

# CTS Catalyst

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Accelerating the pace of transportation innovation

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## New light-rail transit leads to sizable increase in nearby housing values

Light-rail transit (LRT) is commonly thought to stimulate economic development and boost property values. However, knowledge gaps have made it difficult to gauge exactly how much property values increase and when the increase happens.

In a new study, U of M researchers Jason Cao and Shengnan Lou help fill those gaps. Using tax parcel data and modeling techniques, they assessed the impacts of the Green Line LRT on

*Light rail continued on page 7*

## Moving from mobility to accessibility

For several generations, transportation policymakers and practitioners have favored a “mobility” approach, aimed at moving people and vehicles as fast as possible by reducing congestion. However, the limits of this approach have become more apparent over time, as residents struggle to reach workplaces, schools, hospitals, shopping, and numerous other destinations in an equitable and sustainable manner.

Researchers have been able to define this challenge more precisely and elevate the importance of “accessibility” over the past few decades, but the adoption of new policies, tools, and investments by practitioners remains slow and uneven across most regions. During CTS’s 2017 Spring Luncheon

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# What's really behind rear-end highway crashes?



Rear-end crashes are a major cause of highway traffic slowdowns, and preventing these congestion-causing incidents requires a clear understanding of why they occur in the first place. On the surface, it might seem like the driver who rear-ends another vehicle is the primary cause of the collision; however, the reality is much more complex.

In a new study, U of M researchers found that because shockwaves—areas of suddenly stopping or slowing traffic—are usually the cause of rear-end collisions on highways, drivers at the front of a group of cars may have as much or more to do with the rear-end collisions happening at the back of the group than those involved in the crashes themselves.

“The main goal of this research was to better understand how drivers behave when confronted with a stopping shockwave and why some shockwaves produce rear-end crashes but others don’t,” says Gary Davis, a professor in the U of M’s Department of Civil, Environmental, and Geo-Engineering. “The basic idea is that when a driver’s braking reaction time is longer than his or her following time, this increases the likelihood of a crash later in the shockwave.”

This project, conducted by Davis’s advisee Indrajit Chatterjee as part of his Ph.D. dissertation, combined that idea with applied probability theory to quantify the likelihood of a crash occurring under specific traffic conditions in a section of freeway. As part of his work, Chatterjee analyzed video recordings of 41 stopping shockwaves collected by the U’s Minnesota Traffic Observatory on I-94 westbound near downtown Minneapolis.

“This section of I-94 sees numerous rear-end crashes each year because drivers often fail to slow sufficiently when confronted with shockwaves that begin downstream at a high-volume entrance ramp,” Davis says. “We know that by reducing the frequency of rear-end crashes, we could significantly improve freeway capacity, particularly during peak hours.”

For each shockwave, Chatterjee examined key features of the drivers involved, including initial speeds, following headway (the time gap between the rear of the lead vehicle and the front of the following vehicle when the lead vehicle begins braking), average decelerations, and reaction times (the difference between the brake initiation time of the follower and the leader).

Using this data, Chatterjee successfully predicted which shockwaves would result in rear-end crashes. Next, he conducted a detailed analysis of two rear-end crashes to further illustrate how drivers with reaction times that are longer than their following headways play a key role in determining the crash outcome of a shockwave.

“These drivers could be considered unsafe, since they reduce the available stopping distance for succeeding drivers, making crashes more likely,” says Davis. “Results show that a significant portion of the drivers interacting in shockwaves do maintain shorter headways than their reaction times, meaning interventions that can successfully modify the reaction time–headway relationship should be able to reduce the frequency of rear-end crashes on freeways.”

Chatterjee and Davis believe this knowledge could be particularly useful in the design of smart vehicles. For example, future systems such as advanced cruise control features or automated vehicles should be designed so that a vehicle can maintain a following headway that is longer than its braking response time, reducing the likelihood of rear-end crashes.

# New associate dean shares ideas on engagement, sustainability



CTS Scholar Carissa Slotterback has been appointed associate dean of the Humphrey School of Public Affairs effective June 12. She succeeds Laura Bloomberg, who held the associate dean position for four years and will transition to the role of dean this month.

Slotterback, an associate professor, has been a member of the Humphrey School faculty for 13 years and previously served as director of research engagement in the Office of the Vice President for Research. Her academic work focuses on stakeholder involvement and decision making related to environmental, land-use, and transportation planning. She shares thoughts about engagement and sustainability below.

## What drives your interest in public engagement?

I have been so inspired to see a growing emphasis on public engagement in transportation decision making. MnDOT, the Metropolitan Council, and Hennepin County are among a range of organizations taking innovative approaches to promoting engagement in transportation planning and project decision making.

Public engagement is essential to ensure that we are understanding and integrating the public interest when we make decisions about transportation.

Transportation exists in communities, and it is created for and experienced by people. Meaningfully engaging the insights of these people and their knowledge about community context is essential in ensuring that transportation decisions serve our current and future populations.

Meaningful public engagement also means targeting and creatively engaging those who are marginalized and underrepresented in the typical participation processes that have been used for many years. Using approaches that meet people where they are, building partnerships with organizations serving underrepresented communities, and continuing to diversify the transportation, planning, and policy workforce are essential to continued progress.

## What are the benefits of bringing planning and policy experts together with other disciplines involved in transportation research?

As we increasingly understand that technical solutions are only part of what is needed to address the biggest issues facing our society, there is growing recognition of the significance of planning and policy expertise. This expertise helps us understand how people think about issues, how they make decisions, and the role of institutions. Planning and policy disciplines also offer key analytical expertise that helps us to understand the systemic and interconnected nature of

the issues that we deal with, along with key insights on process that can help us think through the range of relevant stakeholders and the most productive ways to engage them.

In transportation specifically, I have seen really productive collaborations among experts across planning, policy, engineering, design, and other disciplines that have allowed us to better understand not only the nature of transportation challenges, but also the actions that might be taken to address them.

## How do you envision transportation becoming more sustainable while meeting mobility needs?

The essential interaction between transportation and land use helps us to understand more deeply the ways that transportation shapes things like economic development, housing prices, health, accessibility, safety, and environmental impacts. For me, sustainability provides a framework for thinking about the means to get to an outcome, rather than an outcome itself. Thinking about sustainability today increasingly asks us to think about long-term impacts such as climate change—as well as the human impacts such as job access and active transportation—along with critical questions about the equity impacts of our transportation investments and the ways we engage underrepresented voices in transportation decision making.



## Bike safety, accessibility highlighted on CTS blog



In conjunction with National Bike Month, Accessibility Observatory lead researcher Brendan Murphy highlighted some of his bicycle-related research in two guest posts on the CTS blog in May.

In one post, Murphy explored the topic of “safety in numbers” for bicycles and outlined a Roadway Safety Institute project that investigated the presence of this phenomenon in Minneapolis. Safety in numbers refers to an individual pedestrian or bicyclist having a lower risk of being hit by a car in areas where more people are walking and biking. In the Institute study, Murphy and other U of M researchers attempted to predict crash rates between cars and bicycles at

street intersections in Minneapolis based on traffic levels. The team then assessed whether there are areas of the city with much higher per-bicyclist crash rates.

Murphy also gave an update on the Accessibility Observatory’s work measuring access to jobs by bicycle. He explained that evaluating real-world bicycle accessibility is more challenging than measuring access by auto or transit since route planning by bicycle is more sensitive to factors such as road type, speed limit, and the presence (or lack) of dedicated infrastructure.

To account for this sensitivity—and more accurately identify the roads that cyclists will actually use—the

Observatory is working to adapt a new framework to its research. The framework assigns a “stress level” ranking to individual roads based on data such as street width, number of lanes, speed limit, the presence of bike facilities, and other factors. The result, according to Murphy, will be not only more accurate metrics of access to destinations by bicycle but also a better way to evaluate how small changes in the bike network affect accessibility.

Read Murphy’s posts and subscribe to our blog at [blog.cts.umn.edu](http://blog.cts.umn.edu).

## Infrared sensing not yet suitable for HOV/HOT lane enforcement

Could the same infrared technology that’s used by security firms to detect trespassers be used to spot carpool lane violators? Not yet, says new research sponsored by MnDOT, which shows that to consistently detect passengers through windshield glass, the system would require a laser that might harm people’s eyes.

“Some vendors have proposed significant investments in sensing technology for HOV/HOT lane enforcement,” says Nikos

Papanikolopoulos, a professor in the Department of Computer Science and Engineering. “This research demonstrated that it’s not safe, so the tests saved a lot of money and protected the well-being of drivers.”

Obtaining technology to assist officers with enforcement is a goal for MnDOT and many other agencies that operate high-occupancy vehicle or toll lanes, and several manufacturers are working to develop enforcement cameras. But this has proven to be a

difficult task. Window tinting and glare from sunlight can thwart common sensing technologies like video cameras and microwave radar (commonly used in speed limit enforcement). Previous research using near-infrared sensors has shown promise, but none has produced completely successful results. This study tested a Honeywell sensor that was originally used to automatically detect intrusions at high-security entrance gates.

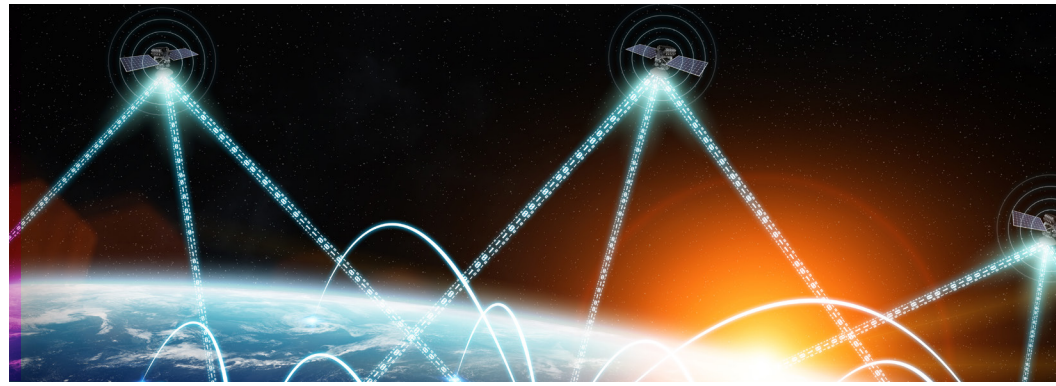
Indoor tests demonstrated that when

# U of M researchers design 'out-of-this-world' navigation technologies

U of M transportation researchers often look at navigation for vehicles, providing real-world value. Another recent project is more out of this world: it looks at using gamma rays for spacecraft navigation. Just as drivers must know the position of their vehicles to get them to the right place at the right time, space programs need to know the position of their spacecraft. However, the current resources available for spacecraft navigation in deep space are both limited and limiting.

"Current position, navigation, and timing methods for spacecraft in deep space are heavily reliant on Earth-based tracking resources, in particular NASA's Deep Space Network," says Demoz Gebre-Egziabher, an associate professor in the Department of Aerospace Engineering and Mechanics. "Unfortunately, the accuracy of these measurements decreases as distance from Earth increases. In addition, as more missions become dependent on these resources, the availability of the network decreases—this could mean satellites with a lower priority on the network would potentially see multiple days without position updates."

To address these limitations, U of M researchers have developed a compact, low-cost gamma-ray detector that could be used for cooperative navigation and time synchronization among a fleet of



*The gamma-ray detector could help synchronize a fleet of vehicles in deep space.*

spacecraft operating in deep space. The gamma ray bursts that the sensor detects and uses for navigation are extremely intense, high-energy celestial events that occur at least once a day and are thought to be caused by the collapse of massive stars in distant galaxies.

"The sensor we developed has the potential to enable gamma-ray-based navigation, which would allow spacecraft to autonomously determine their relative positions independent of Earth-based tracking," says Gebre-Egziabher. "The sensor is both lightweight and inexpensive, meaning it could be used as a navigation instrument aboard micro-satellites and other vehicles with severe size, weight, power, and cost constraints."

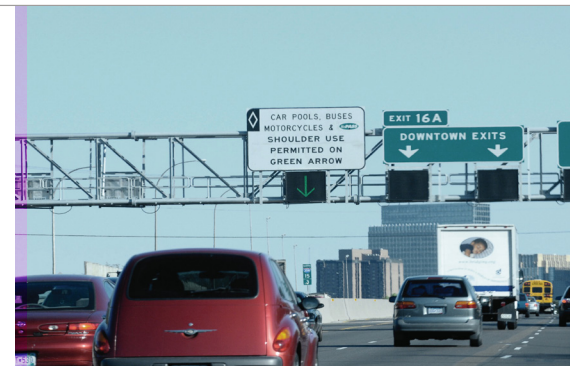
There are currently two satellites in development that will be used to test the new Gamma Ray Incidence Detector

(GRID) in lower-Earth orbit. Once in orbit, the GRID will be able to detect, time-code, and record gamma ray bursts. Those data will then be compared with gamma ray arrival time data from other orbiting spacecraft and used to calculate a relative position for the GRID's satellite. "Since the positions of both spacecraft will be known through other tracking means, we can use this to assess the accuracy of our gamma-ray-based navigation method," Gebre-Egziabher says.

The research was funded by the NASA/Minnesota Space Grant Consortium. A paper about the study was published in the *Proceedings of the IEEE/ION Position, Location and Navigation Symposium, PLANS 2016* (Institute of Electrical and Electronics Engineers/ Institute of Navigation).

aided by supplementary illuminating lasers, the sensor was capable of detecting humans through commonly manufactured vehicle window glass. However, to achieve successful results, these lasers must operate at high power in a narrow range of wavelengths. Despite operating outside the visible spectrum, they can damage human eyes when operating at the necessary power level to enable effective detection through glass. While investigators conducted this project's indoor tests with adequate protection, there is currently no way to ensure safe usage of the lasers in real-world applications.

"Development is still continuing in the industry, so we will cautiously evaluate sensing technologies as they come along," says Brian Kary, MnDOT freeway operations engineer and the project's technical liaison. "This research gave us a solid base of knowledge about what we'll be looking for and what we need to avoid."



*Papanikolopoulos has been investigating the use of vision-based technologies for more than two decades. His work has studied applications for vehicle platooning, pedestrian detection, truck parking, bicycle counting, driver fatigue detection, and transit area surveillance.*



*Infrastructure is about people—making sure they can get to activities they need and want to do.*

presentation, Brookings Institution fellow Adie Tomer offered highlights from the institution's Moving to Access Initiative, which visualizes challenges of the current mobility model, impediments to adopting an accessibility-focused approach, and a vision for where metro areas can go from here.

"Every time there are big infrastructure initiatives, the conversation goes to what we are building," said Tomer. "It's easy to lose sight of the fact that infrastructure is about people—about making sure they can get to the activities they want and need to do in order to find opportunity, success, and happiness."

Urban development trends in recent decades have heightened the need for accessibility and presented new barriers to accessibility as cities expand outward rapidly. "Because of this rapid expansion, the current method we are using to get people around is cars," Tomer said. "Travel in the auto era is on a different scale, and as a result there is often a spatial mismatch between where people live and work. The costs for household transportation and transportation infrastructure have become tremendous, and pollution from the transportation sector has become a major issue."

To address these problems, Tomer advocates building around accessibility. "This allows us to orient our thinking to access to a destination, and transportation becomes the means to an end and not an end unto itself," Tomer said. "There are three main components to this approach: the transportation system itself, urban planning and land use, and finances."

Though the case for moving to an accessibility model is strong, many challenges remain. "First, you have legacy issues—you can't easily tear down what is already built, so we need to figure out how to work with the bones we already have," Tomer said. "In addition, there are issues around who will pay for the infrastructure and operation of our transportation systems, the governance challenges of moving away from our siloed approach to governing, and the lack of definition, measurement, and standardization around the concept of accessibility."

Despite the challenges, Tomer and his colleagues remain optimistic

about the future of an accessibility approach to transportation. "There are already tremendous efforts under way at places like the University of Minnesota's Accessibility Observatory, where they are compiling real-world, tangible examples of accessibility and standardizing accessibility measures; the United Nations, which is implementing sustainable development goals; and cities like Bogota, Columbia, that are realizing the economic importance of accessibility and working to make transit affordable for everyone."

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for links to research reports and other resources.



*CTS launched its luncheon series in 1987. The first topic: The Future of the Automobile—Can Automobility Survive?*

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sale prices of single-family houses near station areas in Saint Paul. They also examined when the value uplift occurred, focusing on two key time points—before and after the Federal Transit Administration’s announcement of the full funding grant agreement (FFGA) in April 2011, and before and after the start of Green Line operation in June 2014.

“In contrast, most studies examine only how property values change after a transit system begins operating,” says Cao, an associate professor with the Humphrey School of Public Affairs and the principal investigator.

The findings show that the Green Line lifted the values of houses within a quarter mile of stations and that most of the value uplift occurred right after funding for the Green Line was confirmed. Using before and after data, the researchers found that housing values rose by \$9.20 per square foot following the FFGA announcement. Prices continued to rise, and by the time operations started, values had risen by \$13.70 per square foot. Prices have remained stable since then.

“Pinpointing the timing of price increases is critical for benefit-cost analysis,” Cao explains. “Higher property taxes associated with the value uplift provide revenues and help justify local government investments in transit



infrastructure. If a before-after analysis looks only at property values after service begins, the ‘premium’ obtained from LRT is undervalued.”

Overall, Cao says, the higher property values benefit homeowners along the Green Line corridor, which is particularly important because of the overrepresentation of low-income homeowners in the area. On the downside, higher home values can result in higher property taxes and increase rental rates, potentially displacing some existing low-income homeowners and renters and contributing to neighborhood gentrification.

Cao also notes that some increases in housing values along the Green Line corridor should be attributed to associated policies and investments, such as streetscape improvements and grant and marketing programs that

helped small businesses survive during LRT construction and thrive afterwards. In addition, zoning amendments implemented in April 2011 increased the development potential of existing properties, which helped to boost housing values. “These policies and plans related to LRT investments also seem to increase property value,” he says.

The study was funded by CTS, and valuable guidance was provided by Donna Drummond, planning director of the City of Saint Paul. “The study is very useful in helping us understand the potential impact of transit investments on property values as we plan for other transit corridors in the city such as Riverview and the Gold Line,” she says.

## A history of transit research

One of the projects funded in CTS’s first year was a study of rural transit service design. Since then, researchers have studied a range of transit-related topics. In 2006, the Transitway Impacts Research Program (TIRP) was

launched by the Hennepin County–University of Minnesota partnership to answer questions about the economic, travel, and community impacts of transitway corridors in the Twin Cities metropolitan area. TIRP-funded projects have looked at impacts on job accessibility, auto ownership, and property values, for example.



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a vision for metro areas.

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