



November 2008 – Vol. 6, No. 10

*CTS Research E-News brings you the latest research project milestones, published reports, and seminar coverage.***In this issue:****Policy & Planning**

- ◆ [Research refines understanding of land use and accessibility](#)
- ◆ [Causes and effects of suburban development probed](#)

Intelligent Transportation Systems

- ◆ [Computational techniques improve vehicle tracking](#)

Transportation and the Environment

- ◆ [Low-sodium diet recommended for Minnesota aquifers](#)

Transportation Infrastructure

- ◆ [Researchers discuss expanding use of intelligent compaction](#)

Events

- ◆ [Fall seminars present a spectrum of transportation research](#)

Upcoming Events

Policy & Planning

Research refines understanding of land use and accessibility



Land-use models were used to predict possible changes to areas including the Highway 610 corridor.

Two new [Access to Destinations Study](#) research reports, from research teams under the direction of study co-leaders **David Levinson** of the civil engineering department and **Kevin Krizek** (now at the University of Colorado, formerly with the Humphrey Institute of Public Affairs), bring researchers closer to a complete picture of the relationship between land use and accessibility in the Twin Cities region.

Levinson, who holds the Richard P. Braun/CTS Chair in Transportation Engineering, and his team used data on regional land use over the last 50 years to develop models of land use changes and their interactions with the growing transportation system. Krizek's team created a new high-resolution dataset of land uses using data on individual land parcels; they incorporated this dataset into a geographic information system (GIS) layer that will aid in the development of an "accessibility matrix" covering the entire region.

Jessica Horning of the Humphrey Institute of Public Affairs and **Ahmed El-Geneidy** (now at McGill University) worked with Krizek. To create their new parcel-level dataset, the team purchased data from commercial vendor Dun and Bradstreet, which classifies businesses according to the six-digit North American Industrial Classification System (NAICS) scheme. In order to make this data usable by geographic information systems (GIS) applications, the researchers then had to resolve incomplete or ambiguous address information,

and then match the data with a parcel level map of the region using specialized software developed by a graduate research assistant in the University's computer science department.

In their final report on the project, the research team notes that many previous efforts to study accessibility have focused on access to employment opportunities, which are hypothesized to be closely connected with urban structure and residential location choices. However, other types of destinations also play influential roles in determining travel and development patterns. The new dataset will help researchers uncover the influence of these other destinations.

Working with Levinson were civil engineering research fellows **Michael Iacono** and **Rania Wasfi**, research associate **Ahmed El-Geneidy** (now at McGill University), and graduate student **Shanjiang Zhu**. To model 50 years of land use changes, they began with a 75-meter grid covering the entire Twin Cities metropolitan area. Each cell in this grid was assigned a predominant land use, using data provided by the Metropolitan Council from 1984 onwards, and derived from digitized historical maps for years before 1984. This grid served as the foundation for the team's modeling experiments, in which three types of models were tested to see how well they could reproduce known historical changes.

After analyzing the performance of these models, the researchers concluded that none was able to faithfully predict the complex changes in land use over the last 50 years. While each type of model proved to have its own limitations, the three approaches also offered a variety of benefits to researchers seeking to study the connection between accessibility and land use. Among these benefits is the ability to incorporate new features of urban growth processes, which will make future modeling exercises more realistic and powerful.

Parcel Level Land Use Data Acquisition and Analysis for Measuring Non-Auto Accessibility (Mn/DOT 2008-19), the sixth report in the Access to Destinations series, and *Monitoring Land Use Activity Changes in the Twin Cities Metropolitan Region* (Mn/DOT 2008-26), the seventh report in the series, are available from the Study's Web site.

Causes and effects of suburban development probed



Xinyu Jason Cao

Suburban development has been blamed for encouraging residents to become dependent on the private automobile, and thus for a host of associated ills including air pollution, climate change, and reliance on oil. The link between suburban development and auto dependence has been supported by numerous studies showing that suburban residents drive more and walk less than their urban counterparts. But have the suburbs been given a bad rap?

Xinyu Jason Cao of the [Humphrey Institute of Public Affairs](#) asked whether the case against suburban development was really conclusive. Cao, along with fellow researchers [Patricia Mokhtarian](#) and [Susan Handy](#) of the University of California–Davis, looked for evidence that the preference for driving over walking observed among suburban residents may be due to self-selection; in other words, suburbanites' personal preferences might lead them to drive even if the built environment around them were conducive to walking.

The question is of more than academic interest—as the researchers note in their final report, many current land use policies are based on the idea that characteristics of the built environment can directly influence travel behavior. Understanding how strongly the built environment affects residents' decisions about driving and walking will help planners and policymakers provide better transportation options.

The research team evaluated several different methodologies and modeling techniques used by other researchers to examine the question of self-selection, and reviewed numerous empirical studies. Although previous studies using a variety of different research methods have concluded that a causal link does exist between the built environment and travel behavior, the researchers found that the strength of the link—and whether it was more important than self-selection—has not been conclusively established.

In their final report, Cao, Mokhtarian, and Handy suggest ways that future studies can address the question of residential self-selection more effectively. The research was partly supported by a University of California Transportation Center Dissertation Grant.

Examining the Impacts of Residential Self-Selection on Travel Behavior: Methodologies and Empirical Findings (CTS 08-24) is available from the Center for Transportation Studies Web site.

Intelligent Transportation Systems

Computational techniques improve vehicle tracking



The traffic data processor divides a video scene into multiple cells to track vehicle movements.

Data on “interesting” traffic events like vehicle turns, merges, and even crashes are important for many intelligent transportation systems applications—but watching for these events is difficult and tedious for human researchers. Professor **Nikolaos Papanikolopoulos** of the University of Minnesota's [Department of Computer Science and Engineering](#) has spent several years developing and optimizing computer systems that analyze video images to detect a variety of significant traffic events. He and graduate student **Harini Veeraraghavan** recently introduced an event detection system incorporating a novel technique that helps the system automatically learn to recognize events that fit a profile established by the operator.

Papanikolopoulos and Veeraraghavan designed their approach around the representation of traffic events as strings of actions; for example, a vehicle being tracked may move through certain areas of the video frame at certain speeds. These strings of actions are then parsed by the computer systems as context-free grammars to determine what events the data represents.

For normal humans, the task of recognizing and classifying events is trivial, but computers lack our powerful pattern recognition capabilities. Teaching a computer system to recognize events based on raw data about vehicle movement is challenging, because the same event—like a left turn—can be accomplished in many different ways, producing different trajectory data every time.

To overcome this limitation, the researchers used a semi-supervised learning method to teach the computer system to recognize events in video data. Instead of programming in every possible variant of a left turn, the computer system is initialized with a small number of clear examples; this helps the computer's pattern recognition system recognize related strings of actions and improve its accuracy as it processes more data.

The researchers applied their approach to video data from a four-way arterial intersection that is typical of the environment where such a video-based data collection system might be used by traffic managers and engineers. Uncontrolled vehicle movements and changing illumination make this type of data difficult for machine-vision systems to analyze. The system performed well compared to machine-vision systems based on other event-detection techniques.

The research was sponsored by the [Intelligent Transportation Systems Institute](#).

Portable Traffic Data Processor (CTS 08-14) is available from the ITS Institute Web site.

Transportation and the Environment

Low-sodium diet recommended for Minnesota aquifers

Too much salt can be bad for your health, and a new study suggests that excess salt may have an adverse effect on Minnesota's water quality as well. Researchers **Heinz Stefan**, **Eric Novotny**, **Andrew Sander**, and **Omid Mohseni** of the University of Minnesota civil engineering department's [St. Anthony Falls Laboratory](#) studied the environmental effects of deicing salt on water quality in the Twin Cities area and found higher than expected salinity in a number of local lakes and shallow groundwater aquifers.

Roughly 350,000 short tons of sodium chloride (common table salt) are applied to roads in the Minneapolis-St. Paul metropolitan area every year to help keep roads free of ice. According to the researchers, only about 30% of this is carried away by the Mississippi River. The remaining 70% is either removed by other means or stays in the area, making its way into lakes and eventually into the groundwater system.

The research team measured salt concentrations in several area lakes and rivers, as well as in groundwater, and collected data on road salt application across the region. They used this information to create a chloride budget for the metropolitan area that showed how much of the salt applied to roads was removed by the Mississippi River. Separate chloride budgets were created for smaller sub-aquifers.

Based on their analysis of seasonal salt levels and historic trends, the researchers concluded that lakes and groundwater aquifers in the Twin Cities area are suffering some deterioration in water quality due to increasing chloride levels. If current trends continue, urban lakes are likely to violate water quality standards in the future, and deterioration of groundwater quality is likely to be noticeable in the coming decades.

The study's final report recommends that policymakers give serious consideration to measures that will mitigate the effects of salt in runoff, including changing how road salt is used, routing runoff away from lakes and groundwater recharge areas, and collecting and treating highly saline runoff.

The research was funded by the [Minnesota Local Road Research Board](#).

Study of Environmental Effects of De-Icing Salt on Water Quality in the Twin Cities Metropolitan Area, Minnesota (Mn/DOT 2008-42) is available from the CTS Web site.

Transportation Infrastructure

Researchers discuss expanding use of intelligent compaction



As part of the ongoing Center for Transportation Studies seminar series at the University of Minnesota, civil engineering professor **Joseph Labuz**, Shimizu professor of civil engineering **Bojan Guzina**, and Minnesota Department of Transportation engineer **John Siekmeier** were on hand September 30 to discuss new research and recent developments about intelligent compaction (IC). Though intelligent compaction has been used for construction of roadways across Minnesota, it's still a fairly new idea. Labuz and associate professors Guzina and **Lev Khazanovich** recently published a research report assessing the use of intelligent compaction in Minnesota.

Also known as continuous compaction control, intelligent compaction is a quality-control system used in pavement construction to continuously monitor the stiffness of materials. The stiffness data can be linked to machine controls, which then adjust the compaction accordingly to avoid over- or under-compaction.

Siekmeier, a senior research engineer at the [Minnesota Department of Transportation](#) (Mn/DOT), opened the seminar by discussing some of the intelligent compaction projects around the state. Siekmeier explained that the soil and asphalt intelligent compaction systems used by Mn/DOT are able to create maps that keep track of the compaction taking place and archive the results for later. This results in increased uniformity, documentation of every lift, and improved worker safety.

Labuz, a civil engineering professor at the University of Minnesota, reviewed previous research that has been influential in the development of intelligent compaction. According to research from as far back as the 1960s, energy input has a great effect on the density and stiffness achieved by compaction. Key factors such as these that were identified in older reports have been significant tools for exploring intelligent compaction uses on roadways today. Labuz went on to discuss the University's involvement in intelligent compaction planning as well as explain the process for identifying potential intelligent compaction project areas in Minnesota.

Labuz, Guzina, and Khazanovich made a qualitative assessment of Mn/DOT's specifications for intelligent compaction based on several intelligent compaction sites around Minnesota. The researchers interviewed field personnel and documented compaction efforts at the sites in order to understand how well the practice is working in the field. In addition to an overview of intelligent compaction implementations, the researchers' final report presents several recommendations for ensuring good results from IC. The research was sponsored by Mn/DOT.

The "Intelligent Compaction Implementation" seminar featuring Labuz, Guzina, and Siekmeier is available as a streaming video on the CTS Web site.

Intelligent Compaction Implementation: Research Assessment (Mn/DOT 2008-22) is available for download from the CTS Web site.

Events

Fall seminars present a spectrum of transportation research

The [Center for Transportation Studies](#) and the [Intelligent Transportation Systems Institute](#) have presented research seminars on a variety of transportation-related topics this fall. Streaming video of the seminars is available on the Web.

CTS Research Seminars this semester have included:

- ◆ "Intelligent Compaction Implementation" (see article in this issue, above)
- ◆ "Transportation Policy and Technology Options to Reduce Greenhouse Gas Emissions in Minnesota"
- ◆ "Intelligent Transportation Systems and Safety: Innovative Uses of Information Systems to Improve Timeliness and Quality of Emergency Response"
- ◆ "Economic Impacts of Transitways: The Hiawatha Light Rail Line"

Links to these seminars, as well as seminar recordings from 2007, are available on the [CTS Research Seminars Web page](#).

The Intelligent Transportation Systems Institute's Advanced Transportation Technologies seminar series has presented ITS-related research including:

- ◆ "Evaluation of Platoon-Priority and Advanced Warning Flasher System at High-Speed Signalized Intersections"
- ◆ "Summary of Research Activities at the Center for Sustainable Mobility"
- ◆ "Solar and Wind Hybrid Electric Generators for Rural ITS Applications"

- ◆ "Intelligent Transportation Systems and Safety: Innovative Uses of Information Systems to Improve Timeliness and Quality of Emergency Response"
- ◆ "Improving Transit System Performance with the Benefit of Automatic Data Collection Systems"
- ◆ "A Predictive Study of Use Impacts on the Denali Park Road"

Links to these seminars, as well as seminar recordings from 2007, are available on the ITS Institute's [Advanced Transportation Technologies Seminar Series Web page](#).

On December 2, the ITS Institute will present its final seminar of 2008, "A Perspective on ITS Research at the USDOT," featuring invited speaker Shelley Row, director of the ITS Joint Program Office at the U.S. Department of Transportation.

To receive e-mail announcements of future seminars and other events hosted by the Center for Transportation Studies and its affiliated programs, visit the CTS Web site and [sign up for our electronic mailing list](#).

More Upcoming Events

November 25

[Access to Destinations Workshop](#): Rolling Out Measures of Non-Motorized Accessibility: What Can We Now Say?, 1130 Mechanical Engineering Building, Minneapolis

December 2

[Advanced Transportation Technologies Seminar](#): A Perspective on ITS Research at the USDOT, 1130 Mechanical Engineering Building, Minneapolis

December 5

[12th Annual Freight and Logistics Symposium](#): Energy Uncertainties—Supply Chain Impacts in the Upper Midwest, Four Points Sheraton, Minneapolis. Contact Sara Van Essendelft, 612-624-3708, cceconf5@umn.edu.

Spring Semester 2009

[Civil Engineering Refresher Course](#), Minneapolis campus.

February 5

Transportation Career Expo, Minneapolis. Contact Shawn Haag, 612-625-5608 haag0025@cts.umn.edu.

February 11

[CTS Winter Luncheon](#), "Intelligent Speed Adaptation: Is European Research Relevant to the United States?" Oliver Carsten, Institute for Transport Studies, University of Leeds. AI Johnson Room at the McNamara Alumni Center, Minneapolis. Contact Sara Van Essendelft, 612-624-3708, cceconf5@umn.edu. Sponsored by the ITS Institute.