Red-light running is one of the most common and dangerous causes of crashes at signalized intersections. Now, new technology and methodologies developed at the U of M could provide traffic engineers with a low-cost, easy-to-use toolbox for identifying intersections prone to red-light running long before crash data are available.

“Engineers traditionally measure an intersection's safety using the number of crashes that actually occur there, but because collisions are rare and somewhat random events, it can take a long time to collect enough data to assess a single location’s safety,” says Gary Davis, a professor in the Department of Civil, Environmental, and Geo-Engineering and the project’s principal investigator.

Annually updated research from the U’s Accessibility Observatory ranks 49 of the 50 largest (by population) metropolitan areas in the United States for connecting workers with jobs via transit. According to the latest data, the Minneapolis–Saint Paul metropolitan area ranks 13th nationally in access to jobs by transit, falling from 12th in last year’s rankings.

The study reports that the average worker in the Twin Cities metro can reach 16,697 jobs within 30 minutes traveling by transit. Overall, workers in the metro can reach an average of 1.64 percent fewer jobs by transit than a year ago. Total employment in the metro area has remained steady at...
The National Science Foundation (NSF) has awarded a $2.5 million grant to a multidisciplinary team of researchers led by the University of Minnesota for a new project to advance access, well-being, health, and sustainability in cities. The project will focus on multiple “smart” infrastructure sectors—water, energy, food, shelter, transportation, waste management—that converge in cities.

The grant is part of the NSF’s Smart and Connected Communities initiative, which is investing $19.5 million nationwide to develop interdisciplinary and community-engaged research to revolutionize the nation’s cities and communities with more responsive and adaptive infrastructures, technologies, and services.

The research effort will be led by Shashi Shekhar, a computer science and engineering professor and CTS Scholar, and Anu Ramaswami, a professor in the Humphrey School of Public Affairs. The project spans four academic institutions and includes co-investigators at Florida State University, the University of Washington, and Purdue University. CTS Scholars Jason Cao, Frank Douma, and Robert Johns at the Humphrey School will also participate on the U of M team.

With transformative new infrastructures coming on the horizon—such as autonomous vehicles, smart and distributed energy systems, novel green infrastructure, and urban farms—the physical fabric of our future cities will be very different from what exists today. The research team will provide new insight on how the future spatial deployment of these new infrastructures in cities will shape access, well-being, health, and environmental sustainability in different neighborhoods in the cities of Minneapolis and Saint Paul as well as Tallahassee, Florida.

The new project will advance basic research in multiple disciplines including environmental and civil engineering, computer science, urban planning, and public policy. It will create a unique public database, establish citizen science protocols, and advance the science of smart sustainable urban systems with cities engaged in infrastructure planning.

The research team will also engage K-12 students, university researchers, and citizen scientists to develop the first comprehensive public database on infrastructure, environment, health, and well-being at the neighborhood level in cities. Researchers will use innovative techniques such as crowdsourcing campaigns using low-cost sensors to characterize air pollution and flooding risks, K-12 engagement in mapping well-being and infrastructure satisfaction at the neighborhood level, and the development of related cyber-infrastructure.

The database will then be analyzed to identify novel, interesting, and useful spatial patterns and to develop urban models. Researchers will work with city partners to help better plan future cities considering emerging smart grid, mobility, and food system transitions.

The project’s educational activities will also connect graduate students from the fields of engineering, urban planning, policy, and sustainability with K-12 teachers and students, with particular attention to underserved populations. Research insights will be broadly disseminated to U.S. cities through partnerships with ICLEI-USA, the National League of Cities, and the MetroLab Network and through the NSF’s Sustainable Healthy Cities Network.

NSF’s Smart and Connected Communities initiative is part of a multipronged strategy for investing in foundational research and education on smart and connected communities.
People experience different emotions during daily travel. Their happiness varies depending on the mode they use, trip duration, and other factors. U of M researchers are exploring how happiness could become a useful metric to assess transportation systems and guide policymaking, supplementing more common measures such as mobility and accessibility.

“Happiness is increasingly seen as a gauge of an individual’s well-being, and this has many social implications,” says Yingling Fan, associate professor in the Humphrey School of Public Affairs. “Happier people often are more productive and creative, have better family and social relationships, live longer, and, in general, are more successful.”

Americans spend, on average, about 75 minutes on daily trips. “Given the known benefits of emotional well-being, it’s important for planners and policymakers to understand the connection between transportation and happiness,” Fan says.

In a recent analysis, Fan and Jing Zhu, an assistant professor at Northwest University in Xi’an, China, used data from the 2012–2013 American Time Use Survey (ATUS) to study how trip- and personal-level factors influence emotions. Zhu conducted the research while at the U of M through a visiting scholar program funded by the National Natural Science Foundation of China’s Young Scholar Program.

“Our results show that emotions are shaped in various ways by the mode, duration, purpose, and companionship characteristics of a trip,” Fan says. “For example, of the modes we examined, biking is the happiest. Long travel—more than 45 minutes—is the least happy and most tiring and stressful.”

In a current project, Fan and Julian Wolfson, an assistant professor in the Division of Biostatistics at the U of M’s School of Public Health, are studying the links between transportation and happiness in the Twin Cities area using the Daynamica™ app. Their work is part of the Sustainable Healthy Cities program, a National Science Foundation-supported Sustainability Research Network. Fan is the co-principal investigator of the four-year effort, which involves faculty from multiple disciplines at eight universities.

The researchers are studying participants in Blaine, Brooklyn Center, Saint Anthony Park, and Minneapolis using in-home surveys and smartphone data collection. “Using the Daynamica app on smartphones reduces the amount of data participants need to input,” Wolfson says. “This allows us to ask them to participate for multiple days or weeks, giving us more accurate and more representative data over a longer time period than in traditional travel behavior studies that use data from a single day.”

After controlling for neighborhood and individual differences, preliminary findings indicate biking is the happiest mode of transportation.

Daynamica™, a smartphone application developed by a University of Minnesota research team, has been granted a patent by the U.S. Patents and Trademark Office.

Daynamica makes it easier and less costly to collect travel behavior information and provides richer, more accurate data than traditional methods. The open-source app combines smartphone GPS sensing with advanced statistical and machine-learning techniques to automatically detect, identify, and summarize attributes of daily activity and travel episodes. The app then allows users to view and annotate information at their convenience.

Daynamica was developed by a multidisciplinary team that included Yingling Fan (associate professor, Humphrey School of Public Affairs), Julian Wolfson (assistant professor, School of Public Health), and Gediminas Adomavicius (professor, Carlson School of Management).

Daynamica expands on the previous SmarTrAC app developed by the team under contract with the Volpe Center at the U.S. Department of Transportation in support of the Intelligent Transportation Systems Joint Program Office. Funding was also provided by CTS.

For more information, visit the Daynamica website:
daynamica.umn.edu.
At the request of the Minnesota Council on Transportation Access (MCOTA), researchers from the Humphrey School of Public Affairs conducted a study of the economic benefits of volunteer driver programs in the state. They used six volunteer driver programs as case studies: a county-based volunteer program, transit-system-based programs, and Faith-in-Action programs.

“The operating costs of these programs mainly include reimbursement to volunteer drivers and personnel for program coordination—customer contributions are either voluntary or designed to cover a small share of operating expenses,” says Jerry Zhao, an associate professor with the Humphrey School. “We wanted to calculate the cost savings of these programs in comparison to alternative services that would have been used if volunteer driver programs were unavailable to better understand their financial value.”

Volunteer driver programs provide flexible transportation services to meet the need of communities. They tend to be especially indispensable in rural areas where other modes of transportation are often unavailable or much more expensive. Through a network of volunteer drivers, they help senior, low-income, or other less independent groups make medical, employment, education, grocery, or pharmacy trips. However, it’s been unclear exactly what—if any—hard cost savings they provide.

Researchers began by interviewing selected providers that use volunteer drivers and reviewing their operation and financial data. The programs studied were Volunteer Services of Carlton County, Central Community Transit (CCT), United Community Action Partnership, SEMCAC (Southeastern Minnesota Community Action Council), Faith in Action for Cass County, and Faith in Action in Red Wing.

These case studies showed that volunteer driver services are often provided through community-based transit programs, including Community Action Partnerships established under the Federal Economic Opportunity Act of 1964, and Faith in Action organizations, which are a network of interfaith, volunteer caregiving service providers.

Finally, researchers calculated the financial benefit of these six programs compared to available alternative transportation services such as private provider or taxi services. “In addition to the cost savings volunteer driver programs provide for federal and state human services programs, they offer significant savings for their users,” Zhao says. “On average, we found that for each round-trip, volunteer driver services can save from $18 to $185 depending on trip length and the type of alternative services available in the area. The annual savings of the six programs we studied in Minnesota range from about $75,000 to as much as $1,480,000.”

The study builds on a 2016 survey that examined the benefits and barriers to volunteer driver programs in Minnesota.

**Happiness from page 3**

mode, which is consistent with findings from the ATUS study. The happiness levels of rail trips are found to be no different from car trips but higher than bus trips. “This is not surprising because on average the rail services in the Twin Cities are of much higher frequency, speed, and reliability than bus services in the region,” Wolfson says.

The results also reveal that the happiness gap between car and bus trips is significant for trips shorter than approximately 30 minutes, but the two modes do not differ in happiness for trips longer than half an hour.

Fan believes the research has important policy implications. “Transit reduces congestion and has environmental benefits, and many people depend on it. We can’t just hope people will use transit—we need to find ways to make these trips evoke happier emotions to increase ridership.”

She also advises making cities more bike-friendly and promoting jobs-housing balance to shorten commute length. “Trip duration has a big impact on happiness,” she says. “This suggests that land-use policies and urban design strategies that shorten trips can influence emotional well-being.”
This fall, 15 professionals from the Shenzhen Urban Transportation Planning Center (SUTPC) came to Minnesota for a new training opportunity. The four-week course was offered by the U of M’s Global Transit Innovations (GTI) Program, CTS, and the China Center’s Mingda Institute for Leadership Training.

“The overall goal is to help to advance the participants’ professional skills and knowledge of state-of-the-art transportation research and practices in the United States, and to identify international collaboration opportunities,” says Yingling Fan, associate professor in the Humphrey School of Public Affairs and GTI director. The course, sponsored by SUTPC, focused on urban transportation planning and design. The 15 professionals were selected by SUTPC leadership. “The participants tend to be mid-career professionals in their departments who are tapped for career advancement,” Fan says. SUTPC plans to sponsor the training yearly.

The course included workshops featuring U of M researchers from multiple departments as well as speakers from the public sector, consulting firms, and other organizations. Field trips to area sites and facilities were also part of the curriculum. “We’re lucky to have this great region as an urban laboratory to teach transportation options,” Fan says.

One of the participants was Zhengxiang Ji, a transportation senior planning engineer/vice president of the Guangxi Branch of SUTPC. “I learned so much through communicating with local professors and engineers,” he says. Another participant, transportation modeler Liu He, noted his interest in the sessions on public involvement and accessibility for people with disabilities.

The SUTPC professionals also shared their insights with Minnesota practitioners and discussed transportation trends in the U.S. and China at a half-day GTI forum.

Established in 1996, SUTPC has grown into the largest transportation planning, design, and research organization in China. “During the early days, the organization had benefited from adopting the best practices in transportation planning from Hong Kong and Singapore,” says Xiaochun Zhang, SUTPC director.

“The United States has formed comprehensive regulation and management frameworks for urban transportation planning,” Zhang continues. “Minnesota is a progressive state in which many innovative transportation policies and planning approaches have been implemented. Further, the University of Minnesota is leading the world in many transportation research fields, including travel happiness research. For these reasons, SUTPC chose the United States, chose Minnesota, and chose the University of Minnesota to carry out training and exchange activities.”

The new course is part of GTI’s growing portfolio of educational programs. In spring semester 2017, GTI coordinated a study-abroad course that included visits to five cities in China. The course was offered by the Humphrey School of Public Affairs; SUTPC was one of the host organizations. A study-abroad course will be offered again in spring 2018 (see below).

GTI is coordinating a study-abroad course with the Humphrey School titled “Planning for China’s Urban Billion.” U of M students, non-U of M students, and planning practitioners can sign up for the three-credit, graduate-level course, to be held May 19–June 1 in four Chinese cities. The application deadline is February 1. For details, please see the GTI website: gti.umn.edu.
1.7 million jobs.

The new rankings, part of the Access Across America national pooled-fund study that began in 2013, focus on accessibility, a measure that examines both land use and transportation systems. Accessibility measures how many destinations, such as jobs, can be reached in a given time.

The 1.64% decline in Minneapolis–Saint Paul is most likely due to changes in the patterns of job and worker locations, says Andrew Owen, director of the Observatory. “Accessibility reflects changes in both land use and transportation. Changes in the transit system between 2015 and 2016 were minor, and the region saw small increases in total jobs and workers. New workers to the region who choose to locate in places with little or no transit service will show up as a decrease in average accessibility. The results for the Minneapolis–Saint Paul region suggest the pattern of regional population growth, rather than changes in transit service, played the largest role in driving the small decline in average job accessibility by transit.”

The Twin Cities’ decline in rank has more to do with what happened in cities with similar ranks, Owen adds.

The findings have a range of uses and implications. State departments of transportation (DOTs), metropolitan planning organizations, and transit agencies can apply the evaluations to performance goals related to congestion, reliability, and sustainability. In addition, detailed accessibility evaluation can help in selecting between project alternatives and prioritizing investments.

“The new data make it possible to see the change from year to year in how well a metro area is facilitating access to jobs by transit,” Owen says. “Transit is an essential transportation service for many Americans, and we directly compare the accessibility performance of America’s largest metropolitan areas.”

This year’s report—Access Across America: Transit 2016—presents detailed accessibility values for each of the 49 metropolitan areas, as well as detailed block-level color maps that illustrate the spatial patterns of accessibility within each area.

Key factors affecting the rankings for any metro area include the number of jobs available and where they are located, the availability of transit service, and population size, density, and location. “Better coordination of transit service with the location of jobs and housing will improve job accessibility by transit,” Owen says.

The research is sponsored by the National Accessibility Evaluation Pooled-Fund Study, a multi-year effort led by the Minnesota Department of Transportation and supported by partners including the Federal Highway Administration and additional state DOTs. The Accessibility Observatory is a program of CTS.

**Top increases in job accessibility by transit**

1. Cincinnati (+ 11.23%)
2. Orlando (+ 10.83%)
3. Seattle (+ 10.80%)
4. Providence (+ 10.64%)
5. Charlotte (+ 10.63%)
6. Phoenix (+ 7.51%)
7. Riverside (+ 6.54%)
8. Milwaukee (+ 6.53%)
9. Hartford (+ 6.43%)
10. New Orleans (+ 6.20%)

41. Minneapolis (-1.64%)

**Video traces progress of accessibility research**

A new video from CTS traces the path of progress in accessibility research. Andrew Owen explains how the Accessibility Observatory is “pushing the envelope and staying ahead of research into what new types of metrics are possible.” The Observatory builds on the tools and expertise developed in two previous U of M studies: the Transportation and Regional Growth Study (1998–2003) and the Access to Destinations study (2004–2012). The video is available on the CTS website.
investigator. “If we can accurately measure traffic conflicts—close calls in which a driver must stop suddenly or swerve to avoid a crash—we can begin to determine where dangerous crashes are most likely to occur.”

While not every red-light-running event leads to a collision, it is often the first step in a process that ends in one. In addition, crashes caused when drivers run red lights are typically right-angle crashes, which are frequently severe. About 45 percent of right-angle collisions result in injury compared to about 25 percent of other crash types. As a result, reducing the frequency of right-angle crashes can significantly improve overall road safety and reduce crash-related costs.

To address this need, researchers at the U of M and the University of Michigan set out to determine whether it was possible to objectively and automatically identify intersections where red-light running is most likely to occur. Several previous U of M research projects (led by Professor Henry Liu, now with Michigan) had developed the SMART Signal system—an automatic system that collects data from traffic signal controllers. The Minnesota Department of Transportation (MnDOT) has installed the system at more than 100 intersections in the Twin Cities.

In this latest MnDOT-sponsored project, researchers developed tools that use SMART Signal data to evaluate safety performance at intersections. Liu’s team at the University of Michigan used the SMART Signal data to estimate both red-light-running events and right-angle crossing conflicts. Because most intersections are not equipped to detect red-light running, researchers found a way to pair vehicle-speed and traffic-volume data with traffic-signal-phase information from SMART Signal to identify potential red-light-running events.

To verify the accuracy of this method, they compared the potential events with data from actual red-light-running events and then developed a formula to predict whether a red-light-running event would occur. Next, researchers designed a method to determine whether a red-light-running event would lead to a traffic conflict and added this new measure—crossing conflict—to a more standard model using average daily traffic.

Finally, researchers at the U of M tested the new model to see if it could improve their ability to predict right-angle crashes at signalized intersections. “We found the frequency of red-light running was a better predictor of angle-crash frequency than the more traditional average daily traffic,” Davis says.

The new methodology could help MnDOT prioritize intersections for safety improvements and improve signal operations, says Steve Misgen, MnDOT Metro District traffic engineer.

20th Annual Freight and Logistics Symposium
December 1, 2017
Radisson Hotel Minneapolis/St. Paul North, Roseville, MN

Join us in our new location for the 2017 symposium to learn about the integral role of freight in the on-demand revolution, the impact of disruptive technologies on the freight industry, and the challenges and opportunities ahead.

Complete program and registration information is available at cts.umn.edu/events/freight/2017.
Report ranks job accessibility via transit for major U.S. cities.

U of M secures grant to improve quality of life in cities.

Happiness: A new way to measure transportation systems.

Research helps predict red-light running at intersections.