



THE HERL QUARTERLY

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**Learn more about
HERL's ASPIRE Center**

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Current Research Abstracts

Sivakanthan S, Castagno J, Candiotti JL, Zhou J, Sundaram A, Atkins EA, Cooper RA, Automated Curb Recognition and Negotiation for Robotic Wheelchairs, *Sensors*, 7810, Vol. 21, No. 23, 2021. <https://doi.org/10.3390/s21237810>

Common electric powered wheelchairs cannot safely negotiate architectural barriers (i.e., curbs) which could injure the user and damage the wheelchair. Robotic wheelchairs have been developed to address this issue; however, proper alignment performed by the user is needed prior to negotiating curbs. Users with physical and/or sensory impairments may find it challenging to negotiate such barriers. Hence, a Curb Recognition and Negotiation (CRN) system was developed to increase user's speed and safety when negotiating a curb. This article describes the CRN system which combines an existing curb negotiation application of a mobility enhancement robot (MEBot) and a plane extraction algorithm called PolyLidar3D to recognize curb characteristics and automatically approach and negotiate curbs. The accuracy and reliability of the CRN system were evaluated to detect an engineered curb with known height and 15 starting positions in controlled conditions. The CRN system successfully recognized curbs at 14 out of 15 starting positions and correctly determined the height and distance for the MEBot to travel towards the curb. While the MEBot curb alignment was $1.5 \pm 4.4^\circ$, the curb ascending was executed safely. The findings provide support for the implementation of a robotic wheelchair to increase speed and reduce human error when negotiating curbs and improve accessibility.

Dicianno BE, Swana HS, Cooper RA, Brei TJ, Innovations in Telemedicine Services in Spina Bifida Clinics in the U.S. During the COVID-19 Pandemic, *Technology and Innovation*, pp. 157-164, Vol. 22, 2021. <https://doi.org/10.21300/22.2.2021.4>

The COVID-19 pandemic has dramatically impacted delivery of outpatient care. Many people with spina bifida (SB) in the U.S. receive outpatient healthcare in a multidisciplinary setting. In accordance with state healthcare mandates, outpatient multidisciplinary clinic visits were deferred, postponed, or canceled, while telemedicine systems were implemented. A survey was created and distributed to all known SB clinics in the U.S. We explored the impact of the COVID-19 pandemic on the delivery of outpatient care for the SB population and the use of telemedicine in response. Novel uses of telehealth, benefits of use, suggestions for overcoming barriers, and future opportunities are identified and discussed.

Duvall J, Grindle GG, Kaplan J, Marks D, Sylvers L, Patel J, Lain M, Bagay A, Chung CS, Cooper RA, VA Technology Transfer Program Responds to Covid-19 Pandemic, *Technology and Innovation*, pp. 173-179, Vol. 22, 2021. <https://doi.org/10.21300/22.2.2021.6>

The COVID-19 pandemic stressed healthcare systems all over the world. Two primary challenges that healthcare systems faced were a shortage of personal protective equipment and the need for new technologies to handle infection prevention for staff and patients. The Department of Veteran's Affairs (VA) Technology Transfer Program responded by prioritizing the development of innovations in the Technology Transfer Assistance Project which addressed the pandemic. This paper describes several innovations that addressed the needs of the VA healthcare system during the pandemic and how they were rapidly developed.

Candiotti JL, Daveler BJ, Sivakanthan S, Grindle GG, Cooper R, Cooper RA, Curb negotiation with dynamic human-robotic wheelchair collaboration, *IEEE Transactions on Human-Machine Systems*, pp. 149-155, Vol. 52, No. 1, February 2021. <https://doi.org/10.1109/THMS.2021.3131672>

Wheelchair users often face architectural barriers such as curbs, limiting their accessibility, mobility, and participation in their communities. The mobility enhancement robotic (MEBot) wheelchair was developed to navigate over such architectural barriers. Its application allows wheelchair users to negotiate curbs automatically while the user remains in control. The application was optimized from a manual to a semi-automated process based on wheelchair users' feedback. The optimized application was evaluated by experienced wheelchair users who navigated over curbs of different heights. Participants evaluated MEBot in terms of effectiveness, workload demand, and usability. Ten participants successfully ascended and descended curbs of different heights at an average completion time of 55.7 ± 19.5 and 30.3 ± 9.1 s, respectively. MEBot maintained stability during the process, while participants reported low levels of effort, frustration, and overall cognitive demand to operate MEBot. Furthermore, participants were satisfied with the ease of learning and using the MEBot curb negotiation application to overcome the curbs but suggested less wheel adjustment for comfort and a faster pace to overcome curbs during real-world conditions.



Attendees of the Eisenhower School of the National Defense University watch a MEBot demo. (See page 7.)

Current Research Abstracts

Candiotti JL, Neti A, Sivakanthan S, Cooper RA, Analysis of whole-body vibration using electric powered wheelchairs on surface transitions, *Vibration*, pp. 98-109, Vol. 5, No. 1, 2022. <https://doi.org/10.3390/vibration5010006>

Wheelchair users are exposed to whole-body vibration (WBV) when driving on sidewalks and in urban environments; however, there is limited literature on WBV exposure to power wheelchair users when driving during daily activities. Further, surface transitions (i.e., curb-ramps) provide wheelchair accessibility from street intersections to sidewalks; but these require a threshold for water drainage. This threshold may induce high WBV (i.e., root-mean-square and vibration-daily-value accelerations) when accessibility guidelines are not met. This study analyzed the WBV effects on power wheelchairs with passive suspension when driving over surfaces with different thresholds. Additionally, this study introduced a novel power wheelchair with active suspension to reduce WBV levels on surface transitions. Three trials were performed with a commercial power wheelchair with passive suspension, a novel power wheelchair with active suspension, and the novel power wheelchair without active suspension driving on surfaces with five different thresholds. Results show no WBV difference among EPWs across all surfaces. However, the vibration-dose-value increased with higher surface thresholds when using the passive suspension while the active suspension remained constant. Overall, the power wheelchair with active suspension offered similar WBV effects as the passive suspension. While significant vibration-dose-value differences were observed between surface thresholds, all EPWs maintained WBV values below the ISO 2631-1 health caution zone.

PAID STUDENT INTERNSHIPS AT HERL

The mission of the Human Engineering Research Laboratories (HERL) at the University of Pittsburgh is to continuously improve the mobility and function of people with disabilities through advanced engineering in clinical research and medical rehabilitation. Part of this mission is accomplished by training the next generation of scientists with our internship programs. Currently, we have four paid programs - for more information, contact Joah Marino (josh.marino@pitt.edu).

- 1) Donation funded Experiential Learning for Veterans in Assistive Technology and Engineering (ELeVATE) program: 4-52 weeks full-time or part-time in-person or hybrid. Undergraduate or graduate any field. MUST be veteran, National Guard, Reserve, or Cadet (ROTC or Academy). Rolling enrollment.
- 2) Craig H. Nielsen Foundation funded internships: 8-26 weeks full or part-time, in-person or hybrid. Undergraduate, graduate or recent graduate with spinal cord injury (including spina bifida). Rolling enrollment, but funding ends October 1, 2022, so act now! We hope to hear from you soon!

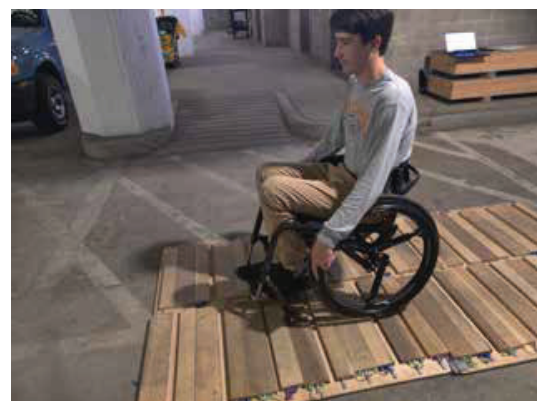
JOB OPENINGS AT HERL

- 1) We are seeking a motivated and talented person to join our team as a **Research Coordinator**. This is a University of Pittsburgh staff position, full-time, on-site at HERL, with benefits.
- 2) We are also looking to add an **Information Dissemination Coordinator** to our HERL team within our Stakeholder Engagement Core. We're looking for a dynamic and creative individual. This is a full-time, on-site position with benefits.

Both of these positions can be applied for via the Pitt Talent Center for Applicants

“In-Wheel Suspension” Study

In this study we wish to evaluate the effects of “in-wheel suspension” on neck or back pain or discomfort from vibrations, shocks, or jolts, users may experience while pushing a wheelchair. We also like to find what effect it may have on overall function and quality of life. We would like your assistance and participation in evaluating and obtaining feedback on a new wheel with built in suspension technology designed to reduce pain and discomfort. Participants will be asked pushing their own manual wheelchairs with multiple wheel types over a mobility course. This study is conducted here at HERL in Bakery Square. If you are interested and wish to learn more about the study, please contact our study team at (412)-407-2047 and ask for the “In-Wheel Suspension” study. THANK YOU!



Be sure to visit our Research Studies page at <https://www.herl.pitt.edu/participate> for more opportunities to help out!

Virtual State of the Science Symposium “Accessible Autonomous Vehicle Design and Considerations” Wednesday, March 9th, 2022

The State of the Science Symposium met on-line via Zoom. 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; 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.



Mathias Koch, Paravan: “European Experiences with Accessible Autonomous Vehicles” **Jon Antin**, Virginia Tech: “Senior Mobility, Awareness, Safety, and Health” **John Teague & Jon Duvall**: “Personal Experiences with Accessible Transportation” **Rosemarie Cooper**, HERL: “ASPIRE Center Journey Mapping” **Rory Cooper**, HERL: “Accessible AVs and Transportation Systems - The Need for Greater Inclusion of People with Disabilities”

Speakers included:

William Chernicoff, Toyota: “Advancements in Accessible Autonomous Vehicles”

Tammy Phipps, Driver Rehab Center: “Adaptive Driving Instruction and the Impact of Changes”

Panel Session - Moderated by Dr. Paul Pasquina, M.D. 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.

Learn More About HERL's ASPIRE Center

Transportation is essential for people with disabilities and older adults to participate in society. It impacts access to healthcare, essential goods and services, interactions with friends and family, and ability to work or attend school, as well as a host of other activities. Nearly all aspects of life for people with disabilities and older adults are affected by access to safe, reliable, timely, and accessible transportation. There are many aspects of accessible transportation with room for improvement. Driving is regarded as an important aspect of personal freedom and autonomy; however, access is very restricted for non-drivers, especially if they live outside the largest metropolitan areas with limited access to public transportation.

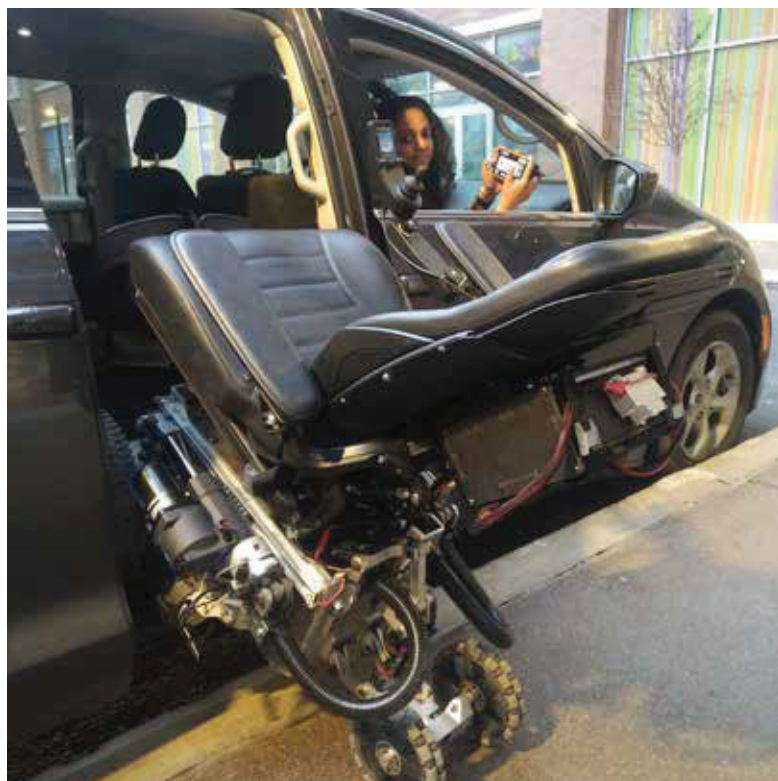
With approximately one billion people in the world having some form of disability and an estimated 25.5 million Americans experiencing a travel-limiting disability, there is an increasing need for accessibility and enabling transportation. Mitigating transportation related barriers for people with disabilities would enable new employment opportunities for approximately 2 million people with disabilities and save \$19 billion annually in healthcare expenditures from missed medical appointments alone. This is in the context of the anticipated broader impacts of autonomous vehicles: \$1.3 trillion in savings from productivity gains, fuel costs, accident prevention, among other sources.

The transportation industry is in the middle of one its largest transformations, with unprecedented investment and advancements in electric and autonomous vehicle (AV),

and autonomous transportation system (ATS) technologies. These efforts have produced significant advances, but the technological, psychological, and regulatory constraints remain.

The Society of Automotive Engineers (SAE) provides a common taxonomy and definitions for automated driving to simplify communication and facilitate collaboration within technical and policy domains. SAE defines more than a dozen key terms and provides full descriptions and examples for each level of autonomy. Unfortunately, it neglects to address usability and accessibility for people with disabilities. The National Council on Disability in its report entitled “Self-Driving Cars: Mapping Access to a Technology Revolution” explored the “emerging revolution in automobile technology and the promise it holds to for people with disabilities, as well as the obstacles the disability community faces to realize that promise.” The report makes several key recommendations: research and development of AVs and their components should include a requirement that demonstrates that any resulting products incorporate accessibility of people with diverse disabilities, and these technologies should be required to comply with Section 508 of the Rehabilitation Act; guidelines are needed for how people with disabilities can safely interact with and use AVs; and all types of common and public use AVs must be fully accessible.

A survey conducted by our UTC confirmed that advancements in technologies related to transportation are very



Take the ASPIRE Center Accessible Autonomous Vehicle and Transportation Systems Survey!

Scan the QR code below
or go to

<https://herl.pitt.edu/avsurvey>



important to individuals with disabilities and represent a significant unmet need. Over 60% of the more than 1000 respondents rated the importance of technology in meeting their personal mobility needs (e.g., home, work, neighborhood) as “critical,” and over 40% felt that traveling freely (e.g., vacation, cruise, airline, bus, taxi, train) was also “critical.” Of those participants who provided comments, approximately 12% mentioned transportation, with “self-driving” vehicles representing about 50% of the transportation comments.

A systematic review of the public focused and scientific literature conducted by our UTC on AV and ATS for people with disabilities showed research was limited to four observational studies with a very low level of evidence, qualitative studies, reviews, design and model reports, and policy proposals. Studies focused on older adults were most common. Public focused literature spanned a variety of media and sources and focused on a variety of disability and impairment types. Results highlight opportunities and barriers to accessible and usable AV and ATS, outline gaps to set a future research and development agenda and identify implications for policy and knowledge translation. People with disabilities are a diverse group and accessible and usable design solutions for AV and ATS 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 and ATS. Studies will need to address not only all vehicle features but

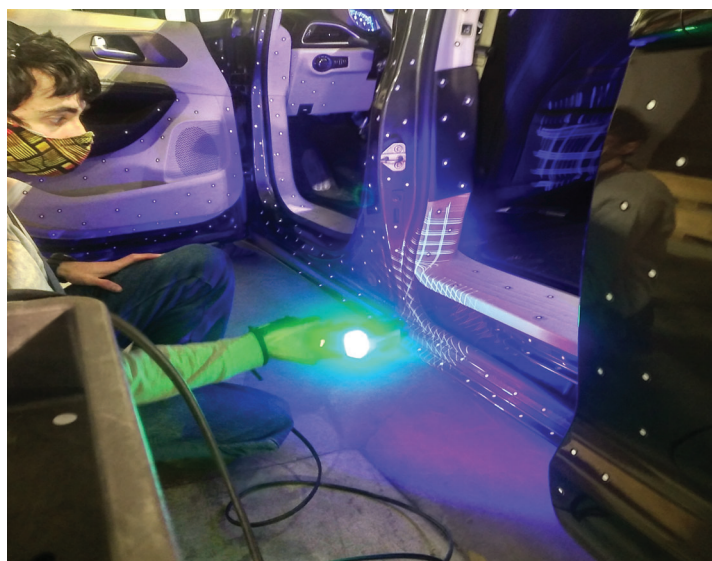
also the entire travel journey.

We would like to thank the more than 20 interviewees with whom we spoke about how they plan and complete journeys using current modes of transportation. These inter-viewees revealed some of the challenges they faced and provided insight into requirements to make AV and ATS accessible. For people who do not drive, people reported rely-ing on drivers for a variety of assistance to include securing their wheelchair and engaging occupant restraints, assisting with loading bags/packages, identifying accessible entrances, helping to transfer into the vehicle seat, loading their mobility technology, providing orientation to surroundings, and much more. People identified challenges that included the wide time frame provided for pick-up and drop-off that often-required people to leave events very early or to arrive late, and potentially involved extended ride times based on scheduling of pick-ups and drop-offs, for example a trip taking over two hours that should require less than 15 min-utes. People revealed some incidences that placed them at risk, such a being dropped off on a traffic island by a bus, that stranded the powered wheelchair user until the next bus came along to transport to the person a few yards to be able to continue to their intended destination. AV and ATS technologies have the potential to greatly improve access for people with disabilities, and **you can help make this happen by completing our survey.** We need to hear from 2000-3000 people as quickly as possible, so please do not keep this information to yourself! It’s very important that we hear from you, so please take our survey today.

-Rory Cooper



Clockwise from top left: The Rotary Club awarding HERL additional funding for the ELeVATE program on February 25th. Pictured are Chuck Desabato, Rory Cooper, Mark Brilmyer, and Stu Benson; Dr. Cooper with leadership of the Eisenhower School for National Security and Resource Strategy of the National Defense University in Fort McNair, February 17; Beth Carmona, 2021 HERL Staff Member of the Year, and Rosi Cooper, awarded 2021 Paralyzed Veterans of America Clinical Excellence Award in Therapy, January 31; HERL researcher Joshua Kanode scans inside a minivan using improved laser technologies, part of HERL's Department of Transportation grant; Rory Cooper chats with VHA Chief of Staff Jon Jensen on YouTube (see p. 7); Demo of MeBOT functions and capabilities; Farewell ceremony for Randy Williams and Michael Lain, February 25.



Cooper Chats with VHA Chief

In the latest installment of his video podcast “Chats with the Chief,” Veterans Health Administration Chief of Staff Jon Jensen sat down with Dr. Rory Cooper to discuss ways of making the world more accessible for Veterans with disabilities.

<https://blogs.va.gov/VAntage/99444/chats-with-the-chief-making-the-world-more-accessible-for-disabled-veterans/>
YouTube: <https://www.youtube.com/watch?v=adRkaW2Xp0M&t=1396s>

See the archive of all “Chats with the Chief” here: <https://blogs.va.gov/VAntage/tag/chats-with-the-chief/>

HERL News

Welcome to Barb Klipa, who is our new Assistant Director for Finance and Research Administration, to new postdoctoral researcher Dr. Chang Dae Lee, and to visiting professor Dr. Celia Lopes. Welcome to HERL!

HERL welcomes back Dr. Brandon Daveler, who graduated from the University of Pittsburgh and HERL with his Doctorate in Rehabilitation Science in 2020. Dr. Daveler is now working with several other HERL researchers on the U.S. Department of Transportation Grant.

Dr. Rory Cooper has been appointed by the American Association for the Advancement of Science Board of Directors to serve on the AAAS Committee on Opportunities in Science.

<https://www.aaas.org/programs/education-and-human-resources/committee-opportunities-science-coos>

HERL researcher Dr. Jonathan Duvall appeared on NPR’s “Here and Now,” discussing the importance of accessible sidewalks.

<https://www.wbur.org/hereandnow/2021/12/20/sidewalk-accessibility-mobility>

HERL researcher Sivashankar Sivakanthan won the University of Pittsburgh Department of Rehabilitation Science and Technology’s Thomas J. O’Connor Award.

HERL Graduate Student Researcher Hailee Kulich was awarded the United States Department of Transportation: University Transportation Centers Outstanding Student of the Year Award.

Pitt’s Health Sciences Diversity, Equity and Inclusion Newsletter published an article about HERL graduate Dr. Anand Mhatre: <https://files.constantcontact.com/afe23d5f001/8ac8a8b2-7dc9-44a0-beaa-d1338774a68f.pdf>

HERL Director Dr. Rory Cooper gave a lecture on Dec. 3 entitled “Assistive Technologies in Rehabilitation for Healthy Aging” for the International Society of Physical and Rehabilitation Medicine

Cooper Receives IEEE Award

Congratulations to HERL Director Dr. Rory A. Cooper for receiving the 2022 Institute of Electrical and Electronics Engineers (IEEE) Biomedical Engineering Award “for extensive contributions to wheelchair technology that have expanded mobility and reduced secondary injuries for millions of people with disabilities.”

<https://corporate-awards.ieee.org/recipients/current-recipients/#technical-field-awards>



Your Voice Matters!

Help HERL and the ASPIRE Center create the next generation of autonomous vehicles!

Take the survey at <https://www.herl.pitt.edu/avsurvey!>

Watch the YouTube video at

<https://www.youtube.com/watch?v=HQ2rqVolong!>

YOU can make a difference!





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
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Automated vehicle Services for
People with disabilities – Involved
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Gina McKernan, PhD
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THANK YOU!!!

We would like to send a special thank you to all of our wonderful donors who helped to make the 2022 Pitt Day of Giving and the ELeVATE Campaign such a huge success. If you are interested in learning more about the ELeVATE Program, or are interested in learning more about the current research studies and other programs we have going on here at HERL please see the information below.



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