Development of an Integrated Algorithm for Variable Speed Limit Control and Dynamic Merge Control

Problem
Performing work-zone activities in highway segments is one of the main contributors to traffic delay and safety, as the capacity reduction, due to the lane closure operations, often causes drivers to perform complex lane-changing and merging maneuvers which in turn incur excessive queue or a high speed variance over the upstream segment of a work zone. To contend with this imperative issue, transportation professionals have proposed a variety of work-zone control devices and strategies over the past two decades. Most of such efforts, however, have been focused mainly on traffic safety such as speed reduction and smooth merging operations, but not on delay minimization or throughput maximization.

Objectives
The principal objectives are twofold: understanding the deficiencies and strengths of existing work-zone traffic control algorithms, and developing an improved system that can best use the available work-zone capacity and also take into account of potential safety issues.

Description
The entire study consists of five major parts: (1) understanding traffic flow properties under congested work-zone conditions, (2) developing an advanced dynamic merge control system and its operation algorithm that can integrate the strengths of the static early and late merge controls, (3) modeling an optimal variable speed control system and its operation algorithm that can maximize the total work-zone throughput and improve the overall traffic safety, (4) integrating the developed DLM and VSL control strategies to maximize their effectiveness in contending with work-zone congestion, and (5) evaluating the proposed algorithms with simulation experiments.

Results
To improve traffic mobility and safety on highway segments plagued by work zone activities, this study has focused on developing the advanced dynamic merge and variable speed limit controls for work zone applications, including an integration of both controls for best use of their strengths in maximizing throughputs and minimizing speed variance in traffic flows. The simulation results have demonstrated that the developed DLM and VSL controls have better performance in terms of traffic mobility and safety than their existing controls based on static approaches, and also shown that the proposed integrated control of the DLM and VSL control has more promising properties than each individual control.

Report Information
This document is available from the Research Division upon request.