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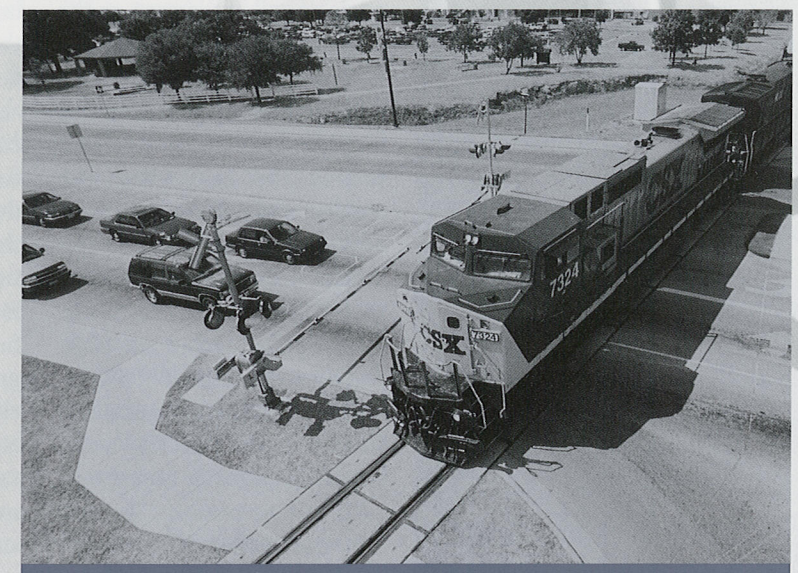

Where the road MEETS THE RAIL

Even though crashes and fatalities have dropped by almost one-third over the past five years, there were still more than 430 deaths and 1,300 injuries caused by more than 3,500 train-vehicle collisions in 1998.

THERE ARE MORE than 3.9 million miles of road and 300,000 miles of railroad track in the U.S. Cars on these roadways and trains on these tracks interact daily at almost 260,000 public and private highway-railroad intersections (HRIs). Millions of drivers never see a train as they daily cross a public HRI.

But when trains approach a crossing, a number of events occur — at the intersection, on the track, and on the road. For many well-traveled public HRIs, these complex series of events take place to make

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Caught on camera

With more than 12,000 public highway-rail intersection (HRIs) in Texas, it is not an easy task to police every location for potential violators. However, Texas Transportation Institute (TTI) research personnel are working to make that job a little easier by proving the feasibility of video detection technology in recording violations.

With successful automated enforcement programs being operated in a number of cities around the nation, TTI recently finished testing the feasibility of camera/video detection system usage at HRIs in Texas.

"It's not cost effective to have police officers patrol every crossing," says Kay Fitzpatrick, TTI associate research engineer. "By automating the monitoring of these crossings, transportation and law enforcement agencies can use technology to tell them who, when and where the problem are."

In 1995, the Texas Legislature passed a bill that required the Texas Department of Transportation (TxDOT) to install and operate automated HRI enforcement systems as a demonstration project. TxDOT enlisted TTI to facilitate the process.

The purpose of the demonstration project was to determine whether the current technology could adequately identify violations. After searching a database of all HRIs in Texas, Fitzpatrick, TTI assistant research engineer Paul Carlson and representatives of TxDOT selected three sites. Two vendors with experience in automated enforcement were selected to install equipment at the three sites.

The systems, once installed and activated, photographed vehicles driving under and around the gate arms. The images and information were sent to a processing center where a clerk confirmed the violation and recorded the license plate number and physical characteristics of the vehicle. The vehicle information was then sent to TxDOT's motor vehicle registration department, who in turn provided the vendor with information on the vehicle's owner. Depending on the site, the vendor or the police department mailed education letters to violators.

Fitzpatrick notes, "Many of the lessons learned during this project point to the need for active communication between all of the different agencies and organizations involved." For example, proper and timely deployment of the equipment needs clear discussions between railroad companies and vendors regarding the installation of the detection equipment. In addition, vendors need a clear understanding of the local law enforcement agencies' definition of a violation.

Another significant finding from this project was the identification of types of violations that exist at gated HRIs. Although not a prime focus of the project, the research team monitored 19 HRIs for a total of approximately 600 hours. Carlson says, "We were surprised to learn that on average, one violation occurs per gate activation."

While the project shed light on the potential of using automated systems at public crossings in Texas, Fitzpatrick notes that there is still work to be done. The issuance of citations and public reaction to mailed citations are two areas that still need to be studied. "Since this was a project to demonstrate the technology, these issues were not included," says Fitzpatrick. Citing other successful automated enforcement programs already in operation in cities around the nation, most notably Los Angeles, Fitzpatrick says, "Other projects around the nation, however, have demonstrated that automated enforcement can reduce violations and incidents at crossings."

For more information:
Contact: Kay Fitzpatrick
Phone: (409) 845-7321
E-mail: k-fitzpatrick@tamu.edu

Contact: Paul Carlson
Phone: (409) 845-6004
E-mail: paul-carlson@tamu.edu

TTI center tests new train detection technique

For years, traffic management centers (TMCs) have been looking for a way to integrate train information into their day-to-day strategies. Train information would alleviate some of the headaches that can occur when the train crosses the highway-railroad intersection (HRI). However, according to Leonard Ruback, Texas Transportation Institute (TTI) associate research scientist, "Current rail and highway systems don't 'speak' to each other except at traffic signals near HRIs, and while this data exchange is sufficient for basic operation of the intersection, it's not very helpful for advanced management applications."

Using the city of College Station, Texas, and a six-mile stretch of its Wellborn Road rail corridor as a test bed, Ruback and colleagues from TTI are developing and testing a promising new technology — radio-frequency Doppler radar. Ruback says Doppler radar systems are a good choice because the systems provide a continuous stream of information, allowing direction and train speed to be recorded. The Doppler systems also have a long detection range, allowing the system to be installed alongside the railroad tracks but outside the railroad right-of-way.

A data collection station provides power and communications for the Doppler system and real-time data feeds to the TMC — in this case the TransLink® Research Center. Ruback says that the data collection stations are designed to be self-sufficient — powered by a single solar panel. The data collection station is connected to TransLink using a corridor-wide wireless data network. "We chose solar power and wireless communications because this eliminates the costs associated with traditional power/telephone hookups — and allows a data collection station to be deployed anywhere," says Ruback.

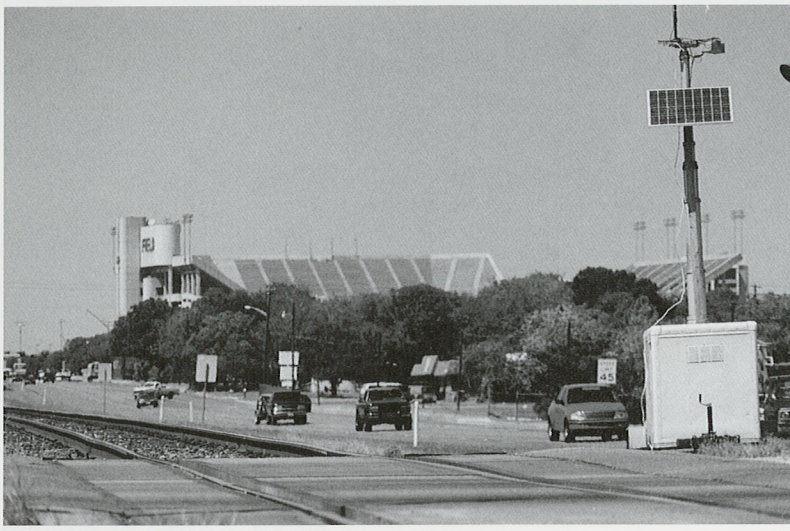
Ruback is currently developing a new technique for train detection that will provide train speed, direction, length and presence information from a single sensor — and that will be linked into a TMC. "Our goal is to explore alternative detection methods that will supplement or further enhance current vital systems in the field," adds Ruback.

After initial testing, data collection stations at HRIs along the Wellborn corridor now report train direction, speed and approach times to each of the selected HRIs. Now a train's approach is known from three to five minutes before it actually arrives at select HRIs in College Station.

Ruback says that this kind of advanced detection could be of great use to TMCs. For example, bus drivers can be given alternate routes when notified of an approaching train, keeping schedules tighter and on time. Using dynamic message signs, commuters can know where trains are and what options are available to them, preventing long lines of vehicles at HRIs. "Basically, we are trying to push the information out — making it available to the general public, giving them advanced knowledge," says Ruback.

The Internet also plays an important part in the research. All of the recorded train data is viewable over the Internet. "We want to make the data available for researchers who might want to use our test bed even though they may be across the country," says Ruback. "Plus, the Internet opens up a new channel for distribution of train data to people who need live feeds of data such as emergency services dispatchers or other transportation professionals."

For more information:
Contact: Leonard Ruback
Phone: (409) 862-4343
E-mail: lruback@tamu.edu



Mounted on traffic signal poles (top) and in portable trailers alongside railroad tracks (bottom), Doppler-radar systems are being tested as a supplement to current advanced train detection information.

When every second counts

The call comes in to the dispatch — a fire. In one minute, the dispatcher takes the call and routes the information to the appropriate fire station. One minute later, firefighters are equipped and the truck is rolling. With the new fire station, the travel time to most emergency scenes in the city of College Station, Texas, will be 4.5 minutes or less.

For College Station, the addition of a new fire station means quicker response to fires and emergency situations. However, each fire station faces an element that could make the difference between a house on fire and a pile of ashes — a highway-railroad intersection (HRI). For example, according to College Station's recent redrawing of fire district lines, the newly constructed Fire Station #4 now sits across the railroad tracks from most of its district, including the 5,200 acres and 100-plus buildings that make up Texas A&M University's campus. If a train enters the HRI while the fire truck or ambulance is en route, 4.5 minutes could become 7 minutes or longer — all because they did not know that the train would be at the HRI.

Assistant Fire Chief Eric Hurt (left) and TTI researcher Leonard Ruback (right) are looking to use advanced train information gathered from Doppler radar systems to help plan travel routes for fire and emergency vehicles in College Station, Texas.

And this is not a small inconvenience. On a busy day, approximately 20 trains will pass through College Station. Combined, those trains will block the road that serves as Fire Station #4's principal fire truck route for almost an hour each day. However, emerging technology being developed at the Texas Transportation Institute's (TTI's) TransLink® Research Laboratory has the capability to make the travel time and travel routes of fire trucks and ambulances shorter and train free.

According to Eric Hurt, College Station Fire Department assistant fire chief, the idea of train monitoring came up while working with TransLink on traffic signal preemption. "I told them that I wished there was a way to preempt trains, not so much to give us right-of-way but to know ahead of time when they would be there," says Hurt.

As it happened, TransLink has been working on a radio-frequency Doppler radar system that monitors trains along College Station's portion of the Wellborn corridor. At the time, they were first testing the system and were able to tell when trains were approaching or leaving an HRI.

Now, TransLink personnel are finishing up the coding and testing of a graphic display interface that converts the data stream into a more user-friendly and visual format. The display shows the speed of the train, its distance from each HRI along the Wellborn Road corridor, its estimated time of arrival (ETA) and estimated time of departure (ETD) from each intersection. According to TTI assistant research scientist Leonard Ruback, the information this system provides will let firefighters be more proactive and predictive in choosing a route, rather than reactive to what is currently happening or has happened.

The first step, Ruback and Hurt believe, is to put the system on a laptop for use at the fire station. "By putting it in the fire station, we can begin to build awareness of the system as well as confidence in the information that it provides," says Ruback. "Plus, the firefighters will be able to give us better feedback as they use the technology and information."

Hurt agrees that the system needs to be put first in the fire stations to get firefighters used to the system. "Firefighters must have confidence in and be able to trust their equipment — and even more so with new technology," says Hurt.

The second step would be to wire the information into the dispatch center to further increase reliability. This will allow fire trucks from nearby fire stations to be dispatched should a train block an emergency or fire response route. Knowing the ETA and ETD of trains at all of College Station's HRIs, dispatchers can send other trucks along clear routes by crossing HRIs already passed or yet to be entered by the train. "There are so many things to consider because of the train — we can't make the tracks an imaginary dividing line for how we dispatch our vehicles," says Hurt.

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Increasing the realism of simulations

Detailed traffic simulation is increasingly being used for transportation and traffic planning, evaluation and research. There is, however, a gap between simulation and real life. Most traffic simulations simply cannot replicate real traffic conditions exactly. As a way to bridge the gap between the two, researchers at TTI's TransLink® Roadside Equipment Laboratory (REL) have developed hardware-in-the-loop simulation.

Hardware-in-the-loop is different from many simulations due to its use of actual traffic signal control hardware as part of the simulation. According to Roelof Engelbrecht, assistant research scientist at TTI, "Since it uses actual hardware, hardware-in-the-loop increases the realism of traffic simulation and can help improve how controllers and signal strategies are implemented in the field."

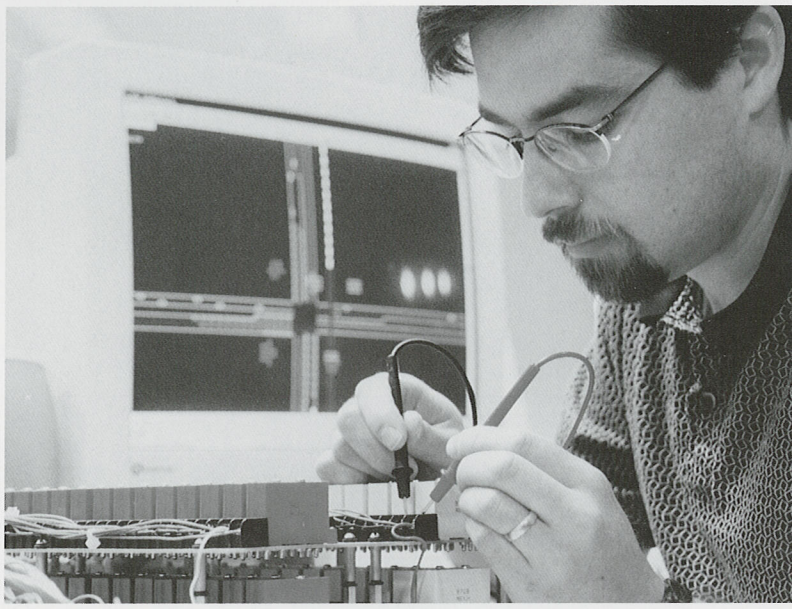
In a hardware-in-the-loop simulation, the software simulates the movement of vehicles through the modeled intersection. The information from the "vehicles" passing through the "intersection" is then sent to real control hardware that is hardwired into the simulation. Reacting to the information, the controller sends updated signal indications back to the simulation where the simulated vehicles stop, go or turn accordingly.

Engelbrecht says that hardware-in-the-loop was developed to solve some of the problems inherent in software-only simulations. One is that many simulations cannot effectively emulate a real traffic controller. "Software-only simulations provide a limited choice of control strategies that can prevent or inhibit certain simulation modeling," says Engelbrecht. "Plus, many real traffic signal controllers offer features and preprogrammed functions that simulated controllers cannot replicate."

Since it is a simulation, hardware-in-the-loop offers a safer alternative than experimenting with real traffic. Also, the use of the same controller equipment used at the modeled intersection allows a greater level of realism for the simulation. "This way," says Engelbrecht, "we can set up traffic controllers for optimal control without much of the costs associated with trying to troubleshoot the controller out in the field."

This is a boon for testing new applications at intersections like highway-railroad intersections (HRIs) where for safety reasons real-traffic testing is undesirable. For example, Engelbrecht and colleagues took actual traffic numbers and train information, and simulated the preemption program of an HRI in College Station, Texas, to see how successful it was at managing the traffic before, during and after the intersection was blocked by a train. "We were able to see how and where vehicles and vehicle lines were building up, how effective the turning lanes operated, and how effective the signals worked to clear traffic off the tracks," says Engelbrecht. Then researchers tested alternatives that would improve traffic management while a train passed through the intersection.

Hardware-in-the-loop is also a key component in the development and testing of a number of new strategies. TTI researchers are developing a new preemption technique called the transitional preemption strategy (TPS) (see page 9) that is being tested with hardware-in-the-loop. "Hardware-in-the-loop is an important component for our research," says Steven Venglar, the TTI researcher who heads up research on TPS. "The simulation lets us see overall efficiencies and inefficiencies, and makes it easier to see where we need to do our fine tuning."



Because hardware-in-the-loop uses actual traffic signal control hardware, TTI's Roelof Engelbrecht (above) says the simulation offers increased realism and helps improve field implementation of controllers and signal strategies.

For more information:
Contact: Roelof Engelbrecht
Phone: (409) 862-3559
E-mail: roelof@tamu.edu

Road meets rail, continued from page 1

drivers aware of a train's presence and prevent the two from colliding. This can include flashing lights, lowered gates, bells and even modified traffic signalization to get vehicles and pedestrians off the track. For other lower-volume roads, drivers at HRIs are required to decide on their own whether or not to yield right-of-way to the train.

Often, when something goes wrong, the results are catastrophic. In March 1999 in Bourbonnais, Ill., a train collided with a semi-truck trailer carrying steel bars, killing 11 and injuring 116. More recently, in July 1999, an Amtrak passenger train slammed into a tanker truck outside Eagle Lake, Texas, derailing the two locomotives and seven of the 10 passenger cars, damaging 800 feet of track and injuring 18 people.

In the past five years, crashes at HRIs have decreased by 30 percent and fatalities by 33 percent through concerted efforts by federal agencies such as the Federal Highway Administration (FHWA) and the Federal Railroad Administration (FRA). In 1998, though, more than 3,500 collisions occurred at HRIs across the U.S., resulting in more than 430 deaths and more than 1,300 injuries.

Texas, with more than 12,000 miles of railroad track, has the nation's largest concentration of HRIs — and the highest number of collisions, injuries and fatalities. That is why the Texas Department of Transportation along with the FHWA has enlisted the aid of research personnel at the Texas Transportation Institute (TTI). TTI is conducting research to find ways to further reduce the collisions, injuries and fatalities associated with the operation of HRIs.

More than 60 percent of the drivers involved in rail crossing accidents last year never stopped at the intersection," said Texas Railroad Commissioner Charles Matthews.

"More than 60 percent of the drivers involved in rail crossing accidents last year never stopped at the intersection," said Texas Railroad Commissioner Charles Matthews.

U.S. Senator Kay Bailey Hutchison, also the chair of the Senate Subcommittee on Surface Transportation and Merchant Marine, recently noted that American motorists are 40 percent more likely to die in a crash involving a train than in a collision involving another motor vehicle.

Hutchison pointed out a recent poll conducted by Operation Lifesaver, a nationwide, nonprofit public information program dedicated to eliminating collisions, injuries and fatalities at HRIs and on railroad rights-of-way. The results showed that 45 percent of Texans were willing to cross railroad tracks even though warning lights were flashing; 30 percent said going around a lowered crossing gate could be justified; and 20 percent said it was more acceptable to go through a gated railroad crossing than to run a red light. Hutchison added, "Texans share with Americans everywhere an unfortunate tendency to disregard these warnings."

Texas Railroad Commission Chairman Tony Garza said, "The real tragedy is that many times these accidents could have been avoided with just a bit more caution and a little patience."

"Ideally, all highway-rail intersections would be grade separated, to virtually eliminate the risk of conflict between rail and highway traffic," said Jolene Molitoris, administrator for the FRA in testimony given to the U.S. Senate Subcommittee on Surface Transportation and Merchant Marine. "However, grade separation everywhere cannot be achieved, and so a broader set of safety measures is required to protect the public."

"Many of the incidents that occur at HRIs relate back to driver behavior or engineering principles," says Kevin Balke, director of TTI's TransLink® Research Center. TransLink is a focal point for a number of HRI-related research projects. Research personnel are developing a number of technologies, strategies and principles all being simulated, tested or monitored from TransLink's host of laboratories and test facilities.

"A safe — and efficient — HRI requires that a number of issues be addressed through research," notes Balke. Current research includes

- design principles and geometric concerns for new and existing HRIs,
- signalization and signage around HRIs,
- automatic enforcement of HRI violations,
- advanced train detection for quicker emergency response, and
- new preemption strategies for the movement of vehicles and pedestrians in an HRI.

The research efforts being undertaken by researchers at TTI represent a concerted effort to make HRIs safer by addressing the issue from highway or roadway aspects. "Many of the problems associated with HRIs come back to our — the highway's — side of the equation," says Balke.

Ultimately, whether at the local, state or national level, HRIs will continue to see millions of vehicles pass through them daily. Molitoris believes that a balanced national transportation system is based on addressing the interaction at HRIs. And when it comes to HRIs, Molitoris added, "We all have a role to play in improving rail crossing safety."

Enhancing the change from passive to active

Every year, the Texas Department of Transportation (TxDOT) spends approximately $22.5 million upgrading 150 grade crossings at highway-railroad intersections (HRIs) from passive to active warning systems. The conversion involves adding a sophisticated system of lights, gates, signals and circuitry to a crossing where before only the traditional HRI crossing sign — the crossbuck — was posted.

To upgrade passive crossings like the one above to an active crossing with gates, lights, signals and circuitry takes around 24 months. To improve roadway safety until the conversion is completed, a TTI-developed enhanced sign system is being considered for use at these intersections.

How big of a job is the conversion? If TxDOT were to upgrade every one of the more than 8,000 passive crossings in Texas within the confines of their budget, it would take just over 53 years. According to Darin Kosmak, railroad liaison branch manager for TxDOT's Traffic Operations Division, the upgrading is based on a priority listing of crossings where passive crossing signage is not enough.

Upgrading the HRI to active status is also time consuming — about 24 months. Even though the potential safety hazards have been identified and the approval for the upgrade has been given, vehicles still pass through the HRI without the benefits of active warning devices. "We needed an effective interim traffic control device that could be easily installed and activated at these HRIs, between the time they are identified and the time they are made active crossings," says Kosmak.

One potential solution Kosmak and TxDOT have shown interest in is from research conducted by Texas Transportation Institute associate research engineer Dan Fambro. Fambro's testing of driver actions and reactions at HRIs led to his development of an enhanced sign system.

The system, which costs around $4,000, uses a vehicle-activated strobe light to alert drivers to the signs on the signpost. These signs, mounted under the strobe, are the traditional round advanced warning sign as well as a new sign that says, "LOOK FOR TRAIN AT CROSSING."

Based on driver reactions before and after the study, Fambro said that the enhanced sign system is an effective traffic-control device and can improve roadway safety at HRIs with passive warnings. While designed to help drivers look at the signage and reduce their speeds, the lights and signage enhancements caused many drivers to approach the intersections with more caution. In some instances, drivers

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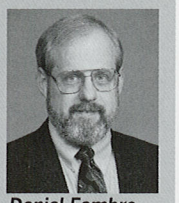


Daniel Fambro

Friends, family and colleagues are mourning the loss of Dr. Daniel B. Fambro, a longtime Texas Transportation Institute (TTI) researcher and Texas A&M University (TAMU) faculty member, who died in Bryan, Texas, Sept. 19 at the age of 48.

Those who knew Fambro at TTI and TAMU will long remember his lasting contributions to the transportation profession and his passionate commitment to students. An associate research engineer at TTI as well as an associate professor and associate department head in TAMU's Department of Civil Engineering, Fambro's research and teaching experience spanned more than 20 years.

As a researcher, Fambro was widely regarded as an international expert in the fields of traffic signalization, highway-railroad grade crossings, geometric design and highway capacity. In recognition of his research contributions, Fambro received the TTI/Trinity Senior Researcher Award in 1998.

Fambro was known for his ability to recruit outstanding students and go the extra mile to make sure those students gained the most from their experiences at TAMU. His dedication to the advancement of knowledge was recognized through two major teaching awards at TAMU — the Zachry Award for Excellence in Teaching and the Birdwell Endowed Teaching Award in Civil Engineering.

For Fambro's family and associates, his passing is regarded as a tremendous loss, personally and professionally, but they take comfort in the knowledge that he left a positive and lasting legacy to the field of transportation and to scores of engineering students.

TPS keeps pedestrians, vehicles on safer, smoother 'track' when train approaches

When a train approaches a highway-railroad intersection (HRI), traffic signals located at nearby intersections are designed to let vehicles that may be stopped on the tracks the chance to move to safety. In many cases, this warning time is as little as 20 seconds before the train crosses the intersection. Because of this small amount of time, crossings can potentially become inefficient.

"Current preemption systems, for the most part, operate in an inelegant manner," says TTI researcher Steven Venglar. "It's similar to using a hammer on a pushpin." Venglar is heading up an effort to develop a new method for signal controller treatment of railroad preemption based on advanced train detection. The transitional preemption strategy (TPS) algorithm offers heightened efficiency and safety for both pedestrians and vehicles.

Existing preemption standards allow traffic signal controllers to cut short pedestrian and vehicle phases that conflict with the track clearance phase. Venglar says that this can lead to problems for vehicles and pedestrians.

The problem for motorists is how to proceed with a shortened light sequence. Shortened sequences can cause confusion and hesitation on the part of drivers. Vehicle lines in certain lanes can also be longer or more "stacked up" due to short traffic light cycles, creating more congestion.

Pedestrians also face shortened crossing signals, leaving them sometimes in a "green-lighted" path of oncoming vehicles. "In the *Manual on Uniform Traffic Control Devices*, the potential danger faced by a pedestrian caught crossing during a preemption sequence is considered a 'relative hazard.' This means that in the case of an approaching train, it is more important to prevent a train-vehicle collision than a vehicle-pedestrian collision — but either case is an unacceptable risk. The idea of TPS is to reduce or eliminate some of the safety issues brought on by an HRI located close to a signalized intersection," says Venglar.

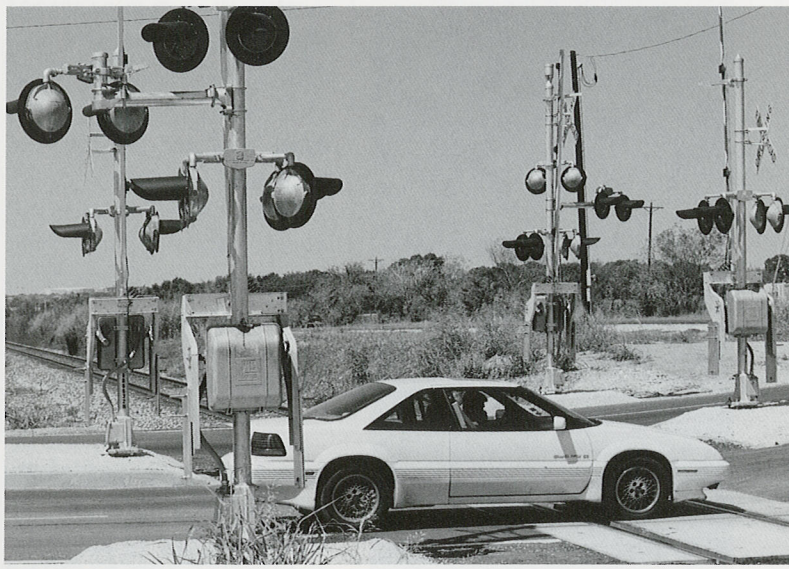
The TPS algorithm relies on advanced train detection technology to offer at least one full minute of advanced warning. Using currently available technologies like radio-frequency Doppler radar, trains can be detected more effectively, efficiently and farther away from the HRI.

TPS is being designed to work in conjunction with current preemption practices. Venglar says the idea is to present a solution that augments the current system. TPS will provide a smoother transition into the preemption sequence by adjusting the timing of each intersection phase as needed.

Pedestrians, for example, are either given enough time to safely cross, or they are signaled not to cross until the preemption sequence has finished. Vehicles are then able to cross the intersection during minimum green light phases without the "relative hazard" of pedestrians. "This is a transition into current preemption practices; in other words, movements that conflict with track clearing are still given the 20 seconds or so needed to proceed without the confusion associated with shortened signal phases," says Venglar.

Venglar says that TPS offers a new look into preemption. "While this type of technology and system has been used in areas like bus priority," says Venglar, "from what we've seen, this type of strategy has never been approached before from a highway-railroad point of view."

Venglar ultimately sees TPS as an opportunity to explore new approaches in the management of highway-railroad intersections. "Whether it's through TPS or a similar approach," he says, "we are seeing new ways to correct potential safety issues found in current preemption practices."



One of the main ideas behind the development of the transitional preemption strategy is the reduction or elimination of some of the safety issues brought on by an HRI located close to a signalized intersection.

For more information:
Contact: Steven Venglar
Phone: (512) 467-0946
E-mail: s-venglar@tamu.edu

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Ultimately, as the city grows or in other cities, a computer could be mounted on board the fire truck or ambulance and be fed real-time location information. The computer would serve as a live connection between the truck, the dispatcher and incoming train approach information.

Both Hurt and Ruback agree that the time and safety benefits could be tremendous. "The quicker we can get there, the better job we can do, but the shortest distance is not always the quickest," says Hurt. "And time is always critical."

For more information:
Contact: Leonard Ruback
Phone: (409) 862-4343
E-mail: lruback@tamu.edu

Legislative update: Proposition 17 affects TTI, Texas A&M

One of the issues on the Nov. 2, 1999, general election ballot directly affects The Texas A&M University System (including TTI), The University of Texas System and other designated public universities. If the proposed constitutional amendment concerning changes in the Permanent University Fund (PUF) passes, TTI could receive additional funds for research equipment. Texas A&M University would receive a multimillion dollar annual increase, which would be used for additional academic facilities and programs.

Passage of Proposition 17 would allow the investment managers more flexibility to manage the PUF, take advantage of broader investment strategies and increase the rate of return. Most importantly, passage of this proposition would provide additional funds for higher education without increasing taxes.

A "yes" vote authorizes the change; a "no" vote means retaining the status quo. For more information about this proposition, please contact the System Office of State Affairs.

The information above was provided by The Texas A&M University System Office of Communications.

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even implied that the enhancements meant transportation officials thought the HRI to be dangerous.

For Kosmak, that is an added benefit. "Our intent is to give motorists an advanced warning of their approach to an HRI," says Kosmak, "where they are responsible for being alert and aware of trains."

Kosmak adds that the systems are fairly easy to install and can be moved and reinstalled when the active warning improvements are complete. "These systems can immediately improve roadway safety at these passive crossings; we don't have to wait the 24 months until the active warnings and hardware are in place," says Kosmak.

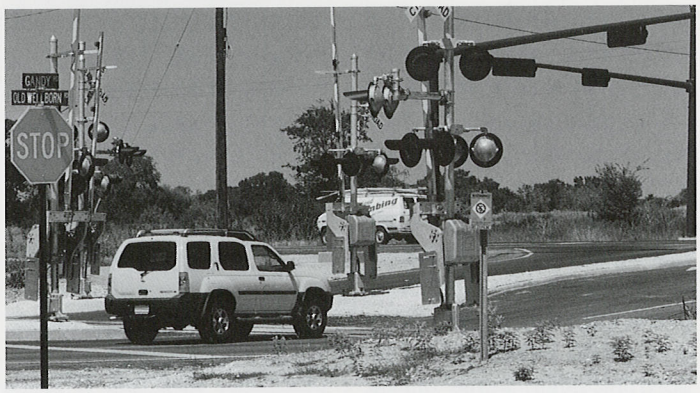
Detailing the design of HRIs

Probably one of the more difficult configurations to design," says Mark Wooldridge, Texas Transportation Institute (TTI) associate research engineer, "is an intersection that involves a highway-railroad grade crossing." As a solution to this problem for engineers and designers, Wooldridge — a former design engineer for the Texas Department of Transportation (TxDOT) — and TTI associate research engineer Dan Fambro are conducting research to develop comprehensive geometric design guidelines that address special considerations such as highway intersections near highway-railroad intersections (HRIs).

Based on his experience with TxDOT, Wooldridge knows that objective and comprehensive guidelines specifically for HRIs would be beneficial. "With the recent high-profile incidents involving trains and vehicles stopped on the tracks, designing an HRI has added importance and responsibilities for the designer and the transportation agency — more so than a typical intersection," says Wooldridge.

HRIs are more difficult to design because of factors brought on by the interaction of trains and vehicles within a small area. The guidelines are one way of making design engineers aware of all the components and situations that can affect the safety and efficiency of the operation of an HRI. Components that affect the design of HRIs include approach grades, turn lanes, lane capacity, illumination, traffic signal operation, appropriate signage, highway speeds, train speeds and traffic diversion around HRIs.

Situations include designing new HRIs, retrofitting older HRIs to function more safely and efficiently, widening highways and repairing railroad tracks.



According to Wooldridge the guidelines will be a time saver for engineers. "The problem is not the lack of HRI design information out there," says Wooldridge. "It is that this information has never been assembled into a single resource." Wooldridge also notes that TTI is looking to fill in the gaps that current research hasn't addressed.

The TTI-developed guidelines will be prepared in a way that will make it easy for inclusion in TxDOT's *Operations and Procedures Manual* or other appropriate print or online manuals.

For more information:
Contact: Mark Wooldridge
Phone: (409) 845-9902
E-mail: m-wooldridge@tamu.edu

TTI Publications Order Form

___ 187-28F, "Prediction of Expansive Clay Roughness in Pavements with Vertical Moisture Barriers," R. Lytton, R. Jayatilaka, 310 pp., $51.00.

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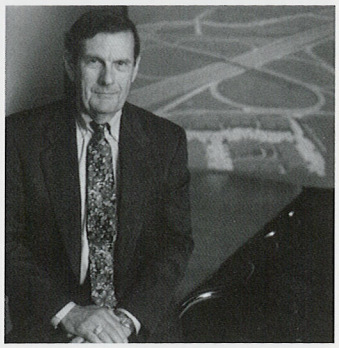

This issue of *Researcher* highlights one of the most troubling transportation safety issues — highway-railroad intersections (HRIs). While most vehicles and trains safely traverse almost 260,000 public and private HRIs each year, the sad fact is that in 1998, there were over 3,500 collisions at HRIs across the U.S., resulting in more than 430 deaths and 1,300 injuries. Texas, with over 12,000 miles of railroad track, has the nation's largest concentration of HRIs — and unfortunately the highest number of injuries and fatalities.

As this issue shows, we take both safety and the efficient movement of vehicles through HRIs very seriously. From the design of highway intersections near these crossings, to research into automated enforcement of gated crossings, to helping emergency services dynamically route fire trucks and ambulances around trains, TTI is developing solutions that address all of the aspects that go into the operation of an HRI.

I'd also like to point out an article featuring TTI research that makes drivers more aware of passive crossings. This affordable and reusable new system is being used at passive intersections that have been slated to become active, gated crossings. Leading this research effort was TTI's own Daniel Fambro. Dan's work in the area of HRIs is one of the reasons we have such diverse and multifaceted research dedicated to making HRIs safer and more efficient.

On Sept. 19, Dan Fambro passed away without warning. I know I speak for all of TTI when I say that we will sorely miss him. He was one of our most productive faculty members and a friend and valued colleague to all.

Herb Richardson

Herbert H. Richardson
Director

TEXAS TRANSPORTATION
Researcher

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