Counting Vehicles for Truck Parking Information

The Kansas Experience

Mark Gallagher, AICP | SRF Consulting Inc.

In each issue, the INCITER features an article coordinated by one of NCITE’s technical committees. This article is a contribution from the ITS Committee.

Semi trucks are big. They can weigh 80,000 pounds. They’re up to 8.5 feet wide and can pull trailers 80 feet long. Rolling down the Interstate a loaded semi can consume diesel fuel at the rate of seven miles per gallon. They can be loud. They can be imposing.

You’d think they would be easy to count.

Accurately counting parked semi trucks is the core technical challenge behind the Truck Parking Information System (TPIMS) project organized by the Mid-America Association of State Transportation Officials (MAASTO). If trucks can be accurately counted at parking facilities, then the availability of parking can be communicated to drivers, allowing them to make better choices about where and when to park their vehicles.

To avoid exceeding Hours-of-Service (HOS) limits, drivers need access to parking facilities where they can take breaks and rest when needed. Unfortunately, most public rest areas will have parking for fewer than 20 large trucks.

Image courtesy of pixabay.com

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The seasons are changing, the temperature is dropping, and the holidays are almost upon us. The end of the 2019 NCITE calendar year is almost here. It doesn’t feel that long ago that I was writing the first newsletter article back in February.

Since summer, we’ve had two very successful Section Meetings. The September meeting was held at Lucky’s 13 Pub to discuss Allianz Field Gameday Operations and had almost 70 attendees. The October Section Meeting was joint with the Interdisciplinary Transportation Student Organization (ITSO) at the University of Minnesota’s Coffman Union and included a discussion about Accessibility in Transportation.

The Annual Meeting at Topgolf was truly a fun event. I enjoyed the opportunity to look back on the year and recall great memories with a fantastic Board of Directors. A couple of which include a road trip to Duluth for an out-of-state Section Meeting and exploring Austin, Texas at the International Annual Meeting. Annual Section recognition awards were handed out to two outstanding individuals and a project. Congratulations to Tyler Krage for being named NCITE Young Transportation Professional of the Year. This recognition showcases his commitment to NCITE as a Board Member, Committee Chair, and always available volunteer. Second, congratulations to Nick Erpelding for being awarded the Past President’s Award and named Transportation Professional of the Year. Nick has been a leader, innovator, and contributor to NCITE and to the profession for many years and is a well-deserved honor. The Transportation Achievement Award was awarded to Alliant Engineering and Duluth Superior Metropolitan Interstate Council for the I-35 Bayfront Traffic Study. Congratulations to this group on completing a challenging project with unique and innovative solutions. I’d also like to congratulate the incoming Board for 2020 which includes a fantastic group.

The final scheduled event for 2019 is the Transportation Symposium scheduled for December 11. The daylong session includes varied technical topics which will cater to all types of engineering professionals. Please check out the registration page on the NCITE website for complete information and presentation schedule. This is a great Professional Development opportunity for new or seasoned transportation professionals.

I have really enjoyed my time as NCITE President for 2019. Board Meetings, Committee Meetings, Summer Social, Annual Meeting, and Leadership ITE makes the year fly by. I’m truly thankful to have had the opportunity to work with a great group of Board and Committee members that strive to enhance our members’ experiences. The great ideas and commitment to the organization by these volunteers is truly amazing. Thank you to them all. I’m very much looking forward to seeing what 2020 has in store.

Sincerely,

Jeff Preston
2019 NCITE President
2019 NCITE Transportation Symposium
December 11, 2019
Continuing Education @ Conference Center | St. Paul, MN

If you have an event you would like to promote please reach out to the NCITE Newsletter Editor!

cfalero@srfconsulting.com

For professional development opportunities:
http://nc-ite.org/content.php?page=Professional_Development_Meetings

Upcoming NCITE Events:
http://nc-ite.org/calendar.php
SEPTEMBER SECTION MEETING

The September Section Meeting was held on September 18, 2019 at Lucky’s 13 Pub.

The presenters were Randy Newton, Tom Sachi, and Phil Kulis presenting on Allianz Field Game-Day Traffic Operations. Highlights of the presentation:

- 19,500 capacity across six fairly evenly split modes, with the largest percent using LRT.
- Signal timing is run at PM peak with slight adjustment
- Event parking clears within 45 minutes

OCTOBER SECTION MEETING

The October Section Meeting was held on October 9, 2019 as a joint meeting with ITSO at Coffman Memorial Union on the University of Minnesota Campus.

The presenters was Kristin Carlson of CTS presenting on Multi-Modal Job Accessibility Evaluations. Her presentation focused on evaluation managed lanes on the I-94 corridor between St. Paul and Minneapolis. Highlights of the presentation:

- Adding managed lanes to the I-94 Twin Cities urban corridor improves access to jobs across the metro
- Transit accessibility is affected by the coordination of transfers.
- Accessibility analyses can be applied to transportation infrastructure planning.
ITSO recently held its fall semester tour of the 35W@94 project on October 5th. They were able to tour the project site by bus stopping at several locations along the way to see the project from different locations.

They had 8 members attend and learn more about the large project and all the different types of civil engineers involved.
The YMC got together in September for an upscale evening in the North Loop's Marvel Bar. We filled up two large booths and enjoyed long conversations as a group. We look forward to hosting more events like this in the future. This month we will begin planning for next year's schedule of varied activities.

Unfortunately, due to poor weather on Oct. 12th, our annual Gopher Game and TMC Tour was cancelled. We look forward to bringing this event back next year.

Join the mailing list so you don’t miss out on upcoming activities!!

If you would like to be added to the YMC email list, or know of any new hires/coworkers that would enjoy our events, please send email addresses to
Ellie Lee (elle@alliant-inc.com) or Kristin Carlson (carl4498@umn.edu)
Most public rest areas often only 8 or 10 stalls. Arriving at a parking area only to find no available stalls can require them to drive an additional hour to find the next facility. If the driver arrived close to their HOS limit, searching for parking could put them in violation.

TPIMS counts vehicles at parking facilities and communicates availability through signs, web sites and 3rd party apps. Drivers can then plan their HOS breaks more accurately, resulting in improvements in regulation compliance and safety.

For TPIMS to work, there must be an accurate count of trucks. Depending on how the parking stalls are organized best way to accomplish counting can vary substantially.

In and Out Counting

The most basic way to know the number of vehicles in an area is to simply count them as they enter and leave. A detector, such as an inductive loop can be used at the entrance and exit, keeping the system simple and cost low. A diagram of and in and out system is shown in Figure 1.

While simple, with this method the count of trucks present with tend to “drift” from the true value over time. Occasional detection errors (missed vehicles, “double” counts, etc.) will accumulate over time. Correcting these errors requires a manual count performed by visiting the site or counting through a surveillance camera.

Per-Stall Detection

A more sophisticated approach is to place detection in each parking stall, as shown in Figure 2. Per-stall detection avoids the issue of counts drifting since only occupied spaces provide inputs to the system.
This approach has its limitations, as well. While stalls are defined by striping, trucks must park in them (and over the sensors) to be detected. In bad weather, when striping isn’t visible, or if it’s too small, the vehicle might not be detected. Compared to an in-and-out approach, the hardware needed to monitor each stall is substantially greater, which increases costs and complexity. Dealing with potential “missed” vehicles can still require a manual verification of occupancy.

**Occupied Volume Detection**

Rather than depend on devices to detect individual vehicles, the Kansas DOT chose a solution based on video processing and 3D modeling to identify available parking spaces. This approach has several advantages:

- Counts of arrivals and departures aren’t used, so it can’t suffer from ‘drift’ in accuracy.
- ‘Disciplined’ parking in defined, striped stalls isn’t needed, allowing unmarked, linear parking bays to be used
- Vehicles of any size can be accommodated, with the system assessing the size of unoccupied volumes and calculating available parking dynamically.

As shown in Figure 3, the occupied volume approach uses several camera arrays to map the 3D volume of the parking area. From this model the length of unoccupied volumes computed. A minimum length needed to park a truck (typically 90 feet) is assumed, and the available spaces are calculated.
This approach is more hardware intensive than detection-based solutions. Generally, a minimum of two camera stations with three cameras each will be needed (Figure 4). Larger parking areas may require additional stations. Processing the images from the cameras is also compute-intensive, and a dedicated computer is needed for each site.

Since accuracy is a key to making TPIMS useful for drivers, how well does the 3D volume approach work?

In short, not perfect, but pretty good.

MAASTO established an 85% accuracy target for the participating states. In Kansas, an initial 18 truck parking areas had the detection system installed, with two more added the following year. Each system constructed as part of the project makes regular, weekly accuracy checks of each site. With over a year of data for the initial 18 sites, a clear picture of system accuracy is emerging.

Figure 5 shows that all sites consistently meet or exceed the 85% accuracy target. No significant variations in accuracy have been observed due to seasonal or time of day conditions. System reliability have been encountered that were not due to a hardware failure. These have included camera mounts that have moved and one failed PTZ mechanism in a camera.

There are some variations in accuracy, however. These have sporadically caused accuracy to dip below the 85% threshold for some sites. Lighting issues are the most frequent cause, with strong reflections on wet pavement and vehicles parked beyond the illumination cones of rest area lighting presenting challenges.

Summary

Overall, the video-based 3D modeling approach has been shown to be a reliable and accurate way to determine parking availability in both disciplined parking areas with defined parking stalls and for parking areas that don’t explicitly define where each truck should park.

Although the system is more hardware intensive and requires good data communications between the cameras and image processors, it doesn’t require any manual corrections or resets, minimizing on-going labor costs.

For more information, see [www.trucksparkhere.com](http://www.trucksparkhere.com)
TECHNICAL COMMITTEE UPDATE

Geometric Design Technical Committee
Committee Chair: Thomas Jantscher - tjantscher@hrgreen.com
Recent Agenda Items: Will Stein, FHWA & Vic Lund, St. Louis County – Continuous Green T Intersections (Joint meeting with ITCC).
Future Agenda Items: TBD
Next Meeting: TBD

Intersection Traffic Control Technical Committee
Committee Chair: Philip Kulis - PKulis@srfconsulting.com
Recent Agenda Items: Will Stein, FHWA & Vic Lund, St. Louis County – Continuous Green T Intersections (Joint meeting with GDC).
Future Agenda Items: Clearance Intervals, Synchro, and ATMS
Next Meeting: TBD in December

ITS Technical Committee
Committee Chair: Todd Olson - tolson@alliant-inc.com
Recent Agenda Items: MnROAD Automated Truck Project by Mike Kronzer of MNDOT Cav-X on Oct 1, 2019.
Future Agenda Items: TBD
Next Meeting: TBD

Pedestrian and Traffic Safety Technical Committee
Committee Chair: KC Atkins - katkins@tooledesign.com
Recent Agenda Items: Brainstorming future meeting ideas and identifying topic champions.
Future Agenda Items: Equity in Street Design
Next Meeting: TBD in December

Planning Methods and Applications Technical Committee
Committee Chair: Krista Anderson - kanderson@srfconsulting.com
Future Agendas Items: Updated ABM Regional Network status, STOPS modeling.
Next Meeting: TBD

Traffic Operation and Maintenance Discussion Group
Committee Chair: Adam Bruening - adam.bruening@co.washington.mn.us
Recent Agenda Items: Round table.
Future Agenda Items: TBD
Next Meeting: TBD

Simulation and Capacity Analysis Technical Committee
Committee Chair: Justin Sebens - isebens@srfconsulting.com
Recent Agenda Items: RDV Systems presentation on lessons learned incorporating VISSIM into the visualization workflow
Future Agenda Items: TBD
Next Meeting: Wednesday December 11th, 1:00pm – 3:00pm, Waters Edge 403.
An ongoing challenge for traffic engineers is ensuring that roadway pavement markings in their jurisdiction remain effective. The goal of effective pavement markings for roadways – good visibility for improved safety – relies on a combination of factors, but especially the use of materials with “retroreflective” properties. A retroreflective surface reflects light back to its source with a minimum of scattering, accomplished by incorporating glass beads or prisms into the material.

Historically, transportation departments have relied on subjective evaluation of reflectiveness based on visual nighttime inspection procedures and, more recently, field measurement of the retroreflectivity of markings, using hand-held devices. Larger departments of transportation may use a blanket replacement approach and routinely replace all pavement markings in a corridor, regardless of actual condition, based on the expected service life of the material used.

However, tight maintenance budgets in many departments have led to a more involved process for pavement marking management. Staff visually examine the reflectiveness of the lane striping, noting stretches of roads that aren’t meeting expectations and estimating the remaining service life of those areas, then prioritizing those with deficiencies to determine when new striping will be required. This is especially important where heavy snow maintenance activities can reduce service life, leading to extensive restriping each year.

One technology that simplifies the process of evaluating lane striping is the mobile reflectometer.

While retroreflectivity devices have been around for a while, the latest advancements have made performing retroreflective testing of roadway markings a lot quicker, easier, and safer. This may be why, in recent years, state agencies have been adding progressively more specifications and requirements for retroreflectivity testing for both existing and newly constructed roads.
The capabilities of mobile retroreflectivity devices have also improved. The latest equipment, which attaches to the side of any vehicle, takes 400 scans per second, and can be used while driving posted speeds. It uses laser-based optics (a laser-diode based system) to measure the reflectiveness of pavement markings as the vehicle drives over them – recording data on a USB stick for immediate viewing on a laptop, tablet or smartphone. Workers stay off the road and safely in their vehicle.

In keeping with standard methods, such as ASTM E 1710 (Standard Test Method for Measurement of Retroreflective Pavement Markings Materials with CEN-Prescribed Geometry Using a Portable Reflectometer), the pavement marking retroreflectivity is measured at the standard 30-meter geometry, the equivalent of a person viewing the material from 30 meters away, and the results are expressed in units of millicandelas per square meter per lux (mcd/m²/lx). The device measures double lines individually, at the same time, with separate retroreflectivity values given for each. This means that only 3 passes are needed to cover markings on a typical two-lane highway (scanning each side and the centerline).

The latest models measure the width of each stripe, as well as the width of the retroreflective surface within each stripe (which can vary) and also calculate the amount of contrast between stripe color and pavement color. Some devices also calculate the nighttime “perceived” pavement marking line width. Any retroreflective raised pavement markers (RPMs) are also recorded.

Not only has the measurement capability improved, newer devices take HD video of the road surface, allowing visual examination of specific areas for conditions that may have affected readings. A built-in auto-positioning system provides continuous measurement and geometry management. The devices even generate KML files compatible with Google Earth so the data can be viewed on an interactive map. These devices function day or night, under humidity levels of up to 95% and temperatures between 20° F and 122°F.

The cost of owning a mobile retroreflectivity device may be prohibitive for small transportation agencies, but consultants do offer this service and can even combine it with broader pavement condition surveys. Either way, being able to quickly survey and measure current conditions of striping will help prioritize re-work and stretch the maintenance budget.

Budget concerns aside, by maintaining clearly marked and highly visible lanes and shoulders, agencies help reduce run-off-road and opposite-direction crashes. Likewise, line visibility will be extremely important as more connected and autonomous vehicles hit the road because they rely on machine readings of pavement markings to guide the vehicle. The use of mobile retroreflectivity devices to effectively, efficiently and safely assess retroreflectivity conditions is a sound solution for transportation agencies and a trend that is here to stay.
Maintenance of Traffic Key to Success of Major Interstate Upgrade

Joseph M. Weaver, PE | TKDA

Interstate 35 in the city of Columbus, Minnesota, has long been subject to frustrating gridlock on summer weekends for Twin Cities residents heading to and from the cabin. That stretch of interstate, which lies just north of I-35W and I-35E Split, accommodates an average of 82,000 vehicles each day. On a typical weekday morning, traffic on Highway 97 snakes a mile or more through Forest Lake as westbound commuters wait to access the freeway; in the afternoons, vehicles exiting I-35 clog northbound freeway through lanes.

Aging bridge infrastructure, drainage problems, traffic congestion, and anticipated growth in the northeast Twin Cities metropolitan area led the Minnesota Department of Transportation to seek federal and state funding to construct its 6-mile I-35 North Metro Split resurfacing and bridge replacement design-build project, slated for completion this fall. A key improvement is the replacement of the congested, structurally deficient TH 97/CSAH 23 bridge with a diverging diamond interchange (DDI) to reduce the number of conflict points and crashes in the area. Other improvements include a new I-35W flyover bridge to replace the bridge over I-35E; the reconstruction of the TH 8 interchange bridge over I-35, including a new loop to southbound freeway lanes to facilitate the future expansion of the interchange; and raising the freeway profile to address drainage problems.

MnDOT’s primary goals for the two-year project emphasized the safe and efficient movement of traffic through the corridor and the minimization of impacts to local traffic. To achieve these goals, MnDOT identified a minimal number of open thru-lanes required in each direction for each segment of the project. Primary contractor Shafer Contracting Co. and lead designer TKDA generated a Maintenance of Traffic (MOT) Plan that exceeded MnDOT’s specified minimum number of thru-lanes in each of these roadway segments in each construction year.
Over the course of the project, the Shafer team’s MOT Plan provided a cumulative total of 18 more thru-lane segments, or Value-Added lanes. This approach also reduced the duration of head-to-head traffic configurations.

In 2018, construction was confined to the area north of the TH 97/CSAH 23 interchange and included the north half of the new DDI structure. This allowed time to surcharge embankments at both the I-35W flyover bridge approach and the TH 8 interchange.

In Substage 1A, northbound I-35 traffic was carried on the inner freeway lanes — one lane on the west side of the median and one on the east side — while the outer northbound lanes were built; in Substage 1B, northbound I-35 traffic was shifted to the newly paved outer lanes while construction of the inner lanes was underway. This made it possible to provide an extra southbound thru-lane during that stage of construction.

In Substage 2A, southbound I-35 traffic was carried on the inner freeway lanes — one lane on the east side of the median and one on the west side — while the outer southbound lanes were constructed. Southbound traffic was shifted to the new, outer lanes in Substage 2B while the inner lanes were built. A similar MOT approach was used in 2019 south of the TH 97/CSAH 23 interchange.

The project team was also able to avoid the complete closure of TH 97/CSAH 23 and eliminate lengthy detours by improving the bridge design profile; eastbound and westbound traffic was maintained on the south half of the existing bridge while the north half of the new bridge was constructed in 2018. In 2019, traffic was shifted onto the north half of the new bridge to make way for construction of the south half. The alignment of the new I-35W flyover bridge was shifted to keep traffic moving on the old bridge during construction.
MnDOT approved several project alternative technical concepts (ATC’s) proposed to reduce congestion, enhance motorist and worker safety, and improve the construction schedule. Bituminous millings were used on-site in various ways to reduce haulage quantities, including as a substitute for various aggregate and granular materials. Trenchless construction using resin-impregnated glass reinforced cured-in-place pipe to rehabilitate existing drainage piping largely eliminated the need for open-cut construction. Reductions in truck trips to and from the site meant fewer merges and reduced emissions, noise, and dust.

Additional project features to enhance motorist safety included increased widths for temporary shoulders; designation of emergency pull-off sites; portable changeable message signs and an intelligent work zone traffic responsive queue warning system; and temporary raised pavement markers at all temporary mainline and ramp crossovers.

When it is completed, the project will have a significant positive impact on the critical, high-traffic I-35 Corridor by providing smoother pavement, improved safety, and better traffic flow.
ITE LOL

Construction Cha-Cha

♪♬ To the left!
Take a detour y’all
Road closed this time!
Right lanes, 2 closed
Left lanes, 2 closed
FREEEEEZE!
Everybody traffic jam!♬♬

Source: imgur
MEMBERSHIP UPDATE

New Members
Mohsen Alibrahim – Minnesota State University

Ethan Bialik – SRF Consulting Group, Inc.

Girma Feyissa – Minnesota Department of Transportation


Jennifer Jordan – City of Brooklyn Park

Lucas Ryan Van Eps – Dordt University

Bryce W. Statz – Kimley-Horn

Jiang Xie – WSB

Moves
Jacob Rojer, Kimley-Horn, formerly Spack Consulting

Kris T. Liljeblad, City of Duluth, MN Planning & Economic Development Department, formerly Retired

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