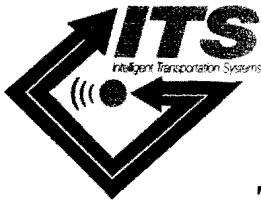


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16. Abstract This report summarizes the accomplishments of the Texas A&M Intelligent Transportation Systems (ITS) Research Center of Excellence (RCE) during Fiscal Year 1996-97. The research program targets the intelligent transportation infrastructure. It focuses on three technical thrusts—public transportation, transportation management, and international border transportation—and two crosscutting concerns—institutional and non-technical issues, and technology integration. Key accomplishments in the public transportation area include testing an automatic vehicle location (AVL) system with a rural transit provider, completing the Houston case study <i>Integrating Transit with TranStar</i> , and publishing the proceedings from the First National Workshop on Integrating Transit with ATMS. Key accomplishments in the transportation management services area include additional hardware and software improvements to the field demonstration of the Smart Diamond control concept, developmental work on a prototype intelligent controller for highway-railroad grade crossings, consolidation and expansion of capabilities of the law enforcement vehicle technologies, testing of equipment and communications technologies for real-time commercial vehicle weigh-in-motion, and development of logic and a system architecture for an intelligent bus priority system at traffic signals. Key accomplishments in the international border area include publication of the "Effect of Telecommunications Deregulation on the Deployment of Intelligent Transportation Systems in Texas and at the Texas-Mexico Border," the "Texas-Mexico Border ITS Assessment," and the "Mexican Presence on U.S. Highways After the 17th of December 1995: Workshop Proceedings."					
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## **DISCLAIMER**

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## **Texas A&M ITS Research Center of Excellence Narrative Summary Report Fiscal Year 1996-97**

During Fiscal Year 1996-97, the Texas A&M Intelligent Transportation Systems (ITS) Research Center of Excellence (RCE) continued pursuit of its goal to be a leader in advancing the development and deployment of ITS. This narrative summary report highlights some of the RCE's accomplishments during the fiscal year. The report is organized according to the three missions of the RCE: research, technology transfer, and human resource development.

### **RESEARCH**

The Texas A&M RCE's research mission is to conduct a balanced program of ITS research and technology applications that enhances the operation, management, and integration of the U.S. surface transportation system. The research program targets the intelligent transportation infrastructure upon which ITS services are built. It focuses on three technical thrusts—public transportation, transportation management, and international border transportation—and two crosscutting concerns—institutional and non-technical issues, and technology integration.

#### **Public Transportation Services Technical Thrust**

Activities and accomplishments during the year focused on developing, implementing, and evaluating ITS applications with public transportation services. The test of an automatic vehicle location (AVL) system with Brazos Transit, a rural provider, was implemented. The Houston case study *Integrating Transit with TranStar* was completed, and the proceedings *First National Workshop on Integrating Transit with ATMS* were published. Also in Houston, the *Gulf Freeway Bus Notification System*, the *Northwest Transit Center Real-Time Next Bus Passenger Information System*, and the *Downtown Houston Traffic Management and Traveler Information System* all moved closer toward implementation. The second phase of the METROLift research examining the advanced paratransit software and AVL systems was also initiated. All of these activities helped to accelerate the deployment of ITS with public transit, facilitate interaction among personnel from transit, transportation, and ITS groups, and document the benefits of transit ITS projects. Dr. Katie Turnbull, (409) 845-1535, should be consulted for further details regarding these activities.

## **Transportation Management Services Technical Thrust**

Major accomplishments in the transportation management services area include additional hardware and software improvements to the field demonstration of the Smart Diamond control concept, developmental work on a prototype intelligent controller for highway-railroad grade crossings, consolidation and expansion of capabilities of the law enforcement vehicle technologies, testing of equipment and communications technologies to provide real-time video snapshot and truck weigh-in-motion (WIM) data to police vehicles, and development of logic and a system architecture for an intelligent bus priority system at traffic signals.

Several different advancements were made in phase three of the Smart Diamond traffic-adaptive control system project. For example, improvements were made to the PASSER III program which will be included in the operating system of the Smart Diamond. Also, the arterial/interchange coordination concept was further developed by defining transition parameters to be used to determine when the most appropriate conditions exist to keep the interchange's signals coordinated with the arterial. The traffic prediction module was modified to use the current on-line historical turning movement database so that the module now works in a real-time mode. Another achievement was the development of a generic ring/phase structure diagram that will allow the use of the five different phasing strategies that are most commonly used in diamond interchanges. This structure will allow the transition from a three-phase to a four-phase signal operation without any special provisions. The structure is designed for use with a 16-phase traffic signal controller. Additional information on the concepts, technologies, and findings developed throughout the duration of the Smart Diamond initiative can be found in the following documents:

Bullock, D. A Distributed Computing Model for Integrating Advanced Traffic Signal Peripheral Devices. Proceedings of the Second World Congress on Intelligent Transportation Systems. Yokohama, Japan. November 1995.

Bullock, D. Deployment of Fiber Optic Lane Use Indication Signs Using a Distributed Control Architecture. *Microcomputers in Civil Engineering*. Forthcoming.

Kehtarnavaz, N., C. Huang, T. Urbanik II. Videoimage Sensing for a Smart Diamond Interchange Controller. Proceedings of the 1995 Annual Meeting of ITS America. Washington, D.C. March 1995.

Lee, S. Fuzzy-Logic-Based Incident Detection for Urban Diamond Interchanges. Proceedings of the 1996 Annual Meeting of ITS America. Houston, Texas. April 1996.

Urbanik, T., II, S. Venglar. Advanced Technology Application: The "SMART" Diamond. 1995 Compendium of Technical Papers, ITE 65th Annual Meeting. Denver, Colorado. August 1995.

Venglar, S. Real-Time Optimization at Diamond Interchanges. Proceedings of the Real-Time Technology and Applications Symposium, Institute of Electrical and Electronics Engineers. Chicago, Illinois. May 1995.

Venglar, S., J. Koothrappally. Real-Time Decision-Making Algorithm for Diamond Interchanges. Proceedings of the 1996 Annual Meeting of ITS America. Houston, Texas. April 1996.

Venglar, S., T. Urbanik II. Evolving to Real-Time Adaptive Traffic Adaptive Control System. Proceedings of the Second World Congress on Intelligent Transportation Systems. Yokohama, Japan. November 1995.

Information concerning more recent developments on this project can be obtained directly from Dr. Thomas Urbanik II at (409) 845-1536.

The prototype intelligent highway railroad intersection (IHRI) controller, being developed as part of the railroad-advanced transportation management system (ATMS) integration project, is designed to receive real-time crossing status information relative to the corridor (clear, soon-to-be-occupied, occupied, ETA, closure duration, and ETD) via a positive train separation (PTS) communication network from a railroad central server. The server maintains data on each train operating in the corridor. The field demonstration has been scheduled for March 1998 due to delays associated with the recent rail mergers, and contract negotiations between the railroads and the company developing the PTS system. Researchers also continued to monitor the PTS pilot project being implemented in Washington state to further investigate the information resources available from the PTS system. PTS utilizes the Global Positioning System (GPS) and other hardware and software located onboard the locomotive to compute and communicate the current train position. The development and implementation of the PTS test-bed (not being developed by TTI) continues, with preliminary testing of the highway/rail intersection components currently scheduled for March 1998. Findings from this project have been presented and published in several venues, including the following:

Richards, H.A., R.T. Bartoskewitz. IVHS and the Highway-Rail Intersection. Presented at the 3rd International Symposium on Railroad-Highway Grade Crossing Research and Safety. Knoxville, Tennessee. October 1995.

Richards, H.A., R.T. Bartoskewitz. IVHS Applications to Level Crossing Safety Improvements. Presented at the Dedicated Conference on Advanced Transport Telematics/Intelligent Vehicle Highway Systems. November 1994.

Mr. Jack Webb, (409) 862-7918, should be contacted for additional information regarding this project.

The project *Expedite Incident Response and Management by Improving Police Vehicle Technologies* achieved several operational goals. The goal of the project was to equip an enforcement vehicle with hardware and software to allow it to be integrated into Houston METRO enforcement activities. Among the major accomplishments on the project was the completion of a communications and processing module that allows the vehicle to receive and display Houston freeway traffic speed data available from TranStar, a module that allows snapshots to be captured from the in-car video camera, and an enhanced user interface that allows officers to easily access various graphical capabilities in the vehicle (freeway speeds, video snapshots, other pictures, etc.). As another significant

contribution, researchers continued development (software) and implementation assistance of handheld data entry computers to expedite citation writing and accident reporting at the crash scene. Researchers also assisted in showcasing this state-of-the-art technology, displaying the vehicle at the Government Technology Conference in Austin during February 1997 and at the ITS America convention in Washington, D.C., during June 1997.

Dr. Thomas Urbanik II, (409) 845-1536, should be contacted for more information concerning this project.

As part of the WIM enforcement project, TTI installed and tested equipment to monitor and communicate WIM and video output to a specially equipped police vehicle. Thus far, the research has tested WIM accuracy and communication technologies using compressed video sent over ISDN lines. Another alternative being investigated is a freeze-frame camera system that transmits via wireless communication to a receiver unit. This research is significant in that it lays the groundwork for completing the link with the car to provide a non-intrusive commercial vehicle weight enforcement screening system. To date, this project has yielded the following presentation:

Middleton, D. Enhancements to CVO Enforcement. International Truck Safety Symposium. Knoxville, Tennessee. October 1997.

Dr. Dan Middleton, (409) 845-7196, should be contacted for more information regarding this project.

The emphasis of this fiscal year's activities on the Bus Priority at Traffic Signals project has been on the logic of an intelligent bus priority system needed to predict the arrival time of buses at an intersection and adjust the timing of the traffic signal to ensure that the bus receives a green indication when it arrives at the intersection, all without causing the traffic signal to lose coordination. Major accomplishments this fiscal year have been the design of an algorithm for predicting bus arrival times at intersections, the design of an algorithm for determining the most appropriate strategy for providing priority, and an algorithm for computing the signal timing plan for implementing the priority strategy. Because the algorithm has been designed to both monitor the movement of buses and vehicular demands at an intersection, the intelligent bus priority system is expected to provide transit agencies with an effective means of providing priority treatment to buses without causing significant delays to cross-street traffic or disrupting signal coordination. Mr. Kevin Balke, (409) 845-9899, should be contacted for additional information regarding this project.

### **International Border Transportation Technical Thrust**

Key project accomplishments for IB-01, *Improve Transportation Efficiency in the U.S.-Mexico Border Area Through the Use of IVHS Technology*, include publication of three major reports: "Effect of Telecommunications Deregulation on the Deployment of Intelligent Transportation Systems in Texas and at the Texas-Mexico Border," TTI/ITS RCE 97/02; "Texas-Mexico Border ITS Assessment," TTI/ITS RCE 97/01; and "Mexican Presence on U.S. Highways After the 17<sup>th</sup> of December 1995: Workshop Proceedings," TTI/ITS RCE 97/04. In addition, IB-01 staff presented papers and participated at major ITS forums, including the ITS America annual meeting, the OECD Conference on Intermodal Transport Networks and Logistics in Mexico City, and the 7<sup>th</sup> Annual

Transporte Internacional Conference in Mexico. Journal publications included articles in *Transportation Journal* and *ITS International: The Journal of Advanced Transport Infrastructure*. Staff were also invited to participate in the planning meetings for the North American Trade Automation Prototype project sponsored by FHWA. The IB-01 Focus Area output for this year represents a significant amount of participation, and visibility, within the national and international ITS community, and the recognition, by this community, of the expertise developed within the ITS RCE in the area of international border transportation issues and ITS applications. Continued interest in border transportation and ITS issues by FHWA, TxDOT, and international interests are being supported through the activities and research of the IB-01 staff. Mr. Eric Lindquist, (409) 845-9945, should be contacted for more information on these projects.

### **Crosscutting Institutional, Non-technical, and Technology Integration Issues**

Key accomplishments in the technology integration area include research on the effectiveness of speed trailers on low-speed urban roadways, and the analysis and improvement of methods for determining multiple paths in a roadway network. The spatial and temporal effects of speed trailers were studied by observing the change in speeds and proportion of speeders at four separate sites throughout the Bryan, Texas, area. The results of the analyses indicated average speeds, standard deviations, and proportion of speeders all decreased when the speed trailer was present. Once the trailer was removed the average speeds, standard deviations, and proportion of speeders increased to values close to the values before the speed trailer's use. Dr. Dan Fambro, (409) 845-1717, should be contacted for additional details regarding this activity.

The second activity in this area examined the application of a number of techniques for determining multiple routes in a transportation network. As part of this research, a multiple-criteria decision-making model (MCDM) based on fuzzy theory was combined with a reasonable path route choice model. The project has been completed, and the final report is being prepared. Dr. Larry Rilett, (409) 845-9880, should be consulted for additional information on this activity.

## **TECHNOLOGY TRANSFER**

Technology transfer and clearinghouse staff continue to provide support for the research initiatives at the three RCEs—Texas A&M, University of Michigan, and Virginia Tech—and at the ITS Institute at the University of Minnesota in promoting the awareness, acceptance, and implementation of RCE products. Clearinghouse staff wrote, designed, and produced the program's third annual report and the quarterly program newsletter, the *RCE Intelliscope*. Both the annual report and program newsletter were distributed to the RCE mailing list, which consists of more than 1,500 names. Clearinghouse staff continued updating the World Wide Web pages for the RCE program, providing additional issues of the *Intelliscope* for on-line access and updating the searchable database of RCE project abstracts.

Technology transfer staff showcased the RCE program's research initiatives at the 3rd World Congress on ITS in Orlando, Florida, and at the Transportation Education Conference at the

University of Tennessee in Knoxville. At the Orlando conference, Clearinghouse staff used a computer with an Internet connection to showcase the RCE web site along with the web pages for the TransLink™ Center, the Houston real-time traffic map, web site pages for the other RCE centers and ITS Institute, and other real-time traffic web sites.

## **HUMAN RESOURCE DEVELOPMENT**

Human resource development activities included a presentation and laboratory tour for a senior undergraduate level industrial engineering human factors course, and participation in recruiting visits by two candidates for graduate research assistantships. Human resource development activities also included distribution of brochures announcing and soliciting applications for the Summer 1997 Undergraduate Transportation Fellows Program, which the RCE coordinates with the Southwest Region University Transportation Center. Three applications were received and reviewed, and three offers were extended and accepted. The RCE also distributed a brochure announcing and soliciting applications for a Summer 1997 Minority Faculty Fellows Program.

## **FUTURE ACTIVITIES**

The RCE staff will be working on documenting the research findings in various formats that will be useful to practicing transportation professionals and that will also facilitate future research efforts.