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16. Abstract

TxDOT research project 0-4421 “A Simplified Approach for Selecting Optimal Traffic Responsive Control Parameters” developed a novel scientific and computationally based procedure and guidelines for operating coordinated systems with traffic responsive plan selection (TRPS) mode. Since its development in the 1970s, TRPS mode remained an underutilized resource due to the complexity of its configuration. Numerous parameters (i.e., detector weights, thresholds, timing plan look-up tables, TRPS timing plans, etc.) had to be set up correctly for the system to work as intended. As a result, traffic engineers have typically preferred to use the time of day mode of operation for its ease of setup.

This project will implement the guidelines developed in research project 0-4421 and document a before and after comparison summary for five locations in Texas. Locations are to be chosen to represent a wide range of traffic and/or arterial configurations. This progress report documents the efforts thus far for fiscal year 2005.

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# SITE SELECTION AND PRELIMINARY DATA COLLECTION FOR TRAFFIC RESPONSIVE CONTROL ON TXDOT CLOSED-LOOP SYSTEMS

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## INTRODUCTION

TxDOT research project 0-4421 “A Simplified Approach for Selecting Optimal Traffic Responsive Control Parameters” developed a novel scientific and computationally based procedure and guidelines for operating coordinated systems with traffic responsive plan selection (TRPS) mode *(1)*. Since its development in the 1970s, TRPS mode remained an underutilized resource due to the complexity of its configuration. Numerous parameters (i.e., detector weights, thresholds, timing plan look-up tables, TRPS timing plans, etc.) had to be set up correctly for the system to work as intended. As a result, traffic engineers have typically preferred to use the time of day mode of operation for its ease of setup.

Research project 0-4421 achieved its objectives with the following activities:

- Study the TRPS control mechanism and evaluate the state of the practice.
- Develop a procedure for optimal overall system performance.
- Develop a procedure for determination of the TRPS system parameters and thresholds.
- Develop guidelines for the selection of optimal TRPS system parameters and thresholds.
- Present the developed guidelines in tables and graphs for ease of implementation.

Research project 0-4421 used a state-of-the-art multi-objective evolutionary algorithm to select optimal timing plans and configure the TRPS parameters. This algorithm was used to minimize both system delays and stops, while at the same time minimizing the TRPS classification errors. Guidelines were verified using Hardware-in-the-Loop simulations. The developed methodology resulted in an average savings of 53 percent in system delay and 19 percent in number of vehicle stops.

This project will implement the guidelines developed in research project 0-4421 and document a before and after comparison summary for five locations in Texas. These locations will be chosen to represent a wide range of traffic and/or arterial configurations.

## SITE VISITS AND SELECTION

The research team visited several potential sites in Texas. TxDOT staff was contacted in advance to arrange for the visits and to gather information about each particular site. After careful consideration, the Texas Transportation Institute (TTI) team selected the following sites to provide various traffic conditions and network geometry:

- Bandera Road, San Antonio (San Antonio District),
- S. Valley Mills Dr., Waco (Waco District),
- E. Milam St (US84), Mexia (Waco District),
- W. Commerce St (US 67), Brownwood (Brownwood District), and
- Voss Ave (US 77), Odem, Corpus Christi District.

## ESTABLISHING COMMUNICATION BETWEEN SYSTEM DETECTORS AT STUDY SITES AND TTI

One of the objectives of this implementation project is to collect before and after data at each site. The TTI team contacted TxDOT staff at the selected sites and made arrangements to establish a communication mechanism between system detectors at these sites and the TTI database system in College Station. The TTI team determined that the best communication mechanism for the purpose of this project is to maintain a closed-loop database for each of the selected sites and update the database with TxDOT-supplied information. This information includes a closed-loop software database created for each site (Streetwise and Marc-NX). The TTI team acquired the database for Bandera Road in San Antonio and Commerce Street in Brownwood. Databases for other sites will be acquired when the before data are collected. It should be noted at this point that the S. Valley Mills Dr. site does not currently operate with TRPS control. However, the Waco District expressed willingness and enthusiasm to get the system up and running for the purpose of this project.

## THE "BEFORE" DATA COLLECTION

The TTI team visited all selected sites and collected geometric information. In addition, the TTI team spent a couple of days in Brownwood collecting travel time and delay data. The travel time data were collected using a TTI vehicle specially equipped to collect time stamped

travel distance and intersection location data. The TTI team also recorded 24 continuous hours of video at three intersections. Video data were recorded in Digital Video Multiplexer and Recorders (DVMR) using time lapse technology. The data are currently being reduced at TTI. The Brownwood District also provided the TTI team with three weeks of system detector data for the purpose of calculating the frequency of different traffic states. This type of data is very important in customizing the guidelines to specific needs.

The TTI team developed special timing plans for the Brownwood system. Corridor Simulation (CORSIM) package simulation will be used to evaluate system performance before the implementation of the TRPS system and the collection of the "after" data *(2)*. Similar activities will be conducted for the rest of the study sites. The schedule of activities is discussed in the following sections.

## PLANNED TASKS FOR FISCAL YEAR 2006

### Configuration of TRPS System on Study Sites

The TTI team will configure the study sites to operate with TRPS control. Field visits will be conducted for system configuration as well as initial monitoring. This task includes the following subtasks:

- Select the final set of timing plans for each study site. Each of these plans will be selected for the specific traffic equipment installed at the site (Naztec versus Eagle).
- Produce all CORSIM simulation files and conduct all simulations to determine the stop-delay input matrix.
- Determine detector weights, thresholds, and timing plan index matrix for each of the five sites.

The TTI team will prepare the CORSIM simulation files to represent each particular site's operation.

### Monitoring System Status and Collecting the "After" Data

The TTI team will continue to monitor the status of each site from College Station. An "after" performance study will be conducted to quantify the benefits of TRPS control. This task will be carried throughout the life of the project to: 1) ensure that developed TRPS guidelines are

robust enough and can accommodate different traffic pattern changes as expected, and 2) fine tune and customize the developed guidelines for special situations (i.e., system detectors installed at locations other than those recommended by the general guidelines).

### Preparation of Before-After Comparison Summary for Documentation Purposes

The TTI team will prepare a before and after performance comparison for system operation with TRPS control. Performance measure will be tabulated and plotted for each site to show the benefits expected under various traffic conditions and network types. This study is intended to document the system performance and to predict the benefits expected so that engineers can decide if they would like to embark on the TRPS operation investment.

### Preparation of a Step-by-Step Field Manual for Field Technicians

One major objective of this project is to facilitate the implementation of the TRPS guidelines. Therefore, the TTI team will prepare a step-by-step field technician manual to guide field technicians through the process of configuring their controllers to run a TRPS control. The field manual will be updated as the project continues to reflect different situations encountered in the field.

## SCHEDULE OF ACTIVITIES FOR FISCAL YEAR 2006

Individual guidelines for site-specific requirements will be delivered by the end of Fiscal Year 2006. Table 1 shows a schedule of activities pertaining to each study site. This schedule reflects changes to the project as a result of its late start. The final deliverable will be submitted on time.

**Table 1. Proposed Schedule of Deliverables to TxDOT.**

| Site and District | Fiscal Year 2006 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **S** | **O** | **N** | **D** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** |
| 1. Brownwood | | | | | | | | | | | | |
| 2. San Antonio | | | | | | | | | | | | |
| 3. Waco | | | | | | | | | | | | |
| 4. Waco | | | | | | | | | | | | |
| 5. Corpus Christi | | | | | | | | | | | | |

## CONCLUSION

The objective of this project is to implement the guidelines developed in research project 0-4421 and document a before and after comparison summary for five locations in Texas. Locations were chosen to represent a wide range of traffic and/or arterial configurations. This progress report documents the efforts thus far during fiscal year 2005.

## REFERENCES


1. Abbas, M., N. Chaudhary, G. Pesti, and A. Sharma. *Guidelines for Determination of Optimal Traffic Responsive Plan Selection Control Parameters.* Research Report 0-4421-2. Texas Transportation Institute, The Texas A&M University System, College Station, Texas, September 2004.

2. CORSIM User's Manual. ITT Systems & Sciences Corporation, FHWA, U.S. Department of Transportation, 2003.