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Now, for the first time, you can find here on the ITS Web site PDF versions of the papers or presentations that Institute of Transportation Studies participants from all four campuses—UC Berkeley, UC Davis, UC Irvine and UC Los Angeles—made at the annual meeting of the Transportation Research Board (TRB), held in January 2002 in Washington, D.C.

Thanks to the Transportation Research Board for extending to ITS this right to post these PDFs, which can also be found in its official record of the event, the TRB CD-ROM. ([Go to the TRB Bookstore](#)).

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For the complete, searchable program of the 2002 TRB Annual Meeting, please visit the TRB Annual Meeting Web site by clicking [here](#). Times and locations of the presentations can also be found there.

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**Taxonomy of Shared-Vehicle Systems
02-3854**

Matthew J. Barth, University of California, Riverside
**Susan Shaheen, University of California, Davis and California Department of
Transportation**

Abstract

In recent years, there has been a tremendous amount of interest and activity in shared vehicle systems as a relatively new transportation paradigm. In general, a shared vehicle system typically consists of a fleet of vehicles that are used several times each day by different users. They offer the convenience of the private automobile and more flexibility than public transportation alone. These systems are attractive since they can potentially: 1) reduce a user's transportation costs; 2) reduce the need for parking spaces in a community; 3) improve overall air quality; and 4) facilitate access and encourage us of other transportation modes, such as rail transit. Shared vehicle systems can serve many different purposes through a range of models—from classical carsharing to station cars. With the recent proliferation of systems, it is useful to establish a shared vehicle taxonomy. Such a taxonomy can outline key program elements that will help policymakers and practitioners characterize and evaluate various aspects of this rapidly evolving field. Further, it helps researchers analyze and compare the many different models, identifying the similarities or differences among them. In this paper, we provide a shared vehicle system taxonomy, describing the different models and examples of each. The authors argue that carsharing and station cars be viewed as two ends of a continuum, sharing many similarities, rather than separate concepts. Indeed, many shared vehicle systems can be viewed as hybrid systems, exhibiting key characteristics of both concepts.

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Computational Vision Model-Based Method to Address Work Zone Conspicuity 02-4083

Joseph E Barton, University of California, Berkeley

Theodore Elliot Cohn, University of California, Berkeley

James A. Misener, University of California, Berkeley

Abstract

A computational means to assess the conspicuity of highway features was developed, verified, then applied to a sample construction work zone scene. This work was conceived as a balance between modeling the complex phenomena within the human visual system and the need for a simple applications-oriented tool for practitioners to derive a quantitative relative assessment of real world construction work zones in order to rank choices in terms of conspicuity. The results indicate that our vision model-based tool can assess the relative conspicuity of individual elements of a roadway or roadside scene and is relatively straightforward in use. As such, it holds potential value in engaging in "virtual" prototyping of work zone sight lines, colors, and placement of hazard warning cues such as cones, markings and reflective vests. [Back to top. PDF](#)

Accelerated Pavement Testing of Drained and Undrained Pavements Under Saturated Base Conditions 02-3750

Manuel O. Bejarano, University of California, Berkeley

John T. Harvey, University of California, Berkeley

Abstract

The California Department of Transportation (Caltrans) requires that all new flexible pavements include a 75 mm layer of asphalt treated permeable base (ATPB) between the asphalt concrete and the aggregate base layers. The purpose of the ATPB layer is to intercept water entering the pavement either through cracks in the asphalt concrete or through high permeability asphalt concrete and transport it out of the pavement before it reaches the unbound materials. This paper presents the results of a study using Heavy Vehicle Simulator (HVS) trafficking to evaluate the performance of drained and undrained flexible pavements under wet conditions. A drained structure is a pavement section that contains the ATPB layer between the asphalt concrete and the aggregate base. An undrained structure is a pavement section that does not contain the ATPB layer. Wet conditions intend to simulate approximate surface infiltration rates that would occur along the northwest coast of California during a wet month for a badly cracked asphalt concrete layer. The results of the accelerated pavement testing indicate that the ATPB strips under

combined conditions of saturation and heavy loading. Both drained and undrained sections have similar pavement lives; however, the primary mode of failure for the drained section was surface rutting, and for the undrained sections was fatigue cracking. [Back to top.](#) [PDF](#)

Engendering Effective Planning: Transportation Policy and Low-Income Women **02-4142**

Evelyn A. Blumenberg, University of California, Los Angeles

Abstract

Current policies aimed at increasing welfare participants' spatial access to employment are largely predicated on the notion of the spatial mismatch between the geographic location of welfare participants in central cities and increasing job opportunities in the suburbs. The purpose of this study is to trace the development of the major federal initiative to improve transit services for welfare participants — the Job Access and Reverse Commute Program — and, in doing so, to examine the merits of reverse commute services in linking low-income women to suburban job opportunities. The popularity of reverse commute programs may be a case of imposing on women findings and policies that have much greater application to men. Recent research on the travel patterns and behavior of welfare participants suggests that reverse commute service may not adequately address the transportation needs of low-income, single mothers. [Back to top.](#)

Adaptive Fuzzy Systems for Traffic-Responsive and Coordinated Ramp Metering **02-3516**

Klaus Bogenberger, Munich University of Technology, Germany

Hartmut Keller, Munich University of Technology, Germany

Stephen G. Ritchie, University of California, Irvine

Matthias Spangler, Munich University of Technology, Germany

Abstract

This paper describes new adaptive fuzzy algorithms for coordinated ramp metering. The new model family named ACCEZZ (Adaptive and Coordinated Control of Entrance Ramps with Fuzzy Logic) was developed to overcome the limitations of existing coordinated ramp metering algorithms. Each model is explained, evaluated via simulation, and compared to other ramp metering approaches in several scenarios. Coordinated ramp metering is achieved in the ACCEZZ models by applying fuzzy control to a series of entrance ramps where the interdependency of ramp operations is taken into account. A simple fuzzy ramp metering controller for each metered on-ramp is the core of each version of the ACCEZZ models. Learning/Optimization methods drawn from both neural network theory and genetic algorithms are used to find the optimal ramp metering strategy. The resulting systems are either called neuro-fuzzy or genetic fuzzy ramp metering. The performance of the ACCEZZ models was assessed in a simulation context with a microscopic traffic flow model and compared with the results of five different standard ramp metering algorithms: demand-capacity, occupancy strategy, ALINEA, Denver's HELPER algorithm, and Minnesota's Zone approach. The total time spent in the system was used to evaluate the overall system performance of a strategy, since it includes both travel times and ramp delays. Additionally, the traffic densities, waiting times, queue lengths, fuel consumption, and pollutants were compared. One of the ACCEZZ models will be installed in Munich at the Olympic interchange of the ring road this summer within the MOBINET project. [Back to top.](#) [PDF](#)

Transport in Delhi, India: Environmental Problems and Opportunities **02-2663**

Ranjan Kumar Bose, Tata Energy Research Institute, India

Daniel Sperling, University of California, Davis

Abstract

Delhi is a rapidly expanding megacity. Population and vehicle use continue to expand, with vehicles being the principal source of severe air pollution. And yet, vehicle ownership is still a fraction of that in industrialized countries. In this paper, we attempt to untangle the complexities of

Delhi's transport sector, exploring what kind of a future is likely and how it might be altered. We interviewed Indian transportation experts and political leaders, analyzed historical data, and examined various policy options and strategies. Finding large institutional, political, economic, and technological uncertainties, and limited knowledge of travel behavior and preferences, we created two scenarios to characterize what is likely and what is possible. One scenario - representing a "business-as-usual" trajectory - is an extrapolation of present trends in Delhi, modified to reflect existing policies and commitments. This scenario results in dramatic increases in vehicle use, translating to about a fourfold increase in transport-related greenhouse gas emissions between 2000 and 2020. The second scenario is premised on strong political and institutional leadership to enhance the economic, social, and environmental performance of Delhi's transportation system. Car use drops, and transit and bike use increase, but even with this aggressive shift toward more environmentally benign transportation, GHG emissions more than double in the 20-year period. Two important observations stand out. First, under any plausible scenario, greenhouse gases will soar, ranging from a doubling to a quadrupling of emissions. Second, although these increases are disconcerting, they indicate that pursuit of the lower greenhouse gas path leads to far fewer emissions - and much lower transport and energy costs. [Back to top.](#) [PDF](#)

Effect of On-Road Loads on Gaseous Emissions from a Modern Heavy-duty Diesel Truck

02-3297

Christie J. Brodrick, University of California, Davis

Emilio Laca, University of California, Davis

H. A. Dwyer, University of California, Davis

Abstract

The objective of this study was to determine the effect of several load variables (vehicle operation, weight, and accessory use) on gaseous emissions production during common on-road heavy-duty vehicle operations. Nitrogen oxide (NO_x), hydrocarbon (HC), carbon monoxide (CO), and carbon dioxide (CO₂) emissions from a 1999 heavy-duty diesel tractor equipped with a 1999 12.4 L engine were measured continuously during on-road tests. The vehicle was operated at predetermined steady-states modes of 25, 55, and 65 miles per hour (mph) as well as full-throttle accelerations from 0-25 and 0-55 mph and 65-0 mph deceleration. Vehicle weight (payload) and accessory (air conditioning) use were varied. Analysis of variance (ANOVA) models were used to identify which factors (e.g. modes, payload, accessories) had a significant effect on emissions. We found that mode explained most of the variation in emissions and had significant effects on all species of emissions tested. Payload had sizable effects on emission of NO_x and CO₂. Specifically, increases in gross vehicle weight from 52,000 lbs to 80,000 lbs resulted in an average 71% increase in NO_x g/mi emissions during highway and transient operation. On average the acceleration modes produced more than four times as much CO₂ g/mi as the steady state modes. HC emissions were particularly high in the 25 mph and acceleration modes. Using regression, we found a strong relationship between NO_x emissions per hour and horsepower ($R^2=0.89$, $P<.0001$). When mode and load were added as factors in the regression model, the overall precision of NO_x emissions prediction was significantly increased and HP became non-significant. [Back to top.](#)

UCLA's Bruingo Pilot Program: An Evaluation

02-2762

Jeffrey R Brown, University of California, Los Angeles

Daniel Baldwin Hess, University of California, Los Angeles

Donald C. Shoup, University of California, Los Angeles

Abstract

Many universities pay a local public transit operator to accept their university identification cards as transit passes. Students, staff, and faculty then ride public transit without paying a fare. This paper evaluates the transit-pass program at UCLA. We determine the distribution of benefits and

costs among students, faculty and staff, the university, and the community. We found that the program produced significant net benefits for all four groups. The program's overall benefit-cost ratio was 2.5. Perhaps the most important factor to stress about the program is that 84 percent of its total cost is added income for students, faculty, and staff who would otherwise pay their own transit fares. [Back to top. PDF](#)

Road Expansion, Urban Growth, and Induced Travel: Path Analysis

02-2265

Robert Burke Cervero, University of California, Berkeley

Abstract

Past research points to a significant induced demand effect. This study employs a path model to causally sort out the links between freeway investments and traffic increases, using data for 24 California freeway projects across 15 years. Traffic increases are explained in terms of both faster travel speeds and land-use shifts that occur in response to adding freeway lanes. While the path model confirms the presence of induced travel in both the short- and longer-run, estimated elasticities are generally lower than those of earlier studies. This research also reveals significant "induced growth" and "induced investment" effects - real-estate development has gravitated to improved freeway corridors and road investments have been shaped by traffic trends in California. [Back to top.](#)

Transit's Value-Added: Effects of Light and Commuter Rail Services on Commercial Land Values

02-2273

Robert Burke Cervero, University of California, Berkeley

Michael Duncan, University of California, Berkeley

Abstract

Transit-oriented development has gained favor as a means of reducing traffic congestion, promoting affordable housing, and curbing sprawl. This study models the effects of proximity to light and commuter rail stations as well as freeway interchanges on commercial-retail and office properties in fast-growing Santa Clara County, California. From hedonic price models, substantial capitalization benefits were found, on the order of 23 percent for a typical commercial parcel near an LRT stop and more than 120 percent for commercial land in business district and within a quarter mile of a commuter rail station. Such evidence is of use not only to developers and lenders but also to transit agencies facing lawsuits over purported negative externalities associated with being near rail. It can also help in designing creative financing, such as value capture programs. [Back to top.](#)

Travel Time Reliability with Risk-Sensitive Travelers

02-2379

Anthony Chen, Utah State University

Zhaowang Ji, Utah State University

Will Recker, University of California, Irvine

Abstract

In recent empirical studies on values of time and reliability, many have suggested that travelers are not only interested in travel time saving but also reduction in travel time variability. Variability introduces uncertainty for travelers such that they do not know exactly when they will arrive at the destination. Thus, it is considered as a risk (or added cost) to a traveler making a trip. In this paper, we report our continuing research on route choice models and its effect on travel time reliability in an uncertain environment caused by demand and supply variations. The goal is to examine what aggregate impact of changes in variability might be on network assignment and how individual travelers with different risk-taking behaviors respond to these changes. [Back to top.](#)

Development of Simulation Laboratory for Evaluating Ramp Metering Algorithms

02-3427

Lianyu Chu, University of California, Irvine
Henry X. Liu, University of California, Berkeley
Will Recker, University of California, Irvine
H. Michael Zhang, University of California, Davis

Abstract

As an efficient traffic control strategy to ameliorate freeway traffic congestion, ramp metering has been successfully applied in the US. However, the applicability and effectiveness of a ramp-metering strategy are required to be investigated during the pre-implementation phase in order to ensure the success of the implementation. The use of traffic simulation models can provide a quick and cost-effective way to test and evaluate a ramp-metering algorithm prior to implementation on the freeway network. In this paper, a micro-simulation laboratory, based on a functionality-enhanced PARAMICS simulation model through integrating some complementary ATMIS modules, has been established for the evaluation study of ramp metering control. Three adaptive ramp metering algorithms, including ALINEA, BOTTLENECK and ZONE, have been evaluated in this PARAMICS simulation laboratory over a stretch of freeway I-405, California. Simulation results show that the two coordinated ramp-metering algorithms, i.e. BOTTLENECK and ZONE, perform better than the current fixed-time control and ALINEA algorithm under both morning and afternoon scenarios. [Back to top.](#) [PDF](#)

Visitor Bicycle Use in Yosemite Valley**02-2899**

Sean Albert Co, Santa Cruz County Regional Transportation Commission

Kenneth S. Kurani, University of California, Davis

Thomas Turrentine, University of California, Davis

Abstract

This document reports on the first comprehensive study of visitor bicycle use in Yosemite Valley. It establishes several important baselines about cyclists during typical busy summer days, for example, demographics, how experience affects bicycle travel, use of other travel modes and estimates of the total number of cyclists in the Valley. Further, cyclists were asked their purpose of their cycling trip as well as how they received information about cycling in Yosemite Valley. Many of the obstacles that urban areas face in promoting bicycle use are less prevalent in Yosemite Valley. (Cycling in Yosemite National Park is virtually synonymous with cycling in Yosemite Valley, especially for visitors.) Traffic congestion occurs during the busy summer months. During this time, the bicycle is the quickest, most convenient way for many people to experience the Valley. It is during the summer months when the weather is warm and pleasant for bicycle riding. The flat terrain of the Valley makes bicycling easy for many groups of people with varying ability levels. Yosemite Valley also has a dedicated bikeway system that covers a large portion of the Valley. Distances to locations in the seven mile long by one mile wide Valley are short, allowing short travel times to destinations. Cycling for both transportation and recreation can be increased by providing accessible and accurate information, cycling services, infrastructure and providing cycling access to day use visitors. Park visitors using the bicycle as transportation can help alleviate much of the summer traffic congestion. [Back to top.](#) [PDF](#)

Design and Operational Concepts of High Coverage Point-to-Point Transit System**02-4006**

Cristian E. Cortes, University of California, Irvine

R. Jayakrishnan, University of California, Irvine

Abstract

This paper presents the conceptual design and preliminary feasibility simulation results for a flexible transit system for travel from any point to any point based on real-time personalized travel desires, which is now possible due to advances in communication and computing technologies. While it is demand-responsive, the concept is significantly different from older demand-responsive transit

systems, which were often failures. The proposed system requires high coverage, referring to the availability of a large number of transit vehicles (often minibuses or vans) which could also operate in conjunction with private and paratransit systems. The design strictly eliminates more than one transfer for any passenger. The system could potentially provide a transit alternative that is much more competitive with personal auto travel than conventional transit systems, due to significantly lower waiting times. The passenger demand for such a system is uncertain, but preliminary simulations show that under a variety of acceptable demand levels, the system can operate with high cost-effectiveness. The focus of the paper is in describing the details of the concept and providing arguments in favor of the system, based on simulations. The system essentially attempts to solve a stochastic real-time passenger pick-up and delivery problem with large number of vehicles. A strict optimization formulation and solution for such a problem is computationally prohibitive in real-time. The design proposed in this paper effectively allows the problem to be decomposed and solved using detailed rules that achieve vehicle selection and route planning in a manner that is similar to optimal stochastic control using probabilities and expected values updated in real-time. [Back to top.](#)

General Purpose Methodology for Link Travel Time Estimation Using Multiple Point Detection of Traffic

02-3991

Cristian Cortes, University of California, Irvine
Riju Lavanya, University of California, Irvine
Jun-Seok Oh, University of California, Irvine
R. Jayakrishnan, University of California, Irvine

Abstract

This paper develops a methodology to find appropriate travel times for highway links using data from point detectors that could be at various points within the link, or could even be outside the link. The travel times are found using a definition that the appropriate value is the one experienced by a virtual vehicle reaching the mid-point of the link at the mid-point of the time step. A simple iterative scheme is proposed to find the travel time profiles. The accuracy of the scheme will depend on whether aggregated detector data or whether individual vehicle spot speeds are used. Comparison of estimated travel times with actual experienced travel times of all vehicles in a microscopic simulation shows the technique to give very good results, comparable to having a high number of probe vehicles reporting travel times. [Back to top.](#) [PDF](#)

Collecting, Processing, Archiving and Disseminating Traffic Data to Measure and Improve Traffic Performance

02-3885

Joy Wilbrand Dahlgren, University of California, Berkeley
Shawn M. Turner, Texas Transportation Institute
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Abstract

Current practices in using archived operations data collected by traffic management centers (TMCs) to measure performance were surveyed and analyzed. There are three major findings. First, better utilization of archived data will take time and experimentation with data. Typically, the regions in which data archiving and performance monitoring are most prevalent and widespread are those in which local/state agencies have been archiving and analyzing data for at least 5 or 10 years. Second, archived traffic data should be used to improve traffic management center performance. Many TMCs view their mission solely as "crisis management," seeing little connection between historical archived data and the crises they manage on a day-to-day basis. However, many "operations-based" organizations make extensive use of "archived" operations data because their profits depend upon their ability to exploit that data to develop ways to operate more efficiently and effectively. Finally, the key to effective use of archived data is clear assignment of responsibility and adequate funding. Although archived data are useful to operators,

planners, researchers, air quality analysts, transit providers, consultants, media, and others, in most cases the data are being maintained by TMC personnel whose equipment collects the data, but who may have neither the resources nor motivation to make the data easily accessible. [Back to top. PDF](#)

Effects of Reconstruction of I-880 on Travel Behavior 02-2153

Joy Wilbrand Dahlgren, University of California, Berkeley

Abstract

The effect of increased highway capacity on vehicle-miles of travel is a subject of considerable importance for transportation policy making. However, the study of this effect is often confounded by the fact that both increased travel and increased highway capacity are motivated by increased development, making it difficult to separate the effects of the increased capacity from the effects of the development. The reconstruction of I-880 in Oakland, California ten years after it was destroyed by an earthquake in 1989 provided a rare opportunity to study the effects of a highway capacity increase that was not motivated by increased development. Travelers on this section of freeway were surveyed in June 1999, to determine how the reconstruction had affected their travel and might affect it in the future. Eighty-seven percent of those surveyed believed that the reconstruction saved them time; 17% believed they saved more than 15 minutes. Forty-one percent would have started their trip at a different time, usually earlier, if this section had not been reconstructed. Nine percent said they would consider moving further from their job and 11% said they would consider taking a job further from home as a result of their timesavings. Seven percent of respondents said they would have used transit if the road had not been reconstructed and 3% said they would not have made the trip at all. [Back to top. PDF](#)

Policies and Practices for Cost-Effective Transit Investments: Recent Experiences in the United States

Elizabeth A. Deakin, University of California, Berkeley

Christopher Ferrell, University of California, Berkeley

Jonathan Mason, University of California, Berkeley

John Thomas, University of California, Berkeley

Abstract

This paper presents findings from a structured survey of transit agency staff and a series of interviews with agency executives and other local leaders in areas that have undertaken a major transit investment project in the past five years. The purpose of the study was to identify the methods and procedures being used to evaluate and select projects, and in particular, to document how land use considerations are being incorporated into project decisions. Staff members responsible for 41 projects were contacted and 28 completed the survey, discussing projects in 23 regions of the US. Supplementary interviews were conducted for ten of the regions. The study found that most agencies use federal guidance and regulations on the evaluation of transit investment as a starting point, but give equal weight in project design and selection to state and local policy objectives such as social equity, economic development, and “fair share” distribution of projects among local communities. A number of transit agencies give priority to projects in jurisdictions with transit-supportive land use patterns or plans. The availability of public or private funding contributions is increasingly important in prioritizing projects. Increasingly, transit agencies are hiring staff to work with local governments on land use planning and on funding partnerships, and are working with them to develop a shared understanding of the area’s transit needs and related development objectives. Staff and political leaders deem these efforts at least as important as technical evaluations of cost-effectiveness. [Back to top. PDF](#)

Freeway Calibration and Applications of PARAMICS Model 02-3803

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Adolf D. May, University of California, Berkeley
Joy Wilbrand Dahlgren, University of California, Berkeley
Alexander Skabardonis, University of California, Berkeley

Abstract

The research described in this paper had multiple objectives, which included developing and evaluating a calibration process for the Paramics microscopic traffic simulation model, and assessing the model's ability to serve as a tool for evaluating freeway improvement strategies. Paramics was applied to the Interstate 680 freeway in the San Francisco Bay Area, providing a case study for an in-depth calibration of the model and an evaluation of potential freeway improvement alternatives. The authors stress the importance of model calibration prior to model applications. A major section of the paper is devoted to describing a procedure that was developed to calibrate two critical driver behavior parameters: the mean target headway and the mean reaction time. A two-dimension process to calibrate these two parameters against target speeds and volumes was successfully applied and is described in this paper. [Back to top. PDF](#)

Analysis of Factors Affecting Occurrence and Severity of Air Traffic Control

Operational Errors

02-4060

Geoffrey D Gosling, University of California, Berkeley

Abstract

The rate of occurrence of air traffic control operational errors, in which the required separation between aircraft is lost due to actions or safety performance of the National Airspace System. As the volume of air traffic increases and new automated air traffic control decision support tools are introduced, there is a concern not only to increase the level of safety in system by reduce the occurrence of operational errors but to ensure that efforts to increase the capacity of the system do not adversely affect safety. The paper presents an analysis of recent trends in air traffic control operational errors in the United States, discusses the factors that have been found to influence the rate of occurrence of these errors, and examines the relationship between the severity of operational errors in an en-route environment and the traffic characteristics at the time. The paper describes the limitations of the information currently available to support the analysis of operational errors and concludes by addressing the data requirements for future research to better understand the causal factors affecting the rate of occurrence of operational errors and develop strategies to enhance the safety of the National Airspace System. [Back to top. PDF](#)

Effect of T-TMA on Capacity and Delay at Los Angeles International Airport

02-4001

Mark Hansen, University of California, Berkeley

Avijit Mukherjee, University of California, Berkeley

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Abstract

Free Flight Phase 1 (FFP1) is a Federal Aviation Administration program for improving the performance of the National Airspace System (NAS) through the deployment of advanced technologies for air traffic management. In addition to the deployment activities, FFP1 includes a significant evaluation component, which faces a significant hurdle. Demands on the NAS, which have grown steadily over the years, are expected to continue to do so in the future, with significant ramifications on system performance. Indeed it is possible that FFP1 will itself trigger user responses that affect demand. Finally, in addition to weather and demand, there is a plethora of other factors—enhancements to the NAS infrastructure not related to FFP1, facility outages, and so on—that may also cause changes in the performance metrics. This paper documents the normalization procedures to assess the impact of the implementation of a FFP1 technology—the Terminal Area Traffic Management Advisor (T-TMA)—at the Southern California TRACON, where it is used for controlling traffic into Los Angeles International Airport. In this paper we have

distinguished between two types of normalization. Implicit normalization focuses on developing metrics that are inherently robust to the confounding effects, while explicit normalization is applied to remove (in a statistical sense) the effect of confounding influences on a metric. The results, while preliminary given the short time since implementation, are consistent: capacities appear to have increased, and delays decreased, as a result of the deployment of the tool. Moreover, the magnitudes of the delays reductions and capacity increases are consistent. [Back to top.](#)

Establishing Peer States for Transportation Performance Comparisons

02-2417

Patricia G. Hendren, University of California, Davis

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Abstract

Comparisons between state DOT's performance have become increasingly more common over time. The problem with such analyses is that states exhibit characteristics that can differ greatly between them, and these characteristics can be highly influential in determining how transportation policy is set and funds are spent. The purpose of this paper is to extend previous efforts to create peer groups by developing a new systematic method that incorporates temporal and locational variability into the peer group delineations. For this effort, we collected data for 144 variables that impact transportation investment and policy, conducted a factor analysis to reduce the large number of variables into sixteen factors, and then statistically clustered states into peer groups based on the factors. The results will provide government agencies, researchers and the public with a grouping of "peer states" that reflect similar attributes contributing to the development and maintenance of state transportation systems. [Back to top.](#)

Traditional Neighborhoods and Automobile Ownership

02-2594

Daniel Baldwin Hess, University of California, Los Angeles

Paul M. Ong, University of California, Los Angeles

Abstract

Many cities have traditional neighborhoods, or established, inner-city districts comprised of diverse housing, mixed land uses, pedestrian connectivity and convenient transit access. This study quantifies the likely effects of land use patterns on auto ownership for such neighborhoods. Using Portland, Oregon, we test a model that explains auto ownership based on household, neighborhood, and urban design characteristics. The index of mixed land use is statistically significant, *ceteris paribus*. We find compelling evidence of the impact of mixed land uses on auto ownership: as land use mix changes from diverse to homogeneous, the probability of owning an auto decreases by 31 percentage points. The findings imply that traditional neighborhoods are more conducive to alternatives to private vehicle use, such as walking and public transit, and to higher motor vehicle costs. [Back to top.](#) [PDF](#)

Demographics of Public Transit Subsidies: Case Study of Los Angeles

02-3966

Hiroyuki Iseki, University of California, Los Angeles

Brian D. Taylor, University of California, Los Angeles

Abstract

Public transit is highly subsidized in the U.S. These subsidies represent a transfer of income from tax payers to transit users. This paper examines the ways that transit subsidy equity can be measured, and reviews the previous studies on this topic. We propose a more sophisticated and precise method for measuring the subsidy of individual transit trips. Using service consumption and travel survey data from the Los Angeles County Metropolitan Transportation Authority and a set of multi-factor cost allocation models developed in an earlier phase of this research, we examine the distribution of public transit subsidies among various demographic groups with far more precision than the past research. In short, we find that the distribution of transit costs and benefits

among transit users is regressive with respect to income, more regressive than was found in most of the research on this question conducted two or more decades ago. We find that, on average, consumers of short-distance local bus service — who are disproportionately low-income, African-American or Latino, younger, and female — require substantially less subsidy per trip than consumers of long-distance express or rail service — who are disproportionately higher-income, Anglo or Asian, older, and male. While low-income residents in general benefit from the public subsidy of transit, this analysis finds that the benefits of transit subsidies disproportionately accrue to those least in need of public assistance. This raises serious questions regarding the conflicting objectives of transit system policies which seek to deploy services to attract both transit dependents and choice riders. [Back to top. PDF](#)

Putting in Perspective the Contribution of Transportation to Environmental Effects of Telework

02-3360

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Arpad Horvath, University of California, Berkeley

Eric Masanet, University of California, Berkeley

Abstract

Telework has been proposed as a possible remedy to traffic and air pollution problems. This paper presents a systemwide environmental model of telework's energy consumption and air pollution implications by quantifying personal and public transportation, office and home electronic equipment use, lighting, heating and cooling effects. A case study using this model and transportation data from the National Telework Survey finds that office and home electronics use, and lighting and heating effects are comparable, but that telecommuting does not eliminate the company office impacts while adding home office-related impacts. As anticipated, the effects of transportation are the most significant of all of the model's components. Latent demand combined with non-work induced travel may prevent any savings normally expected from a telecommuting program. [Back to top. PDF](#)

Constructability Analysis for Asphalt Concrete Pavement Rehabilitation in Urban Corridors

02-2876

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C. William Ibbs, University of California, Berkeley

Jim St. Martin, Southern California Asphalt Pavement Association

Abstract

This paper presents the results of a constructability analysis for the Caltrans Long Life Asphalt Concrete Pavement Rehabilitation Strategies (LLACPRS). With the assistance of California asphalt concrete paving contractors, the analysis explored the effects on construction productivity of rehabilitation materials, design strategy (crack seal and overlay, full-depth replacement), layer profile, AC cooling time, resource constraints, and alternative lane closure tactics. Deterministic and stochastic constructability analysis programs were developed. A sensitivity study was performed that examined construction production within a 55-hour weekend closure. Weekend closures were also compared to continuous closures. Demolition and AC delivery truck flow was the major constraints limiting the AC rehabilitation production capability. This study concludes that efficient lane closure tactics designed to work with the pavement profile can minimize non-working time to increase the construction production efficiency. The results of this study will help road agencies evaluate rehabilitation strategies and tactics with the goal of balancing the maximization of production capability and minimization of traffic delay during urban rehabilitation. [Back to top. PDF](#)

On the Structure of Weekly Activity-Travel Patterns

02-3211

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Abstract

Understanding the process of activity scheduling is a critical prerequisite to an understanding changes in travel behavior. To examine this process, a web-based activity survey program, REACT!, was developed to collect household activity scheduling data. REACT! is unique in that it records the evolution of activity schedules from intentions to final outcomes for a multi-day period. This paper summarizes an investigation of the structure of activity/travel patterns based on a REACT! data set from a pilot study conducted in Irvine, California. The term structure refers to the outcome of a set of decisions facing individuals as they conduct their daily activities. At a minimum, structure can be interpreted as the sequence by which various activities enter one's daily activity scheduling process. Results of the empirical analyses show that activities of shorter duration were more likely to be opportunistically inserted in a schedule already anchored by longer duration counterparts. Additionally, analysis of tour structure reveals that many trip-chains were formed opportunistically. Travel time required to reach an activity was also positively related to the scheduling horizon for the activity, with more distant stops being planned earlier than closer locations. [Back to top.](#)

Dynamic Procedure for Short-Term Prediction of Traffic Conditions**02-3796**

Wei-Hua Lin, University of Arizona

Qingying Lu, Virginia Polytechnic Institute and State University

Joy Wilbrand Dahlgren, University of California, Berkeley

Abstract

Many existing models for traffic condition forecasting are based on traffic flows. This paper shows with field data that the day-to-day traffic condition may not repeat itself in the same manner as the traffic flow does. Consequently, flow data are inappropriate for predicting traffic conditions since the same flow level may correspond to either congested or free-flow traffic state, a phenomenon that can be easily explained with the flow-density relationship. Occupancy, which is proportional to density, is a better indicator of traffic condition. A simple dynamic model based on the occupancy data is proposed in the paper. The method utilizes occupancy and occupancy increments in an integrated way and treats them as two random variables represented by two normal distribution functions. We also show that flow data, which is more stable than occupancy data, can be used indirectly to improve the performance of the proposed model. Self and cross validation efforts are made to examine the performance of the model. The results are promising. The expected absolute deviance for predicted occupancy (ranging from 0 to 100%) is about 1.25%, which is accurate enough for most of the applications. The model requires little effort in calibration and computation. It is exceedingly simple to implement in the field. [Back to top.](#) [PDF](#)

Adaptive Signal Control System with Online Performance Measure**02-3353**

Henry X. Liu, University of California, Berkeley

Jun-Seok Oh, University of California, Irvine

Will Recker, University of California, Irvine

Abstract

This paper introduces an adaptive signal control system utilizing an on-line signal performance measure. Unlike conventional signal control systems, the proposed method employs real-time delay estimation and an on-line signal timing update algorithm. As a signal performance measure, intersection delay for each phase is measured in real-time via an advanced surveillance system that re-identifies individual vehicles both at upstream and downstream stations using vehicle waveforms obtained from advanced inductive loop detectors. In each cycle, the signal timing plan is optimized based on the delay estimated from the vehicle re-identification technology. The main thrust of the

algorithm is on-line control capability utilizing direct intersection delay measures. A description of the overall control system architecture and the optimization algorithm is addressed in this paper. Performance of the proposed system is evaluated with a high-performance microscopic traffic simulation program, Paramics, and the preliminary results have proven the promising properties of the proposed system. [Back to top. PDF](#)

Analytical Dynamic Traffic Assignment Model with Probabilistic Travel Times and Perceptions

02-3340

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Xuegang Ban, University of Wisconsin, Madison
Bin Ran, University of Wisconsin, Madison
Pitu B. Mirchandani, University of Arizona

Abstract

Dynamic traffic assignment (DTA) has been a topic of substantial research during the past decade. While DTA is gradually maturing, many aspects of DTA still need improvements, especially regarding its formulation and solution capabilities under the transportation environment impacted by the Advanced Transportation Management and Information Systems (ATMIS). It is necessary to develop a set of DTA models to acknowledge the fact that the traffic network itself is probabilistic and uncertain, and different classes of travelers respond differently to traffic information. This paper aims to advance the state-of-the-art in DTA modeling in the sense that the proposed model considers both stochastic link travel times and random perception errors, which are specific to individual traveler. We formulate the integrated DTA model through a Variational Inequality (VI) approach. Subsequently, we will discuss the solution algorithm for the formulation. Experimental results are also given to verify the correctness of solutions obtained. [Back to top. PDF](#)

Asymptotically Optimal Algorithm for Dynamic Traveling Repair Problem

02-2311

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Amelia C. Regan, University of California, Irvine
Sandra Irani, University of California, Irvine

Abstract

The dynamic traveling repair problem involves providing service to customers whose locations are uniformly distributed over a bounded area in the Euclidean plane. We assume that customer requests arrive according to a Poisson point process. Earlier research provided a conjecture that the asymptotically optimal algorithm for this problem under very heavy traffic intensity involves the following: partition the bounded area into sub-regions, wait for sufficient demand to accumulate in the sub-regions, serve the demands in the sub-regions according to the optimal TSP tour, and visit the sub-regions in first-come first-served order as in a GI/G/m queue. Further, the researchers conjectured that the optimal algorithm for the single server case can be extended to the m-server problem by simply partitioning the service region into m sub-regions of the same size and assign one vehicle to a sub-region. In this paper we define a class of algorithms which includes the above algorithm. We then demonstrate the asymptotic optimality of an algorithm in this class and that the above algorithm is optimal among the class. Therefore, we prove the first conjecture made by the researchers. Finally, we show argue that the conjecture made about the multiple server case is also true. [Back to top. PDF](#)

Data Sharing of Information for Travelers, State of the Practice

02-3321

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Abstract

This paper presents the results of an examination of the current state of the practice of traveler

information data sharing with the public and private sectors. A review of the literature was initially performed followed by an analysis of responses to a survey instrument that was designed and administered to practitioners in the field, primarily representatives from public sector agencies, who are in the business of collecting traveler information data. Survey results have addressed the subjects of what data is shared, with whom it is shared, why it is shared, how it is institutionally arranged and managed, how effective the sharing enterprise has been, and how the enterprise can be improved. More work is needed and a next step could be the development of an action plan to implement the lessons learned. [Back to top.](#)

Estimating Infrastructure Transition Probabilities Using Stochastic Duration Models 02-3630

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Samer M. Madanat, University of California, Berkeley

Abstract

Sound infrastructure deterioration models are essential for accurately predicting future conditions which, in turn, are key inputs to effective M&R decision-making. The challenge at the heart of developing accurate deterioration models is that condition is often measured on a discrete scale, such as inspectors' ratings. Furthermore, deterioration is a stochastic process that varies widely with several factors, many of which are generally not captured by available data. Therefore, probabilistic discrete state models are often used to characterize deterioration. Such models are based on transition probabilities which capture the nature of the evolution of condition states from one time point to the next. However, current methods for estimating such probabilities suffer from several serious limitations. An alternative approach addressing these limitations is presented in this paper. A probabilistic model of the time spent in a state (referred to as duration) is derived and the approach used for estimating its parameters is described. Furthermore, a methodology for determining the corresponding state transition probabilities from the developed duration model is presented. The testing for the Markovian property is also discussed, and incorporating the effects of history dependence, if found present, directly in the developed duration model is described. Finally, the overall methodology is demonstrated using a data set of reinforced concrete bridge deck observations. [Back to top.](#) [PDF](#)

Analytically Based Approach to Rutting Prediction 02-3327

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John T. Harvey, University of California, Berkeley

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John A. Deacon, University of Kentucky

Irwin Guada, University of California, Berkeley

Abstract

This paper presents the results of an analytically-based (mechanistic-empirical), procedure to estimate the development of rutting in asphalt concrete pavements both as a function of traffic loading and environment relative to its influence on pavement temperatures. The procedure utilizes permanent strain determined for a representative asphalt concrete mix as function of load repetitions, shear stress and elastic shear strain. It combines multilayer elastic analysis for determining key shear stresses and strains in the asphalt concrete resulting from traffic loading to be used in the permanent strain expression with a time-hardening procedure for the accumulation of permanent strain both as a function of traffic loading and environment. The WesTrack test sections were used to calibrate the methodology and results of rutting predictions are included for four different test sections from that experiment. Based on the results of the regression analyses, an expression is presented which can be used to determine coefficients for use in the permanent strain expression which reflect the permanent deformation characteristics of a specific mix as measured in repeated simple shear test at constant height (RSST-CH). In addition to the WesTrack examples, results are also presented illustrating the use of the approach to predict

rutting development in a controlled loading condition at 50o C (122o F) using the Heavy Vehicle Simulator.[Back to top. PDF](#)

Stochastic Framework for Estimating Unpaved Road Vehicle Miles of Travel for PM10 Mobile Emissions Inventories

02-2689

Jennifer E. Morey, University of California, Davis
Debbie A. Niemeier, University of California, Davis
Thirayoot Limanond, University of California, Davis

Abstract

The Clean Air Act Amendments of 1990 mandate that every area in the nation meet standards for six criteria pollutants: ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, and particulate matter with an aerodynamic diameter less than 10 mm (PM10). Every region in nonattainment of these standards must produce an emission inventory for the violating pollutant. By California air quality standards, which are more stringent than federal standards, roughly 90% of California's counties were PM10 nonattainment areas in 2000. Re-entrained dust created by vehicles is considered a large contributor to PM10 in Central California. However, current methods used to estimate PM10 emissions from vehicle activity on unpaved roads are deterministic and do not account for spatial or temporal variability. Using logit and linear regression models, we introduce a new stochastic framework for estimating vehicle miles traveled on unpaved roads. Our study focuses on two counties in California's San Joaquin Valley: San Joaquin County and Fresno County. Since a large portion of the San Joaquin Valley contains agricultural land, our models distinguish between vehicular traffic on unpaved roads associated with harvest and non-harvest activities. Study findings indicate that the new methodology results in 29% less vehicle miles traveled on unpaved roads in San Joaquin County than calculated by the current deterministic method and 40% less vehicle miles traveled in Fresno County.[Back to top. PDF](#)

Simulation Analysis for Management of Electric-Vehicle Sharing System: Case of the Kyoto Public-Car System

02-2653

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Toshiyuki Yamamoto, Nagoya University, Japan
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Abstract

A multi-station electric-vehicle (EV) sharing system has been in operation on an experimental basis in Kyoto, Japan. Members of the system can check out EVs at a station and return them at any station. To reduce the cost of system operation, EVs are not reallocated to stations by the operator. This feature, at the same time, may delimit the efficiency of the system because of the mismatch between the spatial distribution of the demand and the distribution of the EVs among the stations. We construct a simulation model of system operation, and configure the optimal management of the system using genetic algorithms, with the number of checkouts per vehicle set as the objective function to be maximized. The number of vehicles, parking capacity at each station, number of members, are among the decision variables. The results suggest that the optimal number of EVs is about a half of that of parking capacity. This implies that the efficiency of the system does not necessarily improve as the number of EVs is increased. Also, the results suggest that even if a new station is introduced into the system, the efficiency does not necessarily improve.[Back to top.](#)

Postaudit Review: Previous Audits of Project Development on California State Highway System

02-2151

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Harry Hecht, University of California, Davis

Abstract

The California Department of Transportation is responsible for developing and maintaining the state highway system. Since 1973, fourteen audits have been conducted of Caltrans and a majority of the audits have cited expense and timeliness problems with development of new state highway projects. Our research investigates and compares the audit findings and recommendations with newly collected data from interviews with project managers involved in the development of highway projects throughout California. Our findings indicate that many of the recommendations of past audits have not been implemented, do not apply, or if implemented, do not appear to have materially changed, or improved the project development times or costs. We believe that one flaw associated with previous audits was the failure to directly involve project managers. Moreover, our discussions with project managers suggest there is a need to update, review, and value engineer the project development process. The current process is viewed as too rigid. Finally, project managers are not delegated the same level of authority as they are assigned responsibility. Thus, the role of the project manager in project planning, management, and quality control should be considered in the broader context of project development. [Back to top.](#)

Using Emissions-Optimized Trip Assignment Algorithm to Explore Changes in Vehicle Emissions

02-2260

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Abstract

It is often difficult to estimate how much reduction in vehicle emissions can be expected given optimal network management and infrastructure under the current modeling paradigm. This is at least partially a result of the post-processing procedures used for deriving vehicle emissions. It is also a function of the user equilibrium conditions applied in trip assignment, where equilibrated traffic flows almost certainly do not represent equilibrated conditions for mobile emissions. This research explores the development of a trip assignment model designed to systematically compute emission-optimized traffic flows. We then utilize the exploratory theoretical emissions-optimized trip assignment model to estimate maximum emissions reductions under varying congestion levels on a hypothetical network. The experimental results show moderate reductions in system-level vehicle emissions under emission-optimized trip assignment when compared to the conventional time-dependent user-equilibrium and system-optimized models. The results suggest it is possible to approximate the upper boundary of what can be expected in emissions reductions using the standard travel demand model with a modified trip assignment objective function. This technique could be very useful for transportation planners using the standard four-step model for conformity demonstrations. [Back to top.](#)

Real-Time Inductive-Signature-Based Level of Service for Signalized Intersections

02-3684

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Stephen G. Ritchie, University of California, Irvine

Abstract

The U.S. Highway Capacity Manual (HCM) presents a procedure for estimating control delay, which is used to determine Level Of Service (LOS) and to evaluate intersection performance. The HCM is used extensively by traffic engineers. However, it is intended as an off-line decision support tool for planning and design. To meet the user requirements of Advanced Traffic Management Systems (ATMS), new LOS criteria are required for real-time intersection analysis. The objective of this research was to demonstrate a technique for development of such LOS criteria. The study uses a new measure of effectiveness, called Re-identification Travel Time (RTT) derived from analysis of vehicle inductive signatures and reidentification of vehicles traveling through a major signalized intersection in the City of Irvine, California. This paper tackles two

main issues regarding real-time LOS criteria. The first is how to determine the threshold values partitioning the LOS categories. To provide reliable real-time traffic information, the threshold values should be decided so that RTTs within the same LOS category should represent similar traffic conditions as much as possible. On the other hand, RTTs in different LOS categories should also represent dissimilar traffic conditions. The second issue concerns the aggregation interval to use for RTT in deriving LOS categories. An investigation of both fixed and cycle-based aggregation intervals is conducted. Several clustering techniques are then employed to derive LOS categories, including K-means, Fuzzy, and Self-Organizing Map (SOM) approaches. The resulting real-time LOS criteria are presented. The procedures used in this study are readily transferable to other signalized intersections for the derivation of real-time LOS. [Back to top.](#) [PDF](#)

Emergence of Private Advanced Traveler Information Service Providers and Its Effect on Traffic Network Performance

02-3988

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Abstract

This paper examines the emergence of supply side competition in the ATIS industry and marketability of private ATIS. First, this study describes an architectural model in which the ATIS companies collect network information from their subscribers while providing them with real-time traffic information. It is followed by a simulation study on competition and cooperation under multiple private and public information agencies. This study focuses on analyzing the interaction between information agencies and its effect on traffic system performance. [Back to top.](#) [PDF](#)

Real-Time Traffic Measurement from Single-Loop Inductive Signatures

02-4148

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Cheol Oh, University of California, Irvine

Abstract

Accurate traffic data acquisition is essential for effective traffic surveillance, which is the backbone of Advanced Transportation Management and Information Systems (ATMIS). Inductive loop detectors (ILDs) are still widely used for traffic data collection in US and many other countries. Three fundamental traffic parameters, speed, volume and occupancy, are obtainable via single or double (speed-trap) ILDs. Real-time knowledge of such traffic parameters is typically required for use in ATMIS from a single loop detector station, which is the most commonly used. However, vehicle speeds can not be obtained directly. Hence, the ability to estimate vehicle speeds accurately from single loop detectors is of considerable interest. In addition, operating agencies report that conventional loop detectors are unable to achieve volume count accuracies of more than 90-95%. The main objective of this paper is to demonstrate the improved derivation of fundamental real-time traffic parameters such as speed, volume, occupancy, and vehicle class from single loop detectors and inductive signatures. [Back to top.](#) [PDF](#)

Greenhouse Gas Emissions in the Transport Sector, 2000-2020: Case Study for Chile

02-3887

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Abstract

The international community has been negotiating the reduction of greenhouse gas (GHG) emissions since 1992. Greenhouse gas increases are greatest in the transport sectors - in almost all countries of the world, so the evolution of this sector will ultimately determine the success of these efforts. Chile and its capital city, Santiago, are following the same pattern of rapid growth in

transport-related GHG emissions as developed countries. This growth is particularly significant due to the high economic growth rates, that are expected to continue. This paper explores the implications on energy use and GHG emissions from Chile's transport sector in the next 20 years. Plausible assumptions are made about possible futures for the sector, in particular for each mode, and these are then used to project alternative GHG emissions. The results reflect what can be expected from developing countries with rapid growth rates and significant urbanization processes.

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Transportation Greenhouse Gas Scenarios for South Africa

02-2593

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Abstract

South Africa has an expanding population of 43 million with per capita incomes of \$3050 per year. Most people travel by urban rail (available in 6 of the 7 major metropolitan areas), buses, and minibus jitneys. About 1 in 10 persons own a car, rather high for its income level. Bicycles and motorcycles are rare. The performance and structure of South Africa's transport system is largely explained by two phenomena: the legacy of Apartheid and privatization. The overall effect of these two phenomena, even with a deteriorating economy, has been to increase the use of cars and trucks and the use of high-carbon fuels. One outcome is high levels of energy use and greenhouse gas emissions. Two transportation scenarios were designed to characterize alternative futures for South Africa. They draw upon extensive interviews with decision makers and experts in South Africa. The two scenarios reflect higher and lower greenhouse gas emissions in 2020. Because energy and environment are not motivating forces for change, the scenarios are premised on other economic and social motivations, including accessibility and mobility, road safety, tax revenue, traffic congestion, and international pressures. The higher greenhouse gas scenario is essentially an extrapolation of observable and emerging trends. In this scenario, government remains entangled in crisis management, ignoring transportation concerns. Residual land use policies from Apartheid continue to aggravate transportation concerns. The automotive industry remains a pillar of economic development and personal car use accelerates as car prices drop and consumer credit becomes more widely available. The net effect in this scenario is cars increase their share of total passenger kilometers from 51 percent in 2000 to 59 percent in 2020, while public transit's share decreases from 49 to 41 percent. Minibuses retain 60 percent of the public transit modal share. The effect on greenhouse gases is large: it increases by 82 percent from 2000 to 2020. In the lower greenhouse gas scenario, the motivation for change and government action are driven by mobility, accessibility and safety concerns. Land use and housing policies are adopted that promote more efficient urban land use structures, gradually correcting spatial imbalances and reducing travel distances. Government promotes public transport and restructures the taxi, bus, and commuter rail sectors. South African auto manufacturers are provided with incentives to design and build buses and minibuses appropriate to the local market. Sasol starts to use natural gas as feedstock in the production of synthetic fuel. The modal share of private cars and public transit remains approximately constant at 48 and 52 percent, respectively, but minibuses suffer large declines in public transit modal share. The net result, in this scenario, is a 12 percent decrease in greenhouse gas emissions despite the fact that passenger kilometers increase approximately 54 percent. While South Africa is not motivated to reduce greenhouse gas emissions, it is motivated to enhance mobility, accessibility, safety, and economic efficiency. Many of the strategies targeted at those goals will also restrain greenhouse gas emission growth. These strategies are not necessarily costly, but they do require strong political will and a commitment that has yet to be demonstrated. [Back to top. PDF](#)

Nonlinear Model for Predicting Pavement Serviceability

02-2353

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Abstract

A recursive non-linear model was developed for the prediction of pavement performance. Pavement performance is assessed in terms of serviceability, as a function of traffic characteristics, pavement structural properties, and environmental conditions. The model highlights some of the advantages of relaxing the linear restriction that is usually placed on the specification form of pavement performance models. First, a functional form that better represents the physical deterioration process can be used. Second, the estimated parameters are unbiased, owing to a proper specification and the use of sound statistical techniques. Finally, the standard error of the prediction is reduced by half that of the equivalent existing linear model. This improved accuracy has important economic implications in the context of pavement management. The model developed as part of this research enables the determination of an unbiased exponent of the so-called power law and the equivalent loads for different axle configurations. The estimated exponent confirms the value of 4.2 traditionally used. On the other hand, equivalent loads estimated for different axle configurations tend to differ from traditionally used values. The estimated equivalent load for a single axle with single wheels is 42 kN, while the equivalent load for a tandem axle with dual wheels is 150 kN. [Back to top.](#) [PDF](#)

Relative Performance of Heuristics for Dynamic Traveling Salesman Problem 02-3859

Amelia C. Regan, University of California, Irvine
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Abstract

In this paper we present simulation based analysis of heuristics for the dynamic traveling salesman problem in which a mobile server provides service to customers whose positions are known. Service requests are generated according to a Poisson process which is uniform across customer locations. In the general case we assume that the mean service time is known and its variance is bounded. Service time is independent of customer location. We first examine a special case of the problem in which the optimal TSP tour and minimum spanning tree involves only links of equal length and then discuss the case for a general graph. We show that such a tour applies to many grid networks. The goal of this work is to examine the relative performance of algorithms intended to minimize the average waiting time of each customer. [Back to top.](#) [PDF](#)

Comparison of High-Occupancy-Vehicle, High-Occupancy-Toll, and Truck-Only Lanes in Sacramento Region 02-3648

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Robert A. Johnston, University of California, Davis

Abstract

As the evidence mounts that HOV lanes will not produce expected reductions in congestion and emission, alternatives are being sought. High occupancy toll (HOT) lanes and truck only lanes are attractive alternatives. In this study, a region-wide system of new HOV lanes, HOT lanes, and truck only lanes in the Sacramento region are compared. The travel effects are simulated with the Sacramento regional travel demand model (SACMET96). The economic benefits for both personal travel and commercial vehicle travel are obtained from economic welfare models developed for use with the travel model. The DTIM2 model is used for the emissions results. The scenarios are evaluated against travel, emissions, total economic benefit, and equity criteria. With respect to travel and emissions, the results did not vary much among scenarios but the economic benefit results did have more significant variation. The scenarios that included HOT lanes produced economic benefits that were clearly superior to the other scenarios. As a result, it is concluded that the economic welfare models applied in this study can be useful tools in the

analysis of transportation policies. [Back to top.](#) [PDF](#)

Comparison of Highway and Travel Demand Management Measures Using Integrated Land Use and Transportation Model in the Sacramento Region

02-3827

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Abstract

In this study, we apply an integrated land use and transportation model, the Sacramento MEPLAN model, to evaluate transit investment alternatives combined with supportive land use policies and pricing policies in the Sacramento region. Highway investment alternatives are simulated as well for purposes of comparison. The application of the Sacramento MEPLAN model is relatively advanced because the model represents a number of induced travel effects, including land use, destination, mode choice, and route choices. A number of conclusions are made for the case study. First, transportation investment in both highway and light rail may allow for greater decentralization of regional development. Second, new highway capacity projects, even if they include HOV lanes, may increase VMT and emissions. Third, transit investment with supportive land use policies or pricing policies may be very effective in reducing VMT and emissions. Fourth, transit investment with supportive land use or pricing policies may provide congestion reduction that is as great, if not greater, than highway investment policies. Fifth, transit investment combined with land use policies may provide greater benefits (i.e., change in travel time and cost) than highway investment. [Back to top.](#) [PDF](#)

Multivariate Analysis of Carbon Emissions from Urban Transport

02-3406

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Abstract

Income has often been pointed to as the determinant of car ownership, which in turn is a major determinant of carbon emissions from transport. As a result, many analysts have considered the link between carbon emissions from transport and income growth to be unbreakable. This paper offers a multivariate analysis of carbon emissions from urban transport using a number of variables in addition to the income variable. Although rising incomes clearly lead to rising carbon emissions from transport, the present analysis shows that other variables are also important. The analysis uses worldwide city-level data from 1990, and the key explanatory variables are Gross City Product per capita, the price of gasoline, the population density, and a variable that measures the amount of transit service available in the city. An linear ordinary least squares regression analysis using this data yields an adjusted R-squared statistic of 0.89, and a log linear analysis yields an adjusted R-squared statistic of 0.93. This type of analysis can be extremely useful to indicate which variables have the greatest impact on carbon emissions so that more directed policies could be implemented. [Back to top.](#)

Comparative Analysis of State-Regional Relations in Statewide Transportation Planning After ISTEA

02-3212

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Abstract

While governments have been planning transportation for close to a century, surprisingly little research has examined the appropriate division of responsibility over surface transportation systems among the federal, state, regional, and local governments. In particular, since the passage of ISTEA in 1991, there has been little consensus among state and regional transportation

stakeholders over the appropriate level of state involvement in metropolitan transportation. In this paper, we develop a framework (1) to explain the institutional challenges that state DOTs face when planning in metropolitan areas and (2) to identify the circumstances in which state agencies are most likely to positively contribute to regional transportation planning. We base our findings on a review of recent statewide transportation plans in fourteen of the largest states and interviews with 66 state and regional transportation planners and officials. We find that recent statewide transportation plans have attempted to expand state planning efforts in metropolitan areas, yet regional transportation planners surveyed for this study report that they seldom refer to state planning documents. The statewide planning activities were most valued by regional stakeholders address network and environmental externalities (such as in freight or environmental planning), economies of scale in administrative and technical expertise (such as with technology or GIS development), and assistance in enforcing locally unpopular decisions using the political and regulatory power of the state. The findings of our survey suggest that the need for a state-level planning presence in metropolitan areas exists, though for different reasons than those advocates of statewide planning typically argue. [Back to top. PDF](#)

California's Zero Emission Vehicle Mandate: Linking Clean Fuel Cars and Shared-Use Vehicle Approaches

02-3857

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Abstract

To reduce transportation emissions and energy consumption, policymakers typically employ one of two approaches—changing technology or changing behavior. These strategies include demand management tools, such as ridesharing, and vehicle control technologies, cleaner fuels and fuel economy. Despite the benefits of a combined policy approach, these strategies are normally employed separately. Nevertheless, they have been linked occasionally, for instance in the electric station car programs of the 1990s. Station cars are vehicles shared by transit riders at the start or end of a trip, facilitating transit access and helping to manage demand. In 1990, the California Air Resources Board (CARB) focused on reducing mobile air pollution by mandating that automakers introduce clean vehicles through its Zero Emission Vehicle (ZEV) Mandate. In 1998, significant flexibility was introduced through Partial ZEV credits for very low emission vehicles, using advanced battery technologies. In 2000, CARB left the ZEV Mandate intact, but began considering new approaches, including station cars. In January 2001, recognizing the potential for shared vehicles to further improve air quality by reducing vehicle miles traveled—particularly with transit linkages—CARB proposed additional ZEV credits for vehicles in such programs. Thus, the mandate would formally link demand management to clean vehicles. This paper explores shared-use vehicle and station car developments, lessons learned from the shared-use literature, the ZEV mandate, and the proposed credit structure for linking these strategies. Finally, the authors conclude with policy and research recommendations for enhancing the success and impact of this combined approach. Key Words: Station Cars, Shared-Use Vehicles, ZEV Mandate, Demand Management [Back to top. PDF](#)

Freeway Performance Measurement System): Operational Analysis Tool

02-3679

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Abstract

PeMS is a freeway performance measurement system for all of California. It processes 2 GB/day of 30-second loop detector data in real time to produce useful information. Managers at any time can have a uniform, and comprehensive assessment of freeway performance. Traffic engineers can

base their operational decisions on knowledge of the current state of the freeway network. Planners can determine whether congestion bottlenecks can be alleviated by improving operations or by minor capital improvements. Travelers can obtain the current shortest route and travel time estimates. Researchers can validate their theory and calibrate simulation models. The paper describes the use of PeMS in conducting operational analysis, planning and research studies. The advantages of PeMS over conventional study approaches is demonstrated from case studies on conducting freeway operational analyses, bottleneck identification, Level of Service determination, assessment of incident impacts, and evaluation of advanced control strategies. [Back to top. PDF](#)

Simulation of Freeway Weaving Areas 02-3732

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Abstract

The operation of freeway weaving sections is characterized by intense lane changing maneuvers and complex vehicle interactions that often create bottlenecks along the freeway facilities. The CORSIM microscopic simulation model was applied to simulate the operation of eight real-world weaving sites in California, under a wide range of operating conditions. The results indicate that CORSIM with default parameter values underpredicts the speeds in the weaving section by about 19 percent on the average. Numerous simulation runs were made with different values of the model parameters. The following parameters were found to significantly affect the CORSIM results: car-following sensitivity factor, lane changing aggressiveness factor and % of freeway through vehicles that yield to merging traffic. The calibrated CORSIM model reasonably replicated observed traffic operations on all the test sites. The predicted average speeds were within +5 mph on most datasets. Good agreement between measured and predicted values was obtained for all the combinations of design characteristics and demand patterns. [Back to top. PDF](#)

Choice Models of Route, Occupancy, and Time of Day with Value-Priced Tolls 02-2617

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Abstract

Choice models were developed based on data from surveys in 1999 with commuters on California State Route 91, the nation's first operational value priced toll facility. The models represent route choice among the value priced 91 Express Lanes, the parallel non-toll freeway, and the Eastern Toll Road, a roughly parallel fixed toll highway. The models also represent commuters' choice of vehicle occupancy (single occupant, 2-person, and 3 or more person groups), time of day of travel, and whether or not to obtain the transponder needed for electronic toll collection. The models show implied values of time for commuters in the range of \$13-16 per hour, and slightly inelastic response to changes in toll levels. Results demonstrate that there is scope for adjusting toll schedules, even in as small as one hour increments, in order to regulate demand. [Back to top. PDF](#)

San Diego's I-15 Congestion Pricing: Attitudinal, Behavioral, and Institutional Issues 02-4170

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Abstract

This paper is a companion paper to the paper titled: "San Diego's I-15 Congestion Pricing Project: Traffic Related Issues" and focuses on the results of the Attitudinal Panel Study, Business Impact Study, Land Use Study as well as on institutional and public relations issues. ExpressPass/FasTrak Users and Carpoolers Key findings support the view that in the I-15 corridor, the use of congestion pricing to better utilize the Express Lanes is a policy that has received considerable support. Several factors, one of which appears to be a lack of significant negative impacts, are likely to play a role in explaining the positive support for the project: FasTrak offered all travelers on I-15 a choice whether to pay for the use of the lanes. FasTrak users saved time by using the Express Lanes. The most cited reason to join FasTrak was the need of on-time arrival. FasTrak Customer's perceptions of timesavings were in the 20-minute range (which agrees with actual measurements) and they were convinced that the program positively impacted their travel time. The great majority of all other travelers reported no impact. FasTrak Users, as well as I-15 Carpoolers continuously perceived traffic conditions in the I-15 Express Lanes as satisfactory. This is a particularly important finding, as it shows that the policy of adjusting prices to traffic levels in the lanes had been successful in maintaining the level of service. The project was considered a success by a vast majority of FasTrak Customers and an increasing fraction of I-15 Carpoolers. I-15 Solo Drivers were split on this issue; they nevertheless supported the principle of charging solo drivers for the use of the Express Lanes. Only few respondents knew that FasTrak revenue had been used to fund the Inland Breeze service, and both FasTrak customers and carpoolers favored the opinion that FasTrak revenue should be used to add or extend and maintain the carpool lanes. Also, most FasTrak Customers strongly agreed that the program was effective in reducing congestion, and the majority of Other I-15 Users also agreed but less strongly. There continued to be support for the pricing policy. The majority of customers were satisfied with dynamic per-trip pricing, and this preference had increased. Furthermore, the majority of all I-15 respondents favored increasing the per-trip charge over other solutions to prevent the Express Lanes from becoming too crowded. The majority of all I-15 respondents agreed that solo drivers should be allowed to use the Express Lanes for a fee, and most importantly, they believed the project to be fair to travelers in both the main lanes and the Express Lanes. Also, equity issues, commonly perceived as potential problem for such a project, did not emerge, despite the fact that FasTrak users came from the highest income groups. Attitudes of Business and Land Use Issues Potential business interest in a program like FasTrak primarily hinges on the company's perceived dependency on a corridor where the program is installed. In the case of I-15, however, businesses found the more costly FasTrak per-trip pricing system as somewhat less attractive for frequent use than the moderately priced fixed-fee monthly ExpressPass system that allowed unlimited use of the facility. Businesses treated the program availability as a secondary factor influencing their travel. Also, homeowners considered the I-15 pricing program as a secondary factor in their decision to relocate along the I-15 corridor. Institutional Issues Many involved in implementing the project perceived the project matched or exceeded their expectations and that it was a success by virtue of people's acceptance of pricing. They stated it proved pricing was technically and politically viable. The importance of an influential political campaign at the beginning of the project was emphasized. The continued operation of FasTrak beyond the pilot period is testimony to the success and public acceptance of the pricing concept. The media satisfactorily informed the public about the project. [Back to top.](#)

San Diego's I-15 Congestion Pricing: Traffic-Related Issues 02-4169

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Abstract

This paper summarizes the findings from the evaluation of the Interstate 15 (I-15) Congestion Pricing Project. The project was a three-year demonstration that allowed single occupant vehicles (SOVs) to use the existing I-15 high occupancy vehicle (HOV) lanes, known as the I-15 Express Lanes, for a fee. The project was part of the Federal Highway Administration (FHWA) Congestion Pricing Pilot Program and was managed by the San Diego Association of Governments (SANDAG). The pricing project operated in two phases - the Phase I ExpressPass program, which ran from December 2, 1996 through March 30, 1998, followed by the Phase II I-15 FasTrak™ program, which ran through December 1999. During ExpressPass, participants were charged a monthly fee for unlimited use of the I-15 Express Lanes. During FasTrak, participants were charged a dynamic per-trip fee that varied based on time of day and traffic flow in the Express Lanes. The project's primary goals were (1) to maximize use of the existing I-15 Express Lanes; (2) to test whether allowing solo drivers to use the Express Lanes' excess capacity can help relieve congestion on the I-15 main lanes; (3) to fund new transit and HOV improvements in the I-15 corridor; and (4) to use a market-based approach to set tolls. San Diego State University (SDSU) conducted an independent, multi-element evaluation of the I-15 pricing project to assess its impacts. The evaluation considers whether the project met its primary objectives and reports on the measurable effects of pricing in the I-15 corridor during the three years of project operations. This report provides an overview of findings presented in detail in several technical reports that address a range of topics such as traffic, travel behavior, and institutional issues. (See Appendix A for a complete list of reports.) This paper focuses on project description methodology of the study and all traffic-related impacts. A companion paper titled: "San Diego's I-15 Congestion Pricing: Attitudinal, Behavioral, and Institutional Issues" addresses all other findings of the project. At the end of the three-year evaluation, the I-15 pricing project appears to meet its primary objectives. There was a substantial better utilization of the Express Lanes, which was mainly due to the increase of subscriber vehicles. Both ExpressPass and FasTrak were feasible solutions that could generate sufficient revenue to fund transit service improvements in the I-15 corridor. The revenue raised was successful in funding the new express bus service called Inland Breeze, which was quite effective in attracting sufficient ridership. The high proportion of Inland Breeze riders depending on public transit for their travel, however, suggests that the service is closer to reaching market saturation in segments of the population with traditionally higher levels of bus ridership. Although it is important for the Inland Breeze service to retain and perhaps expand this traditional customer base, the program's highest growth potential would appear to be in continuing to attract nontraditional bus riders. Contrary to some pre-project expectations, neither ExpressPass nor FasTrak negatively affected carpool volumes on the Express Lanes. There were substantial increases in HOV volumes during ExpressPass that declined somewhat during FasTrak, but were still higher than in the pre-project period. FasTrak was primarily responsible for the continued increase in total Express Lane volume. Most importantly, FasTrak, in contrast to ExpressPass, was able to redistribute volumes from the middle of the peak to the peak shoulders. Despite steadily increasing Express Lanes volumes, free-flow conditions, as required by law, were maintained at virtually all times. Another positive effect of the project is the apparent ability of the project to alleviate congestion on the I-15 main lanes. Average peak period volumes on those lanes generally decreased slightly, while overall volumes in the I-15 corridor increased moderately. [Back to top.](#)

WesTrack Fatigue Performance Prediction Using Miner's Law 02-3311

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Abstract

The objectives of this paper are to present an approach using statistical analysis and Miner's Law, and to use it to predict the fatigue performance (crack initiation) of the WesTrack test sections. A

strain function, calculated by a layered-elastic program, was statistically determined in terms of temperature at the bottom of the asphalt layer, temperature gradient, subgrade modulus, air-void content and asphalt content. With integration of laboratory fatigue test results, strain calculation, and Miner's Law, the methodology produces the output in terms of cumulative fatigue damage versus cumulative repetitions for both wander and no-wander cases. Lack of consideration of non-linear stiffness deterioration of asphalt concrete, crack propagation and an appropriate correction factor makes the long term fatigue performance prediction conservative and not fully compliant with the condition survey data from WesTrack. The simulation indicated that the WesTrack coarse mixes took longer to initiate fatigue cracks than the fine and fine-plus mixes, but may propagate cracks faster in cold weather. [Back to top.](#) [PDF](#)

Evaluation of Effects of Adaptive Cruise Control Systems on Highway Traffic Flow Capacity and Implications for Deployment of Future Automated Systems **02-3665**

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Mark A. Miller, University of California, Berkeley
Natalia Kourjanskaia, University of California, Berkeley

Abstract

This paper studies the effects on traffic flow of increasing proportions of both autonomous and cooperative adaptive cruise control (ACC) vehicles relative to manually driven vehicles. Such effects are difficult to estimate from field tests on highways because of their necessarily low market penetration of ACC systems. Our approach uses Monte Carlo simulations based on detailed models presented in the authors' earlier work to estimate the quantitative effects of varying proportions of vehicle control types on lane capacity and on queue lengths and wait times at on-ramps. The results of this study can help to provide realistic estimates of the likely effects of the introduction of ACC to the vehicle fleet, so that transportation system managers can recognize that the autonomous ACC systems now entering the market are unlikely to have significant positive or negative effects on traffic flow. An additional value of studying ACC systems in this way is that these scenarios can represent the first steps in a deployment sequence leading to an automated highway system (AHS). Benefits gained at early stages in this sequence, particularly through the introduction of cooperative ACC with priority access to designated (but not necessarily dedicated) lanes can help to provide support for further investment in and development of AHS systems. [Back to top.](#)

Evaluation Study of TravInfo Regional Traveler Information System **02-4108**

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Abstract

TravInfo is a regional traveler information system in the San Francisco Bay Area. It was a federally funded Field Operational Test over a two-year period from September 1996 to September 1998. The paper reports on the results of the TravInfo evaluation study. The major challenges of TravInfo include setting ambitious goals unattainable within the limited time for the field test, underestimating the time required to develop mutual understanding and trust among parties with varying objectives, underestimating consumer market uncertainty for commercialization of traveler information products and services, having inadequate information about how to put a consumer value on the information being provided, defining appropriate roles for the parties involved, and appreciating the importance of having enough time and funds to market the product and convince people to use it. TravInfo implemented a prototype regional transportation information system to benefit the traveling public and ultimately the Bay Area transportation system. It tested a unique concept of open architecture and collaborative public-private partnership to broadly disseminate traveler information and foster a commercial market for

privately offered advanced traveler information services. Despite many challenges, the field test was completed and TravInfo entered a transitional phase to full deployment as an integral part of the Bay Area transportation infrastructure. The lessons learned from the field test will be of value to the sponsoring agencies and the TravInfo partners as well as those public agencies that are interested in implementing similar systems. [Back to top.](#)

Positional Accuracy of Global Positioning System and Cell Phone Tracking for Probe Vehicles

02-4110

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Abstract

The paper presents the evaluation results of two technologies, Global Positioning Systems (GPS) and the cellular phone tracking for vehicle probes to collect traffic data. A custom software package was developed to conduct the technology evaluation. The software, the Travel Information Probe System (TIPS) maps positions of probes of arbitrary accuracy to an embedded Geographical Information System (GIS) to determine the path the probe vehicle took. Once the path has been determined, the software calculates the travel time for each road segment traversed. The simulation study of road data from two counties in the San Francisco Bay Area suggests that GPS and cellular technologies are capable of producing travel time information for nearly all roads. A technology with 20-meter accuracy can produce data for 99.2% of surface street segments and 98.9% of the freeway segments in the two counties studied. While low accuracy location technologies may not be suitable for freeway surveillance due to difficulties distinguishing between freeways and frontage roads, they may still be very effective for traffic surveillance on major surface streets. In particular, systems meeting the E-911 requirement of 100 meter accuracy for two thirds of all calls are, in theory, capable of producing quantitative travel time information for 87% of major street segments, though only 68% of freeway segments. Location accuracy is only one criterion for building a successful traffic surveillance system. The field tests conducted in this study show that variability in the positional accuracy and the total length of the tracking sequence are both important factors in whether or not a technology can be successfully used for a probe system. [Back to top.](#)

Traveler Response to New Dynamic Information Sources: Analyzing Corridor and Areawide Behavioral Surveys

02-3613

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Abstract

Intelligent Transportation Systems present a well-known innovation opportunity to address urban congestion and allow greater access to transportation networks and destination/activity-participation information. New sources of travel information are emerging rapidly and they are likely to significantly impact traveler decisions and transportation network performance. There is a need to assess the value and impact of these new sources. This paper develops a comprehensive behavioral model based on information processing and response of travelers. Specifically, the model accounts for the effect of information source, content and quality on information source awareness, access, travel preferences and choice. The paper presents empirical evidence from several behavioral surveys conducted as part of the TravInfo field test in San Francisco between 1995-1999. The surveys were conducted to understand 1) how travelers access and use new travel information media including telephone advisory systems and the Internet, 2) how participants throughout the nine-county Bay Area respond to travel information, and 3) how a panel of recruited travelers respond to a specific known instance of major incidents in a corridor. We discuss the issues of access to new and conventional technologies and services, their current market penetration levels, switching behavior regarding new information sources/information

service providers, desired information content and willingness to pay for dynamic information. The opportunities and limitations of new technologies and their system-wide impacts are also discussed. Finally paper presents experiences with TravInfo call volumes and the relevant Internet websites and implications of the field test. [Back to top.](#)

Kinematic Wave Traffic Flow Model for Mixed Flow 02-3068

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Abstract

In this paper we extend the Lighthill-Whitham-Richards kinematic wave traffic flow model to describe traffic with different types of vehicles, where all types of vehicles are completely mixed and travel at the same group velocity. A study of such a model with two vehicle classes (e.g., passenger cars and trucks) shows that the model 1) satisfies first-in-first-out rule, 2) is anisotropic, and 3) has the usual shock and expansion waves, and a family of contact waves. Different compositions of vehicle classes in this model propagate along contact waves. Such models can be used to study traffic evolution on long crowded highways where low performance vehicles entrap high performance ones. [Back to top.](#) [PDF](#)

W50 Tutorial on Fuel-Cell Vehicles ITS Davis et al.

Note: This tutorial workshop will be an independent, non-commercial short course on fuel cell vehicle (FCV) technology and policy, organized by ITS-Davis. The two-day event will provide government officials, environmental non-government organizations, transportation researchers, industry and other stakeholders with a basic understanding of FCV technology, fuels, markets, environmental impacts, and policy. Sponsored by the Committees on Transportation Energy and Alternative Transportation Fuels; the University of California at Davis Institute of Transportation Studies (ITS-Davis); and the W. Alton Jones Foundation. [Back to top.](#)