Congestion Relief by Travel Time Minimization in Near Real Time

MIOH UTC TS1p1 2007-Final

Final Report

Developed By:

Charles R. Standridge
Principal Investigator
standric@gvsu.edu
616-331-6759

Shabbir Choudhuri
Investigator
choudhus@gvsu.edu
616-331-6845

School of Engineering
Grand Valley State University
301 West Fulton
Grand Rapids, MI 49546

With Contributions By:

Snehamay Khasnabis
College of Engineering
Wayne State University
2168 Engineering Building
Detroit, MI 48202
skhas@wayne.edu
313-577-3915

May 31, 2007

I. Purpose

This document summarizes the activities concerning the project: Congestion Relief by Travel Time Minimization in Near Real Time since the inception of the project (November 22, 2006) through April 30, 2007. Thus, this document serves as the phase I final report.

II. Phase I Highlights

The following are the major accomplishments of phase I.

1. Established that one major and primary contribution of our project is to understand the flow of traffic in a corridor with respect to time and space.
    a. Designed a traffic routing algorithm that permits time and space relationships to be taken into account.
    b. Formed a team to analyze traffic flow data with respect to time and space using standard statistical techniques as well as data mining techniques.
2. Completed the integrated software environment for model and data fusion.
3. Submitted the following paper concerning the integrated software environment for model and data fusion to the 2007 Winter Simulation Conference: *A Simulation Case Management System* by C. Standridge, J. Gallivan, S. Choudhuri, V. Yada, and M. Lynn.
4. Completed a first version of a web-based content management system for literature reviews.
5. Acquired all available data from the Detroit area intelligent transportation systems (MITS) center for the years 2000-2006 as well as establishing procedures for continuing to obtain data starting with January 2007.
6. Organized and staffed the project for phase II.
7. Established effective relationships with external constituents at M-DOT, SEMCOG and the Grand Valley Metropolitan Council.

III. Project Organization

The project organization is shown in Figure 1. There are two primary subprojects or strands. The investigators share responsibility for each strand with one lead investigator for each strand.

Shabbir Choudhuri is the lead investigator for the modeling and analysis strand. This strand has two activities:

1. Project Scheduling to Level Corridor Capacity
2. Static / Dynamic Route Selection Algorithms with Validation by Simulation

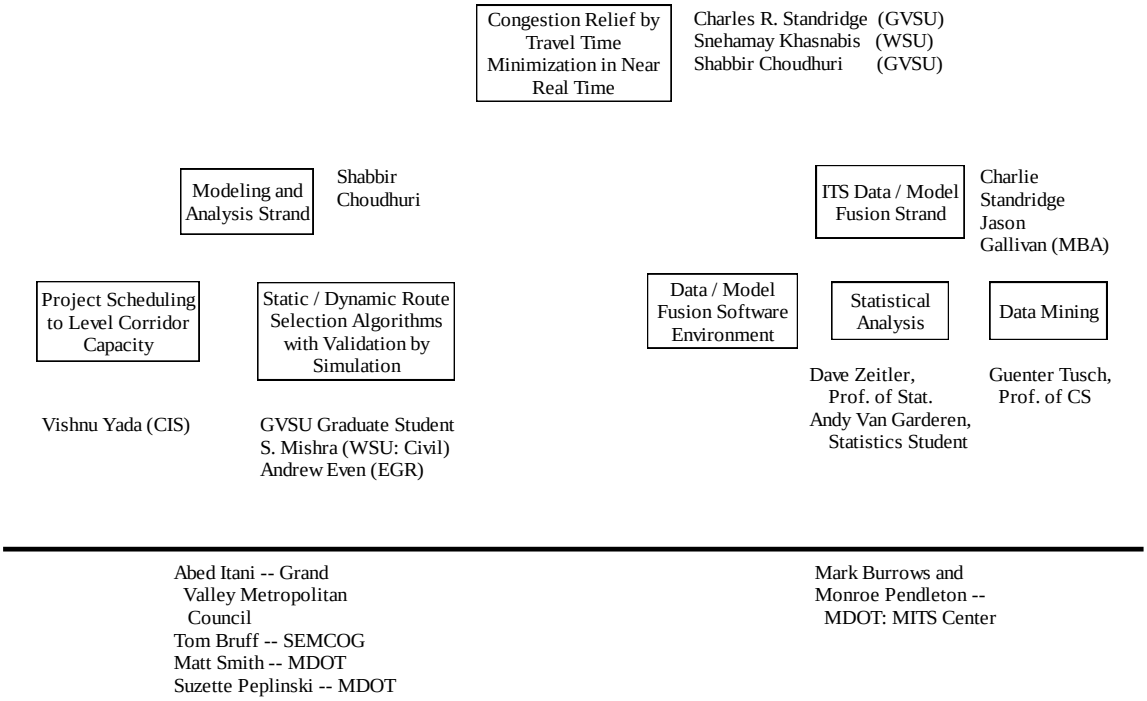

Figure 1: Project Organization

Charlie Standridge is the lead investigator for ITS Data and Model Fusion strand which has three activities.

1. The data and model fusion software environment (completed).
2. Statistical analysis of MITS Center data.
3. Data mining analysis of the MITS Center data.

Dave Zeitler is consulting with regard to the statistical analysis of traffic data collected by the MITS Center in Detroit. Gunther Tusch is leading the data mining analysis of the MITS Center data.

Snehamay Khasnabis serves as a consultant to all subprojects.

We have made contact with and met with our external constituents representing the following organizations as shown in Figure 1:

1. Grand Valley Metropolitan Council – Abed Itani, Transportation Director and staff
2. SEMCOG – Tom Bruff and staff
3. M-DOT
    a. Michigan Intelligent Transportation Center Detroit – Monroe Pendleton
    b. Michigan Intelligent Transportation Center Grand Rapids – Suzette Peplinski and staff
    c. Southfield Office – Matt Smith

In addition, project activities are support by graduate assistants and undergraduate students as shown in Table 1.

Table 1: Student Participation

Activity	Student	Department	Degree Program	Status on Project
Project Scheduling to Level Corridor Capacity	Vishnu Yada	GVSU, Computer Information Systems	Master of Science	20 hours weekly, Graduate Assistant
Static / Dynamic Route Selection Algorithms with Validation by Simulation	TBD	GVSU, Engineering	Master of Science	20 hours weekly, Graduate Assistant
	Andrew Even	GVSU, Engineering	Master of Science	Capstone project, unpaid
	S. Mishra	WSU, Civil Engineering	Ph.D.	Hourly, Graduate Assistant
ITS Data and Model Fusion	Jason Gallivan	GVSU, College of Business	MBA	20 hours weekly, Graduate Assistant
Statistical Analysis of MITS Center Data	Andrew Van Garderen	GVSU, Statistics Department	Bachelor of Science	Semester stipend

In total there are five faculty and six students participating in this project.

IV. Technical Progress

The emphasis of the Phase I effort was on project organization as discussed in section III as well developing relationships with our external constituents, acquiring data from the Detroit area intelligent transportation systems (MITS) center, designing models, building software tools, and developing state of art literature reviews.

IV.A Modeling and Analysis Strand -- Project Scheduling to Level Corridor Capacity Activity

1. Version one of a state of the art literature review was completed.
2. Concepts for modeling construction project selection and the effect of construction projects on traffic flow have been development.
3. Contact has been made with Mark Smith of MDOT concerning the congestion mitigation-project management activity he is managing.

4. Information concerning construction project selection has been obtained through Abed Itani for the Grand Valley Metropolitan Council region. Similar information is available on the SEMCOG web site.
5. The design and implementation of a software tool for an on-line, searchable, and updatable form for any literature review have been completed. This tool will serve as the capstone Masters degree activity for Vishnu Yada. This tool supports living documents that:
    a. Can be kept current over time.
    b. Organize and maintain a large volume of literature.
    c. Make a large volume of literature widely accessible.

IV.B Modeling and Analysis Strand -- Static / Dynamic Route Selection Algorithms with Validation by Simulation

1. Version one of a state of the art literature review was completed by Andrew Even as a part of his Masters of Science in Engineering degree capstone project proposal.
2. A route selection algorithm has been designed that accommodates both dynamic and static routing. A traffic corridor is modeled in the traditional way using a graph. The arc weights are computed as needed in an isolated function and may be a function of time.
3. Contact has been made with Mark Smith of MDOT to help assess the appropriateness of using the corridor chosen for the congestion mitigation-project management activity he is managing.
4. The optimization and genetic algorithm tool boxes for MATLAB have been purchased to support implementation of the route selection algorithm.

IV.C ITS Data and Model Fusion

1. Version one of a state of the art review of ITS systems was completed by Jason Gallivan. This review includes information from the MITS centers in Detroit and Grand Rapids as well as from the Grand Valley Metropolitan Council, including the Grand Rapids ITS strategic plan.
2. The design and implementation of the integrated software environment that includes all models as well as all data fusion capabilities has been completed by Jason Gallivan. A paper discussing this environment has been submitted to the 2007 Winter Simulation Conference.
3. Monroe Pendleton and Mark Burrows of the MITS Center in Detroit have supplied traffic data for the years 2000-2006. Traffic data for 2007 is downloaded bi-weekly from the MITS center.
4. An initial statistical analysis of the traffic data was conducted under the direction of statistics professor Dave Zeitler by Andrew Van Garderen, an undergraduate student in statistics.
5. The planning for a data mining analysis of the traffic data was completed by Professor Gunter Tusch of the GVSU School of Computing.