# state of the Science

## This leading research facility is making great strides to improve the mobility and function of people with disabilities.

*by Christine Heiner and Rory Cooper, PhD*

**With help from the Para-**lyzed Veterans of America (PVA), the Human Engineering Research Laboratories (HERL) aspires to become a worldwide leading institution in assistive technology (AT) and rehabilitation research and development. Directed by PVA member Rory Cooper, PhD, and Michael Boninger, MD, HERL's mission is to continuously improve the mobility and function of people with disabilities through advanced engineering in clinical research and medical rehabilitation.

HERL is a Department of Veterans Affairs (VA) Rehab Research and Development Center of Excellence for Wheelchairs and Associated Rehabilitation Engineering, as well as a National Institute on Disability and Rehabilitation Research (NIDRR)-funded Model Center on Spinal Cord Injury. In 2006, HERL became part of yet another prestigious research facility—the National Science Foundation (NSF) Engineering Research Center on Quality of Life Technology (ERC on QoLT).

In 2004, HERL celebrated its tenth anniversary and published a feature-length article in *PN* ("Decade of Excellence," December) about the labs' history, development, and latest research. Since then, HERL has diversified its efforts and made some significant achievements. In addition to becoming part of the ERC on QoLT, HERL has also strengthened its efforts in continuing-education seminars, educational outreach, international work, and community activities. It also

ABOVE: Col. Raul Marin, MD, Walter Reed Army Medical Center (left), and Brad Impink, HERL, do an ultrasound of Johnny Lee Williams's wrist at the 2006 National Veterans Wheelchair Games.

has developed new collaborative relationships with other leading rehabilitation institutions, universities, and VA facilities.

## Major Developments

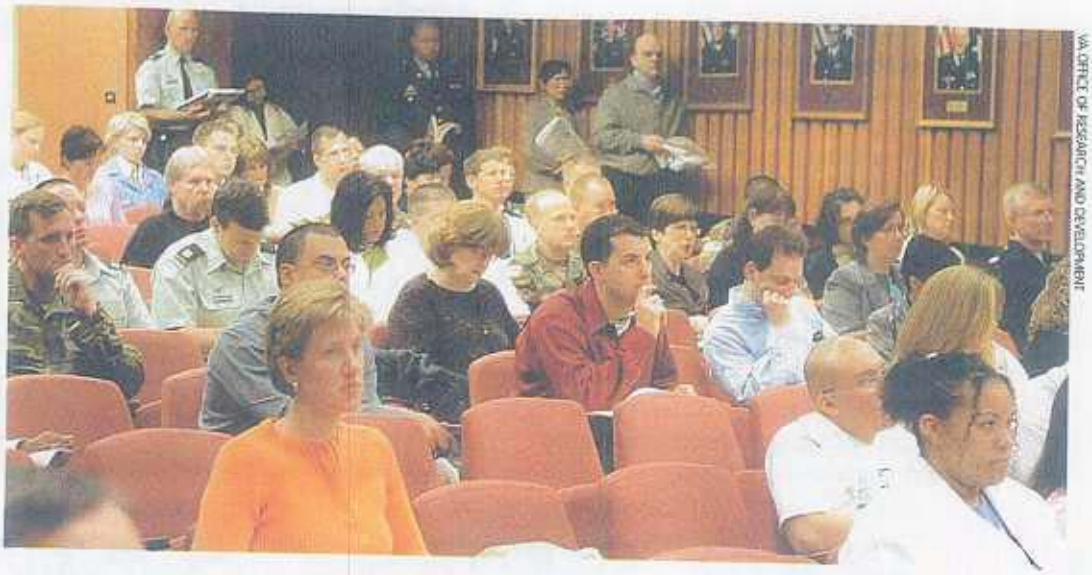
One major development at HERL was the recent awarding of the ERC on QoLT, in 2006. Carnegie Mellon University and the University of Pittsburgh initiated the QoLT Center with funding of a $15-million ERC grant from NSF. An important partner in the QoLT Center, HERL provides some of the core resources.

The QoLT Center is charged with creating transformational technologies that involve "aware systems" (intelligent and adaptive systems that respond to users' needs and intent) augmenting the body and mind. These will be model-rich technologies that learn from functional activities, context, previous experience, human and social behaviors, physiology, physical capacity, and cognition. QoLT will need to be aware—by understanding and adapting to the intent of the person, the context, and the environment's attributes. It is critical that new smart, aware technologies are safe and reliable and provide timely, gracious assistance. These technologies will aid with assessment and training, and increase end-users' capabilities. Dr. Cooper and Carnegie Mellon University's Dr. Takeo Kanade co-direct the QoLT Center.

A second major development was the establishment of the University of Pittsburgh Medical Center (UPMC) Institute for Rehabilitation and Research (IRR) in summer 2005. IRR brought together the basic and clinical research facilities for the University of Pittsburgh's Department of Physical Medicine and Rehabilitation, currently ranked eighth in National Institutes of Health (NIH) funding among departments of its kind, and became the hub of the UPMC Rehabilitation Network. HERL Medical Director Dr. Boninger directs IRR research as well as the Model Center on Spinal Cord Injury (Model SCI).

HERL learned of another success in 2006, when the Model SCI was renewed for five more years, with approximately $2.3 million from NIDRR. This distinguished center focuses on AT for mobility. The renewal brought opportunities for new projects such as examining the impact of the recent Centers for Medicare and Medicaid

During a July 2006 press conference, HERL graduate student Erica Authier explains the Gamecycle exercise system to a female wheelchair user.



VA OFFICE OF RESEARCH AND DEVELOPMENT

The Human Engineering Research Laboratories partners with Walter Reed Army Medical Center and other medical facilities to offer a series of workshops regarding care for military personnel and veterans with disabilities.

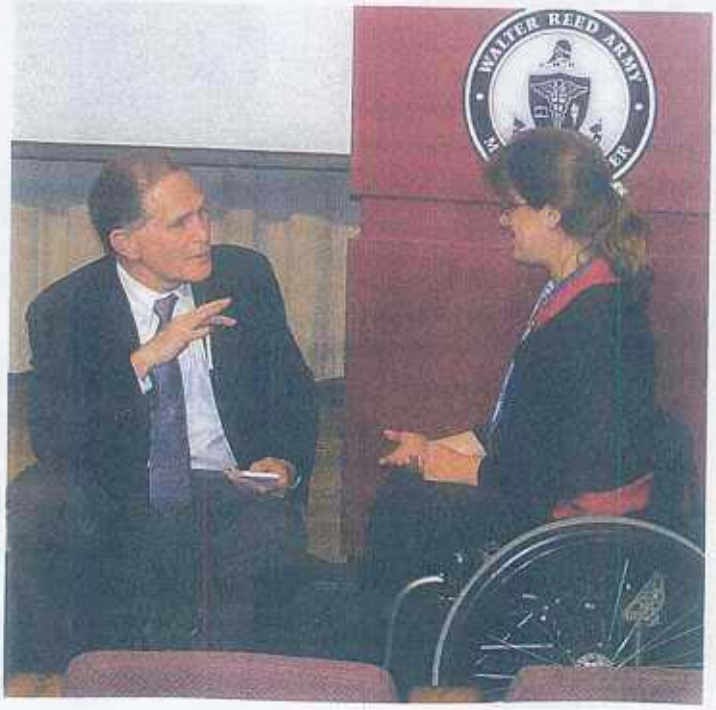
Services (CMS) changes for AT reimbursement.

Another large research focus of the Model SCI is the effectiveness of the *Clinical Guidelines for Prevention of Upper Limb Pain in SCI*, one of the results of the PVA-sponsored Consortium of Spinal Cord Injury. Dr. Boninger chaired the panel that produced this significant publication. HERL investigator Alicia Koontz, PhD, also served on the panel.

## Workshops

The war on terrorism has had the unfortunate side effect of creating substantial numbers of military-service members with lasting impairments. The clinicians at Walter Reed Army Medical Center (WRAMC) and other VA and Department of Defense (DOD) medical facilities have had to adapt. HERL has partnered with WRAMC to offer a series of workshops to translate research findings into clinical practice to ensure the highest quality of care for military personnel and veterans with disabilities.

Prominent experts, many directors of VA Rehabilitation Research & Development Centers, and chief consultants for VA and DOD clinical programs have been speakers. Time is set aside for discussions and for DOD and VA clinicians to coordinate activities.




Graham Creasey, MD, Cleveland VA Center of Excellence in Functional Electrical Stimulation, speaks with an audience member during a break at the April 2005 workshop on traumatic brain injury.

These workshops have helped facilitate communication among DOD, VA, and academic clinicians and scientists by offering sponsorship support and free publications. PVA has been involved by offering sponsorship and services that helped make the workshop series a popular and well-organized event.

The first "State of the Science" workshop took place in January 2005 and focused on wheelchair research and clinical practice. Soon after, HERL received a DOD grant to develop and continue the series. By the end of 2006, HERL had organized seven workshops addressing the topics of traumatic brain injury, sensory impairment, SCI, polytrauma, and AT devices.

## New Workshop

On February 2, the Human Engineering Research Laboratories (HERL) and the McGowan Institute for Regenerative Medicine cohosted—along with Walter Reed Army Medical Center (WRAMC) Physical Medicine and Rehabilitation—the Regenerative Rehabilitation Workshop, at WRAMC. The free event was open to military and government personnel and healthcare providers as well as patients and their families.

The workshop's sponsors were the University of Pittsburgh School of Medicine, Department of Physical Medicine and Rehabilitation; WRAMC Physical Medicine and Rehabilitation; HERL; and the University of Pittsburgh School of Health and Rehabilitation Sciences, Department of Rehabilitation Science and Technology.

Watch for coverage in a future *PN*.

**Contact:** www.herlpitt.org.


U.S. DEPT. OF DEFENSE PHOTO BY DEREK KNIGHT

During the May 2006 workshop on assistive technology devices, Capt. Dave Rozelle discusses his recovery after an amputation.

Since the 1998 National Veterans Wheelchair Games, HERL investigators have gone to annual sporting events to bring their labs' research to veterans. The research team at the 2006 DAV/VA Winter Sports Clinic was (back row, from left) Capt. Tod Wochman, Brad Dicianno, Capt. Rob Wallach, Lt. Col. Paul Pasquina, and Diane Collins; (front row) Capt. Allison Franklin, Dr. Rory Cooper, and Shirley Fitzgerald. Not shown: Emily Teodorski.

HERL has also provided briefings and assistance to the Marine for Life Program, the Army Wounded Warriors Program, and the Military Severely Injured Center. These help facilitate reintegration of service personnel into active duty or the community. Technology is a powerful tool for achieving these goals, and HERL has been able to help.

## Educational Outreach

HERL continues to provide extensive fellowships to graduate students and has supported a large number of students with disabilities. In addition to training graduate students, HERL focuses on encouraging middle-school children and undergraduate students, especially those with disabilities, toward careers in science and technology.

People with disabilities often are underrepresented in the technical fields, and many younger students with disabilities have been discouraged from scientific fields of study due to lack of accessible hands-on learning environments in high schools and middle schools. HERL offers some unique opportunities to introduce these students early to the world of technology and scientific research.

### Tech-Link

In 1997, HERL began working with pre-college students through Tech-Link Programs of Pittsburgh, a nonprofit organization whose mission is to introduce students with disabilities to technical/scientific careers. They partnered to form a team of high-school students for the FIRST (For Inspiration and Recognition of Science and Technology) robot-

HERL engineering graduate students Karl Brown and Andrew Kwarciak prepare the Tech-Link teams for the 2003 regional competition. The event is one way HERL introduces students to the world of technology and scientific research.

ics competition. HERL engineers and students mentored the "Pitt Crew" team, consisting of students with and without disabilities. The FIRST competition's goals were to design and build a large robot and program it to perform a series of tasks.

In 2002, Tech-Link and HERL refocused their efforts on younger middle-school students through the FIRST Lego League annual robotics competition. Children work alongside HERL engineers to design a robot built from Legos and controlled by a small computer. They enter the regional competition coordinated by Carnegie Mellon University's Robotics Academy. The FIRST organization designs a competitive game each year. Teams then build and program robots to accomplish the given tasks within a limited time period. The annual competitions take place in late November/early December. HERL/Tech-Link actively recruits children with disabilities for their teams; they are one of the few—if not the only—teams to do so.

## Undergraduate Intern Program

The HERL undergraduate intern program provides a unique opportunity for students to learn about disabilities, AT, and careers and advanced education opportunities in rehabilitation technology. The program was formalized in 2006 with the award of a National Science Foundation grant, "American Student Placements and Internships in Rehabilitation Engineering" ("ASPIRE"). Along with supplementary funding,

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the grant allowed an increase of summer internship opportunities as well as housing and travel expenses for nonlocal interns. This had never before been possible.

This growth of the intern program also brought opportunities for interns to work outside HERL in affiliated institutions, such as Carnegie Mellon University and—at the University of Pitts-

## For More Information...

- HERL, or to register for future WRAMC workshops, www.herlpitt.org
- Engineering Research Center on Quality of Life Technology, www.qolt.org
- The UPMC Institute for Rehabilitation and Research, http://irr.upmc.com
- Tech-Link Programs of Pittsburgh, www.tech-link.org

HERL's undergraduate intern program enables students to learn about disabilities. Tomás Maldonado (left) a 2006 summer intern, records data from a sensor attached to the subject's blue waist-strap. The project was "Balance Assessment for Everyday Life."

burgh—the Rehabilitation Engineering Research Center on Telerehabilitation and the Department of Rehabilitation Science and Technology. With the newly funded ERC on QoLT, HERL expects even more opportunities for interns to work in related departments in the future, exposing them to as many facets of the rehabilitation engineering field as they have to offer.

### International Work

People with disabilities around the world need AT. In many developing countries, even basic AT is unavailable or difficult to obtain. For two decades HERL has been assisting others in creating and providing AT to developing countries. In the last ten years, HERL became more active in this arena, focusing on India.

HERL reached a major milestone in 2006, when the India Spinal Injuries Centre (ISIC) created a comprehensive AT clinic as a culmination of a six-year effort with HERL. The clinic is managed by Jyoti Vidhani and Nekram Upadhyay. Vidhani completed a Heinz Fellowship at the University of Pittsburgh, and Upadhyay studied with HERL alum Dr. Carmen DiGiovine at the University of Illinois–Chicago and consulted frequently with HERL during his studies.

The ISIC AT clinic is the first of its kind in India, and if successful, will be replicated in other regions. As part of an NSF grant, HERL doctoral student Jon Pearlman will spend three months in India assisting in the AT clinic in order to complete the camera study described in a previous *PN* article ("Making Mobility Real," August 2006), and to conduct research on the further development of an electric-powered wheelchair.

HERL has been involved in workshops and creating wheelchair testing laboratories in Brazil, Columbia, and the Philippines. More importantly, the World Health Organization, US AID, and the International Society for Prosthetics and Orthotics have been sponsoring an international group of experts to create an international guideline for developing, testing, and providing wheelchairs worldwide. Due for publication within the next 18 months, the guideline promises to be a significant and much needed contribution to improving wheelchair availability and service delivery.

HERL continues to provide leadership in the area of wheelchair standards and participates actively in the creation and revision of International Standards Organization (ISO) documents. The labs' product-comparison studies are read around the world and used as supporting documents for many countries.

HERL is gradually building more international research partnerships through studies to

investigate activity levels among manual-wheelchair users, through efforts of the SmartWheel® User Group, and with the study of consumer involvement in identifying environmental and technological barriers. HERL has collaborators in Japan, Australia, New Zealand, India, and England.

## Community Activities

After helping host the 1998 National Veterans Wheelchair Games (NVWG) in Pittsburgh, HERL investigators began traveling to subsequent games to bring the labs' research to the veterans. HERL's presence at the games helps staff interact with and serve veterans who use wheelchairs by recruiting them to participate in research studies. The event also gives HERL the opportunity to disseminate research results, educate wheelchair users about its work, and recruit people who use wheelchairs and who live outside Pittsburgh to participate in research studies.

In 2006, HERL began attending and conducting research at the National Disabled American Veterans (DAV)/VA Winter Sports Clinic. The event promotes rehabilitation by instructing disabled veterans in adaptive skiing and providing an introduction to other adaptive activities and sports.

Through work with DOD, HERL has established research collaborations with several colleagues at WRAMC. Physiatrists from WRAMC and HERL have joined efforts in research projects at the Winter Sports Clinic and the NVWG. Other year-round projects have been initiated. These research partnerships will help document the treatment of war-on-terrorism veterans with disabilities and direct their rehabilitation.

## Future Work

HERL continues to provide leadership in wheelchair research and development and has expanded into other areas of technology to assist people with disabilities, particularly neurological impairments. The research and development activities for electric-powered wheelchairs have expanded, especially in making them smarter and aware.

HERL is moving more of its research out of the laboratory and into the community to interact with consumers where they live, work, and play. This has led to the development and deployment of instrumentation packages and software tools that can unobtrusively record various wheelchair activities. The biomechanics research at HERL continues to make important contributions and has grown to include the study of transfers. PVA continues to provide annual funding to support HERL's investigations.

As HERL moves into the future, its research and development activities will not only build upon the success of the past but also evolve to exploit the strengths of new investigators and the growing number of external partners. ■

In India, HERL Director Dr. Rory Cooper (center) and graduate student Jon Pearlman (seated) visit the comprehensive assistive-technology clinic established after a six-year effort.