As Austin grows, so does its traffic woes

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These photos were taken by Austin photographer Robert Scheidemann. In his project Road Tolls, Scheidemann sets up a camera outside of a popular toll road on Interstate 35.

Ask any Austinite what they enjoy least about the city, and many will mention the escalating traffic issues. According to *Forbes*, Austin is one of the fastest growing cities in the U.S., and without a transportation infrastructure equipped to handle the explosion of new transplants, it also ranks as one of the cities with the worst traffic congestion.

The Network Modeling Center (NMC), a group of researchers within the Center for Transportation Research (CTR) at The University of Texas at Austin, is using advanced transportation models to help transportation agencies understand, compare, and evaluate alternative solutions and development strategies. However, the complex impact of alternative solutions on everyday traffic is not easy to predict.

"The goals of our group are two-fold," Natalia Ruiz-Juri, assistant director of the Network Modeling Center said. "The first is to advance the network models used to evaluate how changes in infrastructure, travel demand, and traffic control impact transportation in the region, and the second is using these models to support planners in decision making."

Dynamic traffic assignment (DTA) models allow Ruiz-Juri and her team to realistically simulate the minutiae of traffic in Austin at specific locations and during specific time intervals. Although similar traffic models have been used for the past 50 years, DTA models are novel in that they account for how traffic changes at distinct time periods, for instance how congestion builds up during the morning rush hour and then slowly dissipates.

To begin analyzing transportation networks for a six county region that stretches from Austin to San Marcos, the team first divides the city into "zones." The zones can be as small as a city block downtown to much larger regions further away from the city's center. Then, using zone-to-zone travel demand data provided by the Capital Area Metropolitan Planning Organization (CAMPO), the model assigns individual travel routes across the region.

Computing simulations allow the researchers to understand how traffic propagates.

"Equilibrium is the main principle we use in DTA models to represent recurrent traffic conditions," Ruiz-Juri said. "The way we decide the paths people take is based on the assumption that we're all selfish. We try to minimize our own travel time or cost, even if it is at the expense of others, which often worsens congestion."

Gaining clarity through TACC

Running these DTA models for large regions left the team with "pages and pages of text," so Ruiz-Juri reached out to Greg Abram, a research scientist in the Scalable Visualization Technologies Group at the Texas Advanced Computing Center (TACC). TACC, one of the leading supercomputing centers in the nation, designs and deploys powerful advanced computing technologies and innovative software solutions to enable researchers to answer complex questions like the ones Austin faces with transportation and traffic.

The NMC's web-based visualization tool displays simulations from DTA models. The left image shows the model's estimation of the time it takes to reach different sections of downtown during the morning peak. The right image shows

the model's estimation of bus passengers boarding and disembarking at each stop on a specific route.

"We developed an interactive, web-based visualization tool that presents traffic simulation results and data in multiple ways, and places a greater focus on analyzing spatial data that changes over time," Abram said.

The visualization tool offers many unique ways to view the Austin transportation network, or any other network modeled by the NMC. The researchers can customize their viewing experience to gain additional clarity into the inner-workings of Austin traffic, the performance of their models, and the potential impact of transportation strategies.

The NMC also began taking advantage of TACC's other services to improve their network model algorithms. Working with Weija Xu, TACC' s manager of Data Mining & Statistics Group, and Amit Gupta, TACC research associate, allowed the team to decrease the model simulation time.

"These simulations can be very complex," Xu said. "Each car has an origin and a destination and the researchers need to find the best route for every car, accounting for the variability of traffic conditions over time. The model then calculates the travel time for thousands and thousands of cars in the city at a given time period, and repeats these steps until equilibrium conditions are found. It's a big computation."

An allocation on XSEDE, the Extreme Science and Engineering Discovery Environment, helped the NMC gain access to TACC's Stampede, one of the world's most powerful supercomputers. Xu and the data team used nodes on Stampede to test and develop algorithms that enhanced the effectiveness of the DTA models.

"Sometimes our models takes days to run, and if you're a decision maker that's an eternity," Ruiz-Juri said. "By working with the TACC team, we have seen some of our computations run five to 10 times faster."

Building an informed community

Not only are the models used to foster a greater understanding of traffic and transit in Austin, but they also support city planners in improving existing infrastructure and developing new strategies.

Through its partnership with CAMPO, and collaboration with other agencies including the City of Austin, Williamson County, and transportation consultants, the NMC shares its models to help evaluate the impact of proposed improvements throughout the Central Texas region. Many of these projects explore ways to account for the increased growth and travel demand in the city. The projects range from evaluating the impact of converting downtown streets from one to two lanes, to analyzing the safety of highway work zones, to adding lanes to major roadways.

One of the NMC's ongoing tasks is to use DTA models within the Mobility35 project. Based on extensive research and public outreach, this program proposes to increase the capacity, optimize the existing structure, and improve connectivity of Interstate 35 (I-35) over the next few years. The I-35 corridor through downtown Austin is one of the most congested roadways in Texas, and improvements will impact most of Austin's almost one million residents.

"The models and visualization tool allow us to input various scenarios proposed by planners and estimate the potential consequences," Ruiz-Juriz said. "We want to help city planners make a decision that considers technical, environmental, and social factors."

The NMC often presents its findings and answers questions at public hearings in neighborhoods around Austin, helping to create an informed community.

Said Ruiz-Juri: "Austin is growing quite rapidly. The city also hosts many events including SXSW, Austin City Limits, and Formula One that bring thousands of additional people into the city. It's imperative that Austin's transportation system can support this growth. And as more people know about us, we're hoping to become a bigger resource for the community."

More information: www.mobility35.org/capital/default.aspx

Provided by University of Texas at Austin