California PATH to Showcase at IVHS America

The California PATH announces its participation at the Second Annual Meeting of the Intelligent Vehicle/Highway Society of America May 16-20 in Newport Beach, California. Renowned for attracting leading proponents of IVHS, this meeting provides a forum for presentation and discussion of the broad spectrum of IVHS issues.

California PATH participation is widespread with several activities showcasing the latest IVHS projects in the areas of Advanced Traveler Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Advanced Vehicle Control Systems (AVCS), Safety and Human Factors, and more.

The California PATH exhibits span across two booths, where representatives will be on hand to provide demonstrations and answer questions. Demos include California Polytechnic State University at San Luis Obispo's INRAD (Inductive Radio) application which uses a SUN workstation to demonstrate two-way vehicle/control center communication passed from inductive loops embedded in the current highway system; U.C. Berkeley's 3-D graphic representation of vehicle maneuvering on an automated highway; and U.S.C.'s dynamic visualization of advanced vehicle control systems, both using a Silicon Graphics computer. In addition, a library of informational videos is scheduled for presentation, along with other helpful material.

Outdoor exhibits include an INRAD vehicle equipped with an onboard computer, LCD unit, and radio transmitter-receiver and Caltrans' PATHFINDER vehicle which demonstrates an in-vehicle motorist information and road navigation system.

In addition, tours will be provided of both the Caltrans District 12 Traffic Operations Center (TOC) and the City of Anaheim Traffic Management Center (TMC), with buses leaving from the conference center hotel on Sunday, May 17, at 9:15 AM. (Please refer to the descriptions on pages 3 and 6 for more information.)

continued on page 7

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* A Partnership Program Between Caltrans and the California Transportation Research Universities
  U.C. Berkeley • U.C. Davis • U.C. Irvine • Cal Poly San Luis Obispo • U.S.C.
**Director's Chair**

*A Word from Director Donald E. Orne*

**Although New & Improved, The California PATH Remains Solid**

Administrative headquarters are located at U.C. Berkeley's Richmond Field Station (which is located approximately 7 miles from the campus and just across the bay, slightly northeast of San Francisco) the truth is that PATH research is being conducted at several locations in California.

While a small percentage of work is conducted by full-time researchers at the Field Station, the majority of the research is carried out by 30 plus faculty members and about 65 graduate students at other prominent California universities. Our academic partners include U.C. Berkeley, U.C. Davis, U.C. Irvine, California Polytechnic State University at San Luis Obispo and the University of Southern California. Meanwhile research is also underway at Stanford University and California State University at Sacramento. Furthermore, the California PATH is involved in several joint research activities with private industry and there are numerous opportunities to further expand this industrial research within the private sector. Collectively, we are involved in a research effort that will bring about phenomenal changes to transportation as we know it today, changes that we know will have a positive effect on mobility.

This discussion of the dynamic and exciting changes in California's IVHS program brings about the question of identity. Over the past several months, the PATH Program has undergone the initial stages of clarifying its distinctiveness. Caltrans and PATH have been working on some exciting yet challenging changes that affect the profile of our program. First of all, our name has changed - PATH (Partners for Advanced Transit and Highways) is now The California PATH. Although our name has been adjusted to emphasize statewide "partners" and "transit," we have not altered our program goals and objectives. West maintain a commitment to safe, efficient, and environmentally sound, multimodal transportation.

In addition, our new logo is introduced in this edition of the newsletter. This logo is representative of the statewide commitment to finding transportation solutions. Soon to follow will be new letterheads, business cards, brochures, and report covers.

Our image certainly looks new when compared to its origins just six years ago. The California PATH is rapidly changing and maturing as it continues to provide superior advanced transportation research and development services to California, the nation and the world.

-- Donald E. Orne, PATH Director

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**An Image Update For The California PATH**

A few editions ago, Intellimation announced the appointment of a new director. Shortly after Don Orne's arrival, PATH became the California PATH, which is exemplified by a new logo. Soon to follow are new and improved brochures and other materials to help explain these program changes.

Look to this edition's Director's column for a discussion of the new and improved California PATH.

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**Guided Tours of Southern California Traffic?**

As part of the California PATH's exhibit at IVHS America, tours will be given of the Caltrans District 12 Traffic Operations Center and the City of Anaheim's Traffic Management Center, described below.

**Caltrans District 12 Traffic Operations Center**

One of Caltrans' six Traffic Operations Centers (TOC) is located in the District 12 Office in Santa Ana, California. Fully operational since November 1990, this center provides real-time traffic management on 80 percent of the 282 instrumented directional freeway miles in Orange County. The District 12 center is operated cooperatively with the California Highway Patrol (CHP), the City of Anaheim and the Caltrans District 7 Office in Los Angeles in order to successfully respond to freeway incidents, hazards and general delays. Emergency and service vehicles can be dispatched from the center in order to quickly alleviate congestion caused by a variety of incidents - from stalled vehicles to major accidents requiring highway closures. Specifically, this Traffic Operations Center monitors CHP field units through the California Highway Patrol communications center. TOC workstations are equipped with a graphic display of the freeway network which is updated every 30 seconds. Recently, District 12 traffic experts have installed a tracking system using Telerac which monitors the location of all Highway Patrol vehicles, traffic management teams and freeway service patrol tow trucks (also known as the Orange Angels). This center operates Monday through Friday from 5 AM to 7 PM with a joint staff of traffic specialists from the CHP and Caltrans Maintenance and Traffic Engineering departments.

**City of Anaheim Traffic Management Center**

In November 1988, the City of Anaheim implemented its Traffic Management Center. Presently, this center controls approximately 210 traffic signals on busy arterials in the city of Anaheim. Traffic engineers at this center can successfully manage large numbers of vehicles as they leave the freeways to enter high-volume destinations such as the convention center, the stadium and Disneyland for example. Effective traffic management in Anaheim involves surveillance of the city streets, adjustments in the timing of signals to adapt to changes in traffic flow, and communication with the Caltrans Traffic Operations Centers in Los Angeles and Orange Counties in order to assess volume changes due to heavy congestion on Southern California freeways.

The center consists of three work stations: 1) for traffic engineers, and 1) for the police department. These workstations face a wall display, which is composed of a large projection screen that graphically represents the Anaheim network in real-time, and four television monitors, which are linked with eight closed circuit television cameras stationed at critical intersections. The City of Anaheim Traffic Management Center operates with a staff of 12, Monday through Friday from 7 AM to 6 PM and extends operation hours as necessary for special evening and weekend events.

Look to page 6 for a schedule of additional presentations at IVHS.
Engineering Update

INRAD Project Hits the Streets

Potential IVHS Applications Demonstrated in Los Angeles

All eyes were focused on the Cal Poly transportation research team during the recent public demonstration of their INRAD (Inductive Radio) project, a system designed to evaluate the effectiveness of short-range radio communication between central traffic operations facilities and INRAD-equipped vehicles via inductive loops embedded under the road. The recent demonstration took place on a specially-equipped five-mile stretch of the Pomona Freeway in City of Industry, near Los Angeles, CA.

The INRAD system communicates messages about traffic jams and other road conditions, and can even provide drivers with instructions as to alternative routes, thereby avoiding further build up of traffic in identified areas.

Here's how: Loops installed under the pavement surface are used as antennas to communicate with INRAD-equipped cars passing above. From the vehicle's computer screen, the driver can select from a menu any message which describes his or her situation. This information is transmitted to the "talking loops" which are connected to roadside control boxes that in turn send the data over dedicated telephone lines to a communications processor in downtown Los Angeles. This processor and computer processes and stores all data collected from the loops installed throughout the area. After analyzing these data, Caltrans staff at Traffic Operations Centers (TOC) respond with-up-to-the-minute information about traffic conditions surrounding the INRAD vehicles, forwarding their messages and warnings to the on-board display screens again via the inductive loops.

The potential uses of the INRAD technology include: a speed warning system which alerts drivers of oncoming emergency slow downs or stop conditions; a highway advisory radio (HAR) alert telling drivers to tune into specific HAR stations; a congestion warning and information device informing drivers of freeway delays ahead of their present location; and a vehicle locating device which not only determines its placement relative to surrounding traffic problems, but may also locate the whereabouts of stolen cars. Additional INRAD demonstrations illustrate its usefulness in identifying and tracking commercial bus movements and passenger load.

Although other traveler information and navigation systems developed in recent years are becoming commercially available, INRAD is one of the very few systems which offers two-way digital communication between vehicles and a centralized control center, all in real-time. The integration of these traveler information systems with other TOC functions poses a challenge to transportation engineers and planners.

Relying on commercially-available components is one way that developers are able to maintain a simplicity in the INRAD design: if test vehicles, INRAD prototypes equipment consists of an on-board computer with an elementary LCD display from which drivers can post and receive messages. This dashboard computer is connected to a radio transmitter that is attached to the car's rear bumper to avoid interference from the engine. The short-range radio transmitter communicates simple messages to and from previously existing underground loops currently used to sense vehicle presence at traffic signals on city streets or to monitor capacity on freeways. INRAD equipment does not interfere in any way with other loop functions.

A communications processor based on a VME bus computer running an OS/9 real-time operating system monitors all loop controllers and manages all communication to and from the central control computers, of which there are two versions. Controllers can rely on a simple MS-DOS-based PC or a UNIX-based SUN Workstation running under an X-Windows environment to send and receive data from INRAD vehicles. The latter provides a more sophisticated graphical interface that displays INRAD loop and vehicle icons on a pictorial map of the freeway. Both versions of the central control computers are able to "talk" with the communications processor via direct cables or, for longer distances, via 2400 baud telephone lines.

"INRAD serves as a bridge between current road transportation facilities and the advanced IVHS applications of the more distant future".

- Alypios Chatzidionis
  INRAD Co-principal Investigator

These central control computers are operated from Traffic Operations Centers (TOC). The Cal Poly campus hosts a sophisticated TOC simulator which allows for testing of alternative control center layouts, operating procedures and traffic control strategies, as well as providing an off-line TOC employee training site.

By integrating these off-the-shelf technology choices with our existing freeway system, developers of INRAD are able to offer near-term relief to our over-stressed road transportation facilities. Walt Winter, Caltrans Project Manager states, "The goal is to implement the technology in such a way that it requires minimal changes to the existing infrastructure and creates little disruption to the system.

The INRAD project also serves as a useful tool for gauging the impacts and effectiveness of Advanced Traveler Information Systems (ATIS). In addition, INRAD is helping to establish a basis of proven technology information necessary for the successful implementation of future applications. Co-principal Investigator Alypios Chatzidionis sees INRAD as "a bridge between current road transportation facilities and the advanced IVHS applications of the more distant future".

Siam Tafj, senior engineer at Cal Poly adds, "The exciting thing about INRAD is that it represents one of the first IVHS technologies to hit the streets. While more sophisticated traveler information systems will undoubtedly surface, INRAD provides a real-world test of the potential of both ATIS and ATMS technologies."
Schedule of Related California PATH Activities at IVHS America Annual Meeting, May 16-20, 1992

<table>
<thead>
<tr>
<th>Time</th>
<th>Session, Title, Author, &amp; General Information</th>
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<tbody>
<tr>
<td>SAT.</td>
<td></td>
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<tr>
<td>4:00 PM</td>
<td>Benefits, Evaluations and Costs (BEC) Committee Meeting - Chair: Donald E. Orne, PATH</td>
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<tr>
<td>7:30 PM</td>
<td>AVCS Committee Meeting - Chair: Steven E. Shladover, PATH</td>
</tr>
<tr>
<td>9:15 AM</td>
<td>Tours: Caltrans Dist. 12 TOC &amp; City of Anaheim TMC</td>
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<tr>
<td>1:30 PM</td>
<td>Benefits, Evaluations and Costs (BEC); Session 1 of 2 - Chair: Donald E. Orne, PATH</td>
</tr>
<tr>
<td>1:30 PM</td>
<td>Advanced Vehicle Control Systems; Session 1 of 2 - Chair: Donald E. Orne, PATH</td>
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<tr>
<td>3:15 PM</td>
<td>Institutional Issues; Session 2 of 1 - Public-Private Partnerships for Evolutionary Development of AVCS in the California PATH Program</td>
</tr>
<tr>
<td>8:30 AM</td>
<td>Opening General Session - James W. van Loben Sels, California Dept. of Transportation</td>
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<tr>
<td>1:45 PM</td>
<td>Advanced Traveler Information Systems (ATIS); Session 1 of 2 - Transportation Information Processing Systems (TRIPS) An Auditable/Videotape-Based System</td>
</tr>
<tr>
<td>3:45 PM</td>
<td>System Architecture; Session 1 of 2 - Chair: Robert E. Parsons, Parsons Transportation Associates</td>
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<tr>
<td>7:00 PM</td>
<td>System Architecture Committee Meeting - Chair: Robert E. Parsons, Parsons Transportation Associates</td>
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<tr>
<td>TUES.</td>
<td></td>
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<tr>
<td>1:45 PM</td>
<td>Safety and Human Factors; Session 1 of 3 (Safety and Human Factors of Crash Avoidance) - Evaluating Safety of AVCS Devices - Anthony Hitchcock, Seal Consultants</td>
</tr>
<tr>
<td>8:30 AM</td>
<td>Standards and Protocols Session - IVHS Standards: Where We're Headed, How We're Getting There - Meeting Toward a Software Quality Process for IVHS: A Case Study of Three Industries</td>
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</tbody>
</table>

PATH on PAPER

Below is a listing of recent PATH Research Reports, Working Papers, and Conference Papers. Anyone interested in obtaining a copy of these or other reports or papers should follow this procedure:

Mail orders to: Institute of Transportation Studies, University of California, 109 McLaughlin Hall, Berkeley, CA 94720.

Prepayment required: Pleasemake checks payable to Regents, University of California.

Sales tax: California residents add 7.50% sales tax; residents of San Francisco and San Mateo counties add 8%; Alameda, Contra Costa, and Santa Clara county residents add 8.50%.

Postage and handling charges: Orders are sent fourth class book rate. Add $2.50 to publication price when ordering one item; $5 for 2-4 items; $10 for 5-7 items; and $15 for 8-10 items.

Foreign orders: Prepayment required in U.S. funds. Overseas orders are sent surface mail fourth class. For overseas air mail, please add $4 per publication.

Correction

In the last issue of Intellimation, prices and page numbers for publications UCB-TTS-PRR-91-5 (Gris) and UCB-TTS-PRR-91-6 (Hua, et al.) were mistakenly inverted. Publication UCB-TTS-PRR-91-5 has a 175 page count and lists for $18.00, while UCB-TTS-PRR-91-6 is 54 pages long and costs $6.00. We apologize for the inconvenience these errors may have caused.

Report Titles

| Evaluation of Highway Breakdowns | Evaluation of Highway Breakdowns |
| UCB-TTS-PRR-91-9: pp. 35; $4.50 | Hall, Kamoun |

| Communications and Positioning Systems in the Motor Carrier Industry | Communications and Positioning Systems in the Motor Carrier Industry |
| UCB-TTS-PRR-91-10: pp. 71; $8.00 | Scopinski & Garrison |

| Model Selection and Initial Application of CONTRAM Model for Evaluating In-Vehicle Information Systems | Model Selection and Initial Application of CONTRAM Model for Evaluating In-Vehicle Information Systems |
| UCB-TTS-PRR-91-11: pp. 10; $15.00 | Gardes, Haldors, May |

| Electronic Toll Collection System (ETC) User Survey | Electronic Toll Collection System (ETC) User Survey |
| UCB-TTS-PRR-91-12: pp. 96; $10.50 | Yim |

*Automatic Vehicle-Following U.S.C. Conference Paper to be presented at ACC in June '92 |

PATH's IVHS America Conference Participation

continued from page 1
Several technical presentations are also scheduled by California PATH researchers from U.C., U.C. Berkeley and Caltrans. In addition, PATH's current and former Directors will preside over sessions. (Please refer to page 6 for more details on these sessions and presentations.)

With the growing attraction and accompanying interest in IVHS, the California PATH looks forward to the opportunity extended by IVHS America for acquiring the latest updates and information. Furthermore, international attendance at the meeting serves as a means of establishing contacts between public and private sectors of the transportation industry in the U.S., Asia, and Europe.

Stats Orne, "The presence of the 1991 IVHS America Annual Meeting in California provides an opportunity for participants from all over the world to become better acquainted with our state's IVHS research and field operations."

By participating in IVHS America, the California PATH reaffirms its position on IVHS advancement, strengthens its growing partner base, and showcases working demonstrations from cooperating California research campuses in all areas of IVHS.

PATH Publications extends thanks to the following for their contribution to this edition of Intellimation: The Transportation Research Group at California Polytechnic State University, San Luis Obispo; City of Anaheim Traffic Management Center; and Caltrans District 12 Office.
H.-S. Jacob Tsao fills the role of Network Analysis Project Manager, focusing on mathematical modeling and optimization for the study of capacity and safety consequences associated with different highway automation strategies and other network-related quantitative analyses. His previous position with Bell Laboratories included work on the AT&T long-distance network. After earning an M.S. in Statistics from U.T. Dallas, Dr. Tsao received his Ph.D. in Industrial Engineering and Operations Research (IEOR) from U.C. Berkeley in 1984.

Anita Franklin joins the California PATH team as Contracts & Grants Assistant at the Richmond Field Station facility, where she provides financial monitoring and budget analysis support. Before coming to PATH, she analyzed and prepared budgets for the new Jersey Department of Higher Education. Ms. Franklin holds a degree in Business Administration from Virginia State University, where she was awarded honors.

Dr. Bobby Satyadev Yerramilli-Rao is the correct spelling of Bobby's name. Dr. Rao's name was misspelled in the last issue.

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Intellimotion is a quarterly newsletter edited and designed by Anna Marie Bozzini and the PATH Publications team, Malou Babilonia Pollard and Andrew Watanabe. For questions or comments regarding this newsletter, please contact:

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