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Databases: Google Scholar, ScienceDirect, SAGE, Taylor & Francis, Springer, TRID.

Search Terms: Traffic signals, Intersection, signalised intersection, high speed roads, road safety, crash risks, crash types, pedestrian safety, cyclist safety, speed zones, highways, motorways, traffic signal installation, traffic signal management, urban roads, traffic signal control.

1. A full Bayes before-after study accounting for temporal and spatial effects: Evaluating the safety impact of new signal installations

Sacchi, E., Sayed, T., El-Basyouny, K., Publication date: September 2016
Accident Analysis & Prevention, 2016, Vol. 94, pp. 52-58

Recently, important advances in road safety statistics have been brought about by methods able to address issues other than the choice of the best error structure for modelling crash data. In particular, accounting for spatial and temporal interdependence, i.e., the notion that the collision occurrence of a site or unit times depend on those of others, has become an important issue that needs further research. Overall, autoregressive models can be used for this purpose as they can specify that the output variable depends on its own previous values and on a stochastic term. Spatial effects have been investigated and applied mostly in the context of developing safety performance functions (SPFs) to relate crash occurrence to highway characteristics. Hence, there is a need for studies that attempt to estimate the effectiveness of safety countermeasures by including the spatial interdependence of road sites within the context of an observational before-after (BA) study. Moreover, the combination of temporal dynamics and spatial effects on crash frequency has not been explored in depth for SPF development. Therefore, the main goal of this research was to carry out a BA study accounting for spatial effects and temporal dynamics in evaluating the effectiveness of a road safety treatment. The countermeasure analysed was the installation of traffic signals at unsignalized urban/suburban intersections in British Columbia (Canada). The full Bayes approach was selected as the statistical framework to develop the models. The results demonstrated that zone variation was a major component of total crash variability and that spatial effects were alleviated by clustering intersections together.
Finally, the methodology used also allowed estimation of the treatment’s effectiveness in the form of crash modification factors and functions with time trends. (TRID)

2. Arterial road speed reduction program – Springfield Road, Kelowna, BC

Dean, D., Tripathi, M.

Springfield Road in Kelowna, BC by 2011 had become one of the community highest collision frequency corridors over the past decade. Analysis of the types of collisions occurring at the corridor intersections indicated an over-representation of collision types associated with excessive speed. Speed studies were conducted that identified an 85 percentile speed of 71 km/h on this corridor that is posted at 50 km/h. These results reflected the growing number of complaints from area residents regarding unsafe speeds. Springfield Road is a four-lane arterial roadway with bike lanes and sidewalks on both sides. It is a key commuter route into the City Centre, but also serves local access as residential lands have access onto the roadway. The multi-function needs of the corridor increases the importance of compliance to appropriate posted speeds. It was understood that a concerted effort utilizing a ‘5E’ approach – Engineering, Encouragement, Education, Enforcement and Evaluation – was needed to reduce speeds. A working group of City staff, RCMP, and the Insurance Corporation of British Columbia (ICBC) was struck to develop an Integrated Speed Reduction Plan. The program results highlight how driving behaviour be influenced by coordinating efforts of partnering agencies and integrating speed reduction strategies. All measures are highly visible and have reduced the frequency of complaints from area residents. Implementation of the 5E measures has resulted in a 7% reduction of the 85th percentile speeds and 8% reduction in 50th percentile speeds. The speed reductions have been sustained over the past three years. Future evaluation will include the continuation of corridor speed monitoring. In addition, an evaluation of the impact of the measures on addressing collisions is currently being undertaken by the University of British Columbia-Okanagan and should be available by year end. (TRID)

3. Contributory factors to traffic crashes at signalized intersections in Hong Kong

Wong, S. C., Sze, N. N. & Li, Y. C.
Accident Analysis & Prevention, 2007, Vol. 39, No. 6, pp. 1107-1113

Efficient geometric design and signal timing not only improve operational performance at signalized intersections by expanding capacity and reducing traffic delays, but also result in an appreciable reduction in traffic conflicts, and thus better road safety. Information on the incidence of crashes, traffic flow, geometric design, road environment, and traffic control at 262 signalized intersections in Hong Kong during 2002 and 2003 are incorporated into a crash prediction model. Poisson regression and negative binomial regression are used to quantify the influence of possible contributory factors on the incidence of killed and severe injury (KSI) crashes and slight injury crashes, respectively, while possible interventions by traffic flow are controlled. The results for the incidence of slight injury crashes reveal that the road environment, degree of curvature, and presence of tram stops are significant factors, and that traffic volume has a diminishing effect on the crash risk. The presence of tram stops, number of pedestrian streams, road environment, proportion of commercial
vehicles, average lane width, and degree of curvature increase the risk of KSI crashes, but the effect of traffic volume is negligible. (ScienceDirect)

4. Dilemma zone protection on high-speed arterials

RiP Project 32778, 2013

Driver behaviour within the dilemma zone can be a major safety concern at high-speed signalized intersections, especially for heavy trucks. The Nebraska Department of Roads (NDOR) has developed and implemented an actuated advance warning dilemma zone protection system. The system continually monitors traffic at an upstream detector as well as at stop line detectors to predict the onset of the yellow indication and provides information to drivers (via flashing signal heads and a warning sign) regarding whether they should be prepared to stop as they approach a traffic signal. The system has been documented as being effective at improving traffic safety at isolated signalized intersections where the controller operates in the fully actuated mode. NDOR is currently considering the feasibility of deploying these devices on its coordinated arterials. One objective of this research is to develop a traffic microsimulation procedure for testing the feasibility of deploying the NDOR actuated advance warning system on coordinated arterials. The calibrated traffic microsimulation model will be used to test potential locations of the upstream detector, durations of the lead flash (amount of advance warning time provided to drivers before the green ends), and the maximum allowable headway at the upstream detector location. This will help establish the sets of design parameters for which the system will be beneficial on coordinated arterials. The findings will be used to develop guidelines for the application of the actuated advance warning system so that NDOR can make more informed decisions about where to deploy the system. (TRID)

5. Evaluation of advance warning signal installation. Phase ii: long-term monitoring

Schultz, G. G., Talbot, E.
UT 08/04, June 2008, p. 151

A driver approaching a signalized intersection where the light has turned yellow must make a decision whether to stop or proceed. A signal that is properly designed will provide an opportunity for a safe and legal manoeuvre. As approach speeds increase, however, it becomes more difficult to execute a safe manoeuvre. One countermeasure that is used to help provide advance warning to drivers of an approaching intersection or the impending signal change at an approaching intersection is an advance warning signal (AWS) system. A number of AWS systems have been installed throughout the country. Four such systems were installed in the state of Utah in 2005. Since that time the effectiveness of these systems has been evaluated as a function of intersection safety. The metrics used for evaluation include crash data analysis, speed distribution analysis, and red-light running (RLR) analysis. The objective of this study is to evaluate and report the long-term effectiveness of the AWS systems installed in the state of Utah in June 2005, particularly at the intersection of Bangerter Highway and 13400 South. The results of the study indicate that overall the AWS system has generally had a positive impact on the community, with positive results noted in all areas of analysis. Given the nature of the study, however, it is difficult to quantify the extent of the overall impact as a function of only the AWS system. (TRID)
6. Evaluation of the scenario coordination module, a traffic network management control system

Wang, Y., Vrancken, J. & Ma, Y.
Research Gate, 2012

The traffic control system called Scenario Coordination Module (SCM) evolved into a network control system, doing control at different levels in the network, in a way in which global scenarios no longer play an important role. This system has been installed in the Amsterdam area since 2010 and is worldwide among the first systems for network control in mixed networks. However, measuring effects of the system is hard. In this paper, we will evaluate the performance of the system by interviewing SCM users and analysing the SCM measurement data. The results show that the SCM is a traffic network management control system with the capability to improve more than 10% of the network-wide traffic flow.

7. Evaluation of traffic control devices: third-year activities

Hawkins Jr., H. G., Sneed, M. A., Williams, C. L.
FHWA/TX-07/0-4701-3, 2007, p. 84

This project was established to provide a means of conducting limited scope evaluations of numerous traffic control device issues. During the third year of the project, researchers completed assessments of three issues: a red border Speed Limit sign, sign and marking design for super high-speed roadways, and a comparison of retro reflectivity measurements made with portable and mobile retro reflectometers. The evaluation of the red border Speed Limit sign indicates that the red border treatment has a beneficial impact on reducing speeds at locations where the speed limit decreases. The researchers recommend using the red border to improve the conspicuity of Speed Limit signs at these locations. On super high-speed roadways, the researchers recommend that the legend on guide signs be a minimum of 22 in. and that an additional guide sign installation be provided in advance of the exit. Furthermore, sign sheeting for overhead signs on super high-speed roads should be limited to sheeting types that will provide adequate luminance. Pavement markings on these highways should be at least 6 in. wide. The researchers found that portable and mobile measurements are consistent with one another if both retro reflectometers are properly calibrated and operated. As part of the third-year activities, the researchers also evaluated lateral spacing for edge line rumble strips on two-lane highways, revised a set of guidelines for conducting a traffic signal warrant analysis, and are developing a handbook that will provide guidance on assessing and addressing the work zone impacts of significant projects. (TRID)

8. Fuzzy sets to describe driver behaviour in the dilemma zone of high-speed signalized intersections

Hurwitz, D. S., Wang, H., Knodler Jr., M. A., Ni, D. & Moore, D.

The Type II dilemma zone describes a segment of road on the approach to a signalized intersection where, if occupied by a motorist presented with the circular yellow indication, is likely to result in a motorist having difficulty deciding to stop at the stop line or proceed through the intersection. This phenomenon results in increased frequency of three failure conditions: rear-end collision at the stop line (excessive deceleration rates), the more severe
right-angle crashes in the intersections, and left-turn head-on collisions (both resulting from incorrect estimates of clearance time). A more effective boundary definition for Type II dilemma zones could contribute to the safe design of signalized intersections. The prevailing approaches to dilemma zone delineation include the consideration of the vehicle’s travel time to the stop line or the driver’s likelihood of stopping at a particular distance from the stop line. The imprecision of the driver’s perception of speed and distance suggest that fuzzy logic may contribute to the identification of the Type II dilemma zone boundaries. A fuzzy logic (FL) model was constructed and validated from driver’s empirically observed behaviour at high-speed signalized intersections. The research resulted in an increased understanding of the phenomenon which, when applied to the timing of signals and the placement of vehicle detection, can improve the overall safety of signalized intersections. (TRID)

9. Intersection crash prediction methods for the highway safety manual

Torbic, D.
RIP Project 37700

Research is needed to expand the range of intersection types addressed in the predictive methods in Chapters 10, 11, and 12 of the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM). These methods address many of the more common intersection configurations and traffic control types, but there are many configurations that still need to be addressed to maximize the utility of the HSM. Intersection types where crashes are more likely should be given priority to be thoroughly addressed. Moreover, the existing methods do not include the ability to predict the change in the fatality and severity distribution as a result of a change in the intersection’s design or traffic control features. Some examples of intersection configurations and traffic control modes that are not currently addressed in the HSM include: intersections with all-way stop control, intersections on high-speed expressways, three-leg intersections on rural highways with signal control, three-leg intersections with a commercial driveway forming a fourth leg, and five-leg intersections. The intersection at a single-point diamond interchange is also not currently addressed. Additionally, the methods do not currently address the crash frequency and severity distribution for intersections located on or near horizontal and vertical curves. Recent research indicates that rural intersection safety is negatively affected by wide medians in higher volume conditions, but positively affected by wide medians in lower volume conditions. This sensitivity is not included in the current HSM predictive methods for intersections. The method should provide information useful to the planning and design of streets and highways and should be sensitive to a wide range of intersection design elements and traffic control features. The objective of the research is to develop a set of crash predictive models consistent with existing methods that are comprehensive in their ability to address a wide range of intersection configurations and traffic control modes in rural and urban areas. The focus should be to: (1) address intersection configurations and traffic control types not currently addressed in the HSM and (2) develop supplemental models for predicting the severity distribution as a function of geometric design elements and traffic control features. (TRID)
10. Improving pedestrian safety at unsignalized crossings
Fitzpatrick, K., Turner, S. M., Brewer, M., Carlson, P. J., Ullman, B., Trout, N. D.
TCRP-NCHRP Report, 2006, p. 109

This report will be of interest to state, county, and city traffic engineers; transit agencies; roadway designers; and urban planners, as well as consultants for these groups and agencies. This material provides considerable information and useful guidance for improving pedestrian safety at unsignalized crossings. The report presents the edited final report and Appendix A, Guidelines for Pedestrian Crossing Treatments. Appendixes B through O of the contractor's final report are contained in TCRP Web-Only Document 30/NCHRP Web-Only Document 91, available on the CRP website. The objectives of the research were to (1) recommend selected engineering treatments to improve safety for pedestrians crossing high-volume and high-speed roadways at unsignalized locations, in particular those locations served by public transportation, and (2) recommend modifications to the Manual on Uniform Traffic Control Devices (MUTCD) pedestrian traffic signal warrant. (TRID)

11. Information dynamics in transportation systems with traffic lights control
Litescu, S. C., Viswanathan, V., Aydt, H., Knoll, A.
International Conference on Computational Science (ICCS 2016), 2016, pp. 2019-2029

Due to recent advanced communication possibilities between traffic infrastructure, vehicles and drivers, the optimization of traffic lights control can be approached in novel ways. At the same time, this may introduce new unexpected dynamics in transportation systems. The authors' research aims to determine how drivers and traffic lights systems interact and influence each other when they are informed one about another's behaviour. In order to study this, the authors developed an agent based model to simulate transportation systems with static and dynamic traffic lights and drivers using information about the traffic lights behaviour. Experiments reveal that the system's performance improves when a bigger share of drivers receives information for both static and dynamic traffic lights systems. This performance improvement is due to drivers managing to avoid stopping at red light rather than adapting their speed to different distances to the traffic lights systems. Additionally, it is demonstrated that the duration of the fixed phases also influences the performance when drivers use speed recommendations. Moreover, the results show that dynamic traffic lights can produce positive effects for roads with high speed limits and high traffic intensity, while in the rest of the cases static control is better. The findings can be used for building more efficient traffic lights systems. (TRID)

12. Investigating the impacts of green signal countdown devices: empirical approach and case study in China
Ma, W., Liu, Y., Yang, X.

This paper presents an extensive investigation regarding the impacts of green signal countdown devices (GSCD) on the intersection safety and efficiency, based on field observation of critical driver and vehicle related parameters at two similar intersections (one with GSCD and the other without GSCD) in Shanghai. Statistical analysis results have revealed that the installation of GSCD can (1) encourage drivers to pass the stop-line during the amber time with higher speeds and thus result in better utilization of the amber time and
13. Influence of traffic signal location on driver braking manoeuvres at urban signalized intersections: lessons from a Korean Case

Transportation Research Board 88th Annual Meeting, 2009, p. 14

At signalized intersections, many accidents can be ascribed to inappropriate driver braking manoeuvres taking place under the influence of intersection layout characteristics such as the location of traffic signals. Decisive directions for locating traffic signals, however, cannot be found in current road design guidelines as empirical evidence is lacking. This paper provides much-needed insight into the impact of traffic signal location on driver braking manoeuvres based on data collected during an experimental test of bringing traffic signals closer to the stop line in Jeon-ju City, Korea. The study encompasses analysis of three facets: (1) stop line crossing behaviour in yellow and red time, (2) braking point behaviour defining the magnitude of driver braking manoeuvres, and (3) formation of driver behaviour manoeuvres versus vehicle speed. In addition, a safety margin concept is introduced to analyse the impact of traffic signal location on driver braking manoeuvres in terms of safety. The findings support the assumption underlying the study: traffic signal location does influence driver behaviour in various ways, while traffic safety at signalized intersection approaches in urban areas can be improved by bringing traffic signals closer to the stop line. For better practicability of these findings, the paper closes by formulating guidelines that can support decision makers involved in traffic signal installation at four-legged signalized intersections in urban areas. (TRID)

14. Impact of some site-specific characteristics on the success of the signalization of high-speed intersections

Stout, T. B., Souleyrette, R.  
CTRE Project 05-236, 2008, p. 30

The conversion of two-lane roadways to four-lane, divided expressways has become a common solution to the need for high-speed, higher capacity travel between rural and suburban communities. As traffic volumes increase on these facilities there are seemingly inevitable increases in intersection crashes. A frequently proposed solution to intersection crashes is the installation of traffic signals, with results that can at best be described as mixed. In some cases there have been reductions in crash risk following signalization while in others there has been no change or even an increase. The public perception seems to be that signals are the universal fix, while transportation safety specialists at present cannot state with assurance that installing signals at a particular intersection will be successful at
reducing the frequency of problem crashes. In an effort to provide some indicators for the safe signalization of high-speed intersections, this study focuses on an analysis of a variety of intersection characteristics and how they relate to crash risk at these intersections. This project expands upon work by Souleyrette and Knox (2005) that evaluated the safety of signalized intersections on high-speed expressways. (TRID)

15. Management of intersections with multi-modal high-resolution data
Muralidharan, A., Coogan, S., Flores, C., Varaiya, P.
Transportation Research – Part C: Emerging Technologies, 2016-17, Vol. 68, pp. 101-112

A high-resolution (HR) data system for an intersection collects the location (lane), speed, and turn movement of every vehicle as it enters an intersection, together with the signal phase. Some systems also provide video monitoring; others measure pedestrian and bicycle movements; and some have vehicle to infrastructure (V2I) communication capability. The data are available in real time and archived. Real time data are used to implement signal control. Archived data are used to evaluate intersection, corridor, and network performance. The system operates 24 × 7. Uses of a HR data system for assessing intersection performance and improving mobility and safety are discussed. Mobility applications include evaluation of intersection performance, and the design of better signal control. Safety applications include estimates of dilemma zones, red-light violations, and pedestrian-vehicle conflicts. (TRID)

16. Next generation traffic control in the Netherlands
Wang, Y., Vrancken, J., Ottenhof, F., Val´e, M.
Research Gate 2011

The common approach to road network traffic control, top-down control by means of scenarios, ran into the problem of too large a set of scenarios and the problem of conflicts between scenarios from different traffic authorities (for motorways and for urban networks) in the same area. This became apparent around 2008 in the development of network management for the Amsterdam area. A tool called Scenario Coordination Module (SCM), intended to handle these two problems, evolved into a network control system, doing control at different levels in the network, in a way in which global scenarios no longer play an important role. This system, still called by its now obsolete name, has been installed in the Amsterdam area and is worldwide among the first systems for network control in mixed networks. In this paper, we will present an approach combining multi-agent control and the SCM for a large scale road network. (TRID)

17. Outcome assessment using connected vehicle data to justify signal investments to decision makers
Krohn, D., Rymarcsuk, L., Mathew, J., Day, C., Li, H., Patel, A., Farley, D., Bullock, D.

Elected officials and decision makers are increasingly seeking outcome assessment of capital projects such as corridor signal modernization and adaptive control projects. This paper describes the use of connected vehicle data to perform corridor travel time outcome assessment along five corridors in the greater Philadelphia, Pennsylvania area. These
corridors are comprised of a total of 2,184 signals and are considered five of the most critical corridors in this region, experiencing a high volume of traffic, with AADT greater than 30,000 vehicles. These corridors were evaluated for six weeks before and after the adaptive installation through the use of private-sector segment speed data. Medians and interquartile ranges of travel times were used to assess the impact on arterial progression. Various graphs, charts, and figures produced through web tools and traditional metrics provide a user-interactive component to the dashboards. In addition, user cost reductions and CO2 emission impacts were also determined. Four out of the five corridors had substantial reductions of arterial travel times that amounted to approximately $36.6 million in annualized user benefits. The paper concludes by recommending these techniques be integrated into modern traffic signal central systems to prioritize timing initiatives to perform outcome assessment. Such tools would complement high resolution traffic signal data performance measures that identify minor side street split failures to provide agencies with a complete set of tools for managing their signal system infrastructure. (TRID)

18. Performance evaluation of traffic sensing and control devices

Day, C. M., Brennan Jr., T. M., Sturdevant, J. R.
FHWA/IN/JTRP/2011, p. 36

High quality vehicle detection is essential to properly operate actuated phases at traffic signals and to facilitate effective management of technician and engineering resources. INDOT operates over 2600 traffic signal controllers, approximately 2000 of which use some form of vehicle detection. The private sector continues to develop innovative sensing technologies that may potentially benefit Indiana motorists and taxpayers by improving system efficiency and lowering installation and maintenance costs. However, the acceptance of new sensing technology requires careful evaluation to ensure that they provide robust performance 24 hours a day, 365 days a year, with minimal impact on maintenance resources. This study developed a technical protocol for evaluating vehicle detector performance and applied those techniques to both video detection (in partnership with Texas) and wireless magnetometers. Based on experiences in designing the detector test bed, recommendations are given for stop bar detection zone design using wireless magnetometers. Additional results include a detailed study of the inductive loop detector sensing range for several loop geometries, and an innovative method for interrogating NTCIP-compliant traffic signal systems to allow quality control on signal timing plan implementation. Since this project spanned several years, interim results were documented in the professional literature as they became available. This technical report summarizes those results and provides references to the published papers. (TRID)

19. Pedestrian safety diagnosis at signalized crosswalks using traffic conflict techniques

Sha, D., Guo, Y., Ding, Y.
16th COTA International Conference of Transportation Professionals, 2016, pp. 1811-1823

The objective of this study is the analysis of pedestrian safety at signalized crosswalks by using traffic conflict techniques. Video data was collected at a busy T-leg signalized intersection in Shanghai, China. Pedestrian-vehicle conflicts as well as pedestrian violations were automatically detected by analyzing the road users’ trajectories. It was found that the major cause of pedestrian-vehicle conflicts was right-turning vehicles that have a permitted
right-turn phase. The right-turning vehicles involved in pedestrian-vehicle conflicts account for 64.81% of the total conflicts. The most serious pedestrian-vehicle conflicts occurred between pedestrians in crosswalks and vehicles from the crossing road traveling at high speed. It was found that more than half of the pedestrians were violation of signal timing or the crosswalk boundary: 37.81% were spatial violations and 18.46% were temporal violations. The results showed that conflicts associated with temporal violation behavior are much more numerous than spatial violation (48.41% and 17.06%). (TRID)

20. Pedestrian safety at intersections in Dhaka metropolitan city

Pervaz, S., Hazanat-E-Rabbi, S., Newaz, K. M. S.
Swedish National Road and Transport Research Institute (VTI), 2016, p. 11

Pedestrian accidents are a serious and growing problem in the cities of developing countries, especially in Dhaka, the capital of Bangladesh. Poor planning of road networks, poor traffic control and management at intersections, inadequate pedestrian facilities and the severe lack of priority and attention given to the pedestrians are the main causes of such dangerous situation. Particular concern is the urban intersections, specifically the signalized ones that have been identified as among the most hazardous locations on the roads which account for a substantial portion of traffic accidents (Helai, Chor & Haque, 2008). Study shows that out of more than thirty six hundred accidents in Dhaka city nearly 63% occurred at non-intersection areas whereas 37% at intersections from 2007-2014 in Dhaka metropolitan city (ARI, 2014). Pedestrian accidents (58%) dominated total accidents occurred during this period. The heterogeneity of traffic, inadequate crossing facilities, plying of modes with varying speed and manoeuvring time make the intersections even more complex. Field study also indicates that nearly 65% of total intersections in Dhaka city have Pedestrian Traffic Signal (PTS) whereas nearly 15% have no pedestrian control devices. Due to the Ineffective PTS and faded crossing marking, pedestrian's risk at intersections is increasing. This paper aims to provide a broad overview of pedestrian safety facilities at intersections in Dhaka city. Analysing the survey data, it has attempted to shed some light on the major causes and factors of pedestrian accidents and also suggested appropriate safety measures to reduce the accidents and enhance crossing facilities at the intersections. (TRID)

21. The evolution of urban traffic control: changing policy and technology


The history of urban traffic control (UTC) throughout the past century has been a continued race to keep pace with ever more complex policy objectives and consistently increasing vehicle demand. Many benefits can be observed from an efficient UTC system, such as reduced congestion, increased economic efficiency and improved road safety and air quality. There have been significant advances in vehicle detection and communication technologies which have enabled a series of step changes in the capabilities of UTC systems, from early (fixed time) signal plans to modern integrated systems. A variety of UTC systems have been implemented throughout the world, each with individual strengths and weaknesses; this paper seeks to compare the leading commercial systems (and some less well known systems) to highlight the key characteristics and differences before assessing whether the current UTC systems are capable of meeting modern transport policy
Traffic signals on high speed roads
Literature survey

obligations and desires. This paper then moves on to consider current and future transport policy and the technological landscape in which UTC will need to operate over the coming decades, where technological advancements are expected to move UTC from an era of limited data availability to an era of data abundance. (TRID)

22. Three dilemma zone strategies for high-speed rural intersections: comparison of field result
Demers, A., List, G. F., Isukapati, I. K.
Seventh International Conference on Traffic and Transportation Studies, 2010

High-speed, rural intersections with both passenger car and truck flows present dilemma zone challenges. Three signal-timing strategies were tested in the field at three intersections of varying geometries with the goal of minimizing the occurrence of dilemma zones without sacrificing efficient operation. The strategies focused on hardware changes impacting vehicle sensing as well as mainline green phase extension and termination. The base strategy was volume-density control. The second one (NQ4) added advance detection of high-speed trucks triggering a fixed green extension. The final strategy replaced the second system with sophisticated advance detection and control system (D-CS) logic based on the work of Bonneson et al. (2002). Results indicate simple volume-density control is surpassed in safety by both other strategies; moreover, the detection-control system dramatically reduced the number of vehicles trapped in dilemma zones at the onset of amber. The second strategy works fairly well in the field. The drawbacks to the NQ4 system are most noticeable at high-volume intersections — it does not actually find times when no vehicles are in dilemma zones, vehicle speeds are not directly used for computing main street hold times (which is accomplished in the D-CS control strategy resulting in improved efficiency), and it is a bit cumbersome and expensive to install. Based on our findings, the addition of the DC-S algorithm into a controller is a worthwhile investment for mixed-traffic, high-speed, rural intersections with dilemma zone issues. (TRID)