NITC Research Roadmap: A decade of multimodal data and modeling research

Multimodal transportation systems are the backbone of U.S. economic activity. An in-depth understanding of multimodal travel, through data collection and modeling strategies, is crucial to inform transportation policy.

In a series of NITC Research Roadmaps, we surveyed the state-of-knowledge and where we're headed across six areas of transportation. Here we share the contributions of a decade of multimodal data and modeling research from the ***National Institute for Transportation and Communities (NITC).*** *Download the full literature review from this roadmap here: https://nitc.trec.pdx.edu/nitc-research-areas*

Nonmotorized Count Data

Counts of people walking and bicycling are important for monitoring trends, planning new infrastructure, and analyzing safety. NITC research has advanced the state of the practice by improving data quality and standardization, as well as by integrating new technologies. One study fused traditional count data with emerging data sources from GPS and mobile devices to estimate network-wide bicycle volumes, and another study is looking into a similar method for crowdsourcing pedestrian data. NITC researchers have explored methods to assess passively collected and crowdsourced data for accuracy, representation, completeness, and bias. Improved sensor technology has a role to play as well: one recent NITC study developed a new intelligent multimodal traffic monitoring device using low-cost mmWave radar.

Transit Data

To assess public transportation in a holistic way – in terms of rider experience, travel time reliability, accessibility, safety, efficiency, and environmental and economic impacts – practitioners need a phenomenal amount of data from a variety of sources. NITC researchers have made great strides in making it easier to gather and use transit-related data.

One NITC study used high-resolution bus data to create more precise and statistically valid trip time models. Another compared bus stop-level data with demand-responsive parking data to show the effect nearby parking prices had on bus ridership. A third study used built environment factors – density, diversity, and walkability – to classify neighborhoods and found that transit-oriented development residents walk more, take transit more, and spend less on transportation than their counterparts in other types of neighborhoods.

Survey Data

Travel surveys provide information about travel patterns that is necessary for planning and policymaking. However, current survey methods do not adequately capture active transportation trips, and may not accurately represent marginalized populations. NITC researchers have significantly refined travel survey methods, improving accuracy and making the data more context-sensitive. One NITC study recommended the creation of pooled samples with comparable and consistent data from cities, which could be beneficial for understanding relationships between travel behavior and the built environment. Other NITC studies have looked at making data collection methods more inclusive of marginalized populations through strategies like increased transparency, protection of privacy, and more robust community engagement.

Applications of Multimodal Data: Equity

Despite recent improvements in household transportation survey methodologies, people of color and immigrant groups remain under sampled and understudied. A NITC study linked census population and housing data to a stratified

random sample of households from the Oregon Household Activity Survey and found that the survey consistently overrepresented white households and underrepresented nonwhite households across the greater Portland area. The study developed a set of recommendations to improve the representation of diverse populations in travel surveys.

Adoption of cashless fare systems has created barriers for lower-income transit riders. One NITC study explored the costs for agencies to maintain some cash options and found that simple approaches, such as cash collection onboard buses, can be quite cost effective at ensuring transit remains accessible and easy for all riders.

Transit agencies currently lack guidelines for assessing the social equity impacts of replacing flat fare with distance-based fare structures. Another study found that shifting to a distance-based fare system may benefit low-income, elderly, and non-white populations; however, the effect is geographically uneven, and may be negative for members of these groups living on the urban fringe.

Applications of Multimodal Data: Economics

A national NITC study explored how investments in bicycle and pedestrian-focused street improvements can impact the economic vitality, business activities and neighborhood equity in surrounding areas across six cities. It found that, generally, street improvements yielded positive or non-significant impacts on business performance.

Proximity to fixed guideway transit stations led to higher rents for commercial spaces and higher regional share of jobs closer to the transit station. One NITC study estimated development outcomes in response to transit and found market rent increases with respect to Fixed Guideway Transit (FGT) station proximity for all commercial types, but not for bus rapid transit (BRT). However, BRT systems are associated with positive development and job location outcomes.

An earlier study revealed that BRT corridors gained new offices and multifamily apartments, and BRT station areas gained jobs in the manufacturing sector at a faster pace than the rest of the county.

Applications of Multimodal Data: Safety

Signal timing treatments can improve bicycle safety. A NITC study analyzed the operational impacts of various signal timing treatments on right-hook bicycle-vehicle conflicts. The research found that while a split leading bike interval treatment was useful in mitigating conflicts during the lead interval, the risk for bicyclists was then shifted to the stale green portion of the phase. The study also revealed that significant confusion was exhibited by both cyclists and drivers in a mixing zone, where bike and car traffic merged.

The 2010 Highway Safety Manual provides methods for predicting the number of motor vehicle crashes on various facilities, but it includes a simplistic method for predicting the number of bicycle-related crashes. A NITC study developed the first bicycle-specific safety performance functions for segments in the U.S. and found that motor vehicle volume is a leading factor associated with more crashes between drivers and bicyclists. Bicyclist exposure, population density, and percent retail land use are also predictive.

Conclusion

Researchers and practitioners share common concerns about current data collection and processing strategies, especially a lack of standardization and validation. These limitations likely result in incomplete, inefficient, or even biased modeling strategies across all travel modes. Considering rapid changes in emerging data sources and technologies, as well as new travel modes, there is a clear need for greater scientific guidance and innovation on data collection, analysis, and modeling strategies.

THE AUTHORS

Sirisha Kothuri, Portland State University
Kate Hyun, University of Texas at Arlington
Thomas Gotschi, University of Oregon
Cathy Liu, University of Utah
Liming Wang, Portland State University
Abolfazl Karimpour, University of Arizona
Abbas Rashidi, University of Utah

Photo by Lacey Friedly

The National Institute for Transportation and Communities (NITC) is one of seven U.S. Department of Transportation national university transportation centers. NITC is a program of the Transportation Research and Education Center (TREC) at Portland State University. This PSU-led research partnership also includes the Oregon Institute of Technology, University of Arizona, University of Oregon, University of Texas at Arlington and University of Utah. We pursue our theme — improving mobility of people and goods to build strong communities — through research, education and technology transfer. Learn more at https://nitc.trec.pdx.edu/