UNIVERSITY TRANSPORTATION RESEARCH CENTER

RESEARCH BRIEF

PROJECT TITLE: ROBUST ROUTING FOR HAZARDOUS MATERIALS TRANSPORTATION WITH CONDITIONAL VALUE-AT-RISK ON TIME-DEPENDENT NETWORKS

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COMPLETION DATE: NOVEMBER 2012

SPONSOR: RESEARCH AND INNOVATIVE TECHNOLOGY ADMINISTRATION / USDOT

The Pipeline and Hazardous Materials Safety Administration defines hazardous materials (hazmat) as a substance or material capable of posing an unreasonable risk to health, safety, or property when transported in commerce. Hazmat accidents can result in significant injuries to the population and damages to the environment. It is therefore desirable that a decision maker considers both objective and subjective factors and makes route choices carefully but flexibly. The need for flexibility provides motivation for this research project on the conditional value-at-risk (CVaR) concept applied in hazmat transportation in time-dependent environments.

The risk along the same route can become significantly different depending on the time of travel. For example, we do not want hazmat trucks traveling on very congested roads, even though they may be safest route in uncongested time periods. Also, special events like football games may make certain road segments, which were safer during normal days, very dangerous for hazmat truck travel on game days. To consider this important issue of time-dependent risk factors in hazmat transportation, this project uses CVaR on time-dependent networks to determine the safest timing of travel as well as the safest route.

This project develops an algorithm based on dynamic shortest-path algorithms for the CVaR minimization problem on time-dependent networks, and applies to the Buffalo area network. This study suggests that CVaR is a proper risk measure for hazmat route decision making in dynamic environments.

The CVaR concept is applied to the Buffalo area network shown in the figure below. The model finds various routes and various departure times depending on the decision maker's preference on the confidence-level parameter in the CVaR model.

It is also found that the CVaR model and algorithm has the potentials to be used for other low-probability/high-consequence events for risk mitigation in time-dependent environments.