



# HERL Quarterly Newsletter



VOLUME 2, ISSUE 4

WINTER EDITION  
DECEMBER 2003

## LETTER FROM THE EDITOR

Happy holidays, and thank you for taking the time to read our winter issue of the newsletter. As usual, we have been extremely busy over the last few months and have a lot of news to report.



HERL students Jon Pearlman and Erik Wolf preparing for a Tech-Link Robotics Camp practice session.

We would like to announce that we began work on our second Tech-Link Robotics Camp in October. Last year's robotics camp was a day-long event to spark interest in math, science, and technology in junior high students both

with and without disabilities. This year, HERL is sponsoring a team of eight Tech-Link middle school students in six half-day practice sessions in preparation for an officially sanctioned FIRST Lego-League Competition in December. HERL doctoral candidate Diane Collins is working with Tech-Link Executive Director Sondra Balouris Brubaker to organize the events. HERL students

Erik Wolf, Jon Pearlman, Karl Brown, and Andy Kwarciak, as well as some undergraduate volunteers from Pitt's School of Engineering, are mentoring the Tech-Link team. The FIRST Lego League Competition will take place on December 6th and we will have more details about it in the next issue of the HERL newsletter.

HERL is also proud to announce that we soon are coming up on our 10th Anniversary. HERL first opened its doors in April of 1994 at the VA Pittsburgh Healthcare System. We are planning a celebration for March 29, 2004 to commemorate our 10th anniversary. We will be sure to report on the celebration in a future issue of the newsletter.

The Human Engineering Research Laboratories would like to wish all of our readers and their families a joyous holiday season.

*-Christine Heiner, Editor, HERL Quarterly Newsletter*

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## CULP-SCI Investigators Held Collaborative Meeting at KMRREC

On November 3-5, HERL investigators and students headed off to the Kessler Medical Rehabilitation Research and Education Corporation (KMRREC) for a CULP-SCI (Collaboration on Upper Limb Pain in Spinal Cord Injury) collaborative meeting and to tour the KMRREC laboratories. The CULP-SCI is a joint research effort between HERL's University of Pittsburgh Model Center on Spinal Cord Injury (UPMC-SCI) and two other Model SCI Systems, the Northern New Jersey Spinal Cord Injury System (NNJSCIS) and the North West Regional Spinal Cord Injury System (NWRSCIS). The NNJSCIS is located at the KMRREC in West Orange, New Jersey, and the NWRSCIS is located at the University of Washington. The



CULP-SCI investigators research the relationship between upper limb injury and wheelchair propulsion biomechanics at all three facilities. KMRREC investigators Dr. Susan Sisto, and Dr. Trevor Dyson-Hudson, NWRSCIS investigators Robert Price and Dr. Michael

Chang, and other investigators were present for the meeting. HERL investigators Dr. Michael Boninger and Dr. Alicia Koontz and HERL students Brad Impink, Rachel Cowan, Ian Rice, Jennifer Mercer, and Yusheng Yang attended the 2-day visit. Dr. Boninger also gave a grand rounds lecture during the collaborative meeting.

*-Christine Heiner*

## CURRENT RESEARCH ABSTRACTS

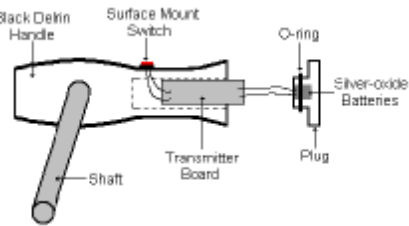
### Addition of a Wireless "Fire-Button" to the User Interface of the GAME<sup>Cycle</sup> Exercise System

BethAnn Kaminski, BSE, Rory Cooper, PhD, William Ammer, BSE, Mark McCartney, Donald Spaeth, PhD

**Objectives:** The Game<sup>Cycle</sup> exercise system is an interface between an arm ergometer and a computer game and was designed to provide motivation to individuals who use wheelchairs to exercise on a regular basis. Some users showed an interest in having "fire-control" buttons in order to



Left: The GAME<sup>Cycle</sup> Exercise System. Right: Diagram of handgrip with fire-button



allow them to use additional features of a wider variety of video games. Thus, buttons would let a person use more features of games they enjoy and add to the motivation of exercising with the Game<sup>Cycle</sup> system. Additionally, the button permits the game operation and menu selection to be accomplished with less use of a keyboard and mouse.

**Methods:** A radio frequency transmitter was fit into the ergometer handgrip. A tactile switch mounted on the outside of the handgrip so that when the switch is depressed, information is sent via radio frequency (RF) to the receiver board. The RF signal is received and the computer is then alerted that the fire-

button has been pressed.

**Results:** A working prototype has been fabricated and successfully operates with the Game<sup>Cycle</sup> system. In a sample video game, Need for Speed II, items could be selected from game menus by pressing the fire-button.

During game play, the fire-

button was able to control one function of choice that is normally controlled by a keyboard key.

**Relevance to wheelchair users:** Exercise is important to the physical health and well-being of all people and helps in the prevention of cardiovascular disease, high blood pressure, obesity, and diabetes. This is especially true for persons with disabilities, who tend to have lower activity levels in general. The addition of game play to exercise could improve the chances that the user will exercise more often and achieve or maintain their fitness level.

-Beth Ann Kaminski, BSE

### Pelvic Positioning Evaluation for Wheelchair Selection: A Comparison Between in Person and Video Conferencing

Ana Allegretti, MS, Shirley G. Fitzgerald, PhD, Michael L. Boninger, MD, Rory A. Cooper, PhD, Rosemarie Cooper, MPT, ATP, Laura Cohen, PT, Nigel Shapcott, MS

**Purpose of work.** Telerehabilitation (TR) is the application of telecommunication technology to provide distance support, assessment, and intervention to individuals with disabilities. There is an absence of any large-scale randomized controlled trials demonstrating either clinical effectiveness or cost-effectiveness of TR in providing seating assessment for individuals who live in remote or underserved areas (2). It was of interest to determine whether this was true for more specific aspects of seating.

**Subjects/ Procedures.** Four licensed therapists with experience in seating and mobility evaluations conducted assessments, on 20 model patients. The model patients used a standard wheelchair during the assessment in order to avoid biasing the evaluators towards a prescription. The group of model patients consisted of ten females and ten males with the mean age of 42.4 years ( $\pm$  13.1 years). The primary diagnoses included Rheumatoid Arthritis, Engel-



Setup of Telerehabilitation equipment at HERL

man's disease, Cerebral Palsy, Spinal Cord Injury, Head Injury, Spinal Muscular Atrophy, Osteoporosis, Spina Bifida, Diabetes, Muscular Dystrophy and Multiple Sclerosis. Two assessments were done, one week apart in person by different clinicians; two assessments were completed via TR. In Person (IP) assessment was compared to another IP assessment, and then one IP assessment was compared to TR assessment.

**Results.** The two IP assessments and the IP and TR assessments were compared using Kappa statistics. A Kappa value of  $> .75$  was interpreted as excellent agreement (3). The data showed that IP to IP were for the most part comparable. IP to TR were not as comparable.

**Relevance to the Veteran Population.** Many veterans who use wheelchair live in remote or underserved areas and are unable to get major cities for specialized wheelchairs care. TR could provide them expertise needed for their seating assessment and needs to be studied further.

-Ana Allegretti, M.S.

## CURRENT RESEARCH ABSTRACTS

### Comparing Driving Habits of Wheelchair Users: Manual vs. Power

April E Hoover, BSME, Rory A Cooper, PhD, Dan Ding PhD, Mike Dvorznak BSE, Rosemarie Cooper MPT, ATP, Shirley G. Fitzgerald, PhD, Michael L. Boninger, MD

**Purpose of the Work.** There is very little information about the actual traveling behavior of users of wheelchairs. This information is critical to the design of wheelchairs, wheelchair components, battery design/specification, and in studies of risk exposure (e.g., risk of injury due to component failure). The purpose of this study is to determine the traveling characteristics of wheelchair users during unrestricted community activities.

**Subjects/Procedures.** A total of 54 wheelchair users were evaluated in this study, 16 manual users and 38 power users. The participants ranged in age from 24 to 70. Participants were recruited during the National Veterans Wheelchair Games in San Antonio, Texas, New York and Cleveland, Ohio and in the Pittsburgh, Pennsylvania area through the Human Engineering Research Laboratories database. A small device was attached to each of the participant's wheelchairs for data collection. The data was analyzed through a computer program for the average speed and distance traveled per hour.

**Results.** The average power wheelchair user traveled 203.34 meters an hour (0.13 miles) at an average speed of 0.3992 meters/second (0.893 miles per hour) and an average of 3792.22 meters (2.36 miles) at a speed of



*"Dataloggers" built at the Human Engineering Research Labs, record speed and distance during wheelchair use*

0.711 meters/second (1.591 Miles per hour) over the entire day. The average manual wheelchair user traveled 180.58 meters (0.11 miles) at an average speed of 0.3092 meters/second (0.692 miles per hour) and an average of 3544.46 meters (2.20 miles) at a speed of 0.53 meters/second (1.186 miles per hour) over the entire day.

#### Relevance to Wheelchair

**Users.** In a study by Brubaker, wheelchair users rated durability as the highest priority. Understanding the actual usage by wheelchair users will help in the design of better wheelchairs. For power wheelchair users this may mean longer battery life. For manual wheelchair users this will lead to more durable equipment. More information on usage patterns will help clinicians justify more reliable equipment when prescribing wheelchairs for their clients.

*-April Hoover, BSME*

### Finite Element Model of the Shoulder Joint During Wheelchair Propulsion

Nethravathi Tharakeshwarappa BS, Alicia Koontz PhD, Rory Cooper PhD, Michael Boninger PhD, Jeff Towers, MD



*3D computer generated shoulder model*

**Purpose of the work.** The purpose of this study was to identify sources of pain and injury at the shoulder joint due to manual wheelchair propulsion. This study focuses on constructing an individualized computer model of the shoulder using Magnetic Resonance Images (MRI) to better understand forces and stresses at the shoulder joint during wheelchair propulsion. These forces and stresses are measured

of pain, wear, and injury.

**Subjects.** The right shoulder of a male wheelchair user, 51 years old, 6'2", 195lb, T5-6 spinal cord injury, was analyzed in this study.

**Procedures.** A computer model of the shoulder bones was constructed using MRI images, which are taken in

different sections to get accurate bone geometry. Commercially available software was used to convert the MRI images into a format necessary for creating the computer model. To complete the model, forces at the shoulder joint need to be calculated using the position of the arm and forces at the palm, which are measured using optical cameras and a SMART<sup>Wheel</sup> (Three Rivers Holdings, Mesa, AZ). This information is then entered into a numerical tool called Finite Element Analysis (FEA) to obtain shoulder joint stresses.

**Results.** To date, we have completed a 3D computer model of the primary shoulder bones. We have also transformed the shoulder bone anatomy into a mesh using commercial FEA software which will in the future enable us to identify areas of stress and strain within the shoulder joint.

**Relevance to Wheelchair Users.** Results from the FEA analysis can be used to detect the areas within the shoulder that are prone to pain/injury, to identify better wheelchair propulsion techniques, and to optimize wheelchair configuration.

*-Nethra Tharakeshwarappa, BS*

## RECENT HERL PUBLICATIONS

Wagner AK, Boninger ML, Levy C, Chan L, Gater D, Kirby RL, Peer Review: Issues in Physical Medicine and Rehabilitation, **American Journal of Physical Medicine and Rehabilitation**, Vol. 82, No. 10, pp. 790-201, October 2003.

van der Woude LHV, Formanoy M, de Groot S, Hand Rim Configuration: Effects on Physical Strain and Technique in Unimpaired Subjects, **Medical Engineering and Physics**, Vol. 25, No. 9, pp. 765-774, November 2003.

Rentschler AJ, Cooper RA, Blasch B, Boninger ML, Intelligent Walkers for the Elderly: Performance and Safety Testing of the VA-PAMAID Robotic Walker, **Journal of Rehabilitation Research and Development**, Vol. 40, No. 5, pp 423-432, September/October 2003.

Boninger ML, Dicianno BE, Cooper RA, Towers JD, Koontz AM, Souza AL, Shoulder Magnetic Resonance Imaging Abnormalities, Wheelchair Propulsion, and Gender, **Archives of Physical Medicine and Rehabilitation**, Vol. 84, No. 11, pp. 1615-1620, November 2003.

Corfman TA, Cooper RA, Fitzgerald SG, Cooper R, A Video-Based Analysis of "Tips and Falls" During Electric-Powered Wheelchair Driving, **Archives of Physical Medicine and Rehabilitation**, Vol. 84, No. 12, pp. 1797-1802, December 2003.

## HERL IN THE MEDIA



**Veterans First, Issue 4, 2003, Page 4:** VA Center Works to Improve Veterans' Quality of Life

**Paraplegia News, October 2003:**

**Pp. 28-30:** FDA Approves Mobility System

**Pp. 67-70:** Donations to PVA Research Program

**Page 73:** VA Research Award

**www.auntminnie.com, October 8, 2003:** Just (over) Do It! Imaging Pegs Overuse Injuries in Specialty Sports.

**Vanguard, September/October 2003, P. 31:** Rory Cooper Awarded Magnuson Award

**RESNA News, Fall 2003,:**

**Page 3:** New Technology Received FDA Approval

**Page 8:** 2003 RESNA Awards

**Pp. 10-11:** Members Making News

**Page 11:** The Department of Veterans Affairs, Research and Development Office Honors Dr. Rory Cooper with the Paul B. Magnuson Award

## CURRENT EVENTS/ANNOUNCEMENTS

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

Ragged Edge online has posted the cover story from its Sept./Oct. 2003 print edition. "Awareness Days: Some Alternatives to Simulation Exercises" offers suggestions for more accurate awareness day exercises than often result from the "tie on a blindfold, get in a wheelchair" approach used to "sensitize" nondisabled students. In the article, Art Blaser of Chapman University's Political Science Dept. looks at exercises that make a more societally-based impact. The article is online at <http://www.raggededgemagazine.com/0903/0903ft1.html>

In October, the website [www.proyectovision.net](http://www.proyectovision.net) for Proyecto Visión, the National Technical Assistance Center for Latinos with Disabilities, was re-launched. The comprehensive website includes new functions, expanded information and has been redesigned to be more accessible to people with visual impairments.

The Pre-Engineering Times, a free pre-engineering newsletter filled with resources to catapult engineering education success, selected HERL director Dr. Rory Cooper as the "Cool Engineer of the Month" in their November 10, 2003 issue. The Pre-Engineering Times is a publication of The Engineering Education Service Center and the Junior Engineering Technical Society. You can read the article and subscribe to the newsletter at <http://www.engineeringedu.com/issue25.html>

## VISITING FACULTY PROFILE: Shojiro Terashima, Ph.D.

Dr. Shojiro Terashima from Niigata University in Japan came to the Human Engineering Research Laboratories in April as our second “visiting professor.” Dr. Terashima, also known as “George,” received the B.S., M.S. and Ph.D. degrees in Mechanical Engineering from Niigata University. He specializes in biomechanics of the human lower extremities, investigating the effects of Total Joint Arthroplasty, Osteoarthritis, and ligament injury on the hip, knee and ankle joints. Dr. Terashima has conducted research studies on gait analysis and has analyzed contact pressure distribution and joint motion in six degrees of freedom in the human joints. Dr. Terashima is working to develop low cost wheelchairs with omni-directional movement capabilities. He is also working on a type of wheelchair that a user can easily transfer from without the assistance of a lift. Dr. Terashima is an Associate Professor in the Department of Mechanical and Control Engineering at Niigata Institute of Technology in Japan. He is also a Visiting Associate Professor in the Department of Rehabilitation Science and Technology at the University of Pittsburgh.



*Shojiro "George" Terashima, Ph.D.*

Dr. Terashima came to HERL hoping to expand his rehabilitation research experience to include the design and development of assistive technology devices and tools. “When I started to research wheelchairs, Dr. Cooper’s name frequently appeared in the journal papers and I decided that I would like to visit his laboratory if I was able to study abroad,” George said about his decision to come to HERL.

During George’s 5 month visit, he participated in HERL’s National Veterans Wheelchair Games research, and worked in the Center for Assistive Technology wheelchair seating clinic. He also gave two lectures entitled, “Biomechanics Research for Lower Extremity Joint Replacements” and “Technical Hints for Research and Application of Assistive Technology.”

George also became very interested in our Wheelchair Mounted Robotic Arm (WMRA) project. He hopes to return to HERL within the next year or two to further design and develop the Robotic Arm controller.

*-Christine Heiner*

## FEATURED HERL STUDENT: Roland Frisch

Roland Frisch came from Budapest, Hungary to the Human Engineering Research Laboratories in April of 2003 to complete an internship for his Masters’ degree project. Roland earned a B.S. in Mechatronics from the Budapest University of Technology and Economics in 2000. While working on his Bachelor’s degree, he worked in a laboratory in Rudostalt, Germany for 5 months on a Leonardo da Vinci European Scholarship. Roland is fluent in both German and English and is interested in mechanics, electronics, and informatics.

Roland began his Masters’ studies in Integrated Engineering at the Technical University of Budapest in 2000. He has completed his M.S. project at HERL on hardware design for a Smart Power Assistance Module (SPAM). The SPAM is a manual wheelchair power assist system for people who are non-ambulatory, have



*Roland Frisch*

a visual impairment and have difficulty using traditional mobility devices for the visually impaired. The SPAM has the ability to detect and steer a wheelchair away from obstacles and drop-offs such as stairs, curbs, and potholes. Roland has also designed handles for the GAME<sup>Cycle</sup> exercise system while working and studying at HERL.

Roland will defend his Master’s thesis on the SPAM hardware design at HERL in December. He has also written a paper on his project for the 2004 Rehabilitation Engineering Society of North America (RESNA) conference. He will be returning to Hungary in December and hopes to finish up at the Technical University of Budapest by the summer of 2004. Roland is considering doctorate studies after graduation and hopes to continue working in the mechanical engineering field.

*-Christine Heiner*

## HERL Acquires Two New Pieces of Machine Shop Equipment

The HERL machine shop, located on the ground floor of the HERL facility, is a state of the art shop staffed by individuals with a wide range of experience. The 3000 square foot shop area is staffed by Bill Ammer, Mark McCartney, John Duncan, Emily Zipfel and Jeremy Puhlman. The shop works in a wide range of materials from wood and plastic to aluminum, steel and titanium. The shop is fully integrated in that we can design as well as manufacture parts and assemblies to support the current needs of the research areas. There are numerous manually operated pieces of equipment such as band saws, lathes, mills and drill presses. A CNC lathe and a CNC Mill are also available for use. CNC is an acronym for Computer Numerical Control. In this type of equipment, the machine is programmed to accom-



*HERL Technical Coordinator William Ammer and our new Laser Lithography machine*

plish the various machining tasks necessary to make the part. Once programmed, the machine will quickly make duplicates of the same part with a high degree of accuracy. Two new pieces of equipment are the Wire EDM and the Laser Lithography machine. The Wire EDM is CNC controlled and cuts with an electrically charged wire that is a mere .010 inches in diameter. In comparison, a human hair is on the order of .003 in. The machine is highly accurate and produces parts with an accuracy of fifty millionths of an inch.

It will cut any type of metal. The Laser Lithography machine allows the shop to produce prototypes of parts and assemblies made from a photopolymer resin. In this machine, a laser is played across the surface of a liquid resin. The resin is cured and hardened by the laser to form layers of the part being produced. After each layer is scanned, the machine covers the part with another layer of liquid resin and the laser is played over the new liquid layer.



*The CNC Mill*



*The new Wire EDM machine*

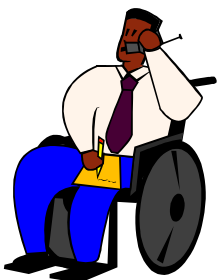
*-William Ammer, B.S.*

## 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 **Rosemarie, Annmarie, or Amy**, for more information.

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



## FEATURED STAFF MEMBER: Annmarie Kelleher

Annmarie Kelleher began working with HERL in 2001 when she was hired as the study coordinator for the IBOT clinical trials. Afterwards, Annmarie joined HERL as a Clinical Coordinator Assistant and soon became a Clinical Coordinator.

Annmarie works hard to ensure that all HERL research is compliant with the regulations of both the University of Pittsburgh and Department of Veterans Affairs institutional review boards. Knowledgeable in the proper administration of clinical studies involving human subjects, Annmarie coordinates complex research projects. She is responsible for assisting in the development of clinical protocols, monitoring and participating in study implementation, subject recruitment, and data management.

Annmarie is also a Wheelchair Seating Clinician at the UPMC Center for Assistive Technology (CAT). At the CAT, she evaluates clients' assistive



*Annmarie Kelleher, OTR/L*

technology needs and works with physicians to make sure those clients receive the appropriate assistive devices.

Annmarie received her Bachelor's degree in Occupational Therapy from the University of Pittsburgh in June 2001. She is a member of Pi Theta Epsilon, an occupational therapy honor society, the Pennsylvania OT Association, the American OT Association and the Rehabilitation Engineering Society of North America (RESNA). Currently, Annmarie is working towards a M.S. in Occupational Therapy and expects to graduate in December of 2004.

In April of 2003, Annmarie married her boyfriend of 9 years, Presley Kelleher. Annmarie and Presley just purchased their first house this fall and are working hard to personalize their new home.

*-Christine Heiner*

## AGENCY SPOTLIGHT: The Hope Network

The Hope Foundation was founded by a man named John Sikora in 1997 when he realized there was a need for recreational activities in the disabled community. This non-profit organization was established to help people with disabilities live a healthy and more independent lifestyle. The Hope Network has enabled people to enjoy more recreational activities than they realized was possible. The idea was to get everyone involved, even family and friends. The staff at The Hope network has provided the chance for those involved to enjoy activities that anyone else can do.

The Hope Network has also established an educational program which has brought people, both with and without disabilities, to a better understanding of each other. The organization strives to educate people on living with a disability, and taking part in leisure activities and athletics. The Hope Network also fosters communication among the staff, volunteers, and participants on how to

participate in athletic activities safely.



Some of the athletic events hosted by the Hope Network are the Snow Ski Classic, a youth development clinic, cycling, a marathon, and self defense classes. The Ski Classic is an annual event held at Hidden Valley Ski Resort in Somerset, PA. The Ski Classic offers such things as Learn-to-Ski clinics, Youth Development Programs, Fun Races and a social banquet. The next Health Sports Ski Classic will be held on January 26-28, 2004. Volunteers from the Human Engineering Research Laboratories have participated in the Ski Classic for the past several years, and we plan on being at this upcoming event.

You can learn more about Hope Foundation on their website at <http://www.hopenetwork-pa.org>. To volunteer, please call their office at (412) 826-2772

*-Dan Tomkiewicz*

Human Engineering Research Laboratories

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the newsletter to the editor, Christine Heiner at:  
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VA Center Of Excellence For Wheelchairs  
And Related Technology  
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

## Interested in Participating in a HERL Research Study?

Research studies at our laboratories involve participants who utilize manual or power wheelchairs as a means for mobility. The majority of our studies involve a visit to the Human Engineering Research Laboratories located at the Highland Drive VA Medical Center in Pittsburgh, PA. However, some of our studies are survey based and do not involve travel.

*If you're interested in participating in a HERL Research Study, contact our clinical coordinators Rosemarie Cooper or Annmarie Kelleher at (412) 365-4850.*

If you are interested in obtaining further information about how you can participate in current or future studies, please contact Annmarie or Rosi, Clinical Coordinators for the Human Engineering Research Laboratories at (412) 365-4850. We look forward to hearing from you.

**You can now receive the HQN by e-mail! If you would like to receive this newsletter electronically, send an e-mail to [heinercm@pitt.edu](mailto:heinercm@pitt.edu). Also, don't forget that all issues of the HQN are available on our website, [www.herlpitt.org](http://www.herlpitt.org).**

