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Current Research Abstracts

Satpute S, Cooper RM, Dicianno BE, Joseph J, Chi Y, Cooper RA, Mini-Review: Rehabilitation Engineering: Research Priorities and Trends, Neurosci-ence Letters, 136207, Vol. 764, November 2021. <u>https://doi.org/10.1016/j.neulet.2021.136207</u>

Rehabilitation Engineering is the use of engineering principles applied to rehabilitation, disability, and independent living. Google Scholar is a searchable resource that allows people from around the world to create profiles of their interests and collaborations, and it provides a means to search the broad scientific and technical literature. Google Scholar was used to identify the 150 most cited people who listed Rehabilitation Engineering in their profile. Research impact, characteristics, and areas of research of the most cited rehabilitation engineers were examined. Furthermore, gender and geographical differences in research metrics of the highest citied rehabilitation engineers were investigated. Consumer priorities in rehabilitation engineering were identified using a voice of consumer (VoC) survey and recent literature based on VoC studies. Gaps between research publication and activities and consumer priorities were identified to recommend seven areas of research with high demand and opportunity for growth and innovation.

Implications: Rehabilitation Engineering appears to be a male-dominated profession similar to other engineering disciplines. There are disparities in the number of rehabilitation engineers and measures of scientific productivity between different regions of the world. Despite people identifying as rehabilitation engineers in every region, the most cited were identified as working in the World Health Organization Region of Americas and the European Region. There appears to be benefits for rehabilitation engineers who have multiple collaborations and who work in doctoral degree-granting institutions.

Seven areas of research identified as consumer priorities were not captured by the most cited rehabilitation engineers; these include: 1) Transportation and automobile driving 2) Recreation/Leisure 3) Autonomous vehicles/ wheelchairs 4) Smart home/IoT 5) Computer/mobile applications and telecommunications 6) Patient transfer devices 7) Power sources. These priorities are opportunities for growth and innovation.

Greenhalgh M, Rigot S, Eckstein S, Joseph J, Cooper RM, Cooper RA, A Consumer Assessment from Women Who Use Wheelchairs, Journal of Military, Veteran and Family Health, pp. 40-49, Vol. 7, No. 2, May 2021. <u>https://doi.org/10.3138/jmvfh-2020-0019</u>

Introduction: Women who use wheelchairs express concerns with current devices that are male-centric and do not address their needs. As women attain more representation in both civilian and military sectors, it is imperative their needs are met to the same degree as those of men. The following assessment analyzes qualitative feedback from groups of women who use wheelchairs or scooters. Information collected may inform a roadmap to address assistive technology needs for women. Methods: Twenty-four women, recruited from two sporting events for Veterans with disabilities, were asked to fill out a survey and partake in a focus group designed to elicit participants' opinions on pros, cons, and areas of need with respect to mobility devices and related services. Demographic data and survey outcomes were analyzed quantitatively, while common themes were identified from the literature and participant perspectives. **Results:** Survey results indicate a need to customize wheelchair technology to the needs of female users. Focus group data identified four major themes women commonly experience when using assistive technology and related services — usability, service delivery, well-being, and design. Participants raised concerns with customizability, delivery methodology, and empowerment. **Discussion**: Female wheelchair users described several necessary improvements related to usability, services, quality of life, and innovation that could address gender disparities. Information from this study can be used to influence further research and design.

Koontz AM, Bass SR, Kulich HR, Accessibility facilitators and barriers affecting independent wheelchair transfers in the community, Disability and Rehabilitation: Assistive Technology, pp. 741-748, Vol. 16, No. 7, 2021. <u>https://doi.org/10.1080/17483107.2019.1710771</u>

Purpose: The purpose of this study is to identify facilitators and barriers to wheelchair transfers in the community and to identify specific places and surfaces in the community where increasing transfer accessibility could enable greater participation. **Methods:** This study enrolled 112 wheeled mo-bility device users who completed a survey de-scribing barriers to independent transfers. Descriptive statistics (means, standard deviations, and percentages) were used to report the survey results. **Results:** The majority of subjects (\geq 50% of the sample) who were impacted by the following features found them to be helpful while transferring: presence of transfer aids, presence of grab bars, large enough transfer surface size, storage space for a wheeled mobility device (WMD), large amounts of space and clearance for legs and feet, soft surfaces, and enough space next to the transfer surface. Ninety percent (90.5%) felt their participation was limited when surfaces higher than their WMD were encountered. Participants also reported feeling limited in their participation due to lack of transfer accessibility at a variety of community destinations, including medical facilities (35.1%), modes of transportation (38.5-52.1%), pools and hot tubs (45.4%), dressing rooms (50.0%), amusement parks (49.1%), and boating areas (52.1%). Conclusion: Improving accessibility for independent transfers in the community may support greater participation and lead to a better quality of life. Study findings provide insight into changes that would make the built environment more accessible and safer for wheelchair users who independently transfer.



Recent HERL Patents: "Mobility Enhancement Wheelchair" and "Computer Pointing Device"



Researchers at HERL once again demonstrated the power of HERL's mission as they were awarded two patents this year: U.S. Patent #10,912,688 for a Mobility enhancement Wheelchair, better known as MEBot; and U.S. Patent #11,144,137 for a Computer Pointing Device, which is actually a computer mouse meant to be used by those with prosthetic hands. Both inventions are meant to be used by Veterans for the improvement of their function and mobility.

The Mobility Enhancement Robotic Wheelchair, or MEBot, uses state-of-the-art robotic technology to conquer difficult terrains when driving, including curbs, and maintain a level seat when traveleing over slopes. It does this without increasing the footprint of a standard power wheelchair, so it's still usable inside, and doesn't use much more power than a standard wheelchair does. The subject testing comparing two iterations of MEBot to users' own wheelchairs has just been successfully concluded (see page 6).

The idea for the computer mouse was actually suggested to Dr. Cooper by Disabled American Veterans past national commander Dave Riley, a computer scientist and quadruple amputee who was looking for a mouse compatible with his prosthetic hooks. After some design work and 3-D printing, the initial version was tested at the 2019 National Disabled Veterans Winter Sports Clinic.

The mouse comes in a left-handed and right-handed version and can be used be anyone without any special software. VA hospitals nationwide are currently using the mouse and distributing models to Veterans.

Both MEBot and the computer mouse may be licensed by interested companies. Contact HERL for more information.



Current Research Abstracts

Dicianno BE, Sivakanthan S, Sundaram SA, Satpute S, Kulich H, Powers E, Deepak N, Russell R, Cooper RM, Cooper RA, Systematic Review: Automated Vehicles and Services for People with Disabilities, Neuroscience Letters, 136103, Vol. 761, September 2021. https://doi.org/10.1016/j.neulet.2021.136103

People with disabilities face many travel barriers. Autonomous vehicles and services may be one solution. The purpose of this project was to conduct a systematic review of the grey and scientific literature on autonomous vehicles for people with disabilities. Scientific evidence (n = 35) was limited to four observational studies with a very low level of evidence, qualitative studies, reviews, design and model reports, and policy proposals. Literature on older adults was most prevalent. Grey literature (n = 37) spanned a variety of media and sources and focuses on a variety of disability and impairment types. Results highlight opportunities and barriers to accessible and usable AVs and services, outline research gaps to set a future research agenda, and identify implications for policy and knowledge translation. People with disabilities are a diverse group, and accessible and usable design solutions will therefore need to be tailored to each group's needs, circumstances, and preferences. Future research in diverse disability groups should include more participatory action design and engineering studies and higher quality, prospective experimental studies to evaluate outcomes of accessible and usable AV technology. Studies will need to address not only all vehicle features but also the entire travel journey.

Speakers included: • Joel Scholten, MD

Virtual State of the Science Symposium October 22, 2021 Outcome Measures in Rehabilitation

The State of the Science Symposium entitled "Outcome Measures in Rehabilitation" met online on October 22, 2021 via a Zoom seminar. The symposium was presented by the Center for Rehabilitation Science Research, the Department of Physical Medicine and Rehabilitation at the Uniformed Services University for the Health Sciences; the Department of Rehabilitation, Walter Reed National Military Medical Center; and the Human Engineering Research Laboratories (a VA RR&D Center) Course Directors were Rory A. Cooper, PhD and COL (Ret) Paul F. Pasquina, MD.



- Melissa Stockwell, Paralympian
- Geoffrey S. Balkman, PhD, L/CPO
- Ignacio Gaunaurd, PT, PhD, MSPT
- Stacey Harcum, MPH, MS, OTR/L
- Elsa Ermer, PhD
- LTC Jeanne C. Patzkowski, MD

• Dan Rhon, PT, DPT, DSc, PhD

As well as a panel session.

Videos, presentations, and photos from archived symposia are available on the HERL

website at

https://herl.pitt.edu/education-outreach/ symposia.

To be added to the mailing list, email herl@groups.pitt. edu.

Top Army Generals, VHA Chief of Staff Visit HERL

On Friday, November 12, HERL was honored to host LTG Laura Potter and MG David Hill and their aides and families for a tour of our laboratories.

Lieutenant General Laura A. Potter is a military graduate of Dickinson College, in Carlisle, PA. During her career, she has commanded the 743rd Military Intelligence Battalion, the Allied Command Counterintelligence Supreme Headquarters Allied Powers Europe, served as the Deputy Chief of Staff for Intelligence US Army Europe, and the Intelligence Center of Excellence. She has deployed in support of Operation Iraqi Freedom, and Operation Enduring Freedom. LTG Potter is currently serving as the Deputy Chief of Staff, G-2, for Headquarters Department of the Army. Her husband Randy, is a retired US Army Lieutenant Colonel, and Pennsylvania native.

Major General David Hill was born and raised in Pittsburgh, PA before attending the United States Military Academy and commissioning as an Engineer Officer in 1990. During his career, he has commanded in the 1st Armored Engineer Brigade, the 16th Engineer Battalion, 1st Brigade Combat Team 4th Infantry Division, and the 36th Engineer Brigade. He has deployed in support of Operation Desert Shield/Desert Storm, Operation Joint Endeavor, and Operation Iraqi Freedom. MG Hill has returned to his home state, and is currently serving as the Commandant of the United States Army War College in Carlisle, PA. On Tuesday, November 16, HERL was honored to host the Veterans Health Administration's Chief of Staff Jon Jensen and his staff. After touring HERL, Mr. Jensen recorded an interview with director Dr. Rory Cooper for his video podcast "Chats with the Chief."

Mr. Jon M. Jensen, M.A., serves as the Department of Veterans Affairs, Veterans Health Administration (VHA), Chief of Staff since June 7, 2020. In this role, he serves as a senior advisor to the Under Secretary for Health and the Principal and Deputy Under Secretaries. He is the lead management official for coordinating organizational solutions and operational activities for the VHA, the United States' largest integrated health care system. Previously he served as Deputy Chief of Staff since November 10, 2019.

Mr. Jensen joined the Department of Veterans Affairs in 2014, serving in the VHA Office of Congressional and Legislative Affairs. He performed as the acting Director and then Director until November 2017, when he was selected as the Special Advisor to the Secretary of the Veterans Affairs. In April 2018, Mr. Jensen took on the role as Senior Advisor to the Under Secretary for Health advising the Under Secretary and other VHA Senior Leaders on all congressional and legislative matters affecting VHA.

The Chats with the Chief archives can be found at <u>https://blogs.va.gov/VAntage/tag/chats-with-the-chief/.</u>











Top Left: Veterans Health Administration Chief of Staff Jon Jensen

Top Right: Members of the Clemson University Board of Visitors

Middle Left: LTG Laura Potter, MG David Hill and their families

Middle Right: Trying out the robotic arm

Bottom Left: HERL Director Dr. Rory Cooper with Ron Poropatich, Brad Nindl, and Dan Fisher on the field during the Pitt game vs. North Carolina on Veterans Day. They were recognized for their many years of Military service and for continuing to serve the Greater Pittsburgh community.

MEBot Study Conclusion

The goal of the study was to compare the usability and stability between two MEBot iterations (MEBot-1, MEBot-2) and participant's own electric power wheelchairs (EPWs) when driving on uneven terrains.

Tips and falls are a frequent consequence of wheelchair-related accidents due to limited user's space awareness and loss of stability on uneven terrains. MEBot is an advanced mobile robot developed to increase the stability and safety of wheelchair users when navigating these challenging environments. MEBot consists of six independent height-adjustable wheels with a modular drive-wheel configuration, omni-wheels as caster wheels to eliminate swivel (e.g. caster management), and a footprint comparable to commercially available EPWs. Its wheels' height adjustability provides the ability to maintain its seat orientation leveled when driving on uneven terrains. For this study, two methods of wheel's height adjustment are proposed. MEBot-1 uses electro-hydraulic actuators in series with shock absorbers while MEBot-2 uses pneumatics actuators operated by air. Experienced EPW users were recruited to operate MEBot-1, MEBot-2, and their own EPWs on three driving tasks (10° ramp, 18° curb-ramp, potholes 2" depth) that simulated uneven terrains. Participants received a demonstration and training on the use of both MEBots. Once they got use to the devices, participants completed 5 trials with each EPW and reported their satisfaction and usability towards each EPW at the end of the study. Satisfaction and usability were measured with the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST) and System Usability Scale (SUS). Stability was measured in terms of averaged local maxima seat angle deviation per task provided by an inertial measurement unit (IMU).

Ten EPW users were recruited who reported common challenging terrains faced more than 3 times per week and their decision making in which 7 reported to face curbs (two avoid them), 7 people drive up/down ramps by themselves, 3 drive on cross-slopes by themselves, 5 drive on curb-cut by themselves, and 6 face potholes but half avoid them if possible.

Participants completed all the driving tasks with MEBot-1, one participant did not complete the curb-ramp and potholes with MEBot-2 due to unease and discomfort, and 2 participants did not complete potholes for fear of wheelchair breakdown.

Quantitative results showed significantly less pitch angle variation with both MEBots compared to EPWs. MEBot-1 self-adjusted its seat to a horizontal plane significantly faster than MEBot-1 which demonstrates the efficiency of electro-hydraulic over pneumatic actuators. Additionally, MEBot-2 showed unnecessary seat adjustment in the roll direction compared to MEBot-1 when driving 10° slope in which participants commented as distracting and feel unsafe. Last, MEBot-1 showed significant less pitch/roll angle variation than MEBot-2 and own EPWs when driving on potholes. Two participants did not attempt this task with their own EPWs due to risk of damaging them. Participants rated the highest satisfaction score using MEBot-1, similar to their own EPWs; but significantly greater than MEBot-2, particularly in terms of safety, ease-of-use, and ease-of-seat adjustment. The design improvements in MEBot-1 were shown by participants usability responses of using MEBot-1 frequently on uneven terrains and less inconsistency to adjust to these terrains. - Dr. Jorge Candiotti



Left: (A) MEBot-PAAS on a 18° curb-ramp. (B) Side view of rear caster suspension and (C) wheels' range of motion Above: Terrains for rolling over

STUDY RECRUITMENT

If you're interested in participating in HERL research studies, please be sure to regularly check <u>https://www.herl.pitt.edu/</u> <u>participate</u>!

We're currently recruiting for the following studies:

- Activity Monitoring in Individuals with Spinal Cord Injury
- Development and Evaluation of Powered Personal Transfer System (PPTS)
- Evaluation of a Group 3 PPTS Focus Group

Please also sign up for our Registry if you'd like to be notified about research studies in the future: <u>https://sbs.ucsur.pitt.</u> <u>edu/herl/</u>

Job Openings

For more information about these positions and directions on how to apply, go to <u>https://www.herl.pitt.edu/jobs</u>.

Graduate Student Researchers

HERL is offering a research fellowship for a student enrolled in affiliated PhD graduate programs at the University of Pittsburgh. Graduate Student Researchers (GSRs) are students who are hired by faculty to assist in carrying out a particular research agenda and are provided mentorship and training to develop a new area of research and to become independent research scientists. This GSR position will include several research areas related to wireless technologies:

- Survey development and deployment
- Literature review and manuscript writing
- Health Policy and Service Delivery
- Data collection and Analysis

Associate Director for Clinical and Regulatory Affairs

The role of the Associate Director for Clinical and Regulatory Affairs position at HERL is to oversee the clinical research coordinator team and collaboration in research activities. This position will provide oversight and leadership for research projects and ensure compliance of the laboratories and clinical coordinator team with regulatory affairs and data privacy. This position will oversee the personnel responsible for designing, developing, implementing, and maintaining of databases.

Postdoctoral or Research Staff Member

HERL is seeking a highly motivated, goal-oriented and hard-working candidate to work on a funded research project on biomechanics of walking with a knee exoskeleton in people with knee osteoarthritis. The position will work with an interdisciplinary team of engineers and clinicians at HERL and also at the James J Peters VA Medical Center at Bronx, NY.

Required Qualifications: PhD in biomedical/mechanical engineering or movement sciences; or MS with at least three years of experience in biomechanics after graduate in research or industry. Candidates should have extensive experience in gait lab biomechanics and data collection using instrumentation such as motion capture, force plates, EMG, and metabolic cart, proficiency in computer programming languages (MAT-LAB, Python etc.), excellent written, spoken, and interpersonal communication skills, and strong research publication record. Experience with musculoskeletal modeling systems (e.g., OpenSim) and working with patient populations (e.g., knee osteoarthritis) is preferred but not required.

HAPPENING NOW AT HERL! Upcoming Events

• Find us at Booth 902 at the NMEDA Conference in Columbus, Ohio, January 15-17!



In the Next Issue

• HERL has received a NIDILRR Rehabilitation Engineering Research Center grant: Promoting Mainstream Wireless Inclusion through Technology Services (PROM-ISE). This project will bring together people of all backgrounds and experiences to create and pilot innovative, viable, and scalable technology services to expand access to and support effective use of mainstream wireless technologies among people with varying disabilities. For more information, read the profile from SHRS News at https://www.shrs.pitt.edu/news/promise-made.

Assistant Dierctor for Finance and Research Administration

The incumbent will be responsible for the overall university administration and coordination of the university activities of the HERL under the supervision of the Director and CEO of HERL. This position has direct administrative responsibility and oversight for all university administrative aspects of budgeting (planning, recording, reconciling, projecting), and submission of requests for all personnel actions (recruiting, hiring, reviewing, renewing, terminating) to the Dean's Office. This position involves coordination of all university grant and contract submissions for HERL. The incumbent provides financial and administrative support to the Director/ CEO, Medical Director/COO, Faculty and staff. Incumbent is responsible for coordination of these and other administrative actions (planning, liaison, ordering) of HERL with similar efforts of University offices. The incumbent supervises the Assistant to the Director as well as oversees the workflow of HERL staff. Incumbent provides recommendations for various personnel actions for exempt and non-exempt employees for HERL and must be able to apply policies to dynamic and complex conditions. Problems generally require significant analysis and judgment. Solutions to problems include using University policies, procedures and systems to address unique situations. Incumbent is responsible for preparation of complex reports, analysis and proposals and formulates, monitors and controls all HERL university budgets.



VA Center for Wheelchairs and Assistive Robotics Engineering

University of Pittsburgh School of Health & Rehabilitation Sciences School of Medicine

University of Pittsburgh NIDILRR Model Center on Spinal Cord Injury

National Science Foundation Advanced Technology Education Center

Automated vehicle Services for People with disabilities – Involved Responsive Engineering (ASPIRE) Center

Rory A. 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

> Garrett Grindle, PhD Associate Director for Engineering

Andrea Bagay, BS, CRA Admimistrative Officer and Assistant Director for VA Finance & Research Administration

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> Gina McKernan, PhD Assistant Director for Data Science

Randy Williams, BA, MBA Assistant Director for Education & Outreach

FROM ALL OF US AT HERL TO YOU,



HAPPY HOLIDAYS!

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