several companies have approached us about bringing PerMMA to market.



*PerMMA on display at the Quality of Life Technology (QoLT) booth at the Consumer Electronics Show in Las Vegas on January 12, 2012.*

# PerMMA Gen II: Facing Ambitious Tasks *(cont. from p. 1)*

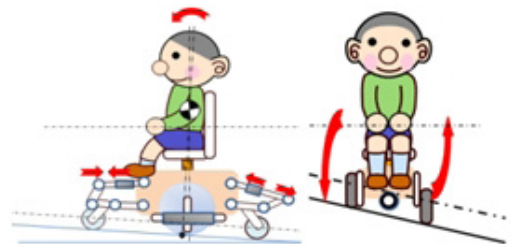


*PerMMA Gen II makes its way up a step.*

onto the curb, and then the driving wheels lift themselves up and forward onto the curb, lifting the chair. This is done automatically, whenever PerMMA Gen II senses a curb or step. The ultimate goal is for PerMMA Gen II to climb a set of stairs.

The same general function is used to operate on icy or slippery surfaces. A traditional power wheelchair can get stuck on this kind of terrain. PerMMA Gen II, however, uses its front and rear caster wheels to inch forward on the slick surface by extending its front casters, moving the seat forward, bringing the rear casters forward, and then repeating the process. Meanwhile, the seat stabilization system keeps the driver safely upright.

Ultimately, PerMMA Gen I and PerMMA Gen II will be combined to create the PerMMA Gen III prototype.





## Human Engineering Research Laboratories



VA Center of Excellence for  
Wheelchairs and Associated  
Rehabilitation Engineering



University of Pittsburgh  
NIDRR Model Center on  
Spinal Cord Injury



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Rory A. Cooper, PhD  
*Director*

Michael L. Boninger, MD  
*Medical Director*

Jonathan Pearlman, PhD  
*Associate Director of Engineering*

Alicia Koontz, PhD, RET  
*Associate Director for  
Research Capacity Building*

Brad Dicianno, MD  
*Associate Medical Director*

Mailing Address:  
6425 Penn Avenue  
Suite 400  
Pittsburgh, PA 15206

Phone: 412-822-3700  
Fax: 412-822-3699

<http://herl.pitt.edu/>

### Contact us!

Comments and questions (or to subscribe to the print newsletter):

[mil72@pitt.edu](mailto:mil72@pitt.edu)

or call:

412-822-3663

To subscribe to the electronic mailing list:

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Check us out on Facebook at

<http://www.facebook.com/herlpitt>

## ARE YOU INTERESTED IN ASSISTIVE TECHNOLOGY RESEARCH?

The Human Engineering Research Laboratories (HERL) is recruiting individuals interested in participating in research studies for the ASSISTIVE TECHNOLOGY REGISTRY.

If you would like to be notified of research studies related to assistive technology for which you may be eligible to participate, contact The Human Engineering Research Laboratories and join the Assistive Technology 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 assistive technology (e.g. wheelchair, scooter, prosthesis, etc) please contact a Clinical Coordinator at (412) 822-3700 or [herlregistry@shrs.pitt.edu](mailto:herlregistry@shrs.pitt.edu).

**Human Engineering Research Laboratories**  
**VA Center of Excellence**  
**Bakery Square, Suite 400**  
**6425 Penn Avenue, Pittsburgh, PA 15206**

Visit

<http://herl.pitt.edu/volunteer>  
for more information

**On the front cover, top right:** HERL graduate researcher Tanya Liu and a wheelchair being fitted with the Virtual Seating Coach (<http://www.herl.pitt.edu/virtual-seating-coach>).

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