

California PATH Annual Report 2007

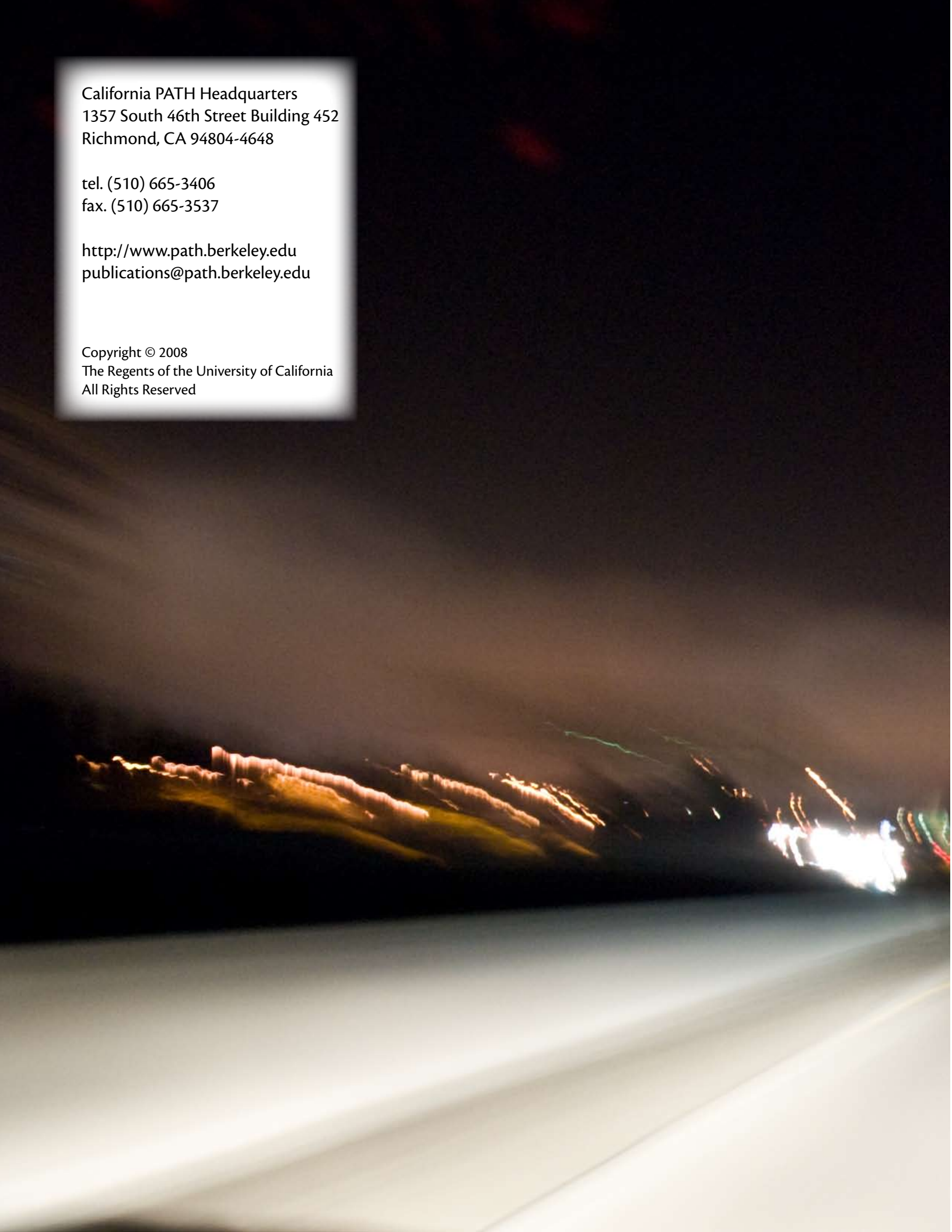


California PATH Headquarters
1357 South 46th Street Building 452
Richmond, CA 94804-4648

tel. (510) 665-3406
fax. (510) 665-3537

<http://www.path.berkeley.edu>
publications@path.berkeley.edu

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The California Partners for Advanced Transit and Highways (California PATH) is a collaboration between the University of California and the California Department of Transportation (Caltrans), together with the U.S. Department of Transportation, other public agencies and organizations and private industry.

PATH's mission is to develop innovative Intelligent Transportation Systems (ITS) strategies and technologies to improve the safety, flexibility, mobility, stewardship and delivery of transportation systems in California, the United States and the world.

Director's Introduction



As this 2007 annual report illustrates, the California PATH Program had an outstanding year. We made significant advances in core research and had several key new developments as well. Highlights include:

- PATH researchers developed analysis tools based on surveillance data for performance measurement, and estimation of the congestion causes and impacts on highway facilities. Improved algorithms for microscopic modeling of oversaturated traffic flow were developed and validated as part of the Federal Highway Administration's NGSIM (Next Generation SIMulation) project. PATH researchers are working on new modeling approaches for traffic corridors as part of the USDOT Integrated Corridor Management (ICM) initiative. PATH also led the research effort on the I-880 in San Francisco Bay Area and I-15 in San Diego corridors, as part of the ICM initiative. Improved freeway control strategies are being developed under USDOT's advance research initiative.
- Research on transit operations developed and field tested an adaptive signal priority system that allow buses to gain priority at signalized intersections while minimizing the disturbance to other traffic. Ongoing work focuses on the implementation of the system in several Bay Area arterials with support from Caltrans and several transit agencies.
- Our automated bus guidance system, developed to add key features to bus rapid transit (BRT), including minimized lateral movement and precision docking, has had strong partnership from Caltrans and AC Transit and is scheduled to become part of the federal Vehicle Automation and Assist (VAA) program in 2008. Preparations are underway for a major milestone coming up next year: taking the long-studied hands-free buses off PATH's research facility, the Richmond Field Station, and onto the city streets.
- PATH researchers are in the forefront of active safety research. The Cooperative Intersection Avoidance Systems—signalized left turn assist (CICAS STLA) project developed concepts and driver based prototype systems for active left-turn countermeasures at signalized intersections. Also an innovative onboard safety monitoring system (OBMS) was developed for commercial truck fleet and drivers under FMSA and Caltrans sponsorship, and successfully demonstrated at the 2007 ITS America Annual Meeting.
- The Vehicle-Infrastructure Integration (VII) Program, a partnership with Caltrans, MTC, and private partners, moved forward with its promise to provide communications systems that advance both safety and mobility. In addition multiple high-level demonstrations on the test-bed, the related Group Enabled Mobility and Safety (GEMS) research track was launched. The GEMS track focuses on VII's critical "safety of life" applications. With green applications and integrated traffic and transit information, GEMS is poised to become a full-service information conduit for travelers, easily accessed after-market mobile devices including PDAs and cell phones.
- "AudiStreets," a new partnership with the German automaker Audi, has PATH researchers studying how traffic information can positively impact the environment, traffic safety and traffic congestion. The project will synthesize data and research in the areas of traffic data collection, emissions- and fuel-consumption-based navigation and "smart engine" controls to turn an Audi vehicle into a working prototype of the ultimate traffic- and fuel-smart car.
- We proudly cut the ribbon on our new lab, the Vehicle-Infrastructure Transportation Application Laboratory (VITAL). The VITAL facility ties together key PATH applications and technologies with a common infrastructure, allowing the idea of information exchange between vehicles—both with each other and the roadside—to become a reality.
- The inaugural PATH-UTC Conference in October attended by more than 300 participants was hailed for its combined planning and technical content on the theme of sustainability, putting transportation technology developers and implementers at the same table.

Our researchers, faculty, students, and public- and private-sector partners have kept California PATH's work at the forefront of national ITS research and deployment. We look forward to another year of working closely with our Caltrans partners to make tomorrow's technology come alive today.

A stylized, handwritten signature in black ink, appearing to read 'A. Skabardonis'.

Alexander Skabardonis
Director, California PATH



"Partnerships that Achieve Results Globally" was the theme for 2007 as the Division of Research and Innovation (DRI) and its research partners worked to enhance transportation worldwide through new partnerships, advanced technology and applied research. What was just a generation ago considered "adventures in imagination" (such as vehicles that drive themselves and interact with the driver) is now being realized through Vehicle Infrastructure Integration (VII), driver behavior analysis and Weigh In Motion research; all made possible through the collaborative efforts of Caltrans, Partners for Advanced Transit and Highways (PATH), the California Center for Innovative Transportation (CCIT), Federal Motor Carrier Safety Administration (FMSCA) and the CalFrance Collaboration.

The VII California Program, led by Caltrans and the Metropolitan Transportation Commission (MTC) with considerable technical assistance from PATH, made significant progress during 2007. Its goal is to improve traffic safety and mobility by employing a wireless vehicle-to-vehicle and vehicle-to-infrastructure communications technology called Dedicated Short Range Communications that enables vehicles and roadside infrastructure to exchange data. In 2007, Caltrans and PATH demonstrated the capabilities of the VII California Program to many interested stakeholders, including three TRB committees; Paul Brubaker, Administrator of the Research and Innovative Technology Association (RITA); and representatives from the Volpe Transportation Center and the National VII Technical Group. These demonstrations provided a forum to show that California is on the leading edge of VII development. Based partially on his observations at this demonstration, Administrator Brubaker has established a new national initiative called "SAFE TRIP-21", which will explore the possibility of accelerating VII deployment using after-market mobile devices, such as cell phones, personal navigation devices, and personal digital assistants, that drivers commonly carry with them in their car. He is hoping to create a "buzz" for Intelligent Transportation Systems (ITS) in general and VII in particular that will help to sustain the national ITS Program in the upcoming discussions for federal transportation authorizing legislation.

The Cooperative Intersection Collision Avoidance Systems (CICAS) Program is another important national-level program that had success during 2007. This program is funded by a \$3.5 million grant from the United States Department of Transportation's (USDOT) ITS joint Program Office, and was given to Caltrans and PATH based on their success with a prior federally-funded project called Intersection Decision Support. In January 2007, Caltrans, PATH, and their auto industry partner, DaimlerChrysler Research, installed the first ever CICAS equipment in a Caltrans operated intersection at the corner of 5th Avenue and El Camino Real in the city of Atherton. This equipment has been used by PATH and DaimlerChrysler to develop a means for warning distracted or inattentive drivers before they violate a red signal light. Since about 25% of all traffic fatalities nationwide occur at intersections, this new system has the potential to significantly improve traveler safety.

Our investigations into driver behavior were also broadened in 2007 through a joint venture with PATH and the Federal Motor Carrier Safety Administration (FMSCA). Research resulting from this collaboration resulted in the development of an onboard safety monitoring system that warns the driver of unsafe conditions. The system also provides fleet managers information that helps to identify need for additional driver training. The prototype system was demonstrated at ITS America Annual Meeting in Palm Springs in June 2007; a four year Field Operation Test of the system will be conducted through cooperative agreement.

The CalFrance partnership (consisting of PATH, CCIT, Institut National de Recherche sur les Transports et leur Sécurité (INRETS) and the French Ministry of Transport) has provided Caltrans with a unique opportunity to work with European partners for collaborative research in a number of areas, including Bridge Weigh-in-Motion and Multiple Sensor applications. Caltrans demonstrated the concept of a Virtual Weigh Station at the ITS America Annual Meeting in Palm Springs in June 2007, and is working to bring new technologies into California's Weigh-in-Motion system statewide. Caltrans Division of Research and Innovation and Division of Traffic Operations, as well as the California Highway Patrol, are working with our principle vendor to update the Virtual Weigh Station to the next generation equipment that can provide real time information to law enforcement.

The long-term relationship with PATH is certainly paying off through national and international collaboratively funded research that benefits the transportation community. The incredible success of our programs is outshined only by the synergy of our partnership with PATH. Our continued teamwork and future outreach efforts will ensure success as we work together to build a safe, flexible, intelligent transportation infrastructure.

Lawrence H. Orcutt

Lawrence H. Orcutt
Division Chief
Division of Research and Innovation

California PATH Program

The California Partners for Advanced Transit and Highways (PATH) Program has been a national and California leader in ITS (Intelligent Transportation Systems) research since PATH's founding in 1986. PATH's focus is on improving traffic operations, and in particular mobility and safety, with advanced ideas, technologies and a deployment focus. Collateral benefits include traveler information, regardless of the mode or modes taken, reduced energy consumption and lesser environmental impact and better land-use management, improving transportation equity amongst all users, and ultimately, in strengthening of California's economy. Because PATH's goals and objectives coincide with national interest in solving transportation problems using advanced technologies, PATH played an important role in initiating ITS in the United States and the creation of the Intelligent Transportation Society of America.

The California Department of Transportation (Caltrans) provides the seed funding for PATH's core research, based on its goal of promoting the development of new knowledge and innovative technology that can improve the safety, flexibility, mobility, stewardship, delivery, and environmental impacts of California's surface transportation systems. As a California statewide ITS research program, PATH's mission is to develop solutions to the problems of California's surface transportation systems through cutting edge, applications-oriented research. PATH also conducts research outside of California—both nationally and internationally. PATH develops these solutions by harnessing the knowledge of transportation researchers, working in conjunction with experts in a host of fields including information technology, electrical engineering, economics, mechanical engineering, planning, systems and policy analysis, psychology, sociology, and business/marketing. Research and development done under PATH auspices include:

- identification of problems and needs
- basic research on enabling technologies
- system conceptualization
- applied technology and research and development
- system-level design and evaluation
- analytical and simulation work in design and evaluation
- experimental verification of design predictions
- evaluations of existing technologies or equipment
- evaluations of costs and benefits
- technology assessments
- investigation of users' behavioral responses
- predictions of the impacts of technology use
- real-world field demonstrations and pilot project testing
- field operational tests
- policy assessment and recommendations
- evaluations of legal and institutional issues.

PATH's charter includes conducting leading-edge research, evaluating and conducting controlled field demonstrations, pilot operational tests and field operational tests, while developing public/private/academic partnerships, and educating students as well as practitioners about operational benefits resulting from research in ITS.

PATH is managed by the Institute of Transportation Studies of the University of California at Berkeley, which established the PATH Program Headquarters Office at the University's Richmond Field Station in 1986. Policy issues are addressed by the PATH Executive Committee, composed of representatives of the primary participating universities, and by the Caltrans-PATH Joint Management Team, composed of program managers from both Caltrans and the University. PATH's day-to-day operations are managed by the headquarters staff.

PATH headquarters has about forty full-time staff members, including a core group of research staff members, plus program leaders and administrators. The full-time research staff at PATH headquarters conducts a substantial body of research, but much PATH research work is done by faculty members and graduate students from various UC campuses and California universities that form the PATH partnership. This work is supplemented by subcontracts to private companies as needed, or by cooperative research agreements with a variety of public and private organizations, both domestic and international. The product-development-oriented work of private companies complements the more basic work of the academic researchers, so that each group can concentrate on what suits it best. Publication of PATH research work is coordinated at PATH headquarters.



Caltrans



ITS institute of
transportation
studies

CALIFORNIA
PATH

Research Groups at PATH

Parsons Arterial Traffic and Transit Laboratory

PATH and Caltrans have established an arterial traffic and transit laboratory at PATH Headquarters. The initial goal of this lab is to collect traffic and probe vehicle data from arterial streets in order to meet the needs of a number of PATH research projects including “Development of Adaptive Transit Signal Priority (ATSP) System,” “Red Light Running Avoidance,” “Relieve Congestion and Conflicts between Railroad and Light Rail Grade-Crossing Intersections,” “Development of Hardware-in-the-Loop (HiL) Simulation and Paramics/VS-PLUS Integration,” and “Development of an Integrated Simulation and Optimization Tool”.

The lab has become a permanent data collection system, which collects real-time or quasi real-time data from several signalized arterials. Data include sensor data, signal status data from field controllers, and automatic vehicle location (AVL) or tag data from busses or probe vehicles. Currently, PATH researchers are developing a set of tools to assist in data processing, analysis and dissemination. The data and software tools in the lab can be used to support academic research on ITS, hardware in the loop simulation, field testing and evaluation of signal control algorithms, and student workshops and training.

The Vehicle-Infrastructure Transportation Applications Laboratory (VITAL)

The **Vehicle-Infrastructure Transportation Applications Laboratory (VITAL)** is a place where the idea of information exchange – a prime enabler for emerging safety and mobility applications – between vehicles, from the roadside-to-vehicle or from the vehicle-to-roadside becomes real. That’s because **VITAL** is part of the University of California Partners for Advanced Transit and Highways (PATH) where the idea of information exchange – a prime enabler for emerging safety and mobility applications – between vehicles, from the roadside-to-vehicle or from the vehicle-to-roadside becomes real.

VITAL researchers are PATH researchers. Since its inception, PATH has been in the forefront of vehicle-infrastructure and vehicle-vehicle communication, initially for mobility with potential safety benefits. This legacy of understanding, expertise and talent from concept to prototyping to evaluation is available to **VITAL**.

The advent of the national “Vehicle Infrastructure Integration” (VII) program and the subsequent first-of-its-kind Caltrans roadside deployment and experimentation of VII, implemented with Dedicated Short Range Communication (DSRC), brings to focus the historical and ongoing PATH leadership in using communications – and information – to facility mobility and safety concepts. Some PATH researchers associated with **VITAL** trace their expertise all the way back to the National Automated Highway Systems Consortium and others have joined on through a host of vehicle-infrastructure transportation applications efforts, up to and including Cooperative Intersection Collision Avoidance Systems (CICAS) and VII California (see www.viicalifornia.org), the regionally- and nationally-significant Vehicle-Infrastructure Integration on-the-“real road” research testbed.

VITAL facilities are PATH facilities. This includes suite of wirelessly equipped vehicles – from passenger vehicles to heavy trucks and buses – and roadside equipment (with a host of DSRC transceivers, WiFi and others), traffic controllers to include an intelligent intersection. VITAL also has a laboratory with a server link real time data from VII California in the San Francisco Peninsula. VITAL is also linked to the Parsons Traffic and Transit Laboratory, which gives researchers high resolution, real-time traffic and transit data from a number of arterials, urban areas and transit systems from Northern and Southern California.

A VITAL future. **VITAL** now gives to PATH and its sponsors and donors:

- Focus on vehicle-infrastructure research at PATH
- Cross-fertilization of research ideas and researchers
- Housing of **VITAL** research assets in a common laboratory

The **VITAL** organization not directly funded by our primary research partner, Caltrans; instead, and to underscore, **VITAL** gives energy and focus to long-standing PATH research and leadership in vehicle-infrastructure cooperative systems.

Innovative Mobility Research (IMR) Group

Since 2002, PATH headquarters has housed the Innovative Mobility Research (IMR) group. IMR is a group of researchers, staff, and students focused on exploring innovative mobility technologies and services that could improve transportation options, while reducing negative societal and environmental impacts.

In 2007, IMR received research grants from Caltrans, the San Francisco Bay Area Metropolitan Transportation Commission (MTC), the Mineta Transportation Institute, the University of California Transportation Center, the Transit Cooperative Research Program, and several automakers (DaimlerChrysler, Nissan, and Toyota). IMR's current research areas include: carsharing, ridesharing, smart truck parking, smart parking for transit, older mobility, uncertainty in travel and land-use models, exploration of hydrogen fuel cell vehicles and infrastructure, low-speed modes linked to transit, transit villages, demographic analysis of diverse traveling populations in California, older mobility, automated enforcement (ASE), virtual weigh-in-motion (VWS), and the Innovative Corridors Initiative (ICI).

In mid 2007 IMR moved affiliation to the new Transportation Sustainability Research Center (TSRC) <http://www.its.berkeley.edu/sustainabilitycenter/> that is also part of UC Berkeley's Institute of Transportation Studies.

State-Funded Core Program of ITS Research

The core of the PATH program is its collection of research projects funded by Caltrans' Division of Research and Innovation. Currently there are over 80 such projects, selected on the basis of an annual Request for Proposals (RFP) and proposals submitted from throughout California. These involve the work of about 45 professors, representing 14 academic departments on more than 14 different university campuses, supervising the research of more than 90 graduate students and post-doctoral researchers. Projects are currently being conducted at: UC Berkeley, UC Davis, UC Irvine, UC Riverside, UC Santa Barbara, UC Los Angeles, California Polytechnic State University at San Luis Obispo, California Polytechnic State University Pomona, San José State University, Ohio State University, San Diego State University, Texas Tech, Utah State University, The University of Southern California, and others.

PATH Activities in National ITS Programs

PATH activities in National ITS Programs continues at a high level. This is underscored by RITA Administrator Paul Brubaker's visits and interest in 2007. Demonstrations and discussions centered on ideas for and innovations in transforming mobility and safety for our nation. It is likely that the intellectual firmament and ideas helped provide the basis for the Safe and Efficient Travel through Innovation and Partnerships in the 21st Century (SAFE TRIP-21).

PATH also participates actively with our Federally- and Caltrans-funded Cooperative Intersection Collision Avoidance System – Signalized Left Turn Assistance (CICAS-SLTA) project. The CICAS program is one of the ITS Joint Program Office's original 'Nine Major Initiatives', in recent years conceptually reconstituted as a primary safety application enabled by the Vehicle-Infrastructure Integration (VII) effort. The VII – or Dedicated Short Range Communication (DSRC)-connected vehicle and infrastructure – work conducted at PATH is Caltrans-funded but has contributed significantly to the national ITS program via our accomplishment; in 2007, our work has led to the creation of a California Development Test Environment, linked to the Federal VII program. In addition, our work and ideas have contributed significantly to SAFE TRIP-21. This work has matriculated to international recognition. On the VII topic alone, public sector delegations from Canada, Japan, Korea, the Netherlands and a host of private companies have come to observe our VII California testbed (see www.viicalifornia.org) and to discuss emerging, innovative ideas with regard to connected vehicle, connected traveler and VII research. PATH researchers were awarded a major grant from the USDOT to develop mobility applications for VII, following a competitive solicitation under the Advanced Research Broad Agency announcement of the US DOT. This study will develop concepts and strategies for freeway management and control utilizing VII.

PATH also participates in USDOT's Integrated Corridor Management (ICM) Program. San Francisco I-880 and San Diego I-5 corridors are amongst the eight ICM pioneer sites. PATH has led the development of the concept of operations, sample data and technical requirements for the ICM systems in the two regions. Under the ICM program, PATH began to focus on ITS approaches for modal integration.

Other Projects

PATH attracted research support from a variety of other sources during the past year. Some of these projects include:

- AudiStreets: a significant effort in environmentally-friendly navigation, both for "green routing" and for fine tuning engine parameters in response to driving conditions
- NEC: support for the Vehicle Infrastructure Transportation Application Laboratory (VITAL)
- Through our reputation, we have a host of other privately-financed projects from vehicle manufacturers and other ITS industrial partners; including General Motors.
- Working with Samtrans and Caltrans, PATH received funding from the Bay Area Air Quality Board for the field operation testing of Adaptive Transit Signal Priority system.

Highlights

- PATH co-hosts "Smart Parking: Moving Research Into Reality" workshop with Caltrans and the UC Davis Energy Efficiency Center at the Green California Summit and Expo in Sacramento, California on March 13, 2007.
- Ms Shelley Row, Director of ITS Joint Program Office visited PATH on April 2, 2007.
- In June of 2007, PATH demonstrated ongoing research to participants of the 11th World Conference on Transport Research hosted by the University of California, Berkeley.
- In June 2007, PATH hosted a meeting with representatives of the European Institutes of Transport, USDOT, TRB and Caltrans to discuss US-European research collaboration.
- In June 2007, PATH hosted the CALFRANCE meeting with representatives of the French DOT, Caltrans and CCIT to discuss joint research under CALFRANCE.
- In July 2007, the Deputy Director General of the Rijkswaterstaat (Dutch DOT) and delegation visited PATH and participated in discussions and demonstrations of transportation innovation.
- In July 2007, the TRB Intelligent Transportation Systems, Traffic Signal Systems, and Vehicle-Highway Automation Committees sponsored a joint mid-year workshop where the PATH work in VII California and demonstrations in the VII California testbed were the primary highlights.
- August 8, 2008: PATH co-sponsors media event with Caltrans, the California Fuel Cell Partnership, and the Transportation Sustainability Research Center (TSRC) in Sacramento, California to kick-off PATH-sponsored research on: "Fuel Cell Vehicles and Hydrogen Infrastructure Drive Clinics.
- In August 15, 2007, PATH demonstrated ongoing research to the participants of the International Conference on Dynamics of Vehicles on Roads and Tracks.
- In September of 2007, PATH, Caltrans and MTC organized the workshop on Transit Signal Priority in the Bay Area. The workshop is a major milestone of the research PATH and Caltrans conducted together with a number of transit agencies in the Bay Area and the Federal Transit Administration on transit signal priority. The workshop attracted significant participation from traffic and transit agencies. Research results, best practice, and lessons learned were presented by a host of the speakers.
- In September of 2007, PATH staff participated in the Sacramento transit fair and showcased a variety of technologies.
- PATH's work in a host of areas – transit, smart truck parking, vehicle-infrastructure integration – was highlighted at the ITS World Congress, October 2007, in Beijing.
- RITA Administrator Paul Brubaker visited PATH twice, in October 2007 for discussions and demonstrations of transportation innovation and in December 2007 to receive a PATH-led VII California demonstration
- 1st Annual PATH-UTC Conference (October 29–31, 2007). Sponsorships: Audi, DaimlerChrysler, Toyota, Delcan, and Nissan.
- In Dec 2007, the national VII Coalition met in Palo Alto, with specific focus on the PATH-led VII California demonstration.

Policy Research

Karen Frick, Program Leader (September 2007-)

Susan Shaheen, Program Leader (January to September 2007)

The Policy and Behavioral Research program focuses on understanding the role, response, and impacts of advanced transportation technologies. It brings together a variety of theories, methodologies, and disciplines in answering applied policy, planning, and implementation questions related to transportation technology use, markets, and response. Disciplines and approaches include: engineering, planning, economics, systems and policy analysis, psychology, sociology, business, and marketing. Research in this area seeks to address transportation issues related to congestion, air quality, energy, and land use.

Projects involve faculty, staff, and students from across the State. These include: innovative strategies to enhance transit services and increase ridership, such as carsharing and low-speed modes; smart parking linked to transit; hydrogen transportation applications for the State and Caltrans; smart cards for transit; wireless Internet access on trains; ITS solutions to goods movement; and understanding travel behavior of diverse population groups.

Effectiveness of the Mobility Pass Program in San Diego (TO 5109) The purpose of this research is to assess the effectiveness on individual travel behavior as a result of using combined car-sharing and transit passes. This assessment was based upon participation in a mobility pass program or Compass + Pass Program that was implemented in late 2004 in the San Diego region. Program participants were highly satisfied for having an alternative to the drive-alone commute. This key finding points to the fact that there is some level of latent demand for alternatives to the drive alone commute, especially in corridors with heavy peak hour congestion. Also of significance is the finding that Program participants improved their views and impressions of nearly all characteristics of transit as a result of their participation in the Program.



An Optimal Resource Allocation Tool for Urban Development Using GIS-based Accessibility Measures and Stochastic Frontier Analysis (TO 5110/TO 6110)

Assessments of transportation investment from a "social efficiency" viewpoint are absent from transportation policy analysis and marketing practice. This is mainly due to the lack of tools capable to assess the role of transportation infrastructure investment on the provision of activity opportunities to residents of each locality. In this research, we demonstrate a tool that identifies specific locations in an entire state where resource allocation has succeeded in maximizing benefits to the public. In addition, the tool and the Geographic Information System maps derived from this tool show which locations in California fail to be optimal and require their residents to travel excessively to pursue the same amount of activities when compared to other optimal locations around the state where traveling enables better time allocation. The outputs examined are indices of location opportunities including retail, education, health, and manufacturing. This new tool also shows the distribution of benefits of the transportation system and identifies differences in benefits across regions.

Commercial Vehicle Parking In California: Exploratory Evaluation of the Problem and Possible Technology-Based Solutions (TO 6101)

The U.S. is experiencing dramatic growth in commercial vehicle truck travel on our nation's roadway system as well as critical shortages in truck parking. The truck parking shortage in California and the U.S. has a number of serious consequences that threaten our roadway safety, public health, and economic productivity. The results of a literature review indicated that the provision of parking information-related services may be a promising near-term solution to the truck parking problem. As a result, the authors worked with researchers at the University of California, Davis to include questions related to truck parking information services in a statewide survey of truckers conducted for the California Air Resources Board. The results indicated that almost 70 percent of the truckers surveyed would use up-to-the-minute information about parking areas and spaces when planning their next rest. Among these respondents, most indicated



that road signs, mobile phones, and radio were their preferred method of accessing this information, and almost half indicated that they would reserve a parking spot in advance, most preferably, by mobile phone.

EasyConnect: Low-Speed Modes Linked to Transit Planning Project (TO 6113)

Access from transit stations to employment and home locations can be a significant barrier to transit use in many urban regions, which is also commonly known as the “first and last mile” problem. The EasyConnect field operational test was launched in August of 2005 to introduce shared-use electric bicycles, non-motorized bicycles, and Segway HTs to employment centers in and around the Pleasant Hill Bay Area Rapid Transit (BART) District stations. Although EasyConnect was initially designed to address the “first and last mile” problem, the results of the field test indicated higher participation demand by day-users rather than by commuters.



Evaluating Wireless Broadband Systems (TO 6100)

Caltrans has partnered with the Great Valley Center (GVC) to launch a field operational test of wireless Internet and Internet kiosks at two rest areas along State Route (SR) 99. The field test technology would provide the following traveler-related information to the public by kiosk, laptop computers, personal data assistants, and cell phone: Transportation and safety information such as emergency information, road condition, and road closures; Tourist information on local attractions and services such as parks, museums, hotels, and restaurants; Historical information on the Central Valley. This project is a research evaluation of the field test, including institutional, user, and financial analyses.



Removing Barriers for Seniors at Transit Stops and Stations and the Potential for Transit Ridership Growth (TO 6102)

This research is designed to determine seniors' perspectives of, and behavior around, bus stops and transit stations in two locations (urban and suburban) in California, and develop and test the impact of various design improvements and interventions to increase transit ridership among seniors. The research plan includes gathering baseline measurements of ridership and perception of bus stops and transit stations at two study sites – Rossmoor, a planned suburban community of older adults and along San Pablo Avenue, an urban area with fixed route transit. The research will produce a handbook that features: (1) a matrix with the types of barriers seniors face at transit stops, (2) a summary of observational studies, focus groups and surveys, (3) a summary of improvements and interventions deployed by agencies or organizations with jurisdiction over the two study sites, and (4) steps to take to apply the improvement and interventions to other settings with California.

Feasibility Study for the Use of Biodiesel in the CalTrans Fleet (TO 6103) Biodiesel is one fuel that offers a number of potential advantages to the Caltrans fleet including opportunities of cleaner air, compliance with fleet/fuel rules and easy substitution. The research will address a number of factors relating to the use of biodiesel fuel in fleet operations, including: (1) biodiesel compatibility with a diverse fleet of engines and exhaust retrofits, (2) emissions benefits and/or disbenefits, (3) commercial availability and pricing of biodiesel for purchase, (4) specifications needed for purchase of biodiesel by Caltrans, (5) regional issues e.g., air quality, weather, etc., impacting the use of biodiesel by Caltrans, (6) optimum biodiesel blend ratio, (7) miscibility with other diesel fuels, (8) emissions and petroleum reduction calculations, and (9) regulations as well as other legal considerations that may have bearing on the use of biodiesel in California.

Compliance & Commercial Vehicle Operators: A Systems Evaluation of the Problem & Virtual Solutions (TO 6105)

In the past five years, truck travel has increased 60 percent on California's highways. Yet, there has been no concurrent increase in the capacity of truck compliance inspection stations or officers assigned to truck enforcement. If a substantial number of trucks need to be inspected, then queues form at weigh stations, causing a number of problems. First, long wait time compromise already slim profit margins. Second, idling trucks waste fuel and contribute to air pollution. Finally, if queues back up into the highway, they can create safety hazards. Recognizing these problems, compliance inspection station operators allow



trucks to bypass overcrowded stations. But for every ten percent by which a truck exceeds its weight limit, there is roughly a 40 percent increase in pavement and structure damage significantly increasing roadway reconstruction and resurfacing costs. And while truckers are among the safest category of drivers, crashes involving trucks are often catastrophic. More recently, concerns about terrorism have underscored the need for increased freight monitoring. In response to these problems, Caltrans has initiated research to test and evaluate Virtual Compliance Stations (VCS) for commercial vehicles. The baseline research for this project culminated in a Workshop in which stakeholders were introduced to the concept and discussed its potential functionality, capability, and implementation.



Designing a Policy Framework for a Statewide Transit Smart Card System (TO 6108) This project will design a policy framework to enable implementation of a statewide transit smart card fare system. Smart card technology has been used in transit operations as a tool to reduce costs, improve service, offer flexible fare policies, and increase revenues. The obstacles to smart card implementation across agencies are less technological as they are managerial, institutional, and political. Accordingly, the research will focus on addressing four major challenges to implementing inter-modal, inter-operator transit smart card systems: (1) weak interagency decision making structures which inhibit reaching and enforcing arrangements for implementing electronic fare media, (2) uncertainty over which institutional partners should be responsible for setting and enforcing standards, protocols, and performance criteria, (3) insufficient models for administering fair, but manageable revenue sharing among transit operators, and (4) difficulty developing smart card systems flexible enough to meet the widely varying needs of transit operators. The products of this research will be clear sets of policy recommendations to overcome these challenges.

Seamless Travel: The Importance of Class I Bike Routes in Journey-to-Work Tips, Pedestrian/Bicycle survey, and Research to Support the California Blueprint for Bicycling and Walking (TO 6117) This research project is the first year of funding for a multi-year project that will (a) evaluate existing bicycle and pedestrian data sources and collection methods, (b) conduct comprehensive counts and surveys of bicyclists and pedestrians, (c) conduct counts and surveys using San Diego County as a model community, (d) analyze how bicycle and pedestrian activity levels relate to facility quality, factors such as land use and demographics, (e) identify factors that are highly correlated with increased bicycling and walking, (f) provide methods for quantifying usage and demand that will enhance research on benefits and exposure, and (g) evaluate how the transit-linkage can be improved.



Effectiveness of Mobility Pass Program in San Diego, TO 5109; Louis Rea, San Diego State University.

A GIS-based Tool for Forecasting the Travel Demands of Demographic Groups within California – an Optimal Resource Allocation Tool, TO 5110; Kostas Goulias, University of California Santa Barbara, Michael McNally and Tom Golub, University of California Irvine.

Understanding Travel Behavior for Diverse Population Groups in California, TO 5111; Susan Handy, University of California Davis.

Evaluating Wireless Broadband System at CA SRRAs, TO 6100; Susan Shaheen, Rachel Finson, California PATH, Transportation Sustainability Research Center.

Strategies for Linking Trucking and Smart Parking Technologies, TO 6101; Susan Shaheen, California PATH, Transportation Sustainability Research Center.

Removing Barriers for Seniors at Transit Stops and Stations and the Potential for Transit Ridership Growth, TO 6102; David Ragland, University of California Berkeley.

Feasibility Study for the Use of Biodiesel in the Caltrans Fleet, TO 6103; J. Wayne Miller, Tom Durbin University of California Riverside.

EasyConnect II: Integrating Transportation, Information, and Energy Technologies at the Pleasant Hill BART Transit Oriented Development, TO 6104; Susan Shaheen, California PATH, Matt Barth, University of California Riverside.

Compliance and Commercial Vehicle Operators: A Systems Evaluation of the Problem and Virtual Solutions, TO 6105; Samer Madamat, UC Berkeley, Genevieve Giuliano, University of Southern California, Mark Miller, California PATH.

Clean Hydrogen for Transportation Applications (Hydrogen Pathways), TO 6107; Are Gjellan, Daniel Sperling, University of California Davis.

Designing a Policy Framework for a Statewide Transit Smart Card System, TO 6108; Brian Taylor, University of California Los Angeles.

Smart Parking at Transit: Phase Two Field Test Evaluation, TO 6109; Susan Shaheen, California PATH, Transportation Sustainability Research Center.

A GIS-based Tool for Forecasting the Travel Demands of Demographic Groups within California, TO 6110; Kostas Goulias, University of California Santa Barbara, Michael McNally, University of California Irvine.

Understanding Travel Behavior for Diverse Population Groups in California, TO 6111; Susan Handy, University of California Davis, Evelyn Blumenberg, University of California Los Angeles, Susan Shaheen, California PATH, Transportation Sustainability Research Center.

Low-Speed and Electric Modes to BART: Project Deployment and Evaluation, TO 6113; Susan Shaheen, California PATH, Transportation Sustainability Research Center.

Exploratory Field Test of Early Fleet Niches for Hydrogen Fuel Cell Vehicles and Fueling Infrastructure, TO 6114; Susan Shaheen, California PATH, Transportation Sustainability Research Center, Tim Lipman, Transportation Sustainability Research Center.

Seamless Door-to-Door Travel: Smart Transit Parking Pilot Project in Conjunction with the San Diego Association of Governments (SANDAG) and the Bay Area Rapid Transit (BART) District, TO 6115; Susan Shaheen, Caroline Rodier, California PATH, Transportation Sustainability Research Center.

A Proposed RFID Field Integration with Smart Parking, TO 6116; Wei-Bin Zhang, California PATH. Linda Novick, Transportation Sustainability Research Center.

Seamless Travel: The Importance of Class I Bike Routes in Journey-to-Work Trips, Pedestrian/Bicycle Survey, and Research to Support the California Blueprint for Bicycling and Walking, TO 6117; David Ragland, University of California Berkeley.

An Evaluation of the Consequences and Effectiveness of Using Highway Changeable Message Signs for Safety Campaigns, TO 6119; Susan Shaheen, Caroline Rodier, California PATH, Transportation Sustainability Research Center.

Commercial Vehicle Parking in California: Exploratory Evaluation of the Problem and Possible Technology-Based Solutions, TO 6120; Susan Shaheen, Caroline Rodier, California PATH, Transportation Sustainability Research Center.

Sustainable Transportation Energy Pathways Program, TO 6121; Joshua Cunningham, University of California, Davis.

Transportation Safety Research

Jim Misener, Program Leader

This past year, transportation safety research at PATH continued to expand in depth and breadth, with increased emphasis in the proposition that communications technologies may at once provide for safety and mobility – the basic premise and promise of Vehicle-Infrastructure Integration (VII). As part of this, a laboratory to capitalize on and give focus to vehicle-infrastructure and vehicle-vehicle communications projects, the Vehicle-Infrastructure Transportation Applications Laboratory (VITAL) has been established. The VITAL facility ties together in a common infrastructure a focus on cooperative safety systems, including cooperative forward collision warning, the continuing and in-depth research series on cooperative safety at intersections, or Cooperative Intersection Collision Avoidance Systems (CICAS) – and finally VII research, with a primary aim on developing a testbed and applications in California.

To complement the VITAL thrust, a solid foundation of work that addresses crash types among transportation modes continues to be performed. In this past year, new research projects have been established in understanding the effects of and providing countermeasures for headlight glare on horizontal curves. Moreover, notable progress has been made on HOV lane ingress/egress safety, automated speed enforcement, a host of pedestrian safety projects, among others.

Specific project groupings are:

- Intersections and Cooperative Systems – crossing path vehicle crashes, safety aspects of cooperative driver-assist systems, VII California
- Driver Behavior – modeling and applications for safety and countermeasure studies of car following and lane changes, at roadway intersections, at-grade crossings
- Employee Safety – work zone warning signals, snow removal equipment
- Pedestrian and Bicyclist Safety
- Development of Tools, Techniques and Data

In 2007, significant accomplishments include our understanding of HOV entry/exit criteria and design on safety, support for the emerging Strategic Highway Safety Implementation Plan, speed enforcement measurements and completion of our prototype onboard monitoring systems development and final report to Caltrans and Federal Motor Carrier Safety Administration; this project was nominated for IT'S America's "Best of ITS" in the area of research.



Intersections and Cooperative Systems

Effects of Cooperative Adaptive Cruise Control on Traffic Flow: Testing Driver's Choices to Following Distance, TO 6202; Delphine Cody, California PATH.

California CICAS and CICAS, TO 6607 and 6608; Jim Misener, California PATH.

Red Light Running Avoidance, TO 6210; Wei-Bin Zhang, California PATH.

ITS Band Roadside to Vehicle Communications in a Highway Setting, TO 6214; Raja Sengupta, University of California Berkeley.

VII California Development and Deployment: Proof of Concept, Jim Misener, California PATH

Driver Behavior

The Naturalistic Driver Model: Development, Integration, and Verification of Lane Change Maneuver, Driver Emergency, and Impairment Modules, TO 6500; Delphine Cody, California PATH.

Reduce Accidents Involving Driver Fatigue, TO 6220; David Ragland, University of California Berkeley.

Methods to Address Headlight Glare, TO 6603; Daniel Greenhouse, University of California Berkeley.

Evaluation of an Animal Warning System Effectiveness, TO 6604; Ashkan Sharafsaleh, California PATH.

Onboard Monitoring and Reporting for Commercial Motor Vehicle Safety, TO 6609; Jim Misener, California PATH.

Employee Safety

Develop Methods to Reduce/Prevent Vehicle Backing Accidents, TO 6206; David Ragland, University of California Berkeley.

Workzone Safety Improvements through Enhanced Warning Signal Devices, TO 6205; Daniel Greenhouse, University of California Berkeley.

Pedestrian and Bicyclist Safety

Pedestrian/Bicycle Safety on a SMART Corridor, TO 5204; David Ragland, University of California Berkeley.

Bicycle Detection and Operational Concept at Signalized Intersections, TO 6203; Steve Shladover, California PATH.

Estimating Pedestrian Accident Exposure, TO 6211, David Ragland, University of California Berkeley.

Evaluate the Effectiveness of Ladder Style Crosswalks, TO 6219; David Ragland, University of California Berkeley.

Evaluate the Causes of Pedestrians and Bicycles Traffic Fatalities and Injuries, TO 6222; David Ragland, University of California Berkeley.

Tools, Techniques and Data

Assessing Automated Speed Enforcement Systems in California, TO 6212; Ching-Yao Chan, California PATH.

Methods for Identifying High Collision Concentration Locations for Potential Safety Improvements, TO 6215; David Ragland, University of California, Berkeley.

Expedited Crash Investigation, TO 6216; Ching-Yao Chan, California PATH.

Evaluation of Traffic and Environment Effects on Skid Resistance and Safety Performance of Rubberized Open Graded Asphalt Concrete, TO 6218; David Ragland, University of California Berkeley.

Quantifying the Performance of Countermeasures for Collision Concentrations Related to Ramp/Freeway Mainline Junctions, TO 6600; Ching-Yao Chan, California PATH.

Safety of HOV Ingress/Egress, TO 6601; Ching-Yao Chang, California PATH.

Evaluation of Wet Weather Accident Causation Criteria, TO 6602; David Ragland, University of California Berkeley.

Data Collection: Strategic Highway Safety Plan, TO 6610; David Ragland, University of California Berkeley.



Traffic Operations Research

Alex Skabardonis, Program Leader

The PATH Traffic Operations Research Program focuses on advancing the state-of-the-art in traffic management and traveler information systems, and producing results that can be implemented in the field. The research is undertaken by a statewide research team of fifteen faculty and more than 40 graduate students and staff working closely with the program sponsors. Currently, there are more than thirty ongoing research projects that fall in four major categories: traffic surveillance, methodologies for data processing, analysis and performance measurement, development and application of modeling tools, and formulation and testing of advanced operational strategies.

Results from ongoing Task Order (TO) 5000 and 6000 series and RTA projects include:

Methods have been developed to perform loop detector diagnostics, and use detector data from conventional and advanced loop detector designs for vehicle re-identification, travel time estimation, and other ITS applications (TO 6300, TO 5304). Work is underway on systematic methods for detector diagnostics and data fusion from multiple detector sources (TO 5327) and on the evaluation of portable data collection technologies (TO 6302). Extensive testing of the new wireless MEMS sensor developed under PATH research (TO 5301 and TO 5328) on freeways and arterial streets demonstrated that it can replace loops and other conventional sensor systems at significantly less costs. A new non-intrusive laser sensor has been developed and successfully tested in the field (TO 5606).

Ongoing enhancements to the freeway Performance Measurement System (PeMS) (RTA 15891) include improved visualization tools, incorporation of other data sources (e.g., toll tag data in the San Francisco Bay Area), and improved algorithms for estimating congestion causes and impacts. Several studies explored the operating characteristics and effectiveness of High Occupancy Vehicle (HOV) lanes (TO 6301, TO 5315 and 5326/6326) using field data and simulation modeling. Ongoing research investigates the optimal sensor placement for freeway traffic management (TO 6328), and the use of both sensor and signal controller status data to improve the performance of signal systems on arterials (TO 6332).



The improved car-following and lane-changing algorithms for oversaturated traffic flow developed as part of the NGSIM project, are being implemented into the state of the art traffic simulators under FHWA sponsorship. A new microscopic traffic flow theory is being developed and validated using the NGSIM vehicle trajectory data. Improved analysis tools have been developed for calibration of microscopic simulation models (TO 5308). A new model, Netzone, has been developed for analysis and management of traffic at work zones (TO 5300). Work has been completed on a tool to produce origin-destination matrices for input to traffic simulation models (TO 5502). The first version of the TOPL model has been successfully completed (TO 6611). TOPL is a macroscopic cell transmission based model that interfaces directly with the PeMS system to analyze freeway operating conditions and alternative control strategies.

Ongoing work on freeway ramp metering strategies focuses on system-wide traffic responsive control and field testing of the most promising strategies (TO 6329). In another study, the effectiveness of ramp metering to improve bottleneck discharge flows is investigated based on detailed field data from video recordings "before" and "after" implementation of ramp metering (TO 6331). Work continues on developing advanced strategies for adaptive traffic signal control on arterials (TO 5322/6322 and TO 5323/6323); a simulation testbed was developed to evaluate adaptive signal control strategies (TO 6322) and new algorithms were proposed for control of traffic signals with adjacent ramp meters (TO 6323).

PATH led the research effort on two major traffic corridors: I-880 in San Francisco Bay Area (TO 6612) and I-15 in San Diego (TO 6613), as part of the US DOT Integrated Corridor Management (ICM) initiative. Work focused on the analysis of existing operating conditions, and the development of multimodal ITS strategies on both the freeway and the adjacent surface street network, including traffic control, traveler information, incident management and transit priority treatments. Related projects include further field testing of the Cartesius system that facilitates the coordination of operating agencies to minimize the response time to incidents along traffic corridors (TO 6324) in Orange County, and the development of guidelines for displaying travel times on changeable message signs (TO 6303). PATH researchers are developing active traffic management strategies for VII as part of a new research grant sponsored by FHWA under the US DOT Advanced Research initiative.

Traffic Surveillance

Conventional Surveillance and Communications Technologies

Maintaining the Health of the Caltrans Loop Detector System, TO 6300; Pravin Varaiya, University of California, Berkeley. UCB-PRR-2007-13.

Systems Engineering Management Plan for Loop Fault Detection, TO 6327; Roberto Horowitz & Pravin Varaiya, University of California, Berkeley, Xiao-Yun Lu, California PATH.

New Detector Technologies

Low-Cost Vehicle Detection and Communication Systems for Freeways, Intersections and Parking Lots, TO 5301; Pravin Varaiya, University of California, Berkeley. UCB-ITS-PRR-2007-4.

Corridor Investigation of Anonymous Vehicle Tracking for Real-Time Performance Measurement, TO 5304; Stephen Ritchie, University of California, Irvine.

Evaluation of IST-222 Detection System, TO 5314; Gabriel Gomes, University of California, Berkeley.

Low-Cost Wireless MeMS System for Measuring Dynamic Pavement Loads, TO 5328; Pravin Varaiya, University of California, Berkeley.

Data Fusion, I-405 TestBed, TO 5327; Art McCarley, Cal Poly San Luis Obispo.



Development and Field Testing of Laser Photodiode Array Based Vehicle Detection Systems on the Highway, TO 5606; Harry Cheng, University of California, Davis.

Evaluation of Portable Automated Data Collection Technologies, TO 6302, James Banks, San Diego State University.

Data Processing/Analysis/Performance Measurement

Traffic Flow

Next Generation Simulation (NGSIM): Developing Algorithms for Oversaturated Freeway Flow, RTA7214; Alexander Skabardonis, University of California, Berkeley. Final Report FHWA-HOP-07-098, April 2007.

Weave Analysis Evaluation and Refinement, TO 6304; Michael Cassidy and Alexander Skabardonis, University of California, Berkeley.

Performance Measurement

Implementation of a Tool for Measuring ITS Impacts on Freeway Safety Performance, TO 5307; Tom Golob, University of California, Irvine. UCB-ITS-PRR-2007-9.

Evaluation of PeMS to Improve the Congestion Monitoring Program, TO 5319; Pravin Varaiya, University of California, Berkeley. UCB-ITS-PRR-2007-6.

Finding and Analyzing the True Effect of Non-Recurrent Congestion on Mobility and Safety, TO 5321; Pravin Varaiya, University of California, Berkeley. UCB-ITS-PRR-2007-10.

What is the Excess Capacity of HOV Lanes, TO 6301; Pravin Varaiya, University of California, Berkeley. UCB-ITS-PRR-2007-5.

Optimal Sensor Requirements for Traffic Management, TO 6328; Alexandre Bayen, University of California, Berkeley.

Improving the Performance of Signal Systems Using Signal and Loop Data, TO 6332, Wei-Bin Zhang, California PATH.

Performance Measurement System (PeMS) Research and Support, RTA15981; Pravin Varaiya, University of California, Berkeley.

Modeling & Simulation

Development of a Path Flow Estimator for Deriving Steady-State and Time-Dependent Origin-Destination Trip Tables, TO 5502; Will Recker, University of California, Irvine, Antony Chen, Utah State University, Michael Zhang, University of California, Davis. UCB-ITS-PRR-2008-10.

Integrated Construction Zone Traffic Management, TO 5300; Michael Zhang, University of California, Davis. UCB-ITS-PRR-2008-9.

Integrated Ramp Metering Design, Evaluation and Optimization Platform with PARAMICS Simulation, TO 5305; Will Recker, University of California, Irvine.

Developing Calibration Tools for Microscopic Traffic Simulation, TO 5308; Michael Zhang, University of California, Davis. UCB-ITS-PRR-2008-7, UCB-ITS-PRR-2008-08.

Tools for Operations Planning, TO 6611, TO 6614; Pravin Varaiya, University of California, Berkeley. UCB-ITS-PWP-2008-4.

Integrated Corridor Management (ICM): Analysis, Modeling and Simulation, RTA 7661; Alexander Skabardonis, University of California. Berkeley.

Traffic Control, Management and Traveler Information Systems

Evaluation of Hybrid Vehicle Usage in HOV Lanes, TO 5315; Will Recker, University of California, Irvine.

Measure and Field Test the Effectiveness of Adaptive Traffic Control for Arterial Signal Management, TO 5322 (6322); Alexander Skabardonis, University of California, Berkeley.

Optimal Control for Corridor Networks: A Mathematical Logic-Based Modeling and Solution, TO 5323 (6323); Will Recker, University of California, Irvine.

Cartesius and CTNET – Integration and Field Operational Test, TO 5324 (6324); Michael McNally, University of California, Irvine.

Determining the Effectiveness of HOV Lanes, TO 5326 (6326); Adolf May, University of California, Berkeley. UCB-ITS-PRR-2007-17.



Optimal Use of CMS for Displaying Travel Times, TO 6303; Alexander Skabardonis, University of California, Berkeley.

Ramp Metering Design Tools and Field Test of Ramp Queue Control, TO 6329; Roberto Horowitz, University of California Berkeley.

Evaluation of Open Road Electronic Toll Collection for California Applications, TO 6330; Brian Taylor, University of California, Los Angeles and Hiroyuki Iseki, University of Toledo.

On Ramp Metering and Commuter Delay: A Before and "After" Study, TO 6331; Michael Cassidy, University of California Berkeley.

Northern California Integrated Corridor Management Demonstration (I-880 Alameda County), TO 6612; Wei-Bin Zhang, California PATH.

San Diego Integrated Corridor Management Demonstration, TO 6613; Alexander Skabardonis, University of California, Berkeley.

Development and Application of Selected Mobility Applications for VII, Steven Shladover, California PATH, US DOT DTFH61-07-0038.



Transit Operations Research

Wei-Bin Zhang, Program Leader

The PATH transit program researches new service concepts, methods and ITS technologies for innovating and enhancing public transit systems that will make public transportation more attractive to choice riders and ultimately help to reduce traffic congestion. We are working toward bringing advanced yet practical solutions to real-world problems. While addressing research on transit subjects, PATH has devoted significant efforts to investigate strategies and technologies for integrating transportation networks to reduce congestion and improve efficiency across the transportation system as a whole. These efforts have been a collaboration among different programs within PATH. Under the collaborative efforts, PATH researchers, including faculty, staff, and students from across California, are working closely with transit and traffic operation agencies to address real world problems in the areas of Bus Rapid Transit, innovative concepts for transit operations, integrated corridor management, connection among different mode of transportation systems, transit safety and rural ITS applications. Below are highlights of the projects conducted in 2007.

Modal integration issue: PATH research address issues related to integrated transportation systems. Participating in two consortium of agencies in the Bay Area and San Diego, studies on Integrated Corridor Management are being conducted to investigate how to integrated the existing ITS technologies to facilitate integrated operation in order to encourage mode shift, reduced congestions, and ultimately achieve higher efficiency for the existing transportation infrastructure. Studies are also being conducted to investigate the interaction between urban/suburban rail and street traffic that is often problematic, resulting in delays on both systems. PATH has developed integrated solutions including practical means for predicting Time-to-Arrival at the grade crossing and adaptive signal control strategies to minimize the delays to motor vehicle traffic while improving schedule adherence for rail operation. Investigation of approaches for improving intermodal connectivity at California airports is also being conducted.

- **Bus Rapid Transit:** Building upon the extensive research on Bus Rapid Transit (BRT), PATH continues to devote efforts in the area of BRT, investigating issues focusing on large impact solutions such as vehicle assist and automation technologies. PATH has prepared field operational tests for transit lane assist technologies along an AC Transit route. Additionally, studies have been conducted to evaluate cost effective BRT system using bidirectional dedicated lane and innovative pavement designs that will allow pavement to be durable against an unusually high rate of distress evolution in the pavement due to accurate guidance.
- **Innovative Transit Operations:** PATH has been conducting significant research on transit operations for a variety of applications, including field testing and evaluation of Adaptive signal priority system that allows buses to gain priority at the intersection while minimizing the disturbance to other traffic. Concept of cost effective transit-taxi as a means to fill the need for improvement in off-peak public transport is being explored. Efficient Deployment of Advanced Public Transportation Systems (EDAPTS) for suburban and rural applications is moving into deployment stage and will soon be field tested.



In 2007 the PATH transit program embraced the following research areas in the Task Order (TO) 6000 series, RTA's or outside funding sources:

Multimodal and Integration

A Combined Quantitative and Qualitative Approach to Planning for Improved Intermodal Connectivity at California Airports , TO 6406; Xiaoyun Lu, California PATH.

Relieve Congestion and Conflicts Between Railroad and Light Rail Grade-Crossing Intersections; TO 6407; Wei-Bin Zhang, Meng Li, California PATH.

SPRINTER Rail Project - Grade Crossing/Traffic Signal Optimization Study, TO 6409; Wei-Bin Zhang, Meng Li, California PATH.

Northern California Integrated Corridor Management Demonstration (I-880 in Alameda County), TO 6612; Wei-Bin Zhang, Steven Shladover, Irene Li, California PATH.

San Diego Integrated Corridor Management Demonstration (I-15 in San Diego County), TO 6613; Alex Skabardonis, Linda Novik, Yuwei Li, Mark Miller, California PATH.

Improving Performance of Coordinated Signal Control Systems Using Signal and Loop Data, TO 6332; Meng Li, Liping Zhang, California PATH.

Tools for Operations Planning-2 (TOPL2), TO 6614; Pravin Varaiya, Alex Skabardonis, University of California, Berkeley.

Transit Operation

Field Operational Tests of Adaptive Transit Signal Priority (ATSP), TO 6400; Wei-Bin Zhang, Meng Li, California PATH.



Efficient Deployment of Advanced Public Transportation Systems (EDAPTS), TO 6401; Xudong Jia, Cal Poly State University Pomona, Edward Sullivan, Cal Poly State University San Luis Obispo.

Development of Performance-Based Specifications for Efficient Deployment of Advanced Public Transportation Systems (EDAPTS), TO 6402; Jeff Gerfen, Cal Poly State University San Luis Obispo, Xudong Jia, Cal Poly State University Pomona.

Stage 5 Test Deployment of Efficient Deployment of Advanced Public Transportation Systems (EDAPTS), TO 6403; Jeff Gerfen, Cal Poly State University San Luis Obispo, Xudong Jia, Cal Poly State University Pomona.

Improving Mobility through Enhanced Transit Services, TO 6408; Brian Taylor, University of California Los Angeles, Mike Cassidy, University of California Berkeley.

Bus Rapid Transit

Evaluation of Cost-Effective Planning and Design Options for Bus Rapid Transit in Dedicated Bus Lanes, TO 6404; Mark Miller, Steven Shladover, Wei-Bin Zhang, California PATH.

Establish Infrastructure Requirements for Lane Assist/Precision Docking, TO 6605; Wei-Bin Zhang, Steven Shladover, Fanping Bu, California PATH.

Field Demonstration and Tests of Lane Assist/Guidance and Precision Docking Technology, TO 6606; Wei-Bin Zhang, Fanping Bu, Hanshue Tan, California PATH.





POLICY

AN OPTIMAL RESOURCE ALLOCATION TOOL FOR URBAN DEVELOPMENT USING GIS-BASED ACCESSIBILITY MEASURES AND STOCHASTIC FRONTIER ANALYSIS

Konstadinos G. Goulias

The lack of tools capable of assessing the role of transportation infrastructure investments on activity opportunities for local residents denies a "social efficiency" viewpoint from being addressed in transportation policy analysis and marketing practice. In this report, a tool is demonstrated that identifies specific locations in a state where resource allocation succeeds in maximizing public benefit and where resource allocation fails to provide adequate transportation for similar activities.

Efficiency is measured using stochastic frontier regression analysis, with derived land use and transportation infrastructure indicators as inputs. Outputs examined are indices of location opportunities.

UCB-ITS-PRR-2007-7,
June 2007, 32 pp.

COMMERCIAL VEHICLE PARKING IN CALIFORNIA: EXPLORATORY EVALUATION OF THE PROBLEM AND POSSIBLE TECHNOLOGY-BASED SOLUTIONS

Caroline J. Rodier, Susan A. Shaheen

Growth in commercial vehicle truck travel and shortages in truck parking characterize California's roadways, ranking first in the United States for commercial vehicle parking shortage. The truck parking shortage in California (and the United States) has a number of serious consequences that threaten roadway safety, public health, and economic productivity.

This report begins with a literature review of commercial vehicle parking problems in California and the United States. This indicated that changes to information-related services may be a near-term solution to the parking problem. The principal investigators worked with researchers at the University

of California, Davis to conduct a statewide survey of truckers, which indicated that almost 70 percent of the truckers surveyed would use up-to-the-minute information about parking areas and spaces when planning their next stop. Of those, most indicated that road signs, mobile phones, and radio were their preferred method of accessing this information. A parking spot reservation system, using a mobile phone, was also supported.

UCB-ITS-PRR-2007-11
August 2007, 18 pp.

EFFECTIVENESS OF THE MOBILITY PASS PROGRAM IN SAN DIEGO

Louis Rea, Sherry Ryan

This research assesses the effectiveness of car-sharing and transit passes at changing individual travel behavior, based on participation in a 2004 mobility pass program (Compass + Pass Program) in San Diego. Program participants were highly satisfied with the alternative to a drive-alone commute, especially in corridors with heavy peak-hour congestion.

UCB-ITS-PRR-2007-16
November 2007, 145 pp.

TRAVEL OF DIVERSE POPULATIONS: LITERATURE REVIEW

Evelyn Blumenberg, et al.

Increased immigration of diverse demographic groups into California means planners need a better understanding of travel behavior across demographics. As part of a larger project studying the attitudes, constraints, needs, and preferences that influence travel choices and outcomes among diverse groups in California, this report provides a review of existing literature on travel behavior among specific demographic groups. In particular, this report provides a review of what is currently known about the travel patterns and transportation needs of the following five demographic groups: the elderly, immigrants, Native Americans, racial and ethnic groups (i.e. Asians, Blacks, and Hispanics), and youth.

UCB-ITS-PWP-2007-5
September 2007, 105 pp.



SAFETY

CALIFORNIA INTERSECTION DECISION SUPPORT: A SYSTEMS APPROACH TO ACHIEVE NATIONALLY INTEROPERABLE SOLUTIONS II

Jim Misener, et al.

The Intersection Decision Support (IDS) research plan identifies the requirements, tradeoffs assessment, and technology investigations necessary for a definition of IDS. This plan combines an understanding of the problem definition with IDS and standard Caltrans intersection technologies, intended to design a deployable, testable IDS demonstration.

IDS systems promise to reduce the number of crashes, fatalities, and injuries on the roadway. Federal and state governments, together with private industries and academic institutions, are pursuing the deployment of IDS as well as Cooperative Intersection Collision Avoidance Systems (CICAS). These combine infrastructure-based and vehicle-based functions, providing optimal solutions for drivers.

UCB-ITS-PRR-2007-1
January 2007, 337 pp.

AUTOMATED SPEED ENFORCEMENT FOR CALIFORNIA: A REVIEW OF LEGAL AND INSTITUTIONAL ISSUES

Caroline J. Rodier, Susan A. Shaheen, Ellen Cavanagh

Excessive speed is a major contributing factor to motor vehicle crashes and is an important focus of highway enforcement efforts. Automated speed enforcement programs have been applied outside the United States to address speeding-related safety problems. This literature review explores the potential benefits and barriers of automated speed enforcement program implementation in the United States by examining literature on automated enforcement programs, including red-light and speed programs.

UCB-ITS-PRR-2007-14
September 2007, 39 pp.

ONBOARD MONITORING AND REPORTING FOR COMMERCIAL VEHICLE MOTOR SAFETY

Doug Cooper et al.

This report describes the process of developing and product of testing a prototypical suite of Onboard Monitoring and Reporting System (OBMS) hardware on a Freightliner Century Class Truck. The OBMS suite provides online measurements of unsafe driving indicators—following distance, lane keeping performance, safety belt use, speed, and turn signal use. Feedback can be provided to the driver directly or through carrier management.

This concept would be pioneered in commercial fleets with the resources and organizational structure to provide feedback and training to professional drivers. The objective is to improve and maintain truck driver safety behaviors.

UCB-ITS-PRR-2007-15
September 2007, 291 pp.

EXPEDITED CRASH INVESTIGATION - WITH USE OF TECHNOLOGIES FOR DOCUMENTATION AND PROCESSING

Ching-Yao Chan, Thang Lian, Jeff Ko

California highways are impeded by recurrent and non-recurrent congestion on a daily basis, often because of roadway incidents like collisions. This project explores technologies that could benefit law enforcement officers and other personnel involved in handling collision sites and subsequent investigations.

This project includes three major components: (1) the experimentation of integrated vehicular technology systems for law enforcement officers, (2) the exploration of GPS devices for vehicle and incident locations, and (3) the development of photogrammetry tools to extract supplementary information from collision scenes.

Successful deployment of technological systems requires easy-to-learn operation features and friendly user-machine interfaces. From the perspectives of local agencies or jurisdictions, integrated multiple-function capabilities and open architecture are also important considerations for

favorable cost-benefit returns on investments.

UCB-ITS-PRR-2007-18

November 2007, 45 pp.

OPTIMIZING COMPREHENSION OF CHANGEABLE MESSAGE SIGNS (CMS)

Daniel Greenhouse

This research intends to assist the California Department of Transportation (Caltrans) to optimize the message content and presentation of changeable message signs (CMS). Optimized content improves information transfer and minimizes congestion from slowing motorists attempting to read the message. Research was restricted to signs displaying 16 characters in each of their three lines (permanent CMS displays), or signs containing only 8 characters in each of their three lines (portable CMS displays). Most information can be contained on a single screen for permanent signs, but multiple screens are often required for portable CMS displays.

This study focused on "early vision," distinct from "cognitive processes." Early vision problems are those relating to the limitations of the first several stages of the visual system. Cognitive process limitations involve active thinking (e.g. abbreviations) on the part of the observer. The project was divided into two phases, a laboratory phase and then a field test.

UCB-ITS-PRR-2007-24

November 2007, 79 pp.

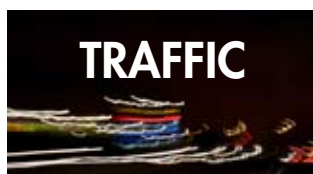
APPLYING SAFETY IMPROVEMENTS TO FLEET VEHICLES

Douglas L. Cooper, et al.

The need for an objective strategy to address safety equipment deployment issues, including determining where equipment changes should be made, what types of vehicles should be involved, and how changes should be made, prompted this project. Though the problem may have non-equipment solutions such as changes to policies and procedures, some may require equipment.

UCB-ITS-PWP-2007-3

August 2007, 46 pp.



DEVELOPMENT OF AN INTEGRATED MICROSCOPIC TRAFFIC SIMULATION AND SIGNAL TIMING OPTIMIZATION TOOL

Yafeng Yin, Henry X. Liu, Jorge A. Laval, Xiao-Yun Lu, Meng Li, Joshua Pilachowski, Wei-Bin Zhang

Most traffic signal control systems in California (and in the United States) are closed-loop systems. These systems need improvement, as wide-scale deployment of advanced adaptive control systems is years away. To address this need, this project focuses on developing an integrated micro-simulation/signal optimization tool (using Paramics with Synchro and TRANSYT-7F) to help generate efficient signal timing plans, accompanied by the development of a three-component systematic approach to improve closed-loop system efficiency.

UCB-ITS-PRR-2007-2

January 2007, 137 pp.

HIGHWAY TRAFFIC DATA SENSITIVITY ANALYSIS

Xiao-Yun Lu, Benjamin Coifman

Part one of this project describes a systematic approach for highway traffic data sensitivity analysis by looking at input, output, and processes between input and output to identify key factors affecting output. Part two examines the trade-off between detector station spacing and detector network latency in traffic control applications by calculating the response time of active controls and subsequent traveler delay.

UCB-ITS-PRR-2007-3

January 2007, 208 pp.

TRAFFIC SURVEILLANCE BY WIRELESS SENSOR NETWORKS: FINAL REPORT

Sing-Yiu Cheung, Pravin Varaiya

The disadvantages of inductive loop detectors in traffic surveillance systems have led to a search

for a reliable and cost-effective alternative. This report summarizes a three-year research project in the prototype design, analysis, and performance of wireless sensor networks for traffic surveillance, using both acoustic and magnetic sensors. Wireless sensor networks are easy to install, flexible, remotely maintained, low-cost, and highly accurate; their future deployment will provide fine-grained vehicle detection for effective traffic monitoring and control.

UCB-ITS-PRR-2007-4

January 2007, 161 pp.

EFFECTIVENESS OF CALIFORNIA'S HIGH OCCUPANCY VEHICLE (HOV) SYSTEM

Pravin Varaiya

This is the most extensive empirical evaluation of the effectiveness of California's HOV system, based on data from traffic sensors. Four major conclusions are made: (1) an HOV lane suffers a twenty percent capacity loss compared with multi-lane freeways, (2) HOV lanes are under utilized, (3) HOV lanes do not markedly increase car-pooling, and (4) HOV lanes do not reduce overall congestion in a reasonably well-managed system.

UCB-ITS-PRR-2007-5

May 2007, 21 pp.

EVALUATION OF PeMS TO IMPROVE THE CONGESTION MONITORING PROGRAM

Jaimyoung Kwon, Bill McCullough, Karl Petty, Pravin Varaiya

Highway congestion monitoring program (HICOMP) reports are based on data from either "tach" vehicle runs or PeMS. This project suggests a plan to move towards PeMS-based HICOMP report for six reasons: (1) PeMS-based estimates of the magnitude, extent, and duration of congestion on specified freeway sections are more accurate than those based on "tach" vehicle runs, (2) error in year-to-year comparisons of "tach" vehicle runs averages 25 percent, (3) PeMS can yield valid comparisons year-to-year through careful analysis, (4) PeMS data collection costs less than "tach" vehicle runs and is more accurate, (5) PeMS estimates recurrent and

non-recurrent congestion, congestion "hotspots," and travel time reliability, making HICOMP reports more useful, and (6) PeMS offers an outline of standardized congestion reporting protocol.

UCB-ITS-PRR-2007-6

June 2007, 83 pp.

INTEGRATED ROADWAY/ADAPTIVE CRUISE (IRAC) CONTROL SYSTEM: SAFETY, PERFORMANCE, ENVIRONMENTAL AND NEAR TERM DEPLOYMENT CONSIDERATIONS

Petros Ioannou, Yun Wang, Hwan Chang

The IRAC system is a highway traffic control system which integrates ramp metering strategies and a speed control strategy by taking into account highway-to-vehicle communication and adaptive cruise control (ACC) system technologies on board vehicles. The IRAC system closes the loop of an open loop highway traffic system by controlling the ramps and the speed distribution along highway lanes.

Available communication technologies such as Dedicated Short Range Communication (DSRC) systems are shown to be adequate for vehicle communication, showing the desired speed limit generated by the IRAC system. The validated simulation model is used to evaluate the IRAC system under different traffic scenarios, with mixed traffic ranges, different traffic flow demands, and recurrent and non-recurrent disturbances. Results demonstrate that the IRAC system could lead to a better managed traffic flow system, with improved travel times and traffic flows in every scenario.

UCB-ITS-PRR-2007-8

July 2007, 59 pp.

IMPLEMENTATION OF A TOOL FOR MEASURING ITS IMPACTS ON FREEWAY SAFETY PERFORMANCE

Thomas F. Golob, James Marca, Will Recker

This research was undertaken to develop a tool for assessing the impact of freeway traffic flow on traffic safety. Safety is measured as the probability of a reportable accident. The tool is restricted to urban freeway mainlines with substantial traffic levels and will

monitor the safety level of freeway operations, aiding in freeway planning. The tool is calibrated using advanced statistical models and actual data from Vehicle Detector Stations (VDS) in Orange County (District 12) and the Traffic Surveillance and Analysis System (TASAS). Final recommendations include improving the accuracy and evaluation of safety predictions and extending this modeling approach to Caltrans' districts.

UCB-ITS-PRR-2007-9

July 2007, 83 pp.

FINDING AND ANALYZING TRUE EFFECT OF NON-RECURRENT CONGESTION ON MOBILITY AND SAFETY

Pravin Varaiya

This report summarizes empirical research about the causes and impact of non-recurrent congestion. A method is presented to divide total congestion delay on a freeway section into delay caused by incidents, special events, lane closures, and adverse weather; and reduction in delay at bottlenecks from ideal ramp metering. The method can be applied to any site with minimum calibration, but requires data about traffic volume and speed, the time and location of incidents, special events and lane closures, and adverse weather.

A simpler method, which depends on routine data collected by PeMS, has been implemented and provides a "congestion pie" for any district or freeway segment. The pie divides total congestion delay into three categories: potential reduction, excess demand, and accidents.

UCB-ITS-PRR-2007-10

August 2007, 23 pp.

HEALTH OF CALIFORNIA'S LOOP DETECTOR SYSTEM

Ram Rajagopal, Pravin Varaiya

The California Department of Transportation (Caltrans) freeway sensor network has two components: the sensor system of 25,000 inductive loop sensors grouped into 8,000 vehicle detector stations (VDS), covering 30,500 freeway direction-miles; and the communication network over which sensor measurements are transmitted to Caltrans Traf-

fic Management Centers. The sensor network is the only data source for traffic operations, performance measurement, planning, and traveler information. The value of these data is greatly reduced by the poor reliability of the sensor network: on a typical day in 2005, only 60 percent of the statewide sensor network provided reliable measurements.

This report conducts an empirical study of the reliability of the sensor network based on two data sets: one obtained from PeMS, one from field inspection reports of more than 4,000 loops conducted as part of Caltrans' Detector Fitness Program. Three metrics of system performance are used: productivity (the fraction of days sensors provide reliable measurements), stability (how often sensors switch from reliable to unreliable), and life-time fixing time (the number of consecutive days sensors are work or fail). These metrics are used to evaluate the effectiveness of the Detector Fitness Program (DFP), as the DFP is unlikely to be cost-effective. Two-thirds of visited loops show no improvement in system performance, while the remaining one-third show only marginal improvement. The report proposes a statistical model of sensor failure using a scientific approach to maintain and replace the sensor system.

UCB-ITS-PRR-2007-13

August 2007, 63 pp.

DETERMINING THE EFFECTIVENESS OF HOV LANES

Adolf D. May, Lannon Leiman, John Billheimer

This project evaluates the air quality, congestion, occupancy distribution, person-travel, shape and duration of the peak period, and vehicle-travel of freeway HOV lanes and adjacent mixed-flow lanes. A comprehensive literature review, along with current and historical field data, produced summaries of current knowledge about HOV lane effectiveness. The analysis revealed strong public support for HOV lanes because of significant time savings for commuters, steady growth in carpooling, and low violation rates. The air quality module in the freeway simulation model FREQ was updated to reflect up-to-date techniques for predicting air quality,

developed by the California Air Resources Board EMFAC model.

Accurate data on vehicle occupancy distributions and traffic demand levels is needed to create effective HOV lanes. The modified freeway simulation model FREQ was applied to two freeway study sites, one in Northern California and one in Southern California, to demonstrate this principle. The FREQ model proved suitable for investigating HOV lane design and operating parameters.

UCB-ITS-PRR-2007-17

November 2007, 324 pp.

FIELD DEPLOYMENT AND OPERATIONAL TEST OF AN AGENT-BASED MULTI-JURISDICTIONAL TRAFFIC MANAGEMENT SYSTEM

Craig R. Rindt, Michael G. McNally

This report reinterprets how the Cartesius multi-jurisdictional incident management prototype can be used as an organizing principle for real-world multi-jurisdictional systems. This interpretation focuses on the power of a Distributed Problem Solving (DPS) approach Cartesius uses to partition analysis and optimization functions in the system across jurisdictions. This partitioning minimizes the amount of local information shared between jurisdictions and defines a collection of TMC-to-TMC messages to support the Cartesius DPS perspective.

The report recommends building a new TMC software agent to provide operators with a view of the system from Cartesius DPS perspective. This tool will be advisory in nature, providing operators with guidance regarding how local actions are to conflict with the actions of neighboring jurisdictions (or lack thereof). Where appropriate, the new management agent could be connected to available control subsystems to provide operational or tactical control in response to system problems.

UCB-ITS-PWP-2007-1

June 2007, 49 pp.

TRANSIT

RESERVATION, SCHEDULING, AND NAVIGATION SYSTEM FOR A CHECKPOINT DRT SERVICE

Yuwei Li, Nicole Foletta, Ken Elkabany, Fan Yang, Anthony Wee, Michael Cassidy

The report documents a prototype system developed to serve Demand-Responsive Transit (DRT). Fremont, California is the proposed location for DRT deployment (i.e. a pilot project). This includes a "hybrid" model, including service alternates between traditional fixed-route modes and the DRT model, for bus operations. The report describes the configuration and deployment of the prototype system from the perspective of system users (i.e. administrators, bus drivers, and customers). Software development notes are also provided to document the lessons learned from development. Conclusive evidence shows that reserving DRT trips and dispatching the buses can be done in automated fashion.

UCB-ITS-PRR-2007-12

August 2007, 49 pp.

TRANSIT INTEGRATED COLLISION WARNING SYSTEM VOLUME I: SYSTEM DEVELOPMENT

California PATH Program, Carnegie Mellon University - Robotics Institute

For this project, Frontal Collision Warning System (FCWS) and Side Collision Warning System (SCWS) teams joined together to improve collision warning algorithms. The objective of the ICWS Program is to study how frontal and side collision warning systems might interface with each other, and to develop prototype ICWS systems on two buses: one at Samtrans, one at PAT. Prototype ICWS buses in the Bay Area and Pittsburgh collect field operational data and driver responses, the results intended to design, build, and integrate efforts. An analysis of early data collections are documented in this technical report. Evaluation and performance analyses are be-

ing finalized and will be issued in a separate report.
[UCB-ITS-PRR-2007-19](#)
November 2007, 305 pp.

TRANSIT INTEGRATED COLLISION WARNING SYSTEM VOLUME II: FIELD EVALUATION

*California PATH Program,
Carnegie Mellon University -
Robotics Institute*

This evaluation report examines the performance of the Integrated Collision Warning System prototype by testing sensors and processing both algorithms and driver-vehicle interfaces in controlled and real world operational environments. Evaluation metrics and methodologies were used to evaluate the effectiveness of the system.

[UCB-ITS-PRR-2007-20](#)
November 2007, 213 pp.

LANE ASSIST SYSTEMS FOR BUS RAPID TRANSIT, VOLUME I: TECHNOLOGY ASSESSMENT

Steven E. Shladover, et al.

This report documents information collected by an FTA-led delegation to several European organizations with experience in the development and operation of transit lane assist systems. This includes (1) optical guidance in Rouen, France, (2) magnetic guidance in Eindhoven, Netherlands, and (3) mechanical guidance in Essen, Germany. Summaries of the briefings prepared by the European hosts in response to delegation questions are included in the report.

[UCB-ITS-PRR-2007-21](#)
November 2007, 61 pp.

LANE ASSIST SYSTEMS FOR BUS RAPID TRANSIT, VOLUME II: NEEDS AND REQUIREMENTS

Wei-Bin Zhang, et al.

This report defines transit service needs and requirements met using lane assistance systems, based on a review of existing literature and research regarding lane assistance and case studies of transit properties needing lane assistance systems. The project team conducted workshops with those transit properties to learn about their needs and to learn about the benefits and the risks

they believe are associated with lane assistance technology.
[UCB-ITS-PRR-2007-22](#)
November 2007, 143 pp.

LANE ASSIST SYSTEMS FOR BUS RAPID TRANSIT, VOLUME III: INTERFACE REQUIREMENTS

*Fanping Bu, Wei-Bin Zhang,
Susan Dickey, Steven E.
Shladover, Han-Shue Tan*

Vehicle Assist and Automation (VAA) systems provide high quality transit service within reduced lane widths using lane assistance, precision docking, and longitudinal control of transit vehicles. Transit vehicles in North America are manufactured based on individual transit agencies' customized requirements. The interfaces between VAA components and the electrical, electronic, and mechanical systems on the existing transit vehicle, if not defined properly, can be an impediment to large scale deployment of VAA technologies. This report summarizes a research effort in specifying VAA interface requirements to facilitate progress toward the development and deployment of VAA systems on transit vehicles in the United States.

[UCB-ITS-PRR-2007-23](#)
November 2007, 118 pp.

VEHICLE/DRIVER MONITORING FOR ENHANCED SAFETY OF TRANSIT BUSES

*Mingyu Shi, Masayoshi
Tomizuka*

The goal of this project is to design and implement reliable vehicle/driver monitoring systems to improve transit bus safety. The main objectives of this project are: (1) to identify a simple model for describing the driving patterns of human drivers, and (2) to develop an algorithm that can generate warning messages upon notification of danger.

Online data processing and prediction can estimate three critical parameters for driving safety: driver response time, time-to-collision (TTC), and time-to-lane-crossing (TLC). From this, a timely warning message scheme incorporating all three parameters is designed to determine when an alarm should be issued.

[UCB-ITS-PRR-2007-25](#)
November 2007, 47 pp.

CAL POLY POMONA EDAPTS TEST DEPLOYMENT OPERATIONS DESCRIPTION VERSION 6.0

Xudong Jia, Jeff Gerfen

Rural and small urban communities face significant public transportation problems. Efficient Deployment of Advanced Public Transportation Systems (EDAPTS), a program begun in the late 1990s, made intelligent transportation system (ITS) technologies more available to the small transit community.

EDAPTS research is now ready for commercialization. The Cal Poly Pomona EDAPTS Test Deployment system, referred to as the Bronco Express EDAPTS system, is being designed, installed, operated, and tested through the Federal Transit Administration (FTA) and California Department of Transportation (Caltrans). This test deployment assesses and facilitates the commercialization of EDAPTS concept systems.

[UCB-ITS-PWP-2007-2](#)
July 2007, 49 pp.

DESIGN OF A DEMAND-RESPONSIVE TRANSIT SYSTEM

*Yuwei Li, Jessica Wang, Justin
Chen, Michael Cassidy*

This research investigates demand-responsive transit (DRT) service in situations of low demand density. The study region is AC Transit District 2, the cities of Fremont and Newark, California. Using a methodology to evaluate the operating efficiencies of existing bus lines and line segments, areas were identified as suitable for DRT service, an alternating strategy of checkpoint DRT service was compared to other strategies, and an automated reservation and scheduling system was discussed.

Initial findings of the research include agreement with service cuts and route changes implemented by AC Transit District 2 after 2001, resulting in a net savings of 2 to 3 buses and increased passenger access, reliability, and service cost.

[UCB-ITS-PWP-2007-4](#)
August 2007, 64 pp.



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