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MESSAGE FROM THE (PAST) PRESIDENT

Hello ITS Texas Members and Friends,

Thank you for all you have done for our efforts to increase safety and mobility through ITS. As we look forward to the future, we continue to see new innovations and technologies from researchers, vendors, and agencies. We are excited to keep you updated in this newsletter to what is going on in the industry. In addition, we are looking forward to another in person meeting with all of you this September in San Marcos. There we will have presenters across all spectrums to keep us all informed and learning how to apply the best in class to what we do.



See you there,

Joe



MESSAGE FROM THE PRESIDENT

ITS Friends and Members –


Well, the dog days of summer are definitely with us this year so hopefully you're all staying safe and hydrated. Coming to Central Texas in September might seem counter-intuitive but we promise to keep you cool, entertained and educated at the 2022 Annual Meeting in San Marcos! Because it's so early this year we won't be offering a standalone summer training workshop, but as usual for the Annual Meeting, we will have a class the day before on Wed 9/28 followed by a terrific social event that evening, then a great meeting Thu-Fri 9/29-30.

Your response to the Call for Presentations was perhaps too good – we're still sorting out how many we can provide time for! And this year we're expanding the technical toolbox to be a full-audience Vendor Showcase where your company has an opportunity to make a succinct (45 seconds) verbal presentation about your firm, products, and/or services you are featuring at this year's meeting. See details and how to participate on the meeting registration website.

Speaking of registration website, the event page is now live so please go to the [ITS Texas website](#) immediately to register! And be sure to reserve your hotel room as noted below.

We look forward to seeing you in September!

– Alex



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2022 ITS TEXAS ANNUAL MEETING – SEPTEMBER 28-30

ITS Texas is looking forward to holding the 2022 ITS Texas Annual Meeting in San Marcos. It's earlier than typical for us due to limited hotel availability as the world returns to in-person gatherings.



Vendors – as always, we need your support to make this a successful meeting. The vendors provide a tremendous amount of information, knowledge and experience in addition to all of the presentations given at the Annual Meeting. See the meeting website to register for an exhibit booth and to sign up to speak at the Vendor Showcase.

Wednesday Training (Sept. 28) – as we typically do, ITS Texas will offer a training session on the first day of the meeting. We're pleased to announce that Nader Ayoub of Iteris will be providing insights, experiences and outcomes regarding *Diamond Interchange Operations*. Discussion of operational and design considerations will look at standard diamond interchanges using traditional 4-phase and 3-phase operation and will also look at alternative designs such as diverging diamond interchange (DDI) and displaced left turn operation. A more detailed description is on the meeting registration site.

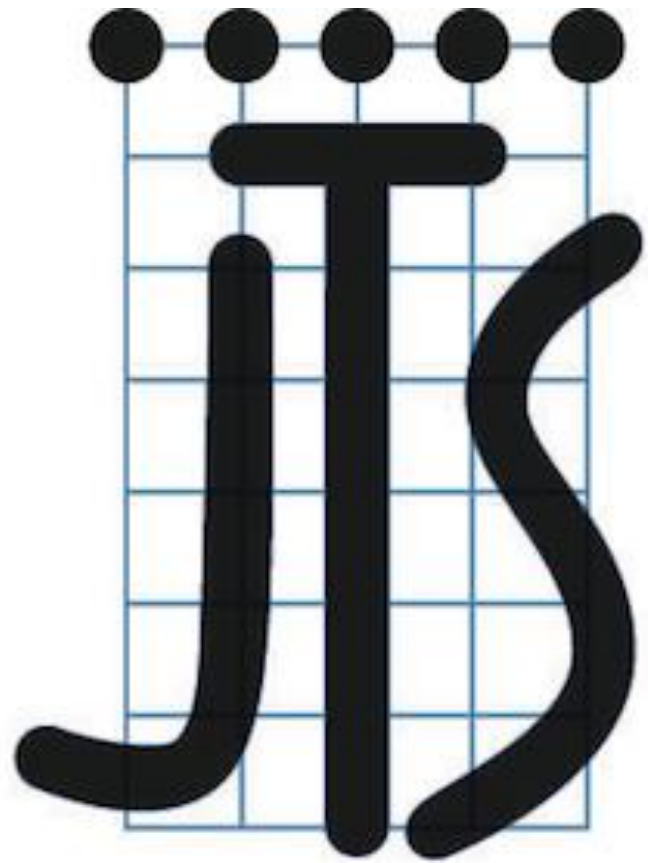
But the Annual Meeting is not just all about education, business and networking – we like to have a little fun too!!! On Wednesday we will have our Social Event at EVO Entertainment at 1180 Thorpe Lane just three exits down the road on IH 35. Sign up your team of 4 for our bowling tournament and compete for the bragging rights of the best bowlers in ITS Texas! There is no additional fee to attend this event which will include a buffet, pool tables, bowling and lounges – all reserved just for ITS Texas; EVO also has dozens of video games for you to conquer just on the other side of our velvet ropes. Come enjoy some time with friends and colleagues and start the Annual Meeting off right!

Make your reservations now as ITS Texas has reserved a limited number of rooms at the Embassy Suites. The meeting promises to be exciting with dynamic speakers, an informative ITS-related workshop, and a fun evening of networking and socializing. **We look forward to seeing you September 28-30 in San Marcos! Reserve your room now by going to the ITS Texas website. Make sure you use the group code "ITS".**

2022 ITS TEXAS SCHOLARSHIPS APPLICATIONS

Applications for ITS Texas Scholarships are now being accepted. Every year ITS Texas provides scholarships to deserving graduate students at Texas colleges and universities who are pursuing educations in fields which contribute to ITS. Applications can be submitted thru the ITS Texas Website in our scholarship application [link](#). Feel free to reach out to our scholarship coordinator [Minh Le](#) with any questions about the process. Scholarships will be awarded at the Business and Awards Luncheon on Sept. 30.

In the meantime, we need two **member volunteers to join our Scholarship Committee** to make it all happen! Volunteers must be a current ITS TX member and cannot be associated with a candidate graduate student at any college or university in the State of Texas. This is a great opportunity to get involved with the Board get to know and make a difference in developing the next generation of ITS industry leaders! Please let Minh Le at <mailto:scholarships@itstexas.org> know if you are interested in joining the ITS Texas Scholarship Committee.



TWINCREST



TECHNOLOGIES

ITS WORLD CONGRESS IN LOS ANGELES – SEPTEMBER 18-22, 2022

The ITS World Congress will be held September 18-22 at the Los Angeles Convention Center. It is the premier event for Intelligent Transportation Systems (ITS) around the world. Each year, industry stakeholders, including policymakers, OEM's, entrepreneurs, researchers, academics, investors, and other leaders gather in North America, Europe, and Asia-Pacific on a rotating basis. The ITS World Congress features live education sessions in which industry experts present the latest developments in ITS, tours and demos that showcase cutting-edge technology in action, multiple networking events, and a comprehensive expo floor.



More details to come on the ITS World Congress [website](#).

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ITS AMERICA COMING TO TEXAS – APRIL 22-24, 2023

ITS America will be bringing their Annual Meeting to Texas on April 22-24, 2023. This event will be held at the beautiful Gaylord Texan Resort and Conference Center.

Be sure to mark your calendars for these exciting upcoming events and keep an eye out for more details to come!

More details to come on the ITS America [website](#).



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WRITE AN ARTICLE FOR THE NEWSLETTER

The ITS newsletter is a great way for you as an ITS professional to **share your projects, plans, initiatives or other ITS related items with the ITS community**. If you would like to share something with the ITS Texas members through the newsletter, please contact any of your ITS Texas Board members. They are listed in the newsletter and you can send an email to any by simply clicking on their name.

SAFE OPERATIONS AT ROADWAY JUNCTIONS – DESIGN PRINCIPLES DRAWN FROM AUTOMATED GUIDEWAY TRANSIT

Introduction – The complexity of major roadway signalized intersections within an urban area can be quite challenging when automobile, pedestrian/bicycle, and transit modes are all vying for right of way, and even more so when adding automated/autonomous vehicles¹ (AVs) to the mix. Even without automated vehicles, about 36% of collisions occur at intersections, with most occurring upon left turns (22.2%) or crossing over (12.6%), and only a small percentage (1.2%) while turning right at an intersection. Of this 36%, about half (52.5%) of those vehicles were traveling through a signalized intersection.² AV operation for the purpose of public transportation must operate safely in dense urban districts where their services are needed most, while mitigating any crash hazards. The authors have proposed in a paper³ recently published in the *SAE International Journal of Advances and Current Practices in Mobility* that safely navigating such complexity calls for enhanced roadway infrastructure. It is asserted that advanced sensing technology combined with digital communications is necessary not only to enable safe AV operations in dense urban environments, but also to address current safety issues with conventional traffic. Given this high number of collisions that occur at intersections—with failure to yield being the primary cause of crashes—intersection safety that provides an additional layer of protection from vehicles that fail to yield is critical for effective AV deployment.

Application of AGT Principles – Precedent for such functionality is available from over 50 years of fully automated guideway transit (AGT) systems installed at airports and major activity centers, and such driverless transit systems are now deployed on a regional scale in many locations worldwide. AGT systems provide an essential point of reference with respect to functional safety for AV roadway transit systems and other similar managed AV fleets, whether operating in fixed routes or on-demand services. Ultimately, the AV fleet operations within dense urban settings will be automated to a level like that of modern AGT systems. These urban settings are referred to throughout this article as “automated mobility districts” (AMDs). To accomplish this level of automation, the AV fleets of driverless vehicles would have fleet management personnel remotely monitoring the continuous activity of potentially hundreds of vehicles, especially when operating in mixed traffic.

For urban areas in which multiple AV service fleets are operating within a common region or district, an “AMD system-level” safety design is needed to safely deconflict the various turning movements at complex intersections. Digital bidirectional communications, commonly referred to as vehicle-to-infrastructure (V2I) subsystems, are essential to the provision of safe operations for AV fleets by alerting AVs to situations where another vehicle is failing to yield and thus presenting a crash hazard. This concept—referred to as safety-affirmative signaling—can be extended to traditional traffic as well, helping to mitigate the rash of crashes that now plague our system. The required framework for safe roadway junctions can draw key principles from AGT fixed guideway transit systems to greatly enhance safe passage of any vehicle, whether automated or not.

To deconflict turning maneuvers at complex roadway junctions where AVs must interact with each other and with vulnerable road users, the required sensing and communications are comparable to the

¹ The term “automated/autonomous vehicle” (AV) as used here refers to the class of automation described in the SAE ITC Automated Vehicle Safety Consortium’s lexicon AVSC00002202004. This *AVSC Best Practice for Describing an Operational Design Domain: Conceptual Framework and Lexicon* specifically addresses a managed fleet operation of automated driving system dedicated vehicles (ADS-DVs) with SAE Level 4 high driving automation.

² U.S. Department of Transportation National Highway Traffic Safety Administration. 2010. *Crash Factors in Intersection-Related Crashes: An On-Scene Perspective*. Washington, D.C.: NHTSA. DOT HS 811 366. <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811366>

³ J. Lott, S. Young, and L. Zhu. 2022. “Safe Operations at Roadway Junctions - Design Principles from Automated Guideway Transit.” *SAE Int. J. Adv. & Curr. Prac. in Mobility* 4 (1): 260–269. <https://doi.org/10.4271/2021-01-1004>

functional safety of AGT command and control systems. At each guideway junction in an AGT system, dedicated safety-critical equipment is employed, combined with a dedicated communications system. The discussion below further describes this infrastructure-based safety subsystem, referred to as junction “interlocking,” with comparisons to the roadway equivalents needed to protect AVs.

Functional Comparison of Automatic Train Control Systems with AV Fleet Systems – For AGT systems, a modern automatic train control (ATC) system is described in the IEEE 1474 standard for communications-based train control (CBTC). Through this and other standards, the internationally accepted functional definition of an ATC system is to “control train movement, enforce train safety and direct train operations.” The subsystems comprising the overall ATC system are shown on the right in **Figure 1**. The train control equipment of particular interest is the subsystem dedicated to functional safety that protects guideway junctions—highlighted in the figure by the term “interlocking.” Every guideway junction, whether a complex crossing junction or a simple merge point, is protected from unsafe incursion of any automated vehicle/train by this standardized feature of junction interlocking.

A set of functional AV subsystems defining AV fleet operations is shown on the left side of the figure, aligning with the comparable AGT’s CBTC subsystems. This comparison of CBTC with the concept of a fully automated AV fleet acknowledges that any given fleet can be unique with respect to its vehicle platform, automated driving system (ADS) technology and communications methods, and operational management system necessary to implement overall automatic fleet operations.

This direct comparison of CBTC’s fully automatic train control with the subsystems within an AV fleet operations control system highlights two critical missing elements. First is that of compatible (standard) communications among and between all fleet vehicles and with infrastructure, and second that of infrastructure that is “intelligent” in terms of spatial sensing and perception that is inclusive of all traffic modes. These two elements, which combined facilitate the signaling to each vehicle by the infrastructure-specific directives of whether to proceed or yield when passing through roadway intersections, is analogous to the guideway transit’s “interlocking” functions.

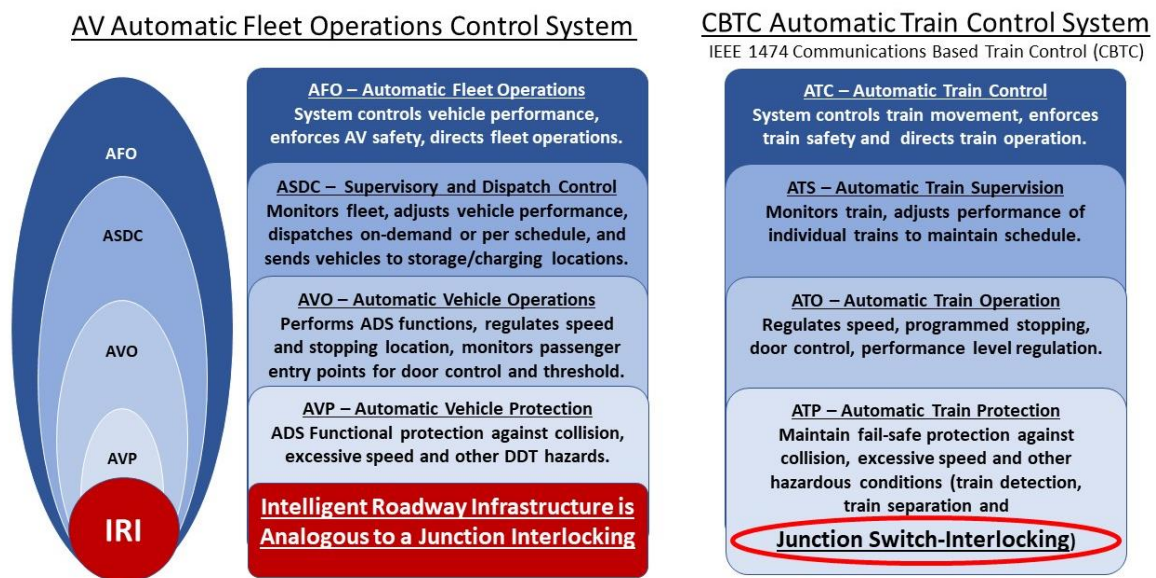


Figure 1. Functional subsystems of the combined in-vehicle ADS, emergency braking systems, and CV communications with ITS infrastructure equipment/systems

SAE International has developed a principle referred to as “cooperative driving automation” (CDA) that begins to acknowledge the needs for such subsystem functionality when AVs are responding to roadway infrastructure directives. Specifically, the principles for CDA, codified in SAE J3216, define automation based

on machine-to-machine communication that enables cooperation among two or more entities with capable communications technology. SAE J3216 discusses features related to a “cooperative traffic signal,” with an example given of cooperation between what it calls highly automated “ADS dedicated vehicles” and roadway junction infrastructure to facilitate safer, more efficient movement of road users.

The Concept of an IRI Intersection – The comparison between critical safety functions of intelligent roadway infrastructure (IRI) with guideway transit CBTC automated systems is critical to protecting roadway junctions. It is proposed that within dense urban environments with complex roadway junctions, a safety management approach utilizing dedicated safety systems to protect roadway junctions be accomplished with infrastructure-based advance sensing and artificial intelligence perception technologies similar to those enabling Level 4 driving automation ADS vehicle technology. This IRI should employ local, hardened, and standardized communication systems to protect the intersections and all its users, analogous to CBTC “interlocking.” This requires that the infrastructure’s perception and control at the roadway intersections be cooperatively used by all AV fleet vehicles operating within an AMD, including a common communications protocol and intersection safety “command and control” protocols.

This would greatly enhance safety not only for AVs, but also all conventional traffic, as the IRI for each intersection would monitor movements of all vehicles, pedestrians, and other active transportation users. IRI would perceive the trajectories and forecast probable movements of all vehicles and vulnerable road users to give directives to AV fleet vehicles (as well as appropriately equipped, connected conventional vehicles) such that the risks of crashes or pedestrian/bicyclist accidents would be mitigated. As with CBTC, AV fleet vehicles could not, under their own volition, violate the signals within the zone of the IRI system. The IRI system would not only signal a “green light” condition (as with existing signal phase and timing messages), but also affirm that no other vehicle is impending on the intersection in an unsafe manner that would create a hazard to the AV fleet vehicle. In addition, the overall efficiency of operations could be managed to improve energy use and lower emissions of fleets at that location.

When operating in multimodal urban environments, incidents such as pedestrian/bicycle/scooter incursion commonly occur in disregard to the pedestrian crosswalks and the associated signal timing. This is exacerbated by the inability of AVs to “see around corners,” being limited to line of sight with respect to onboard sensing. The infrastructure-based sensors and perception system would be better suited for detecting and communicating hazardous incident conditions within the intersection domain. The authors believe that IRI roadway junction protection is essential for high-performance, safe operations when multiple fleets of Level 4 ADS dedicated vehicles are deployed for public mobility purposes.

Junction Safety with Multiple AV Fleets in Service – The concentration of AV operations that include multiple managed fleets (transit, delivery, and on-demand car services) will typically occur in the coming years within dense urban environments (i.e., AMDs). By integrating this IRI technology application across these multiple AV fleets, the concept of roadway junction “interlocking” functionality will be accomplished through a “system-of-systems” safety design. The resulting safety-affirmative signaling will apply equally to AVs and conventional vehicles, and potentially to pedestrians and other vulnerable roadway users as they move across vehicular lanes within the intersection. This real-time monitoring of all vehicle and pedestrian movements in all approaches will provide enhanced command and control across multiple AV fleet vehicles operating within each roadway intersection while allowing the highest reasonable operating speeds to be safely maintained.

This is the first of a two-part series by J. Sam Lott of Automated Mobility Systems, LLC. The second part will be featured in a future newsletter and will discuss a framework, architecture, and supporting technology to implement intelligent roadway infrastructure, as well as the reliability of detection.



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Newsletter	3.5"x2"	Logo	\$ 50	\$ 125	\$ 125	\$ 200
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