The Future of Global-Scale Spatial Data Collection and Analyses on Urban (in)Accessibility for People with Disabilities

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The United Nations' *New Urban Agenda* positions equity and inclusion as core principles of modern urban development, emphasizing that for the 15% of the world's population with a disability, there is "*widespread lack of accessibility in built environments, from roads and housing, to public building and spaces*."[1] Inaccessible urban infrastructure not only contributes to and further reinforces systemic exclusion of people with disabilities but also impacts public health, physical activity, and quality of life for all[2,3]. And yet, most work in spatial analyses and mobility has focused on roadways and vehicles rather than pedestrian infrastructure and accessibility.[4] To reposition urban accessibility as a first-class concern and to enable accessibility-aware models and maps, we need new data collection techniques, data standards, and visual analytic tools focused on the quality and accessibility of pathways, transit ecosystems, and buildings.

In this SDSS session, we bring together experts in disability, human mobility, urban planning, and computer science to discuss state-of-the-art methods for measuring the quality, condition, and accessibility of urban infrastructure, how these methods may enable new types of geospatial analysis and visualization, and the possibilities for data-driven policy change and accessible urban development. Our overarching goal is to identify open challenges, share current work across disciplines, and spur new collaborations. We propose a 90-minute session beginning with a series of "lightning" talks overviewing work from selected speakers with brief Q/A followed by breakout discussions and mapathon activities.

To help frame and inspire discussions, we highlight an initial series of large, open topics:

- **What does "equitable access" mean?** Many accessibility-oriented transitions plans mention 'equity' in the context of access, but "equitable access" remains ill-defined. We need to improve our definition of and measures for equity as it relates to subpopulations and the built environment.
- **Data origins.** Assessing the accessibility of various urban environments requires high-quality data on pedestrian pathways (*e.g.,* where sidewalks exist and their topology and condition), public transportation, and destinations (places-of-interest or POIs). Where does the data come from? How is it collected? What is its composition (*e.g.,* image, LiDAR, on-the-ground sensor-infused wheelchair measurements like IMUs, professional surveying output)? Who (or what) collects the data? How often is it refreshed?
- **Data analysis.** How can we leverage advances in machine learning and computer vision to aid data analytics? As no automatic inference model is likely to be perfect, how can AI + humans work together to scale data collection, transform cost structures, and enable new types of analyses? How can diverse datasets be integrated to evaluate city-scale accessibility, enabling comparison between cities over time?
- **Data management.** How is both the raw and analyzed data stored, validated, and maintained? Who has access? What open standards are required to help drive mobility innovations, mapping tools, and data reuse?

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[1] United Nations. 2020. The New Urban Agenda, Lead authors: Rana Amirtahmasebi, Zuzana Vuova, Emily Fox.
[2] Addy, C. L., Wilson, D. K., Kirtland, K. A., Ainsworth, B. E., Sharpe, P., & Kimsey, D. (2004). Associations of perceived social and physical environmental supports with physical activity and walking behavior. *American journal of public health*, *94*(3), 440-443.
[3] Christensen, K., Holt, J., Wilson, J. Effects of perceived neighborhood characteristics and use of community facilities on physical activity of adults with and without disabilities. Preventing Chronic Disease. 2010;7(5). https://stacks.cdc.gov/view/cdc/20495
[4] Froehlich, J., Brock, A., Caspi, A., Guerreiro, J., Hara, K., Kirkham, R., Schöning, J., and Tannert, B. 2019. Grand challenges in accessible maps. *Interactions* 26, 2 (March - April 2019), 78–81. DOI:https://doi.org/10.1145/3301657

There is substantial variation in the quality and type of data collected across municipalities, a lack of metadata standards, and substantial inconsistencies in data standards, which creates significant barriers to data integration and comparative studies. For emerging work, see OpenSidewalks, the w3c group on specifying open standards for physical accessibility data, and the Mobility Data Interoperability Principles.

- **Modeling.** How can we create personalizable, interactive models of human mobility and accessibility, and access to opportunities for people with disabilities? How is mobility impacted by environmental features and transit services?
- **Policy.** How can we create effectively synthesized reports and visualizations to help support new policy and urban planning? How can various stakeholders use new data to advocate for needed changes? How might AI+crowdsourcing be used to improve the obligations for planning accessible environments that are required under the ADA and other international disability rights laws?
- **Tools.** What new tools and analyses are enabled by emerging data collection and inference techniques? In prior work[5,6], we have identified five key stakeholder groups with unique opportunities for tool development, from personalized routing algorithms to decision-support tools.

Speakers

- **Jon E. Froehlich** is a professor in the Allen School of Computer Science at UW, director of the Makeability Lab, and founder of projectsidewalk.org. His group's research explores new crowdsourcing + AI data collection and visual analytics tools for pedestrian infrastructure mapping and assessment.
- **Victor Pineda** directs UC Berkeley's Inclusive Cities Lab, is founder and president of World Enabled, and is an internationally recognized disability rights advocate and scholar. He also runs Cities4all.org, an initiative aimed at incentivizing and transforming 100 cities to be more inclusive and resilient by 2050.
- **Anat Caspi** directs the Taskar Center for Accessible Technology at UW, is the founder of OpenSidewalks.com and AccessMap.io, and co-author of Mobility Data Interoperability Principles.
- **Holger Dieterich and Sebastian Felix Zappe** are from Sozialhelden e.V., a German non-profit that runs Wheelmap.org. They are also co-founders of Accessibility.Cloud, a data exchange for accessibility data, and the w3c group on specifying an open standard for physical accessibility data.
- **Maryam Hosseini** is a Ph.D. candidate at Rutgers University and NYU studying semi-automatic methods for the large-scale assessment of pedestrian infrastructures.
- **Yochai Eisenberg** is a professor in Disability and Human Development at the U. of Illinois, Chicago. He studies how built environments, local policies, and systems impact health behaviors and outcomes for people with disabilities using data analytics, policy evaluation, and community-engaged research.
- **Andres Sevtsuk** is an Associate Professor of Urban Science and Planning at MIT, where he also leads the City Form Lab. He is the author of *Street Commerce: Creating Vibrant Urban Sidewalks* and the Urban Network Analysis toolbox, a standard in modeling pedestrian flows along city streets.
- **Roberto M. Cesar Jr.** is a Computer Science professor at the University of São Paulo, Brazil. His research interests include applications of computer vision and machine learning for urban informatics.
- **Eric K. Tokuda** is a postdoctoral researcher at the University of São Paulo, Brazil interested in the analysis of city images and complex networks to solve urban problems.

Expected Participation

We will advertise this panel broadly amongst our various disciplines: we expect participation from research communities interested in urban infrastructure, disability, equity, and human mobility.

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[5] Saha, M., Chauhan, D., Patil, S., Kangas, R., Heer, J., Froehlich. J., 2021. Urban Accessibility as a Socio-Political Problem: A Multi-Stakeholder Analysis. ACM Human Computer Interaction 4, CSCW3, Article 209, 26 pages. DOI: https://doi.org/10.1145/3432908

[6] Hara, K., Chan, C., and Froehlich, J. 2016. The Design of Assistive Location-based Technologies for People with Ambulatory Disabilities: A Formative Study. Proceedings of CHI'16, ACM., New York, NY, USA, 1757–1768. DOI: https://doi.org/10.1145/2858036.2858315