

The background of the cover features a blurred image of a laboratory or research environment. On the left, a computer monitor displays some data or code. In the foreground, a joystick or game controller is visible, suggesting human-machine interaction research. The entire image is overlaid with a semi-transparent orange filter. A solid dark blue vertical bar runs along the right edge of the cover.

#HERL QUARTERLY

HUMAN ENGINEERING RESEARCH LABORATORIES
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PUBLICATIONS

Nam V Vo, PhD, Sara R Piva, PhD, PT, Charity G Patterson, PhD, Gina P McKernan, PhD, Leming Zhou, PhD, DSc, Kevin M Bell, PhD, William Anderst, PhD, Carol M Greco, PhD, Michael J Schneider, PhD, DC, Anthony Delitto, PhD, PT, Brad E Dicianno, MD, Jessa Darwin, MLIS, Gwendolyn A Sowa, MD, PhD

As a member of the Back Pain Consortium (BACPAC), the University of Pittsburgh Mechanistic Research Center's research goal is to phenotype chronic low back pain using biological, biomechanical, and behavioral domains using a prospective, observational cohort study. Data will be collected from 1,000 participants with chronic low back pain according to BACPAC-wide harmonized and study-specific protocols. Participation lasts 12 months with one required in person baseline visit, an optional second in person visit for advanced biomechanical assessment, and electronic follow ups at months 1, 2, 3, 4, 5, 6, 9, and 12 to assess low back pain status and response to prescribed treatments. Behavioral data analysis includes a battery of patient-reported outcomes, social determinants of health, quantitative sensory testing, and physical activity. Biological data analysis includes omics generated from blood, saliva, and spine tissue. Biomechanical data analysis includes a physical examination, lumbopelvic kinematics, and intervertebral kinematics. The statistical analysis includes traditional unsupervised machine learning approaches to categorize participants into groups and determine the variables that differentiate patients. Additional analysis includes the creation of a series of decision rules based on baseline measures and treatment pathways as inputs to predict clinical outcomes. The characteristics identified will contribute to future studies to assist clinicians in designing a personalized, optimal treatment approach for each patient.

Vo, Nam V., et al. "Toward the Identification of Distinct Phenotypes: Research Protocol for the Low Back Pain Biological, Biomechanical, and Behavioral (LB3P) Cohort Study and the BACPAC Mechanistic Research Center at the University of Pittsburgh." *Pain Medicine* (2023): pnad009.

Duvall, Jonathan; Sivakanthan, Sivashankar; Daveler, Brandon; Sundaram, S. Andrea; Cooper, Rory A

In the United States, about 26% of the population reports having some form of disability. However, people with disabilities (PwD) are under-represented in science, technology, engineering, and mathematics (STEM). The representation of PwD as patented inventors is unknown, but likely under-represented, given their limited numbers in STEM and the workplace. This study set the goal of identifying PwD with patented technologies that have also been introduced into the marketplace. Using web searches and patent awards/applications, 21 influential inventors with disabilities were identified. The impact of these inventors was assessed and is briefly described. Technologies that were invented for PwD that have had mainstream success were also identified. Inventors with disabilities have made important contributions, but further study is required, as the inclusion of PwD in the inventor community is a nascent field of study that is important for expanding the innovation community.

Duvall, Jonathan, et al. "INVENTORS WITH DISABILITIES—AN OPPORTUNITY FOR INNOVATION, INCLUSION, AND ECONOMIC DEVELOPMENT." *Technology & Innovation* (2022).

George F. Wittenberg, Xiaoqi Fang, Souvik Roy, Bryan Lee, Nataša Miškov-Živanov, Harry Hochheiser, Layla Banihashemi, Michael Vesia, Joseph Ramsey

Transcranial magnetic stimulation (TMS) is a painless non-invasive method that allows focal activation or deactivation of a human brain region in order to assess effects on other brain regions. As such, it has a unique role in elucidating brain connectivity during behavior and at rest. Information regarding brain connectivity derived from TMS experiments has been published in hundreds of papers but is not accessible in aggregate. Our objective was to identify, extract, and represent TMS-connectivity data in a graph database. This approach uses nodes connected by edges to capture the directed nature of interregional communication in the brain while also being flexible enough to contain other information about the connections, such as the source of information and details about the experiments that produced them.

Wittenberg, George F., et al. "Representation and Retrieval of Brain Connectivity Information derived from TMS Experiments." *bioRxiv* (2023): 2023-01.

Marc P Powell, Nikhil Verma, Erynn Sorensen, Erick Carranza, Amy Boos, Daryl P Fields, Souvik Roy, Scott Ensel, Beatrice Barra, Jeffrey Balzer, Jeff Goldsmith, Robert M Friedlander, George F Wittenberg, Lee E Fisher, John W Krakauer, Peter C Gerszten, Elvira Pirondini, Douglas J Weber, Marco Capogrosso

Cerebral strokes can disrupt descending commands from motor cortical areas to the spinal cord, which can result in permanent motor deficits of the arm and hand. However, below the lesion, the spinal circuits that control movement remain intact and could be targeted by neurotechnologies to restore movement. Here we report results from two participants in a first-in-human study using electrical stimulation of cervical spinal circuits to facilitate arm and hand motor control in chronic post-stroke hemiparesis (NCT04512690). Participants were implanted for 29 d with two linear leads in the dorsolateral epidural space targeting spinal roots C3 to T1 to increase excitation of arm and hand motoneurons.

Powell, Marc P., et al. "Epidural stimulation of the cervical spinal cord for post-stroke upper-limb paresis." *Nature medicine* (2023): 1-11.

Chang Dae Lee, Brandon J Daveler, Jorge L Candiotti, Rosemarie Cooper, Sivashankar Sivakanthan, Nikitha Deepak, Garrett G Grindle, Rory A Cooper

The QLX is a low-profile automatic powered wheelchair docking system (WDS) prototype developed to improve the securement and discomfort of wheelchair users when riding in vehicles. The study evaluates the whole-body vibration effects between the proposed QLX and another WDS (4-point tiedown system) following ISO 2631-1 standards and a systematic usability evaluation. Whole-body vibration analysis was evaluated in wheelchairs using both WDS to dock in a vehicle while riding on real-world surfaces. Also, participants rated the usability of each WDS while driving a wheelchair and while riding in a vehicle in driving tasks.

Lee, Chang Dae, et al. "Usability and Vibration Analysis of a Low-Profile Automatic Powered Wheelchair to Motor Vehicle Docking System." *Vibration* 6.1 (2023): 255-268.

DR. DICIANNO AND COHORT COMPLETE THE STATE OF PENNSYLVANIA PARALYSIS RESOURCE CENTER GRANT



The Dept. of Physical Medicine and Rehabilitation at the University of Pittsburgh School of Medicine, in collaboration with the Human Engineering Research Laboratories, was awarded a two-year cooperative agreement totaling \$399,292 from the Administration on Community Living. The Pennsylvania Paralysis Resource Center (PRC) is a pilot program aimed to help improve the quality of Pennsylvanians (of all age) who are living with paralysis and their caregivers by improving or increasing the services and supports offered by community-based disability organizations. This information is all found at:

PRC Outcomes

- Pennsylvania was one of four states to participate
- Impacting (more than double the intended goal of 200 people) a total of 562 people with paralysis participated in these programs, along with caregivers
- Twelve community-based organizations received funding to carry out their innovative programs
- Programs focused on adaptive sports, service coordination, nutrition services for those at risk of wounds, art therapy, and adaptive gaming
- In total, we awarded over \$250,000 to these organizations. This funding allowed the programs to become sustainable past the end of the contract period.

DR. RORY COOPER INDUCTED INTO THE NATIONAL INVENTOR’S HALL OF FAME

Dr. Cooper has been inducted into the 50th class of the National Inventors Hall of Fame (NIHF) for 2023 based on his work in improving the overall quality of manual and electric wheelchairs. U.S. Patent Nos. 6,276,705; 8,264,458 will be highlighted in the National Inventor’s Hall of Fame Museum.

With Cooper’s induction into the NIHF HERL team members received a shirt with the US Patent and the NIHF logo for their contribution!



What is the National Inventor’s Hall of Fame?
The National Inventor’s Hall of Fame, located in Alexandria, Virginia, is a non-profit organization that aims to recognize individual engineers and U.S. Patents. The NIHF’s overall goal is to encourage innovation, creativity, and entrepreneurship by displaying life changing technology.

Visitors of the NIHF can learn about past inventors’ work as well as interact with the current class of inductee’s inventions. Some inventors you may recognize among many are Steve Jobs, and Thomas Edison! Dr. Cooper’s patent will be displayed and available to try out if you find yourself visiting the museum!

NIHF Class of 2023
The NIHF inducted 15 inventors plus Dr. Cooper into the 2023 class. The class is a very diverse group of innovators from helping create the COVID vaccine, enhanced food products, to Dr. Cooper’s wheelchair technology.

The National Inventors Hall of Fame produced a short documentary on Dr. Cooper showcasing his motivation for enhancing the lives of others through his work in assistive technology.

HERL ACCOLADES

Tim Balz, a HERL Collaborator, was recognized recently for his startup in the article “Alumnus Tim Balz’s Innovative Startup Redesigning Wheelchair Technology”. Balz started Kalogon Inc. which created the world’s first smart cushion. This product was awarded the Most Innovative Product in Accessibility at this year’s Consumer Electronics show in Vegas. His work got him recognition from his alma mater in which he received the Rose-Hulman Alumni Association’s 2022 Distinguished Young Alumni Award.



Mr. Koenig, Director of VA Pittsburgh Health Care, presented Dr. Cooper with his award of being recognized for 25 years of dedicated service to the United States Government. Congrats Dr. Cooper on this achievement!



HERL alumnus Dr. Hervens Jeannis received the 2023 Modern-Day Tech Leader Award from the National Society of Black Engineers. At Boeing Dr. Jeannis is a systems engineer on the Model Based Engineering Team. Congratulations to Dr. Jeannis on his award!

On March 3rd HERL team member, Sara Peterson PhD, CPO, FAAOP(D), was awarded the Fellow of the Academy with Distinction which is the highest honor bestowed upon an Academy Active member who has exceeded the Fellow of the Academy requirements. The Academy Fellow with Distinction designation recognizes those who have made outstanding contributions to orthotics/prosthetics through leadership, publication, and presentation of concepts and research nationally and internationally. Congratulations, Dr. Peterson on her award!



HERL conducted a hooding ceremony for Nahom Beyene, a former HERL graduate student and friend of HERL, who in April of 2013 was not able to participate in his own graduation ceremony. He earned his PHD in Rehabilitation Science and Technology. Amy Lane and Dr. Cooper, his Dissertation Advisors, were more than happy to make up for this missed opportunity and conducted the hooding. His dissertation was on “The Synthesis of Navisection: Modernizing Driver Rehabilitation Programs to Encompass Intelligent Vehicle Technologies”. Congrats Dr. Nahom Beyene!



HERL is excited to have finalized the selections for the summer 2023 internship cohort. We cannot wait to welcome this new upcoming cohort of students into our HERL team this May. This class of students will be split among three highlighted programs, ASPIRE, VALOR, & ELeVATE. Students will be assigned projects with hands on experience, guided by a mentor. Below please find the descriptions of our current internship programs.



HERL's Distinguished Lecture: Vicky Tolfrey on "Supporting the Wheelchair Athlete for The Paralympic Games: a Multidisciplinary Perspective"

Vicky Tolfrey is a professor of Applied Disability Sports at Loughborough University and the Director of the Peter Harrison Centre for Disability.

Professor Tolfrey provided an inspiring lecture at the Human Engineering Research Labs about the work being done at the center that she leads, and how science has helped the British team become a powerhouse at the Paralympic Games and in world competitions. Dr. Tolfrey is a recipient of the International Paralympic Committee Scientific award, and one of the world's leading experts on Parasport. Science has the power to improve human performance and human health.



VISITORS



Yves Vanlandewyck & Colleagues



Limerick University



National Defense University

ASPIRE

Undergraduates seeking an in-depth summer research experience should consider the American Student Placements in Rehabilitation Engineering (ASPIRE) program at HERL. ASPIRE is:

A ten-week research program at the University of Pittsburgh's Human Engineering Research Laboratories
Sponsored by the National Science Foundation (NSF)
Emphasis on research in the rehabilitation engineering and assistive technology fields

VALOR

The VALOR program seeks to enroll undergraduate and graduate students majoring in diversified areas of engineering, computer science or related fields who are interested in learning more about VA research and development opportunities. HERL staff and faculty engage students in rehabilitation engineering and medical device design to understand issues and apply engineering principles to improve function, quality of life and societal participation for Veterans and Veterans with disabilities. VALOR is designed to increase the number of underrepresented students prepared for and energized to pursue careers in VA research and development and assist them in pursuing their career goals.

ELeVATE

Experiential Learning for Veterans in Assistive Technology and Engineering (ELeVATE) is a program designed to re-integrate veterans to college through a unique three-phased approach.

Note: ELeVATE has ongoing enrollment throughout the year.

For more information contact Josh Marino at josh.marino@pitt.edu

ACTIVE STUDIES

Principal Investigator: Rory Cooper, PhD



This research study will collect feedback from rehabilitation professionals and caregivers on the PPTS transfer process and the new custom seating system.

YOU MAY BE ELIGIBLE TO PARTICIPATE IF YOU ARE:

- Are over the age of 18 years.
- Weigh less than 250 pounds (weight limit of device).
- Fit in an 18-inch-wide and 18-inch-deep seat.
- Are a rehabilitation professional (therapists, caregivers, physicians, nurses, attendants and aides) with experience transferring adults with complex disabilities who use Electric Power Wheelchair (EPW)

The study will take one visit lasting no longer than three hours. Participants may be compensated up to \$80 for completing the study. Location: Human Engineering Research Laboratories (Bakery Square, 6425 Penn Ave., Suite 400, Pittsburgh, PA, 15206). CALL 412-417-7923 for more information!

PARTICIPANTS WILL BE ASKED TO:

- Transfer a rescue dummy from the EPW to the bed using PPTS.
- Compare the test wheelchair with the original manufacturer's seating by maneuvering the wheelchairs through a few obstacles and evaluating them through a series of questionnaires.
- Complete additional testing of the PPTS which will involve evaluating the transfer process, if needed.

THE PPTS STUDY IS ACCEPTING PARTICIPANTS THROUGH APRIL 2023!

Principal Investigator: Alicia Koontz, PhD



This study will require two visits for care recipients and up to four visits for caregivers, and you will have the option to participate remotely in your home. For the first visit, you will be asked to complete surveys and perform routine transfers to be evaluated. For the second visit you will be asked to perform the same transfer procedures as visit one. Visits three and four for caregivers involve completing an online assessment of their transfer skills. Care recipients could earn up to \$50 and caregivers could earn up to \$100 for participation in the study. Caregivers will be given the opportunity to participate in an option sensor portion of the study for an additional \$50.

THE CAREGIVER ASSISTED TRANSFER TECHNIQUE (CATT) STUDY IS ACCEPTING PARTICIPANTS THROUGH DECEMBER 2023!

This is a research study conducted by the University of Pittsburgh. The purpose of this study is to examine the Caregiver Assisted Transfer Technique Instrument (CATT), which has been developed as a tool to assess proper technique of caregivers who provide transfer assistance to individuals with physical disabilities.

YOU MAY BE ELIGIBLE TO PARTICIPATE IF YOU ARE:

- Over the age of 18 years old
- Routinely provides transfer assistance to an adult with a physical disability for at least two years
- Served as a caregiver for at least three months
- Have no formal training on assisted transfer techniques

Principal Investigator: Alicia Koontz, PhD



This study will require two visits and 12 weeks of at-home in-wheel suspension use. During your first lab visit, you will be asked to complete a standardized mobility course of various surfaces and obstacles you may encounter during daily activities of living. You could earn up to \$250 for your time!

FOR MORE INFO ON EFFECTS OF IN-WHEEL SUSPENSION IN REDUCING VIBRATION, NECK, AND BACK PAIN STUDY CALL 412-407-2047 AND MENTION "IN-WHEEL SUSPENSION STUDY"

The purpose of this research study is to examine how in-wheel suspension in manual wheelchairs changes vibrational exposure and how this impacts pain and fatigue.

YOU ARE ELIGIBLE TO PARTICIPATE IF:

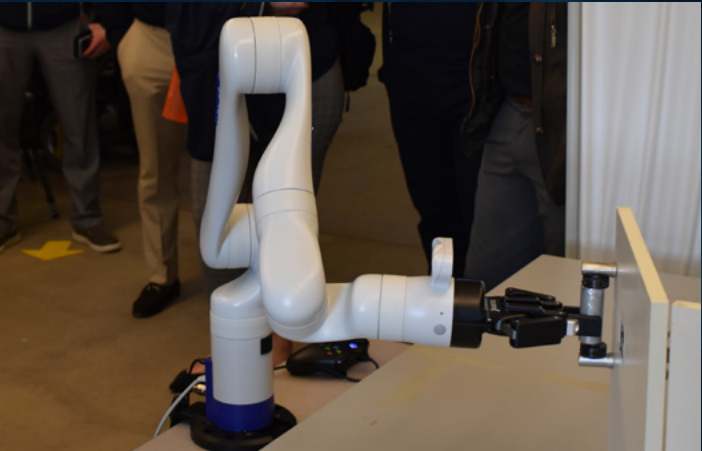
- You have an SCI which occurred at least one year ago
- You use a manual wheelchair full time (>30 hours per week)
- You use a manual wheelchair with 24" or 25" quick-release wheels
- Your wheelchair does not have in-frame suspension elements
- You weigh under 265 lbs. (weight limit of suspension wheels)
- You have moderate chronic neck/ or back pain

YOU ARE ELIGIBLE TO PARTICIPATE IF:

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- You use a manual wheelchair fulltime (>30 hours per week)
- You use a manual wheelchair with 24" or 25" quick-release wheels
- Your wheelchair does not have in-frame suspension elements
- You weigh under 265 lbs. (weight limit of suspension wheels)
- You have moderate chronic neck/ or back pain

YOU MAY NOT BE ELIGIBLE TO PARTICIPATE IF YOU:

- Have impaired vision
- Have pressure ulcers that prevent you from sitting continuously for a long period of time



This study will be completed in six hours - either in one session or multiple sessions - and is located at our Human Engineering Research Labs (Bakery Square, 6425 Penn Ave., Suite 400, Pittsburgh, PA, 15206). Participants will receive \$25 per hour and up to \$150 for completing the study.

INTERESTED IN THE ROBOTIC ARM STUDY? CALL 412-822-3705 FOR MORE INFORMATION

A THANK YOU TO OUR PARTICIPANTS!

Thank you to all research participants who have volunteered their time to participate in our HERL studies! We value the contributions and loyalty to HERL and we look forward to continued participation in HERL research activities.

HERL MAKING A DIFFERENCE IN THE COMMUNITY

In January, Dr. Cooper presented the NIH Director's Wednesday Afternoon Lecture Series, commonly known as the WALs, which is the highest profile lecture program at the National Institutes of Health. WALs helps to keep NIH researchers and clinicians abreast of the latest and most important research within the United States and beyond. Dr. Cooper met with NIH leadership, investigators, and trainees.



In February, Dr. Cooper presented the VA Lunch and Learn Lecture for VA central office team within the Office of Research and Development. Dr. Cooper presented an overview of HERL research and development and its impact on Veterans.



Dr. Rory Cooper was recognized as a Leader in the Community at the Pitt basketball game on February 7th. Pitt honored Cooper's induction into the National Inventors Hall of Fame and received a standing ovation from the crowd! He is pictured with Chris Hoppe (Executive Associate Athletic Director for Pitt men's basketball) and Celeste Welsh, Director of Media Operations and Community Engagement when being recognized on the court. Dr. Cooper attended the game with current HERLers Dr. Jorge Candiotti, Dr. Garrett Grindle, and Siva Sivakanthan supporting Pitt Men's basketball! Pitt defeated Louisville 91-57.

HERL FEATURED IN THE PRESS



In February, the State-of-the-Science Symposium Series kicked-off its 19th year. The theme was Global Health Engagement with presenters from WHO, US Southern Command, DHA, VA, and others. There was wide attendance in-person and on-lie. The Symposium was recorded and is available at www.herl.piutt.edu.



In February, Dr. Cooper spoke with middle school and high school students from across the state of Texas. Cooper led a discussion with students and answered questions from the budding inventors and scientists about innovation, invention, and how to approach solving real-world problems. Students subsequently participated in workshops to build prototypes addressing a real-world problem familiar to them.



HERL is excited to announce it's collaboration with the All of US Research Program.

What is the All of Us research program?

All of Us Research Program is meant to speed up health research and medical breakthroughs by surveying anyone will to provide health information. The health data shared will be added to the All of Us Research Program database that researchers can access and conduct studies.



To Participate in All of Us Research Program go to
or **CALL 800-664-0480**

PITT DAY OF GIVING 2023 THANK YOU

The Human Engineering Research Laboratories would not be able to have accomplished all it has today without your generosity! Thanks to everyone who supported HERL on Pitt's Day of Giving.

Our mission here at HERL is to continuously improve the mobility and function of people with disabilities through advanced engineering in clinical research and medical rehabilitation and our vision is to create a world where all people with disabilities have unencumbered mobility and function so that they can fully participate in and contribute to society. Without all your support and donations, HERL wouldn't be what is without you today and for that we thank you!

- RORY COOPER, PHD
Director
- BRAD DICIANNO, MD
Medical Director
- ALICIA KOONTZ, PHD, RET
Senior Associate Director for Research
- ROSEMARIE COOPER, MPT
Associate Director for Stakeholder Engagement
- GARRET GRINDLE, PHD
Associate Director for Engineering
- ANDREA BAGAY, BS, CRA
Administrative Officer and Assistant Director for VA Finance & Research Administration
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