

## **Institute of Transportation Studies Research Highlights 2003-2004**

**PATH (Partners for Advanced Transit and Highways)** is the nation's largest program of intelligent transportation systems research. Its mission is to develop solutions to the problems of California's surface transportation systems through cutting edge research. PATH develops these solutions by harnessing the knowledge of transportation researchers, working in conjunction with experts in the fields of information technology, electrical engineering, mechanical engineering, economics, transportation policy and behavioral studies. The PATH charter includes conducting leading research, planning and evaluating field operational tests, developing partnerships between academia, the public sector and private companies, and educating both students and practitioners.

The PATH Program emphasizes research directions that offer potentially large improvements in the operations of the transportation system, relative to those that can make only incremental improvements. At the same time that PATH addresses the relatively long-term, high-impact solutions, it also addresses the evolutionary steps that will be necessary to get to the long-term solutions.

The California Department of Transportation (Caltrans) provides a portion of PATH funding; the remaining funding comes from the US Department of Transportation, other state and local agencies and private industry.

Some recent research at PATH:

### **1. Policy and Behavioral Research Program**

In 2003, the Policy and Behavioral Research program was launched. This program focuses on understanding the role, response, and impacts of advanced transportation technologies. This crosscutting initiative brings together a variety of theories, methodologies, and disciplines in answering applied policy and planning questions related transportation technology use and response. Disciplines and approaches include: engineering, planning, systems and policy analysis, psychology, sociology, and business/marketing.

Highlights from 2003-2004 include:

**CarLink II Pilot Program** final evaluation completed;

**Smart Parking, Linked to Transit, Field Operational Test** launched at Rockridge BART District station (December 8, 2004) in conjunction with Caltrans, BART, and private sector partners (ParkingCarma, Quixote Corporation, Intel, Microsoft, and Verizon Wireless);

### **2. Transportation Safety Research Program**

PATH is among the leading research programs for conceptualizing, developing and testing intersection safety systems and technologies. It also continues work in automated snow blower development.

Additional areas are:

- Automated speed enforcement
- Identification of high collision concentration locations
- Pedestrian safety
- Work zone safety
- Applications of wireless technologies to vehicle safety and efficiency
- Methods to help the elderly driver drive safely

- Onboard monitoring for (truck) carrier fleet safety

### **3. Traffic Operations Research Program**

The PATH Traffic Operations 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 statewide research team of 15 faculty and more than 40 graduate students and staff. Currently, there are 30 active research efforts in areas such as surveillance technologies, algorithms for data processing, fusion and analysis, analytical and simulation techniques for performance measurement, simulation and visualization tools for impact analysis and evaluation, and advanced operational strategies for managing congestion and reducing commuter delays. In addition, unique laboratories and test beds have been created to provide the data and operating environments to study traffic flow dynamics and test improved strategies in real-world conditions. These facilities and data are being used by researchers worldwide.

In 2004, PATH researchers developed and tested a new wireless MeMS sensor that could replace loops and other conventional sensor systems. Continuous research in machine vision algorithms for processing video recordings produced the most detailed data set of vehicle trajectories for studying driver behavior and vehicle dynamics on freeways. This data set is available worldwide as part of the NGSIM project of the Federal Highway Administration. Work continues on the Performance Measurement System (PeMS), which has been deployed statewide in California. New analytical capabilities include algorithms for bottleneck identification, lane closure planning, and estimation of congestion causes and impacts. A pilot implementation of PeMS on arterial streets (ApeMS) is also underway in cooperation with the Los Angeles DOT to provide estimates of delays and travel times from real-time detector and signal control data. In traffic management, new ramp metering strategies have been developed. The results from field experiments show that the proposed strategies are effective in alleviating bottlenecks at freeway merging areas. Work is in progress on systems that facilitate the coordination of operating agencies to minimize the response time to incidents.

### **4. Transit Operations Research Program**

The research in transit operations has been expanded in a number of research directions, including Bus Rapid Transit (BRT), Demand Responsive Transit, transit collision mitigation technologies, and efficient and safe crossings between rail and highways. Notably, in 2003-2004, PATH has completed a number of research projects in the area of BRT planning and technology such as signal priority. In August 2003, PATH successfully demonstrated an Advanced BRT system on the I-15 in San Diego. Working with transit agencies and university partners, PATH is directing its early research on frontal collision warning systems into the area of integrated collision warning systems.

**Traffic safety research** has long been an area in which the Institute has been active. In 2001, the Institute joined with the School of Public Health in creating the Traffic Safety Center (TSC) with a grant from the California Office of Traffic Safety. It is the first university-based center in the western states and only the fourth nationwide. It is developing curriculum and outreach programs in addition to doing research on the unique safety problems facing communities of color, driver safety, pedestrian safety, occupant protection, land use and its relation to traffic safety, physical activity and health.

#### **TSC Projects 2003-2004**

#### **Pedestrian and Bicycle Safety in a SMART Corridor**

This study analyzes pedestrian and bicycle collisions along the San Pablo Avenue Corridor in San Francisco's East Bay. This research will help understand pedestrian behavior, collision factors, and patterns of travel. The TSC will then develop a detailed countermeasure plan for San Pablo Avenue.

The **San Francisco PedSafe** project is a collaborative project of the Traffic Safety Center, the Institute of Transportation Studies (particularly PATH), and the Department of Parking and Traffic of the City/County of San Francisco. The TSC is currently collaborating on Phase II of this project. Phase I included a problem analysis/countermeasure plan which consisted of developing a comprehensive crash picture of pedestrian crashes at intersections in the city by analyzing zones for high densities of collisions, observing pedestrian and vehicle behavior, as well as physical attributes of intersections, reviewing available countermeasures and developing a countermeasure deployment plan. Through this project we have developed and refined methods for assessing pedestrians exposure (along with other pedestrian-related variables).

**The Oakland Chinatown Scramble Evaluation:** An analysis was conducted of pedestrian-vehicle conflicts and pedestrian violations occurring at the intersection before and after the signal was modified, and pedestrians were surveyed to ascertain public attitude toward and comprehension of the change. In this study we used video recordings with manual review for analysis of pedestrian volumes (as well as other pedestrian-related variables).

**Pedestrian Volume Modeling:** The TSC has conducted research on ways to estimate pedestrian volumes for the city of Oakland, California. These estimates calculated pedestrian exposure rates and created a Relative Risk Index for the city's first pedestrian master plan.

### **IDS Project**

The Intersection Decision Support (IDS) project, a PATH project funded by the Federal Highway Administration (FHWA) in conjunction with Caltrans, is designed to research and solve a significant portion of the crossing path (CP) intersection crash problem using emerging intelligent transportation technologies. PATH, in conjunction with the Traffic Safety Center, is researching the feasibility of placing an IDS system at an intersection in Berkeley, California, where there is heavy left-turning traffic with no protection from a left-turn arrow.

### **Pedestrian and Bicycle Safety in Emeryville, CA**

To ensure pedestrian and bicycle safety, the City of Emeryville proposed the study of four of its key intersections. The TSC evaluated the safety, perception of safety and ease of use (comfort level) for pedestrians and bicyclists. Researchers are developing recommendations for countermeasures.

### **Predictors of Driving Behavior and Adverse Driving Outcomes in an Elderly Population**

This NHTSA-funded study used data collected in an epidemiological study of aging and physical function conducted among elderly citizens of Sonoma, California. The purpose of this project was to examine age-related patterns of driving-related behavior and adverse driving outcomes. The study also determined how driving cessation in the elderly affects access to social and other activities (etc. shopping, medical visits). This study was part of the NHTSA-funded Study of Physical Performance and Age Related Changes in Sonomans (SPPARCS). The SPPARCS study is a community-based longitudinal study of older adults 55 years or older residing in the city and surrounding area of Sonoma, California.

The Institute is a recognized leader in **traffic flow theory and traffic management**. Its researchers have developed new ways to understand the behavior of freeway traffic. In addition, ITS researchers have developed some dozen software programs that help engineers and traffic professionals analyze

traffic in a variety of settings under numerous circumstances in order to evaluate different scenarios for routing traffic and constructing additional lanes. ITS programmers' freeway simulation model, FREQ, is widely used by Caltrans staff and is widely taught in TechTransfer training programs.

**Transportation policy** is an important area of the Institute's work. In partnership with other research groups, including the University of California Transportation Center (UCTC), ITS researchers have analyzed crucial questions such as environmental justice, the costs and benefits of intelligent transportation systems, transportation finance, mobility for the elderly, transit, reverse commuting, and the role that land use decisions play in shaping transportation outcomes.

**Aviation research** at the Institute takes place at the National Center of Excellence for Aviation Operations Research (NEXTOR), part of a five-campus consortium sponsored by the Federal Aviation Administration (FAA), which consists of UC Berkeley, the Massachusetts Institute of Technology, the University of Maryland at College Park, Virginia Polytechnic and State University and George Mason University. Its focus is on developing advanced air traffic management systems, improving air traffic safety and enhancing the performance and productivity of the national aviation system. NEXTOR's work on next-generation air traffic management tools included the development of analytical techniques to support evaluations of Air Traffic Management Tools deployed under the FAA Free Flight Problem. NEXTOR researchers have also studied airport security issues, the role of airport design in security issues and capacity constraints, and the relation of airport fleet mixes on performance and efficiency in the aviation system.

Starting in August 2003, after the reorganization of the PATH program, CCIT was renamed the **California Center for Innovative Transportation** and became a stand alone center within the Institute, separate from PATH. CCIT's role was expanded to facilitate the implementation of projects and to work with other programs at other campuses. In 2003-2004, the maintenance of the Berkeley Highway Lab (BHL) loop and video systems was transferred over to CCIT. A second generation video data collection system was installed in Emeryville, providing on-demand digital video of traffic on I-80. Currently, CCIT is working with Caltrans to implement the automatic display of travel times on changeable message signs, and develop the next generation of probe vehicles for Caltrans freeway data collection. The Calfrance Effort was initiated by CCIT in collaboration with PATH, Caltrans, INRETS, ARIEL within l'ecole des Mines and the French Ministry of Transportation. Collaboration with MTC, Caltrans and industry was initiated to facilitate the implementation and evaluation of automated video incident detection.

The **Pavement Research Center (PRC)** has given support to Caltrans' pavement programs through its work in the California Accelerated Pavement Testing Program (CalAPT) from 1994 through 2000, and the Partnered Pavement Research Program (PPRC) since 2000. The PRC's efforts are helping Caltrans deliver the rehabilitation and reconstruction of much of the state's freeway infrastructure over the next 10 years, at lower cost and with fewer traffic delays. The PRC has also been working with the Pacific Coast Conference on Asphalt Specifications on the development of improved specifications for the asphalt binder used in asphalt concrete mixes.

**The ITS Technology Transfer Program** provides training, technical assistance, and information services to California's transportation professionals, helping bridge research with practice and encourage use of best transportation practice throughout the state. Tech Transfer is the California Local Technical Assistance Program, one of the largest of a national network of 58 state and tribal LTAP centers. During this fiscal year Tech Transfer delivered more than 230 days of professional training, reaching 3400 people in locations from San Diego to Redding. Classes ranged from effective transportation planning to work zone safety, from system engineering to advanced pavement design,

and from land use integration to transportation finance. Expert field staff provided more than 200 technical assists to cities and counties in California, helping locals meet new air quality requirements, get the most from their pavement maintenance work, resolve critical safety issues, and understand changing state and federal transportation requirements. Use of the Tech Transfer Web site grew by 20 percent this year, reflecting improved functioning and enhanced resources, including the on-line California Clearinghouse of Transportation Training. Updated quarterly, the clearinghouse includes more than 800 scheduled open enrollment classes for the transportation community as well as links to web-based training and more than one hundred training providers. And finally, Tech Transfer convened the 19th annual international symposium on aviation and the environment Jet Set Go, in Palm Springs, drawing together 350 people from around the nation and the world to share views on advanced aviation technologies, critical noise and air quality issues, and community response.

**The Institute's Harmer E, Davis Transportation Library** continued its extensive outreach activities to ITS branches at UC Davis, Irvine and Los Angeles. It collaborated with the Berkeley Water Resource Center Archives to produce the fifth in its series of annual calendars featuring historic photographs, with gratis copies going to policymakers at the campus, state and national level as part of ongoing outreach/marketing activities. (Copies were also available for purchase.) It circulated more than 41,000 items (with over 1,900 items being loaned nationwide to off-campus clients through its interlibrary loan service), answered more than 1,400 reference questions, cataloged over 9,000 titles for the Melvyl on-line catalog, added thousands of bibliographic records to the national TRIS Database, added more than 1,000 abstracts to the Library's PATH Database of intelligent transportation systems materials, which contained 28,680 fully abstracted records as of June 30, 2004. The Library continued its collaborative work with the Institute's Technology Transfer Program with outreach activities targeted to California public sector employees. Professional staff continued active participation in the national activities of the Transportation Division of the Special Libraries Association, the Transportation Research Board and in campus activities of LAUC, the Librarians Association of the University of California.

The **ITS Publications unit** conducts outreach via electronic and print publications, maintains the ITS publications catalog (which is searchable over the Internet) and helps maintain and enhance the ITS Web site. A weekly headline and news alert goes out to several hundred subscribers, in California and around the country. The online version of the ITS Review goes out to more than 2,500 subscribers. The publications unit also helped create an online quarterly newsletter for the Traffic Safety Center. Almost every new research report is now produced in an electronic version available for free downloading over the Internet. ITS has continued outreach efforts to recruit alumni for the online Transportation Alumni Network, creating an alumni in academia page on the ITS Berkeley Web site for Berkeley transportation graduates. Other enhancements to the Web site include awards pages about students and faculty, an opportunities page, and a site devoted to environmental justice topics. With funding from the University of California Transportation Center, the Publications unit created a prototype of a database that will contain freely-available transportation images that can be downloaded by faculty, students and researchers to illustrate talks and presentations. Images are donated by participants or specially commissioned by the Publications unit.