Communication Document

February 29, 2011

NetZone: An Integrated Work Zone Traffic Management Tool

RESULTS: NetZone, a dynamic work zone traffic impact analysis software tool developed in a previous phase of the project, was updated, refined, and expanded in several dimensions to make it more robust, user-friendly, and powerful in modeling various types of work zones and assessing their traffic and environmental impact in the context of large networks.

The new NetZone software can model lane closures or directional closures with segment-specific work zone speed limits and capacity reductions; actuated traffic signals and traffic responsive ramp metering, or time-of-day signal timing plans with coordination; and high occupancy vehicle lanes. It implemented state-of-art traffic flow and dynamic traffic assignment models/algorithms where travelers are divided into habitual travelers who stick to their routes and adaptive travelers who switch routes from time to time in response to traffic congestion to capture network wide traffic diversion and queuing caused by the work zone.

The NetZone software also comes with a suite of performance statistics and visualization tools for scenario analysis and report generation. These include travel time/delay, vehicle hours/miles traveled, fuel consumption, and emissions of several kinds (CO2, CO, NOx, HC); queuing diagrams, contour plots and animation of congestion growth and decay in the network.

The NetZone software was successfully applied to the Fix-I5 project, in which directional closure of I-5 near downtown Sacramento was modeled. Modeling projects in NetZone take less time to develop and calibrate, compared with microsimulation models. NetZone reproduces better congestion patterns by modeling queues and traffic diversions compared with planning models.

Why We Pursued This Research

Many California highways were built more than thirty years ago. These highways have been exposed to heavier traffic volumes and loads compared to their designed capacity. Therefore they have deteriorated significantly and need major rehabilitation/reconstruction which creates traffic delays, environmental impacts and affects traffic safety. Careful traffic management planning should be carried out to minimize the impact of construction work in heavily traveled urban corridors during commuting hours.

There are various limitations with several types of traffic analysis tools used to help plan and mange traffic in work zone projects. Microscopic simulation is time-consuming to use and difficult to calibrate. Planning models often fail to capture the congestion produced by large bottlenecks like a work zone. Input/output (or determinist queuing) models are too simple to capture the spillover effects of congestion to alternative routes. Clearly, there is a need for a work zone modeling tool that 1) is easy to use, 2) models congestion evolution in an entire network, not just the freeway containing the work zone, 3) captures traffic diversion, and 4) provides a comprehensive set of measure of effectiveness (MOE) and visualization tools for problem analysis and report generation. NetZone was designed to meet this need.

What We Did

Previously we developed a work zone traffic impact assessment software package called NetZone. This current project added features that include improved traffic analysis and traffic control models, a fuel consumption and emission modeling module and a High Occupancy Vehicle (HOV) analysis module, and an updated and enhanced Graphical User Interface (GUI). The updated NetZone software obtained satisfactory result when it was tested in the Fix-I5 project in Sacramento.

Some of these features are highlighted in the following figures. Figure 1 shows the new GUI of NetZone with the Sacramento area network. Figure 2 shows the density contour plot for a link. Figure 3 shows the queuing diagram for a link. Figure 4 shows the animation of traffic congestion growth/decay over a portion of a network.

A detailed user manual and a brief tutorial were prepared to help users learn how to develop NetZone projects. The NetZone software, a final

report, and the supporting documentation are available through Caltrans.

Fig. 1 NetZone Graphic User Interface (GUI)

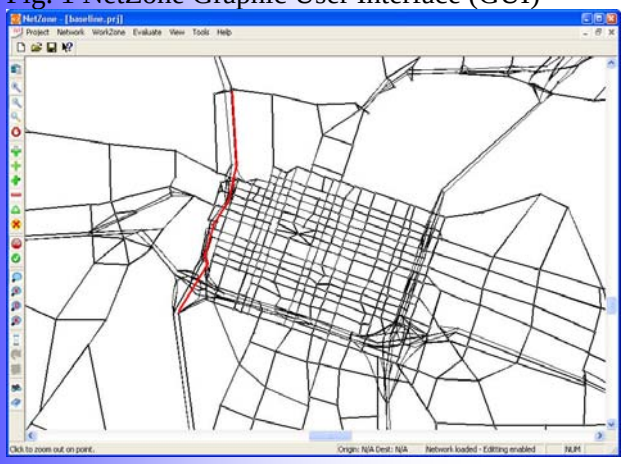


Fig. 2 Density Contour in NetZone

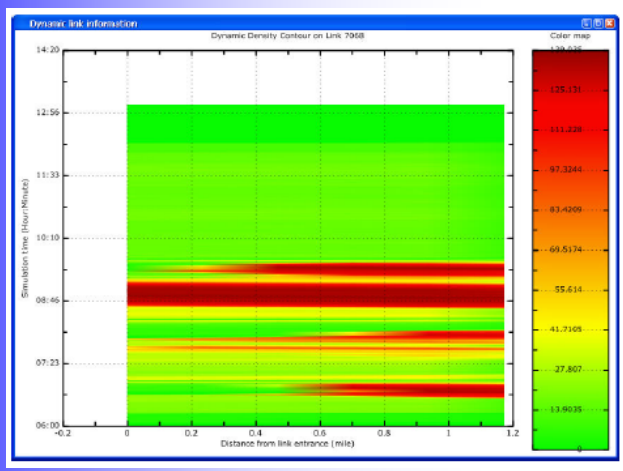
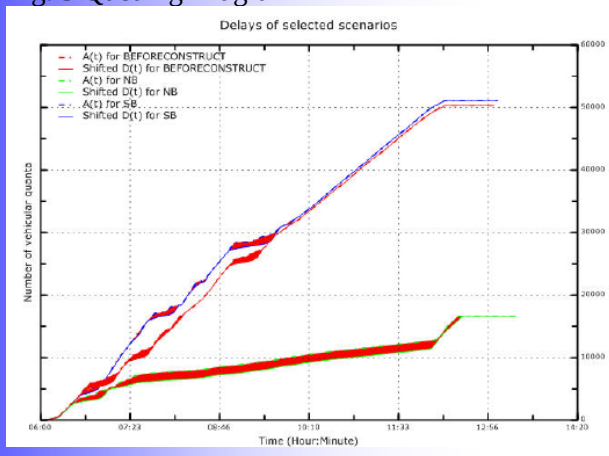


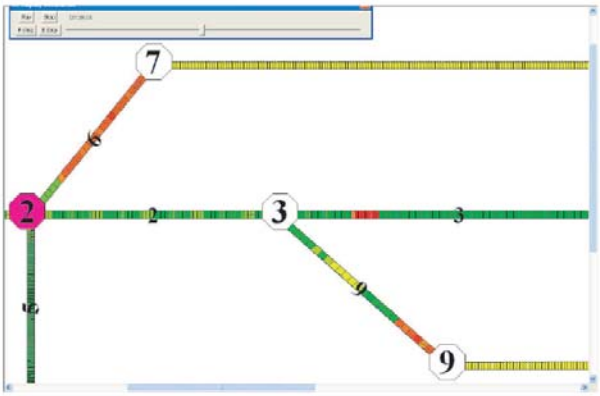
Fig. 3 Queuing Diagram



The Researchers Recommend

NetZone is a versatile dynamic traffic modeling and analysis tool developed for work zone projects in corridors or large urban networks. Initial applications of NetZone to the Fix-I5 project in Sacramento, the SR-41 project in Fresno, and the I-880 corridor project in Oakland (reported elsewhere) demonstrated that it can be applied to analyze work zone or corridor management projects in a reasonable and shorter time than using microscopic simulation software with satisfactory modeling results. The researchers recommend its wider use within Caltrans for particularly large scale reconstruction projects with immense traffic impact.

Fig. 4 Spread of Congestion (animation of how congestion grow and decay, ideal for hot spot analysis)



Like any dynamic network traffic analysis tool, NetZone is a complex software package that integrates a variety of sophisticated models and algorithms. It requires a steeper learning curve than its simpler brethren, such as FREQ. Hands-on training and readily available technical support in the initial adoption of NetZone is highly desirable to develop a user community within Caltrans. It is also recommended that the software be maintained to keep up with programming language and operating system upgrades and updated on a regular basis based on user experience and feedback.

Contact information:

Prof. Michael Zhang, PhD
Institute of Transportation Studies
University of California Davis
hmzhang@ucdavis.edu, (530) 754-9203

Haniel Chung,
Division of Research and Innovation
Caltrans
haniel_chung@dot.ca.gov, (916) 657-4064