

# Transportation Literature Search



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## Transportation Security

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*Transportation Literature Searches are prepared for WisDOT staff on issues of interest to the department. The literature citations and meeting summaries listed here are from the TRB 84<sup>th</sup> Annual Meeting Compendium of Papers and from the Final Program. The full text of these preprints is available on the Compendium CD-ROM. Final revised versions of some of the papers will be published by TRB as part of its Transportation Research Record series. Additional information from the meetings cited, such as PowerPoint presentations or other materials, may be available from the session organizers.*

### **KEYWORDS**

security, facility security, continuity of operations, continuity of government, emergency government, emergency management.

### **Compendium of Papers CD-ROM**

#### **Probabilistic Vehicle Identification Techniques for Semiautomated Transportation Security (05-0099)**

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**Abstract:** Intelligent Transportation Systems can play a significant role in transportation security in addition to their traditional roles in transportation operations and management. A multidetector semi-automated vehicle surveillance framework is presented. The objective of the framework is to assist in the search for a “vehicle of interest” involved with security threats such as terrorism, abduction or crime. When a vehicle of interest is wanted, this framework can be applied to reduce surveillance data sets, thus reducing time and labor. This system estimates the posteriori probabilities which indicate the closeness of the match between a vehicle of interest and any vehicle in the search space. This paper explores the use of multi-detector fusion of video and inductive loop data with a linear fusion model. This system classifies vehicle pairs into possible correct match or incorrect match classes and transforms the problem into the probabilistic domain using Bayesian and Probabilistic Neural Networks (PNN). The use of Bayesian and PNN classifiers assumes equal losses. In using Bayesian estimation and Generalized Regression Neural Networks (GRNN), the posteriori probability is used as a threshold representing unequal losses. A comparison between the traditional Bayesian approaches and the equivalent neural network methods is presented. The use of different feature combinations, methods to balance training data sets, forward sequential search, and combined/uncombined feature approaches are also investigated. Field arterial data from Southern California shows that by retaining only 29 percent of the search space the framework produces 92 percent accuracy which is a promising result.

#### **Optimizing the Location and Relocation of Response Units in Guarding Critical Facilities (05-0253)**

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**Abstract:** The ability to optimally locate military units or equipment, police forces and first responders, and to quickly relocate idle units in response to changing conditions, is crucial to a country’s ability to guard its critical

facilities. Such facilities include, for example, vital components of the transportation infrastructure, government and monumental buildings, locations of large gatherings, emergency operations centers, and public and private utilities and communications facilities. In this paper, the problem of making optimal location and relocation decisions for a fixed fleet of response units in a transportation network, where travel conditions are uncertain, is addressed. A mixed integer linear program with multiple objectives (maximize secondary coverage and minimize cost) is presented. Because exact solution of such problems may require considerable computational effort, a metaheuristic based on the principles of genetic algorithms is proposed. The heuristic seeks the set of Pareto-optimal location and relocation decisions for each network state. All facilities of concern must be covered by at least one response unit. If the state of the network changes such that coverage is lost (e.g. travel times increase or a response unit is no longer available), one or more of the response units must be relocated. These relocation decisions are also addressed.

### **An Evaluation of Biometric Technologies for Access Control at Transportation Facilities and Border Crossings (05-1254)**

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**Abstract:** To ensure that only authorized individuals -- workers, travelers, visitors -- enter a transportation facility or border crossing, their identities must be ascertained. Because manual procedures are time-consuming, resource-intensive, and prone to human error and manipulation, the use of biometric technologies should be considered. The following biometric technologies -- fingerprint recognition, iris recognition, facial recognition, and hand geometry -- are discussed by the authors, and their feasibility for use in access control at transportation facilities and border crossings are assessed. The advantages and disadvantages of the technologies are provided along with cost, accuracy and other performance data for each technology. Also, potential privacy and data issues are presented and discussed in this paper.

### **An Interdependent Systems Framework: Development and Initial Application in the State of New Mexico (05-1516)**

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**Abstract:** The State of New Mexico, through the Surety Task Force, developed a theoretical approach to understanding interdependencies among critical systems. The approach is called the Interdependent Systems Framework (ISF). Within each society there are numerous systems, many of which are significant to sustained growth. A critical system is one that if successfully attacked and fails, can bring about the failure of the society. Transportation is one such critical system. The ISF framework was successfully applied in the State of New Mexico in risk management of critical systems. The New Mexico Surety Task Force, co-led by the Secretary of the Department of Transportation and the Director of the Governor's Office of Homeland Security, developed and implemented the framework. It was used to (1) select state agencies to participate in statewide vulnerability assessment of critical infrastructure, (2) guide development of a vulnerability checklist for specific high consequences sites within the State of New Mexico, and (3) select critical systems for standard security awareness training material preparation. Each of these applications is described in this paper. Application and refinement of the ISF is an ongoing process. The paper identifies areas of planned application, including actionable intelligence and homeland security resource allocation and accountability. The ISF is an example of joint efforts by State agencies in the New Mexico Surety Task Force to serve the people of New Mexico and the United States.

### **Ensuring the Security of Transportation Facilities: An Evaluation of Advanced Vehicle-Identification Technologies (05-1780)**

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**Abstract:** Advanced vehicle identification technologies can enhance our national security and the security of our transportation facilities, workers and customers by preventing unauthorized vehicles from entering a transportation facility, border crossing or parking area. Manual checks are time consuming -- the vehicles' license plates need to be checked against authorized plates and the identity of workers and travelers passing through the access point needs to be confirmed. Advanced vehicle identification technologies allow faster access for authorized vehicles, reduce the possibility of fraud and error, and permit security personnel to spend more time evaluating unknown vehicles and persons. The authors discuss the following advanced vehicle identification technologies -- automated license plate readers, electronic license plates, and vehicle-based identification systems -- and their applicability in localized access control and in national security applications. The features of the technologies, costs, accuracy and feasibility are discussed, and recommendations for further research are suggested.

#### **Using Ant Algorithm to Derive Pareto Fronts for Multiobjective Siting of Emergency Facilities (05-1784)**

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**Abstract:** Efficient and timely response during accidents has received increased attention from both practitioners and researchers. The siting of emergency service facilities (ESFs) plays a crucial role in determining the efficiency of safety protection and emergency response. This paper explores a novel Multiobjective (MO) Ant algorithm for siting of ESFs. With the aid of GIS, the algorithm finds a population of solutions, uses Pareto Ranking to sort these solutions, and derive the Pareto Front. It is demonstrated that the algorithm successfully captures a pool of non-dominated solutions, thereby providing decision makers with a set of alternative solutions. The case study also presents how decision makers may choose one "best" solution from the pool according to their preference or determinant criteria.

#### **Remote-Sensing Applications for Pipeline Security Assessment (05-1966)**

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**Abstract:** A variety of advanced technologies are available to enhance planning, design, management, operation and maintenance of pipeline system. Aerial and satellite remote sensing represents one area of rapid development that can be leveraged to assist pipeline risk assessment to assure the safety of pipeline facilities. Industrial and scientific advances in airborne and satellite remote sensing systems and data processing techniques are opening new technological opportunities to develop an increased capability to accomplish the pipeline mapping and safety needs of the industry. These technologies have significant and unique potential for application to a number of crosscutting system security issues. This paper addresses some of the applications of these technologies to pipeline security assessment.

#### **Evaluation of Emergency Evacuation Strategies for Downtown Event Traffic Using a Dynamic Network Model (05-2164)**

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**Abstract:** This research studied the feasibility of applying a dynamic traffic assignment model, Dynasmart-P, for evaluating the effectiveness of alternative strategies for evacuating the traffic in downtown Minneapolis, Minnesota, under a hypothetical emergency situation that included the evacuation of the sellout crowd in the Metrodome. For this study, the southwest portion of the Twin Cities metro area was selected as the study network and a set of different network configurations were evaluated in terms of their effectiveness in coping with a given emergency situation. The simulation results indicate that managing traffic conditions at the outbound freeway links in the given network during the evacuation period and the access capacity from the downtown area to those outbound freeway links are the critical factors affecting the effectiveness of evacuation operations. For example, the evacuation time under the contraflow operations with the freeways surrounding the downtown area was substantially reduced when the capacities of the key entrance ramps were also increased.

### **Reducing Security Risk for Transportation Management Centers (05-2378)**

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**Abstract:** Transportation Management Centers (TMCs) make an important difference in the lives of commuters around the country every day. Different types of threats exist that can damage or destroy a TMC's ability to operate. These threats range from rare but devastating terrorist attacks to the more frequent and troublesome impact of utility failures or severe weather conditions. The TMC Risk Assessment Methodology introduced in this paper is based on best practices of several proven risk assessment methodologies. The underlying algorithm and approach are drawn from the Systematic Assessment of Facility Risk (SAFR). A second contributing methodology is the Department of Homeland Security (DHS) Office of Domestic Preparedness toolkit. A final contributing methodology is the AASHTO Guide to Highway Vulnerability Assessment for Critical Asset Identification and Protection. The TMC Risk Assessment Methodology (TMC RAM) components include asset identification, threat assessment, consequence assessment, vulnerability assessment and countermeasure development. The research team selected 10 TMCs to use as a basis of the gathering of best practices and common challenges. As initial data were developed for the selected set of 10 centers, the selection was narrowed down to three sites for a more comprehensive on-site Vulnerability Assessment. This paper provides a number of general recommendations which can be readily applied to all TMCs. These recommendations include taking the time to conduct a comprehensive risk assessment; reviewing, updating and revising the risk assessment on a regular basis; correcting simple physical vulnerabilities; and training employees in security awareness.

### **Evacuation Modeling and Operations Using Dynamic Traffic Assignment and Most-Desirable-Destination Approaches (05-2401)**

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**Abstract:** This paper reports the results of a microscopic evacuation simulation study in the event of a major nuclear power plant accident. The two main thrusts of this study are the use of dynamic traffic assignment (DTA) to route evacuees in a non-equilibrium environment, which is the case for unplanned or "no-notice" large-scale disasters, and the consideration of most desirable destinations (MDD) for all evacuees in a transient traffic network, where a nearby shelter may not be the most desirable depending on the network condition at the time. By affording flexibilities in the route assignment and destination selection processes, this study demonstrates feasibility and superiority of using DTA and MDD with microscopic simulation of traffic evacuation operations. For the study site of Sequoyah nuclear power plant in Tennessee, a 58 percent reduction in overall evacuation time was achieved when DTA and MDD were implemented. This paper also details the steps involved in preparing necessary data for the proper representation of the transportation network, the evacuation traffic demand, and other tangible aspects for various evacuation scenarios.

### **Dynamic Traffic Management for Evacuation (05-2369)**

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**From Abstract:** Several notable area-wide traffic evacuation models have been proposed over the past two decades. They deal with situations ranging from nuclear disasters to hurricanes and earthquakes. But they are inherently restricted to being planning tools, given that they deal with providing evacuation plans and measures for a single given scenario or one chosen from a set of probabilistic scenarios. In addition, emergency response modeling in these tools significantly underplays the important role played by the evacuating drivers' response to suggested evacuation strategies. This under emphasis on evacuee behavior is quite important to be overlooked. In this paper we discuss the development of a real-time traffic management system for evacuation, with applicability to flooding

disasters. An emergency management scheme based on a structure that includes a feedback loop using surveillance systems is outlined. Of particular focus is the quantification of the system performance degradation which results from the route choice decisions made by evacuees and the real-time pre-trip route guidance scheme, based on feedback from observed traffic to influence the system performance towards an optimum level.

**A Simple Algorithm to Estimate Emergency Vehicle Travel Time Savings on Preemption-Equipped Corridors: a Method Based on a Field Operational Test (05-2147)**

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**Abstract:** Increasing congestion within many jurisdictions challenges public officials charged with developing strategies that provide the highest levels of emergency response across a wide range of potential incidents (man-made or natural). Public safety officials must get emergency vehicles (EVs) to the scene using the same transportation links used by the general population. Performance of these links and the impact on EV travel time is dependent on several factors: traffic flow density, roadway geometries, intersection signalization, and auto driver behavior in response to EVs. This paper introduces a simple method that considers the way that EV drivers respond to differing intersection traversal conditions and generates estimates of corridor level travel time savings based on the provision of EVP. Current analysis methods do not provide adequate fidelity because they do not consider impact of auto driver behavior in the progression of EVs. The method proposed capitalizes on research that characterized auto driver behaviors in response to approaching EVs in the vicinity of signalized intersections. The research results advance the practice of EVP benefit evaluation by offering a means to estimate the EV travel time benefits of EVP without conducting high cost field studies or accepting the limitations of current traffic micro-simulation based methods. The research described in this paper provides new tools in quantifying the benefits of roadway elements of emergency response investment strategies. The findings may lead to information that will support public officials who must make resource decisions in an environment where public safety initiatives compete with other societal priorities.

TOC title: **Developing Decision Support System for Emergency Evacuation: Case Study of Bush Fires (05-0318)**

Paper title: **Understanding Household Evacuation Decisions Using a Stated Choice Survey – Case Study of Bush Fires**

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**Abstract:** There are two types of emergencies: those which can be anticipated and those that cannot. Among those that can be anticipated are such events as cyclones, floods, bush fires and tsunamis. When such events are anticipated, one course of action that may be taken is the evacuation of residents from a threatened area. When evacuation takes place, there often remains a need to provide access for emergency vehicles and personnel to the threatened area creating a conflict between the needs to maximize capacity for evacuation, while continuing to provide access to the threatened area. Relatively little is known about when residents will decide to evacuate. A model of evacuation behavior is needed that would predict the proportions of the population that would leave within certain time periods, thus leading to the development of an evacuation travel demand model. Under a contract from Emergency Management Australia, the authors developed a method to predict evacuation decisions by residents from bush fires. This paper describes the methods used to determine when a household would evacuate, and describes the resulting model that predicts how many partial and full evacuations will take place by time period from when the emergency is first perceived.

**Modeling and Performance Assessment of Contraflow Evacuation Termination Points (05-2570)**

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**Abstract:** Currently, there are about 20 hurricane evacuation contraflow segments planned for use in the U.S. When activated, these routes will serve as lifelines for people fleeing the potential destruction of approaching storms. The termination points of these segments are critical because they move traffic from the reverse flowing lane into the normal flow direction. They are also thought to significantly affect the overall effectiveness of the sections because they can regulate the amount of volume that exits the section. The research effort described in this paper was undertaken to assess and compare the operational characteristics of contraflow evacuation termination point designs that will be used under threat from catastrophic storms. Among the developments of the research was an approach and set of assumptions for using CORSIM to model contraflowing freeway traffic under evacuation conditions.

These models were used to comparatively assess and rank the planned termination designs and to identify the factors that made some designs more effective than others, including the effect of reducing traffic volumes prior to the termination. The quantification of the operations revealed several important concepts relative to the use of contraflow evacuation segments. The first was that it was advantageous to maintain all lanes through the termination point by using split, rather than to use merge designs. Another was that it is advantageous to reduce the volume entering the termination point by maintaining exit points along the route. The study also suggests that merge zones located after exits, as opposed to prior to them, and the use of channelization/separation devices well in advance of forced maneuvers can enhance the quality of the flow through the termination vicinity.

### **Conceptual Framework for Simulating Pedestrian Evacuation Behavior from Buildings (05-2297)**

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**Abstract:** From a social science perspective it is useful to think of the evacuation behavior during emergency, commonly referred to as emergency egress, as having four distinct analytical dimensions: the physical environment from which to evacuate, the threat forcing the evacuation, the managerial policies and controls deployed at evacuation, and the psychological and social organizational characteristics impacting the persons that participate in the movement. It is much more common in the physics and engineering literature to find direct consideration of the first three dimensions than of the fourth. This article reports on a conceptual framework for incorporating consideration of the latter dimension into the simulation of the pedestrian evacuation behavior. This framework can be put to great use by architects, engineers and computer scientists alike in determining the outcomes of evacuation processes. Such multidisciplinary precedent can promote highly beneficial and enduring collaborations between the previous disciplines. The sections that follow describe the conceptual framework and its potential account into simulation software, and draft some conclusions.

### **A Two-Level Integrated Optimization Model for Planning of Emergency Evacuation: A Case Study of Ocean City Under Hurricane Evacuation (05-1786)**

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**Abstract:** This paper presents a two-level integrated optimization model for use in generating the initial set of optimal evacuation plans that serve as the input for a simulation-based evacuation system. In the proposed model, the high level optimization aims to maximize the throughput during the specified evacuation duration, while the low level intends to minimize the total travel time and waiting time for the entire system. To effectively represent traffic flow relations with mathematical formulations, this model employs the cell transmission concept, but with a revised formulation for large-scale network applications. The performance of the proposed formulation and its applicability have been tested with simulation that uses a microscopic program to replicate the Ocean City evacuation network. Evaluation results from these numerical studies have demonstrated the promising properties of the proposed model.

## **Meetings, Sessions and Workshops**

### **Critical Transportation Infrastructure Protection Committee (ABE40)**

Agenda Jan. 11 committee meeting: [http://trb.org/am/ip/assembly\\_detail.asp?id=3571](http://trb.org/am/ip/assembly_detail.asp?id=3571).

Annual Meeting events:

[http://trb.org/am/ip/assembly\\_search.asp?c=ABE40&comm=Critical+Transportation+Infrastructure+Protection](http://trb.org/am/ip/assembly_search.asp?c=ABE40&comm=Critical+Transportation+Infrastructure+Protection).

### **Committee on Critical Transportation Infrastructure Protection- Subcommittee on System Architectures Integration and Management (TRB ABE40(2))**

Agenda Jan. 10 committee meeting: [http://trb.org/am/ip/assembly\\_detail.asp?id=4091](http://trb.org/am/ip/assembly_detail.asp?id=4091).

Annual Meeting events:

[http://trb.org/am/ip/assembly\\_search.asp?c=ABE40&comm=Critical+Transportation+Infrastructure+Protection](http://trb.org/am/ip/assembly_search.asp?c=ABE40&comm=Critical+Transportation+Infrastructure+Protection).

### **Systems Analysis and Planning: Interdependencies Subcommittee (ABE40(1))**

Agenda Jan. 10 committee meeting: [http://trb.org/am/ip/assembly\\_detail.asp?id=3581](http://trb.org/am/ip/assembly_detail.asp?id=3581).

Annual Meeting events:

[http://trb.org/am/ip/assembly\\_search.asp?c=ABE40&comm=Critical+Transportation+Infrastructure+Protection](http://trb.org/am/ip/assembly_search.asp?c=ABE40&comm=Critical+Transportation+Infrastructure+Protection).

### **Transportation Safety Management Committee: Emergency Evacuation Subcommittee (ANB10(4))**

Jan. 10 committee meeting.

Annual Meeting events:

[http://trb.org/am/ip/assembly\\_search.asp?c=ANB10&comm=Transportation+Safety+Management](http://trb.org/am/ip/assembly_search.asp?c=ANB10&comm=Transportation+Safety+Management).

### **Application of Intelligent Transportation Systems to Homeland Security**

Jan. 10- Session 251

[http://trb.org/am/ip/assembly\\_detail.asp?id=3932](http://trb.org/am/ip/assembly_detail.asp?id=3932).

Program:

- FHWA's Role in Homeland Security (P05-1038), Vincent P. Pearce, Federal Highway Administration;
- ITS Technologies Applied to Bridge Surveillance (P05-1039), Vijay Kohli, Fulcrum Corporation;
- Integration of Emergency Data, Information, and Systems to Improve Management of Traffic (P05-1040), Christopher Cluett, Battelle Seattle Research Center;
- ITS in Support of State's Security Efforts (P05-1094), Jeffrey L. Western, Wisconsin Department of Transportation.

### **Tunnel Rehabilitation and Safety Assessment**

Jan. 12- Session 646

[http://trb.org/am/ip/assembly\\_detail.asp?id=3389](http://trb.org/am/ip/assembly_detail.asp?id=3389).

Program:

- Tunnel Rehabilitation (05-1752), Henry Adam Russell, AASHTO;
- Rail Transit Tunnels: Whole-Life Asset Planning and Security (05-1328), Jonathan Austin, Dr Sauer Group;
- Assessment of Fire-Induced Damage on Concrete and Shotcrete Tunnel Liners (05-0892), Alp Caner, Parsons Brinckerhoff Quade & Douglas Inc.; Sanja Zlatanic, Parsons Brinckerhoff Quade & Douglas Inc.; Nasri Munfah, Parsons Brinckerhoff Quade & Douglas Inc.;
- European Tunnel Fire Research: Large-Scale Tunnel Fire Tests in Runehamar Tunnel, Norway (05-0529), Rene van den Bosch, Promat, Netherlands.

### **Bridge and Tunnel Security Update**

Jan.9- Workshop 152

[http://trb.org/am/ip/assembly\\_detail.asp?id=2682](http://trb.org/am/ip/assembly_detail.asp?id=2682).

Program: The events of 9/11 revealed that the nation's transportation infrastructure has vulnerabilities. Shortly after 9/11, AASHTO in cooperation with FHWA created the AASHTO Task Force on Transportation Security. To set direction, in 2002 FHWA and AASHTO jointly sponsored and convened a Blue Ribbon Panel of bridge and tunnel experts drawn from professional practice, academia, federal and state agencies, and toll authorities. Significant research has been conducted under TRB's Cooperative Research Program in cooperation with AASHTO and FHWA. Several transportation security pooled-fund projects have also been initiated, and the AASHTO Task Force on Transportation Security has now transitioned to the AASHTO Special Committee on Transportation Security to continue its work. This workshop will provide an update on the various activities, as well as an audience discussion on lessons learned by states on their successes, difficulties and issues regarding their state bridge and tunnel security efforts. The intended audience of this workshop is state bridge engineers, consultants, academics and industry partners interested in protecting the nation's highway infrastructure.