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Second Annual Symposium On Advanced Traffic Management Systems (ATMS) And Advanced Traveler Information Systems (ATIS), November 5, 1990

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Second Annual Symposium on Advanced Traffic Management Systems (ATMS) and Advanced Traveler Information Systems (ATIS)

Adolf May
Bruce Haldors

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November 5, 1990
(edited l/91 by A. Bozzini)

Acknowledgements

Foreword

The goals of the Program on Advanced Technology for the Highway, PATH, are to increase the capacity of the most used highways, to improve road safety, to decrease traffic congestion and energy consumption, and to improve air quality. It is evolutionary and voluntary. It is a cooperative venture of automakers, electronic companies, local, state and federal governments and universities.

The purpose of the Symposium on Advanced Traffic Management (ATM) and Advanced Traveller Information Systems (ATIS) was to allow researchers involved in ATM/ATIS work to become familiar with other research in the ATM/ATIS areas in the state of California. The symposium was a one-day event held on November 5, 1990, in the Bechtel building on the campus of the University of California at Berkeley. This document provides a brief summary outlining the presentations made at the symposium. Included in the appendix is a list of the names and addresses of the presenters.

List of Presentations

List of Presentations (continued)

Introduction

On Monday, November 5, 1990, a group of more than fifty researchers, research managers, and public agency staff people spent a full day in Berkeley reviewing the status of current Caltrans-sponsored research on Advanced Traffic Management Systems (ATMS) and Advanced Traveler Information Systems (ATIS). The work reported here represents the first stages of progress toward Intelligent Vehicle/Highway Systems (IVHS), providing some indications of future directions for the evolution of road transportation in California and the nation as a whole. Indeed, it is a mark of Caltrans' national leadership role in promoting the application of advanced technology to the operation of the road system that the November 5 symposium could even be held. No other state or combination of states would at this time be able to assemble a program of this breadth or depth.

All of the projects described in this symposium were sponsored by Caltrans. Approximately half of them belong to the Program on Advanced Technology for the Highway (PATH), which is conducted for the Office of New Technology and Research Management by researchers on three campuses of the University of California (Berkeley, Davis, and Irvine). The other projects, which are also part of the New Technology Development Program, are managed by other Divisions and Districts of Caltrans. The symposium is an important forum to enable these geographically dispersed researchers and research sponsors to compare notes, evaluate progress, and coordinate their activities.

We have attempted to cluster the presentations into groups by subject areas, although the boundaries between these clusters are to some extent arbitrary:

> General Transportation System Management Technologies
> - Skabardonis
> - Ritchie
> - Varaiya
> - Hockaday/MacCarley
> - Winter
>
> SMART Corridor(s) Related Projects
> - Rowe
> - Endo
> - Kay
>
> Advanced Traveler Information Systems and Human Factors
> - May
> - Jovanis
> - Mendel
> - Kitamura
> - Recker

Consumer Response and Economic Evaluation
- Kanafani/Lee
- Al-Deek
- Yim
- Sperling/Turrentine

A note on terminology:

We have used the term Advanced Traveler Information Systems (ATIS) rather than Advanced Driver Information Systems (ADIS) for reasons which relate to the need to broaden the definitions of IVHS functions. First of all, ATIS explicitly includes provision of pre-trip information about traffic conditions and transit service that can be made available to all travelers in their homes and workplaces to enable them to alter their trip making before they start a trip (change of mode, departure time, or even cancellation of trip). The benefits of these aspects of ATIS could exceed the direct benefits to drivers alone of in-vehicle information.

The symposium was organized by Professor Adolf May and Graduate Student Researcher Bruce Haldors, who devoted substantial effort to making it succeed. The participants are grateful to them for their work, which was vital to its success.

PROJECT TITLE:	Control Strategies and Route Guidance in Signal Controlled Networks
AGENCY:	ITS - PATH UC Berkeley
INVESTIGATOR(S):	Alex Skabardonis

OBJECTIVES:

1. Assess the impacts of re-routing traffic from freeway to surface streets.

2. Develop control strategies so that networks can handle the diverted traffic.

3. Analyze relationships between predicted impacts and network capacity and configuration.

APPROACH:

1. Literature search

2. Develop traffic diversion scenarios

3. Propose/test strategies to handle diverted traffic

4. Simulate alternatives

STATUS/SCHEDULE: Strategies tested in several networks.
Currently analyzing results stage.
Report expected by early 1991.

PUBLICATIONS: None to date.

PROJECT TITLE:	Real-Time Decision Support for Traffic Surveillance and Control

AGENCY:	UC Irvine DOT Transportation Center National Science Foundation (PYI Award)

INVESTIGATOR(S):	Stephen Ritchie (PI) - UC Irvine Neil Prosser

O B J E C T I V E S :	To develop and implement a novel artificial intelligence-based solution approach to provide operator decision support in integrated freeway and arterial traffic management systems as part of a more general Intelligent Vehicle-Highway System.

APPROACH:	The approach involves the implementation of the basic components of a hierarchically-defined set of decision support modules within a distributed blackboard framework, and emphasizes the use of real-time knowledge-based expert systems (KBES). In practice, these KBES might be associated with multiple agencies, computers, traffic operations centers and traffic sub-networks, even in one corridor.

STATUS/SCHEDULE:	A prototype component system named FRED (Freeway Real-Time Expert System Demonstration) has been developed for managing nonrecurring congestion on a six mile section of the SR-91 Riverside Freeway in Orange County, California. We are now in the second year (8/90 - 7/91) of this multiyear project. An interim report for Year 1 is in preparation.

PUBLICATIONS:	Ritchie, S.G., Prosser, N.A. (1991). "A Real-Time Expert System Approach to Freeway Incident Management. " To be presented at the Transportation Research Board Annual Meeting, Washington, D.C. Prosser, N.A., Ritchie, S.G. (1991). "Real-Time Knowledge-Based Integration of Freeway-Based Integration of Freeway Surveillance Data. " To be presented at the Transportation Research Board Annual Meeting, Washington, D.C. Ritchie, S.G., Prosser, N.A. (1990). "Development of a Prototype Real-Time Expert System for Managing Nonrecurring Freeway Congestion." Proceedings, First OECD International Workshop on Knowledge-Based Expert Systems in Transportation, Expo, Finland. Ritchie, S.G. (1990). "A Knowledge-Based Decision Support Architecture for Advanced Traffic Management." Transportation Research, Vol. 24A, No. 1, Pergamon Press, Oxford, U.K.

PROJECT TITLE:	Neural Network Models for Automated Detection of Nonrecurring Congestion
AGENCY:	PATH National Science Foundation (PYI Award) University of California - Irvine
INVESTIGATOR(S):	Stephen Ritchie (PI) Wilfred Recker Kelvin Cheu Martin Dix Hognggjun Zhang
OBJECTIVES:	To investigate, assess and implement neural network (NN) models from the field of artificial intelligence research for automated detection of nonrecurring congestion in integrated freeway and signalized surface street networks. The basic objective in Year 1 is to determine the feasibility of the approach in freeway incident detection, with the expectation of developing a robust technique for signalized surface streets in Year 2, and an integrated system in Year 3.
APPROACH:	Literature review and in-depth assessment of conventional incident detection algorithms and NN pattern recognition model. Development and investigation of most promising NN architectures. Implementation and evaluation of selected NN's, with training based on actual and simulated incident and non-incident data sets.
STATUS/SCHEDULE:	This project has just begun. Literature reviews are underway, as is the INTRAS calibration for a six mile section of the SR-91 Riverside Freeway in Orange County, California. Actual freeway datasets are being acquired. Initial experimental NN results using synthetic data are most encouraging.
PUBLICATIONS:	None to date.

PROJECT TITLE: IVHS System Architectures

AGENCY: PATH
                         University of California - Berkeley

INVESTIGATOR(S):   Pravin Varaiya

OBJECTIVES: To develop an open systems architecture for fully and partially automated
                         IVHS systems. The architecture will serve to frame and guide detailed
                         work.

APPROACH: Two scenarios of IVHS systems are considered: one involving partial
                         automation and one involving full automation. Management and control
                         tasks are inferred. A hierarchial five layer architecture for performing
                         these tasks is proposed. A reference model for each layer is developed.

STATUS/SCHEDULE: First version of architecture to be available in February 1991.

PUBLICATIONS: Preliminary draft available for comment.

PROJECT TITLE: Inductive Radio Demonstration Project

AGENCY: Caltrans Laboratory Skunk Works with contract to Cal Poly SLO and sub contract to IBI Group

INVESTIGATOR(S):

	Caltrans:	Walt Winter and Skunk Works staff
	Cal Poly SLO:	Stephen Hockaday, Alypios Chatziioanou, Sam Taff and staff
	IBI Group:	Scott Stewart, Paul Lavalee, and staff

OBJECTIVES: To demonstrate the feasibility and value of short range, two-way, communications between roadway and vehicle.

APPROACH: The project will equip the existing main line traffic loop detectors by installing inductive radio transceivers on approximately five miles of the Pomona Freeway in the City of Industry. These transceivers will be mounted in STET total of 15 controller cabinets.

Approximately 20 vehicles will be equipped with inductive radio transceivers and digital front panel operator interfaces.

The controller cabinets will be connected through STET phone lines to a communications processor in the Los Angeles District office. The communications processor will be connected through dial up lines with a Traffic Operations Center (TOC) simulator at Cal Poly, San Luis Obispo .

A number of usage scenarios will be demonstrated for the use of this type of communications capability.

STATUS/SCHEDULE: The system is scheduled to be installed and field tests performed in the winter of 1991.

PUBLICATIONS: None to date.

PROJECT TITLE:	The Los Angeles Smart Corridor Demonstration Project

AGENCY:

The principal agencies involved are:
- Los Angeles Department of Transportation
- Los Angeles County Transportation Commission
- California Department of Transportation
- California Highway Patrol
- Los Angeles Police Department
- Southern California Rapid Transit District

INVESTIGATOR(S):

JHK & Associates
(The System Manager)

OBJECTIVES:

Improve Corridor Flow
- Reduce delays
- Balance the network
- Incident Handling
- Coordinated Response

Apply Advanced Technologies
Travel Time Reliability
Implement Advanced Motorist Information System

APPROACH:

CONCEPTUAL DESIGN: This stage identified the various elements that could be involved in a Smart Corridor Project. Initial cost estimates and implementation plan were prepared as part of this stage.

DETAILED DESIGN: This stage involved the preparation of Plans, Specifications and Estimates of the elements identified from Stage 1. Some of these elements are: centralized signal control, freeway and surface streets traffic and video surveillance systems, changeable message signs, etc.

IMPLEMENTATION: This stage will construct and integrate the Smart Corridor elements.

OPERATION/EVALUATION

STATUS/SCHEDULE:

Stage 1 was completed October 1989. Stage 2 is underway. Stage 3 for a number of the elements is scheduled to start in June 1991 and should be completed by October 1992. Stage 4 is scheduled for January 1993.

PUBLICATIONS :

Smart Corridor for the City of Los Angeles: Demonstration Project Conceptual Design Study: Volume I, Final Report. JHK & Associates; October 1989. JHK & Associates, Los Angeles, CA.

PROJECT TITLE: Pathfinder

AGENCY: Caltrans
                   FHWA
                   General Motors

INVESTIGATOR(S):   Goro Endo
                   Frank Mammano
                   Walter Albers

OBJECTIVES: 1.   Development of Real Time In-Vehicle Displays

                   2.   Evaluation of Drivers Response

                   3.   Evaluation of the Vehicle as a Data Source

APPROACH: 1.   Modify Off-The-Shelf In-Vehicle Navigation Devices

                   2.   Develop Strategies for use of Pathfinder Vehicles as "Floating
                         Car" Data Source

                   3.   Develop and Evaluate Data Fusion Algorithm

STATUS/SCHEDULE: Conceptual Design Study Began October 1988.
                   Data Collection from July 1990 to Mid 1991.
                   Final Report of Findings Due January 1992.

PUBLICATIONS: "Pathfinder - Moving Ahead with Motorist Information and In-Vehicle
                   Road Navigation" by Ralph Blackburn, et al. IEEE's Position Location
                   and Navigation Symposium; Orlando, Florida, November 1988.

                   "Pathfinder System Design" by Roy Sumner and Frank Mammano.
                   VNIS Conference; Toronto, Canada, September 1989.

PROJECT TITLE: Smart Corridor Statewide Project

AGENCY: Caltrans, Headquarters with contract to
                        JHK & Associates

INVESTIGATOR(S):   caltrans: JHK & Associates:
                        Peter Anderson   Jack L. Kay

OBJECTIVES: The project examined the opportunities in the urban Districts of Caltrans (Districts 3, 4, 7, 8, 11 and 12) to apply the technologies identified in the Smart Corridor Demonstration project.   The project resulted in a report to the legislature recommending the application of corridor concepts in congested areas where alternate routes were available.

APPROACH: The study focused on locations with existing congestion and/or accident problems and where potential alternate routes were available. The cost and effectiveness of traffic control and motorist information systems were developed and a statewide program identified.

STATUS/SCHEDULE: Project report completed and submitted to legislature.

PUBLICATIONS :   Final Report dated June 1990 (copies available through Caltrans or JHK).

PROJECT TITLE:	Potential Benefits of In-Vehicle Information Systems
AGENCY:	ITS - PATH UC Berkeley
INVESTIGATOR(S):	Dolf May Y onnel Gardes Bruce Haldors
OBJECTIVES:	Evaluate potential benefits of in-vehicle information systems in conjunction with different management strategies (freeway control, arterial control) in an integrated freeway/arterial corridor.
APPROACH:	The SMART Corridor in Los Angeles will be simulated using the CONTRAM 5 Traffic Simulation Model.

APPROACH continued:

Different scenarios to be tested include:
- level of demand
- percentage of IVHS equipped vehicles
- traffic conditions (incident versus non-incident)

STATUS/SCHEDULE: Currently collecting data from the SMART Corridor and coding the network.

Preliminary results are expected by March 1991. A final report including final results is expected in June 199 1.

PUBLICATIONS: PATH Research Report 90-3 - Yonnel Gardes, Adolf May, "Traffic Modeling to Evaluate Potential Benefits of Advanced Traffic Management and In Vehicle Information Systems in a Freeway/Arterial Corridor." (June 1990).

PROJECT TITLE: The Role of Dynamic Route Guidance Information Systems in Incident Management

AGENCY: ITS - PATH
UC Berkeley

INVESTIGATOR(S):   Adib Kanafani
Haitham Al-Deek

OBJECTIVES: Investigate cases when it is relevant and cases when it is irrelevant to give route guidance information under incident conditions in the network.

Study the relationship between benefits of dynamic route guidance and the fraction of vehicles equipped with route guidance information.

Compare the benefits of guided drivers and unguided drivers for different dynamic route guidance strategies.

APPROACH: Develop a deterministic queuing model to assess reduction in delay for travellers using different strategies of incident management.

Investigate all possible cases of queue evolutions when a strategy is applied.

STATUS/SCHEDULE: Working paper will be released that documents the development of the model and summarizes preliminary investigation.   Expected date of publication is December 1990.

PUBLICATIONS: "Some Theoretical Aspects of the Benefits of En-Route Vehicle Guidance (ERVG)" by Haitham Al-Deek and Adib Kanafani, PATH Research Report UCB-ITS-PRR-89-2.

"A Simple Model for Route Guidance Benefits" by Adib Kanafani and Haitham Al-Deek, Transportation Research Journal, Part-B, (in press) 1990.

PROJECT TITLE: Interaction Between Highway Information Systems (HIS) and Congestion Pricing

AGENCY: ITS - PATH
UC Berkeley

INVESTIGATOR(S):   Adib Kanafani
Jae Choon Lee

OBJECTIVES: Evaluate the implementation of Highway Information Systems and Congestion Pricing.

Study the implication of Highway Information Systems and Congestion Pricing.

APPROACH: Identify the interaction between Highway Information Systems and congestion pricing.

Develop a simulation model.

Estimate the benefits of Highway Information Systems and congestion pricing in diverse environments.

STATUS/SCHEDULE: Model Construction complete.
Preliminary results available.
Estimation of the benefits of Highway Information Systems and congestion pricing with the model will be evaluated through March 199 1.

PUBLICATIONS: None to date; publication expected in May 1991.

PROJECT TITLE: Expanding Usage of Cellular Phones: User Profile and Transportation Issues

AGENCY: caltrans
ITS - PATH
UC Berkeley

INVESTIGATOR(S): Adib Kanafani
Y.B. Yim
Jean-Luc Ygance
Rula Sadik

OBJECTIVES: To understand the expanding market for increased electronic aids in vehicles. To study new communication technologies, such as route guidance devices, by analyzing how cellular phones affect the travel behavior of the users.

The concerns are:
1. The effects of cellular phones on travel behavior of cellular users in general.

2. The extent to which traffic and road information available through cellular phones modifies travel patterns.

APPROACH: The study is divided into three parts. Phase I concentrates on understanding the behavior of the local cellular market. ITS is currently working with GTE Mobilnet in developing a survey questionnaire for their customers in the Bay Area. The Phase II of the study will include an investigation of cellular market trends in other parts of the U.S. A comparative analysis between the U.S. and other countries will be done in Phase III.

STATUS/SCHEDULE: The Phase I study will be completed in June 1991. The questionnaire for the GTE Mobilnet customers will be distributed during the first week of January 1991. Data entry will be done by an optical scanning machine. Data analysis is expected to be completed by the end of March 1991.

PUBLICATIONS: A working paper is in progress for the background material on the effects of telecommunications technology on travel behavior.

PROJECT TITLE: Safety Implication of In-Vehicle Navigation Systems (CADIS)

AGENCY: caltrans
Transportation Research Group at UC - Davis

INVESTIGATOR(S):   Paul Jovanis
Ryiuchi Kitamura

OBJECTIVES: To determine the extent to which safe driving performance is influenced by navigation system attributes, driver characteristics, traffic and environmental conditions.

APPROACH: The study will use the advanced driving simulator at Hughes Aircraft Company.

Subjects will be put through a series of driving scenarios aimed at representing a range of driving conditions.

A range of alternative navigation technologies will be examined:
- "Low Technology" - paper map with directions
- Moving Electronic Map - with and without traffic data
- Heads Up Display - Route Guidance
- Optional Displays
- Voice as Supplemental Information Source

STATUS/SCHEDULE: Similator experiments will be initiated in June 1991 due to need for simulator upgrades and contract schedule.

The following performance measures have been defined:
- Following Headway
- Deviation in Lateral Lane Position
- Ability to Route-Follow
- Reaction Time to External Events
- Eye Movement (possibly)

Developing experimental design and driving scenarios.

PUBLICATIONS :   "User Perceptions and Safety Implications of In-Vehicle Navigation Systems" by Paul P. Jovanis and Ryuichi Kitamura. VNIS Conference; Toronto, Canada, September 1989.

PROJECT TITLE: Rapid Prototyping of User Interfacing for ATIS

AGENCY: PATH
UC Berkeley

INVESTIGATOR(S):   Max Mendel
Jim Roseborough

OBJECTIVES: To create an environment where users without specialized training can rapidly prototype a control/display panel.

Users can test different designs and human factors can be evaluated and tested very rapidly.

Modifications to any design can be made on the go; however all designs will be constrained by standard human factors.

APPROACH: Create a computer environment which will allow for:
- direct manipulation interfacing
- an object oriented environment
- dynamic binding (compile separately)
- standardized pallets

Using NEXT STEP on the NEXT computers

STATUS/SCHEDULE: Just underway.

PUBLICATIONS: None to date.

PROJECT TITLE: Driver Responses to ATIS: A Progress Report

AGENCY: Caltrans
Transportation Research Group at UC - Davis

INVESTIGATOR(S):   Ryiuchi Kitamura
Paul Jovanis

OBJECTIVES: To examine a driver's response to route-guidance and other information provided en-route by in-vehicle information systems.

Possibly formulate a predictive model of route change behavior with en-route ATIS information.

APPROACH: Examine the drivers decision processes.

Focus on commute trips.

Examine the relationship among en-route information, degree of belief and route choice behavior through:
- in depth interviews
- psychometric measurement

STATUS/SCHEDULE: Report summarizing the results of a literature review, driver information components, analytical framework, methodology and experimental design.

PUBLICATIONS: Paper at VNIS September 1989; TRB Meeting 1991; IATB Conference 1991; ASCE Conference 1991.

PROJECT TITLE: A Conflict Model for Analyzing the Impacts of Real-Time Information on Driver Behavioral Choice

AGENCY: Caltrans
PATH
UC Irvine

INVESTIGATOR(S):   Wilfred Recker
Jeffrey L. Adler
Michael G. McNally

OBJECTIVES:

1. Explain and predict real-time route assessment and adjustment.

2. Estimate impact of real-time information on driver choice.

3. Classify driving behavior and route choice by preferences and attributes.

4. Estimate driver decision protocol under real-time information.

5. Provide insights to public policy-related issues of ATIS research, development, and implementation.

APPROACH: Focuses on measuring and predicting RECOGNITION and RESOLUTION as components of driver behavioral choice in real-time. The approach used to study this relationship is a model of CONFLICT ASSESSMENT AND RESOLUTION. A VIDEO-BASED ROLE PLAYING SIMULATION is being used to collect data for observing driver behavioral route choice in real-time.

STATUS/SCHEDULE:

1. Literature review completed.
2. Research Hypotheses identified.
3. Theoretical CONFLICT MODEL under development.
4. Prototype Video-based role playing simulation will be developed.

Anticipate completion by spring 1991.

PUBLICATIONS :   None to date.

PROJECT TITLE: Consumer Demand for IVHS Technologies

AGENCY: UC Davis

INVESTIGATOR(S):   Daniel Sperling
                      Thomas Turrentine

OBJECTIVES: Exploratory empirical analysis of consumer attitudes toward the use and purchase of adaptive cruise control and collision avoidance systems. The larger research goal is to understand consumer demand for advanced vehicle technologies and to provide guidance to government and industry in the introduction of advanced navigational and automated technologies.

APPROACH: The use of focus group interviews to help formulate and informally test initial hypotheses.

STATUS/SCHEDULE: Completed September 1990.

PUBLICATIONS :   "Consumer Acceptance of Adaptive Cruise Control and Collision Avoidance Systems" by Thomas Turrentine, Daniel Sperling, and David Hungerford, presented to the Transportation Research Board 70th Annual Meeting, Washington, D.C., January, 1991 (Paper No. 910541).

PROJECT TITLE: Advanced Traffic Management Research Projects

AGENCY: California Department of Transportation (Caltrans) and Others

INVESTIGATOR(S): Various (Patrick Conroy - Caltrans Coordinator)

OBJECTIVES: Expedite deployment of full-function Advanced Traffic Management Systems (ATMS), including Advanced Traveler Information Systems (ATIS), in California.

Provide Transportation Operation Center/System (TOC/S) designers and operators with timely "state-of-the-possible" ATMS evaluations based on actual field trials.

Enlist the technological capabilities of private industry, particularly the telecommunications, electronics and aerospace sectors.

Forward California's Intelligent Vehicle-Highway System (IVHS) agenda by taking maximum advantage of Caltrans' greatly expanded IVHS R&D resources.

Help satisfy Districts' needs for quick implementation of TOC's.

Foster cooperation among transportation practitioners and researchers, within Caltrans and among other partners in the public, private and academic sectors.

Test new ways of doing business in transportation operations, including public/private partnerships and privatization.

APPROACH: Develop and implement ATIS/ATMS test packages that would meet both TOS-related needs and advance IVHS goals. Depending on funding availability, costs and breadth of packages, Caltrans hopes to undertake from two to seven test packages in FY 1990-91. Considering potential Federal IVHS funding and private industry contributions, a total of $15 million or more may be available for ATIS/ATMS research over the next three fiscal years.

STATUS/SCHEDULE: Conceptual proposals were submitted by Caltrans districts by mid-October 1990. Proposals will be refined by December 1990. Contract documents (RFP's, etc.) will be drafted by January 1991. Funds should be encumbered by June 1991. Project durations up to three years, with funding over three fiscal years (including FY 90-91).

PUBLICATIONS: Project workplans, schedules, and budgets available by June 1991.

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