



University
of Idaho

Semi-Annual Report

July 1, 2005--December 31, 2005

*National Institute for
Advanced Transportation Technology*



*prepared for
University Transportation Centers Program
Research and Innovative Technology Administration
US Department of Transportation*

NIATT



National Institute for Advanced
 Transportation Technology
 P.O. Box 440901
 Moscow, ID 83844-0901
 Phone: 208-885-0576
 Fax: 208-885-2877
 Email: niatt@uidaho.edu
<http://www.webs1.uidaho.edu/niatt>



Director January 23, 2006
 Michael Kyte

*Center for Traffic
 Operations
 and Control*

Ahmed Abdel-Rahim
 Michael Dixon
 Brian Johnson
 Axel Krings
 Michael Kyte
 Paul Oman
 Richard Wall
 Richard Wells

Amy Stearns
 Research and Innovative Technology Administration
 US Department of Transportation
 400 7th Street, SW; Room 2440
 Washington, DC 20590-0001

Dear Amy:

I am pleased to transmit our semiannual UTC report, covering the period July 1, 2005 to December 31, 2005.

*Center for
 Clean Vehicle
 Technology*

Donald Blacketter
 Steven Beyerlein
 Karen R. DenBraven
 David Drown
 Donald Elger
 Edwin Odom
 Charles Peterson
 Karl Rink
 Judi Steciak
 Joseph Thompson

Enclosed in this report, as required, you will also find our Research Project Status and current Financial Status.

Best regards,

Michael Kyte

*Center for
 Transportation
 Infrastructure*

Fouad M. Bayomy
 Karl Chang
 James F. Frenzel
 James Hardcastle
 James Kingery
 Stanley Miller
 Richard Nielsen
 Ed Schmeckpeper

Michael Kyte
 Director

MK/jb

*Technology
 Transfer
 Center*

Doug Moore, Director
 Bruce Drewes

Engine Performance Work Continues

Donated Van Used for Studies of Catalytic Ignition

Over the past five years, a 13-passenger van, in which the V-8 engine was rebuilt and converted into a dual fuel platform, has served as a teststand for basic research on catalytic ignition. The van (formerly owned by Valley Transit of Lewiston, Idaho), was retrofitted with catalytic igniters and can run on either gas or an ethanol-water fuel. Catalytic ignition is like a mix of spark plug and diesel ignition. It is similar to spark ignition because there is a homogeneous mixture of air and fuel under pressure in the cylinder that is ignited by the catalytic igniter. However, the source of ignition (insite the igniter) is like an auto ignition that is seen in diesel engines.

Under the direction of Dr. Steven Beyerlein, emissions data for the van in different modes of operation has been collected over the past two years and additional studies are planned.

Work Relies on Infrastructure Improvements

This research has been possible because of the investment in infrastructure NIATT has made in the development and upkeep of the Small Engine Laboratory.

Results of Testing

Catalytically assisted combustion of ethanol-water mixtures represents a possible alternative to conventional ignition of gasoline fuel in a spark ignition engine. While the greatest finding has been the increases in thermal efficiency, additional testing and a more in-depth analysis of the combustion model is required to verify the

substantial increases in efficiency. The possibility of increasing efficiency even further by improving combustion characteristics exists. Increased combustion efficiency could reduce fuel requirements.

Catalytic igniters allow ignition of fuels not possible with conventional ignition sources. Instead of reducing pollutants with after-treatment systems at the expense of engine performance and increased system cost, the formation of pollutants is controlled at the source by chemical and gas dynamic modifications of the in-cylinder combustion process.

Future work will focus on improving the low temperature performance and durability of the entire system. While the initial goal was reduced emissions, an increased efficiency appears possible using this alternative fuel technology. Further testing may suggest that some after treatment may further clean the exhaust emissions.

Current testing has used only one ethanol-water fuel mixture (70 percent ethanol and 30 percent water). Once operating temperature has been reached, the engine runs as well on 60 percent ethanol and 40 percent water. Further testing on mixtures of both higher and lower water content will give a more complete image of how the amount of water present during combustion effects power output and emissions.

Student Involvement

Three graduate student researchers have received MS degrees in mechanical engineering working on the transit van project, including Dan Cordon, UTC Student-of-the-Year in 2005, who is now pursuing his PhD at the University of Idaho.



Transit Van Teststand on Chassis Dynamometer

Projects: Modeling and Application of Catalytic Ignition in Internal Combustion Engines; Small Engine Laboratory Support for Multi-Fuel Performance and Emissions Testing; Characteristics of Catalytic Igniter Performance and Emissions; Improved Transportation Performance and Emissions thorough Fundamental Studies

For more information, contact Steven Beyerlein (sbeyer@uidaho.edu).

Sustainable Transportation Conference Attracts 200 Participants

Conference Overview

On September 22-23, 2005, 200 participants from the University of Idaho, the City of Moscow, and neighboring communities and universities, businesses, and experts met to learn about and discuss ways of making our local and campus transportation systems more sustainable.

After an opening session, participants broke into five sessions, each of which was led by an expert, and discussed one of the following five problem statements:

- ✓ *How can we make transportation to and within the University of Idaho campus more sustainable and environmentally-friendly?*
- ✓ *How can we design and build a Sustainable Energy Laboratory and Transit Facility?*
- ✓ *How can we integrate sustainability into our curriculum?*
- ✓ *How can we use sustainability concepts in land use and transportation decisions within the Moscow community and region?*
- ✓ *How can we develop a biodiesel fuel production facility on the Palouse?*

Keynote Speakers

Will Toor, Boulder County, Colorado Commissioner, former mayor of the City of Boulder, and former director of the Environmental Center at the University of Colorado, and author of "Transportation and Sustainable Campus Communities: Issues, Examples, and Solutions."

Eva Matsuzaki, principal, Matsuzaki Architects Inc., Vancouver, British Columbia, contributor to green building designs, and active in public transportation improvements in the Vancouver metropolitan area.

Matthew St. Clair, first Sustainability Specialist for the University of California's Office of the President, supporting sustainability efforts across the ten-campus UC system.

Jean Brittingham, Vice President of CH2M-Hill; and Don Forbes, former director of the Oregon Department of

Transportation, authors of "A Template for Sustainable Transportation."

Dr. Mark Stemen, Coordinator for the Environmental Studies Program, and affiliated with the Department of Geography and Planning at California State University, Chico.

Financial Support

Sponsor support for the conference, including a donation from UI President Tim White, allowed NIATT to waive all registration fees for participants. Fifteen sponsors donated from \$5000 to \$100, for a total of \$27,700, matching the \$10,000 from UTC funding used to conduct the conference.

Participant Commitments

At the conclusion of the conference, each participant was asked to identify one or more commitments that he or she was willing to make regarding sustainability. Representative of these comments are the following:

- ✓ *Walk to work more.*
- ✓ *As a student, I will become involved with the City of Moscow, volunteer to serve on a committee, commission, etc., related to promotion of sustainability*
- ✓ *Investigate the feasibility of developing a small biodiesel facility for the Treasure Valley.*
- ✓ *Continue to look for ways to encourage the production and use of biofuels.*
- ✓ *I will focus my graduate thesis project towards ideas of sustainable architecture and how it affects people, psychologically, physically, and socially. I can thus further educate my fellow designers.*
- ✓ *Work towards revising Moscow's comprehensive plan to create non-car oriented development. Also work towards revising zoning/building codes to achieve vision.*
- ✓ *Conduct at least one service learning project with my students focused on sustainable transportation.*
- ✓ *Promote sustainability concepts within my program. Practice sustainability concepts within my life. Take an active role in helping develop a curriculum focused on sustainability.*
- ✓ *Participate in the group that will continue discussion of the ring road concept and sustainable transportation planning.*

Project: Sustainable Transportation Conference
For more information, contact Michael Kyte
(mkyte@uidaho.edu).



Sustainable Transportation Conference Outcomes

What Next!

So, the conference was well-attended and invigorating. But if it stopped there, it would have just been a couple of great days to ride the Vandal Trolley to the UI Commons, meet and talk with other environmentally-sensitive folks, make a personal commitment, and then go home. That's not what's happening here at UI. The following are brief explanations of how work resulting from the conference and supporting sustainable transportation is continuing:

Land Use and Sustainable Development

A Sustainable Transportation Working Group led by Michael Kyte with representatives from the City of Moscow, Latah County and the Idaho Transportation Department developed a seminar that will be offered at UI during the spring semester.

"We will all be students," said Dr. Kyte, "in this scholarly exercise." Fifteen faculty, students and community members enrolled in the seminar will be reflecting on the nature of interdisciplinary work. Faculty and community members will discuss the barriers to working in interdisciplinary groups and learning how to overcome the barriers to solve community problems by working together. Students will be expected to write collaborative papers on sustainable transportation topics.

A community-wide workshop for 2006 is in the planning stages.

Integration of Sustainability into the Curriculum

As part of UI President White's new strategic plan, "A Plan for Renewal of People, Programs, and Place," the University has invited proposals for strategic investment in academic areas. Through Director Michael Kyte, NIATT is involved in two pre-proposals that have been submitted to a Blue Ribbon committee. The pre-proposals are for collaborative, interdisciplinary research and education with transportation components. The proposals, "Sustainable Idaho Initiative" and "Building Sustainable Communities," grew from ideas that were generated at NIATT's Sustainable Transportation Conference.

Transcripts and streaming video for the keynote presentations are available on the NIATT website at http://www.webs1.uidaho.edu/sustainable_transportation/conference%20results/conference_results.htm

More information about the workshops and outcomes will be made placed on the website as available.

Campus and Local Transportation

Brian Johnson, UI Assistant Vice President for Facilities, feels he is carrying forward the "great interest and enthusiasm" generated by the conference. The UI campus, he believes, is greener than many other comparable universities. However, a group within the facilities division was formed to enhance and improve current efforts on sustainability. That group also submitted a proposal to the President's Blue Ribbon Committee.

Sustainable Energy Lab and Transit Facility

The conference workshop involved interdisciplinary design charettes facilitated by graduate students from the school of architecture. Following the workshop, six students continued working on a preliminary design for the green sustainable energy lab, which was presented in the spring to architecture faculty and students, to the Engineering Advisory Board meeting, and to Don Blacketter, director of the Center for Clean Vehicle Technology. Funds from the Federal Transit Administration have been set aside for this building, designed for use as an alternative fuel research facility and a bus maintenance and operations building. One of the next steps will be presenting the plans to the Idaho State Board of Education.



Computerized Model Developed by Architecture Student, Jessica Friend

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Project: Sustainable Transportation Conference
For more information, contact Michael Kyte
(mkyte@uidaho.edu).

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Combustion Laboratory at UI Boise Completed

Laboratory for Catalytic Ignition Studies

No one was more pleased than Dr. Judith Steciak when the University of Idaho opened the six-story Idaho Water Center in Boise, Idaho, in the fall of 2004. 14,000 square feet of space in that building is now a combustion laboratory. Steciak, a mechanical engineering professor in the UI Boise Center, has been and continues to direct fundamental studies of the catalytic ignition process to elucidate underlying reaction mechanisms.

Converting Empty Space into a Laboratory

A \$100,000 NSF award for Steciak and Steve Beyerlein provided equipment installed in the new facility in Boise. Graduate student Bob Lounsbury spent the summer of 2005 preparing a layout scheme for the lab.

Bob describes his work this way:

“Lab setup was the theme of last summer’s work in the combustion lab at the UI Boise Center. It began with the preparation of a lab layout scheme using SolidWorks to guide us through the space limitations. We had to figure out what equipment we would need to perform the experiments we would want to run in the future. Then we had to determine the most functional layout for all of this equipment. The design tool SolidWorks allowed us to

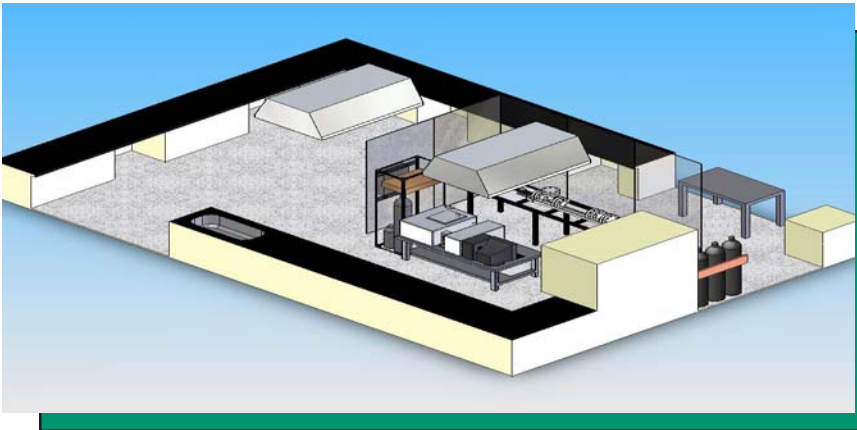
model each piece of equipment and place it in a virtual three-dimensional space. We were able to move each piece of equipment around to determine the optimal location for all the equipment.

“The first piece of equipment to go into the lab was an equipment rack to hold the NO_x analyzer, the hydrometer, and gas cylinders that will be used to calibrate other pieces of equipment.

“The second piece of equipment, a reactor table, required special designing because of the weight capacity requirement--the table needs to support several hundred pounds.

“We found aluminum construction sets from a company called 80/20 from which we could create numerous designs. We took their products and created a table that would support the reactor assembly. Prior to actually purchasing the parts, the entire table was designed, prepared, and tested in SolidWorks. Machining was done here at the UI Boise Center on the aluminum parts to be joined together and assembled.

“Now that the lab equipment is setup, we are prepared to continue our research work. The next step is to perform a hot-wire anemometer test on the reactor to ensure that we have achieved plugged-flow in the reactor test section. Once this has been proven we can begin our work on the catalytic ignition of various fuels over platinum.”



The SolidWorks Design of the Combustion Lab

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Projects: Modeling and Application of Catalytic Ignition in Internal Combustion Engines; Small Engine Laboratory Support for Multi-Fuel Performance and Emissions Testing; Characteristics of Catalytic Igniter Performance and Emissions; Improved Transportation Performance and Emissions through Fundamental Studies

For more information, contact Judi Steciak (jsteciak@uidaho.edu).

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The Controller Interface Device-- What Next?

Technology for the Future

The Controller Interface Device (CID) and how it facilitates traffic signal research and education has been a major focus of the NIATT Center for Traffic Operations and Control for the past several years, leading to the commercial release by McCain Traffic of the CID II. Several projects related to further CID development have since followed; however, all deal more with evolutionary changes to the CID or the development of applications facilitated by the CID.

Brian Johnson has taken a broader look to see if the CID design is suitable for a reasonable time into the future. He investigated applications where the CID or its variants could have a significant impact on transportation engineering and transportation engineering education.

Current Software Applications

The first task was to identify the current software applications of the original CID and the developments and applications made for the CID II. Those applications are:

- 1) A real-time interface between the microscopic traffic simulation running on a computer and 170, 2070 and NEMA TS1 and TS2 traffic controllers (hardware-in-the-loop simulation). The simulation runs with the real traffic controller instead of a generic model in the simulation, resulting in more realistic simulations that can be used to test traffic signal plans or train new engineers. The following microscopic traffic simulation programs are presently supported: TSIS/ CORSIM, VISSIM, SimTraffic and Paramics.
- 2) A suitcase tester where a laptop computer and a CID are used to test the settings of a traffic controller and simulate full operation of the controller. This allows signal timing and progression to be checked under multiple scenarios prior to field installation.
- 3) A hardware tester which can be used to test operation of the CID periodically and test the continuity in the cables connecting the CID to the traffic controller.

CID II Developments and Applications

- 1) The CID II design is presently being modified to support synchronous data link control communication between the CID and TS2 or 2070 controllers.
- 2) A software development effort to improve the performance of the USB driver running on Microsoft Windows to minimize latency in the communication between the PC and the CID.
- 3) A remote access traffic simulation laboratory has been developed that will allow engineers and students to run hardware-in-the-loop traffic simulations remotely.

Conclusions

Currently, the CID technology fills a relatively small niche in the traffic control market. While there are a number of research applications and some evolutionary changes to the CID hardware platform yet to be made, the CID is at the point where further hardware development is probably not needed.

The key future developments related to the CID will be in the area of software development. The two key projects to pursue would be (1) developing an automated suitcase tester and (2) working with the traffic controller manufacturers to make their code available to the microscopic traffic simulations. This could be done either as a set of binary libraries, or possibly by adding a port to the traffic controller to allow it to communicate with the PC, basically moving the CID inside the traffic controller.

Future developments will be driven by the traffic applications and could require some tinkering with the CID. However, further NIATT involvement in CID development should be limited to supporting current NIATT projects or externally-funded CID development.

New Direction in Hardware and Software

One result of this study was the decision to pursue a new hardware and software codevelopment direction. Richard Wall's project concerning plug-and-play technology is described elsewhere in this report.



Noise is a Challenge for a Senior Design Team

Preparing for the 2006 Competition

The UI Clean Snowmobile Team knows what needs to be improved before they head to Michigan to compete in the 2006 SAE Clean Snowmobile Challenge. The Clean Snowmobile Challenge is SAE's newest Collegiate Design Series competition that challenges engineering students to re-engineer an existing snowmobile for improved emissions and noise while maintaining or improving the performance characteristics of the original snowmobile. The modified snowmobiles are also expected to be cost-effective so that snowmobile outfitters could afford to purchase them and still make a profit.

The sound power output of the UI sled in the 2005 competition was measured as 108 dBA (weighted decibels), which was louder than the control snowmobile, so the team received no points. The student snowmobile scoring the best in the noise output tested at 105 dBA, so the goal of this year's team is to best that. The design, manufacture, and installation of a quieter air intake system on the Polaris 600 engine is the subject of a capstone senior design project in the mechanical engineering department this academic year.

Exploring Progress at the Senior Design Snapshot

On Tuesday, December 6, 2005, more than 20 senior design teams had an opportunity before final exams and the semester break to display customer-approved design ideas, first prototypes, experimental findings, and results from modeling activities--progress they had made during the fall semester. The design rooms in the Gauss-Johnson Engineering Building were filled with students displaying and talking about their work while faculty, other students and staff listened, asked questions, and made suggestions for the work yet to be done.

Among the senior design teams displaying their prototypes was the "Quiet Riot" team of mechanical engineering undergraduates Brady Calvert, Andrew Hixson, Aaron Hunter and Erik Van Patten, whose redesigned intake system is designed to make the competition snowmobile quieter for the competition in during the second week of March 2006.

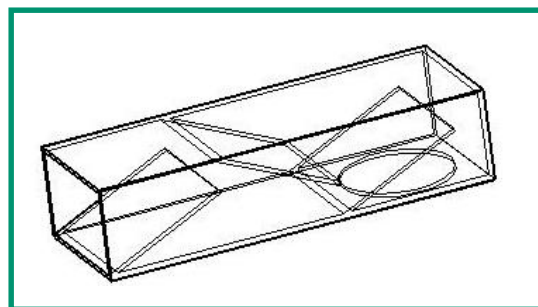
Redesigning the Intake System

The students define the deliverables of their senior design project as

- A properly packaged and installed intake system on the naturally aspirated engine
- Verification of the system's functionality
- A complete set of drawings and installation instructions
- A technical report documenting the design
- A portion of the technical report that will be used at competition
- A portion of the presentation that will be given at competition
- Research and background information on intake systems for future team use
- Math models, computer programs, and software for future team use

The Third Iteration

At the Senior Design Snapshot, the team showed two iterations of the intake system that had been less successful than they desired, and a third prototype they will continue developing. This external baffle trap, as designed, will connect to the airbox leading into the engine. The baffles in the trap are placed to reduce the flow of air from the engine after ignition while facilitating its flow into the engine, thus reducing noise.



Baffle Trap Design

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Project: Design and Construction of a Turbocharged Direct-Injection Two-Stroke Snowmobile for Competition in the SAE Clean Snowmobile Challenge

For more information, contact Karen Den Braven (kdenb@uidaho.edu).

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More Data, Better Data Can Lead to Better Decisions

Responding to Current Needs

Transportation engineers face a number of challenging problems. As the population grows and becomes more mobile, there is increased demand on the transportation infrastructure. In addition, the infrastructure continues to age. To further complicate the issue, as the labor force ages, more experienced transportation engineers retire. The public is less willing to invest in infrastructure as they face more and conflicting demands on the use of their scarce tax dollars..

To meet these demands, the transportation community needs better technology and better ways to use current technology. That's where Michael Dixon's interest in data can help. For the past three years, Dixon has initiated research projects that focus on collecting data, improving methods of collecting data, making that data available in a useful form, including for students in his transportation classes.

Collecting Field Data to Improve Modeling

Consider a situation in which a local authority decides that a road is either in need of improvement or is going to be built. The design of that road involves many decisions. How many lanes should it have? Should its intersections with other roads be signalized or unsignalized or should there be a roundabout? If a signalized intersection is preferable, what type of signal control will work best? What about turn radii and grade? Engineers rely on modeling when making such decisions about improving or adding elements to the transportation infrastructure.

The linkage between design quality, modeling and data quality is straightforward. Good data improve the quality of models and thus an engineer's ability to accurately predict real world conditions. Improved model predictions augment engineers' capabilities to produce high quality designs.

Modeling is typically based on limited data. For example, engineers might want to refer to a model when planning to construct a two-lane highway. That model might be based

on data collected from one or two existing two-lane highways that do not have the same characteristics as the one being planned, such as passing lanes or vehicle makeup. Additional field data can help engineers know what adjustments or calibrations need to be done to improve the modeling.

Better Ways to Collect Data

One outcome of Dixon's work is better ways to collect data for measuring delay time. The standard way of measuring delay has been to watch video data and count the number of vehicles stopped during each time increment. Instead, Dixon's graduate students used video to watch and time each vehicle going through the intersection to collect the data. The accuracy of this method is not only comparable to the standard method, but provides additional data, such as vehicle turning movement.

Using Data in Transportation Classes

This past semester, Dixon used the data that were collected over the summer of 2003 for a number of roundabouts across the US (for a project funded by NCHRP) in his engineering classes. Students used these data to evaluate how well models work. This experience improves their ability to assess model results, a skill needed when they begin their engineering practice.

Future Work

Nine graduate students have been involved in various aspects of Dixon's research. Data have been collected for three intersections in Moscow, Idaho, and two in Lewiston, Idaho. Dixon plans to add one or two intersections each year. Students will be heading to Spokane County, Washington, next semester, to collect data.

Dixon will continue to organize the data, document how it was collected, and determine the best way to post the information on the Internet, making it available for researchers and engineers and their staff.

Projects: Maximizing Data Quality to Optimize Traffic Signal System Performance; Area-Wide Performance Measures for Traffic Signal Systems

For more information, contact Michael Dixon (mdixon@uidaho.edu).



Plug-n-Play Technology Shows Promise

Peers Review Research Progress

On October 13, 2006, NIATT Richard Wall hosted a day-long meeting to present, along with his graduate and undergraduate students, their progress on the Plug-n-Play project. The group's goal was to determine whether or not the project deserves continuing, and if so, to discuss problems and roadblocks and brainstorm solutions. Darcy Bullock, Purdue University, Tom Urbanik, University of Tennessee, and Gary Duncan, Econolite Traffic Systems, joined other UI faculty members from civil engineering, psychology, computer science, and electrical and computer engineering, graduate student Andy Huska, and a team of senior undergraduates for an intensive day's discussion.

Is There a Need for New Technology?

Modern signalized intersections require the installation of several hundred dedicated conductors to each traffic signal head, pedestrian indication, pedestrian button, loop detector and other auxiliary devices. No intelligence is distributed outside of the signal cabinet.

Regardless of the capability of the processors used, present day traffic controllers are information-bound since the architecture uses a central processor and one wire per output for signals or input for sensors. The information density is constrained to a single symbol per display. Signals are further constrained to the configurations as installed and require extensive manpower and possibly traffic disruption to modify. Signals cannot be easily changed from ball signals to arrow signals to adapt to emergency, construction, or special activity events. In order to add control for additional phases of traffic movement today, additional control signals must routed from the traffic control cabinet to the new signal or sensor.

One area in which additional controls are used is in countdown pedestrian signals. Current installations are drop-in replacements for conventional pedestrian signals. Due to the limited information available to the pedestrian signal, the new countdown pedestrian signals must "learn" when to initiate the countdown sequence by observing the adjacent green phase interval. Any changes due to time-of-day signal timing result in an inaccurate countdown, potentially stranding pedestrians in the middle of the intersection.

Advantages and Challenges of Plug-and-Play (PnP)

PnP distributed sensor technology for traffic signals would facilitate the deployment of intelligent traffic signal infrastructure. Network communications connected to four nodes could control a single traffic signal and eight count down pedestrian signals connected to a simulated traffic controller.

Dr. Wall identified four potential benefits of PnP distributive signal and sensor network (DSSN) technology:

- ✓ *Reduced cost (with fewer connections, wires, etc., and easier repairs)*
- ✓ *Increased bandwidth (enabling complex communications)*
- ✓ *Improved scalability*
- ✓ *Increased capacity (with new sensors or dynamic signage)*

He described the challenges of the technology as conflict monitoring, system time response for actuated systems, and the assurance of a network-wide fail-safe system.

Following Wall's discussion, Urbanik, Bullock and Duncan led a discussion about several challenges:

- ✓ Is a PnP system maintainable--current technical support is insufficient.
- ✓ Would there be problems with installation--the skill level of contractors is limited to industrial wiring.
- ✓ Is there an advantage to new installations vs. upgrades ?
- ✓ Can the PnP reliability be proven in a court of law--which would require documented performance.

Further technical challenges, network security issues, and human factors were also discussed.

Conclusions

By the end of the day, the group agreed that PnP technology has value and is worth pursuing. The suggestion was made that the senior design group should focus on a countdown pedestrian signal to demonstrate improved performance with a side-by-side comparison of new vs. existing countdown ped signals. Using a PnP DSSN along with existing signal controls could lead to improved sensor data and additional fault sensing.

Projects: Plug-n-Play Smart Sensor Traffic Signal Systems; Full-Scale Implementation of Plug-n-Play Smart Traffic Signal Pedestrian Wait/Walk Display; Conflict Monitor for Plug-n-Play Distributed Smart Signals and Sensors
For more information, contact Richard Wall (rwall@uidaho.edu).



Statewide Safety Conference Organized by NIATT for Governor Kempthorne

Bringing Together Leaders

In summer 2005, Idaho Governor Dirk Kempthorne issued a call to leaders in government, the private sector, and education institutions to improve safety on Idaho's highways and roads. On October 19 and 20, more than 100 leaders from these groups gathered in Boise to identify how deaths and injuries on Idaho's highways can be reduced.

Michael Kyte headed the planning committee for the summit, a group that included Dave Ekern, Idaho Transportation Department director; Michael Blankenship from Boise State University; Steve Moreno of FHWA; Steve Jones of the Idaho State Police; Doug Moore, NIATT's T2 Director; Joe Haynes of the Local Highway Technical Assistance Council; and five additional ITD and FHWA personnel.

Keynote Speakers and Breakout Sessions

Five keynote speakers helped set the agenda for the meeting:

- ✓ *Tony Kane, Director, Engineering and Technical Services, AASHTO*
- ✓ *Rich Cunard, Engineer of Traffic Operations, Transportation Research Board*
- ✓ *Brian McLaughlin, Associate Administrator, National Highway Traffic Safety Administration*
- ✓ *Rudy Umbs, Traffic Safety Engineer, Federal Highway Administration*
- ✓ *Kathy Swanson, Director, Office of Highway Safety, Minnesota Department of Public Safety*

During the two-day summit, participants worked in five breakout sessions, each focusing on a highway safety problem specific to Idaho. Participants considered their assigned problem, and then identified causes, potential strategies to solve the problem, and challenges that could get in the way of a solution.

Project funded by the Idaho Transportation Department. For more information, contact Michael Kyte (mkyte@uidaho.edu).



Outcomes: Getting to Zero Deaths

Following the two-day summit, the planning committee members identified ten emphasis areas that represent the highest priority needs to achieve the goal of zero deaths on Idaho's highways:

- ✓ Aggressive driving
- ✓ Commercial vehicles
- ✓ Emergency medical services
- ✓ Impaired drivers
- ✓ Mature drivers
- ✓ Occupant protection
- ✓ Railroad/highway crossings
- ✓ Road-related crashes
- ✓ Vulnerable users
- ✓ Youth

The committee also formulated six steps to address these emphasis areas.

1. Develop, implement and manage an integrated multi-stakeholder process to improve the attributes of roads, users and vehicles to reduce traffic-related deaths, life-altering injuries and the related economic losses on Idaho's roadways.
2. Charge the Idaho Traffic Safety Commission with a larger mandate that includes reviewing ITD's highway safety investment program and monitoring the implementation of the strategic highway safety plan.
3. Encourage leadership to champion solutions to highway safety problems--Idaho's governor must challenge each state agency head to develop its own plan for highway safety and identify how it intends to work with other state and local agencies.
4. Complete a strategic highway safety plan to address how Idaho will increase its investment in highway safety improvements and meet its vision of zero highway deaths.
5. Form new regional partnerships to bring together engineering, enforcement, education and emergency services expertise.
6. Establish a Center for Excellence for Highway Safety involving both Boise State University and the University of Idaho.

Collaboration for Northwest UTCs and DOTs

Federal Region X Transportation Meeting

Representatives from six Northwest universities along with the Alaska, Oregon and Washington Departments of Transportation met in Seattle, Washington, on October 13, 2005, in Seattle, Washington, to discuss how they could collaborate in education and research.

Directors from the four University Transportation Centers in the region each spoke to the group about some of the issues they see as important to the region, in particular, and transportation research in general. They discussed the challenges of multidisciplinary efforts both within and between the universities and the importance of using UTC funds to meet the research agendas of the state DOTs and FHWA.

The participants agreed that substantive collaboration in the areas of research, education and training could help meet both local, regional and national needs in transportation.

The lively half-day discussion ended with the formation of four task forces that would continue exploring ways to overcome the barriers of working together and build on the strengths of each of the University Transportation Centers:

- *Education Task Force--chair, Michael Kyte, NIATT*
- *Research Task Force--cochairs, Leni Oman of WSDOT and Bernie Jones of ODOT*
- *Training Task Force--chair, Scott Rutherford, UW*
- *Teleconferencing Task Force--chair, Rob Bertini, PSU*

The participants enthusiastically identified several areas in which the task forces could generate work plans:

- Regional conferences
- Student conferences
- Multi-university courses
- Cross-disciplinary degrees
- Interdisciplinary and interuniversity proposals for research
- Dissemination of success stories

Initial Task Force Meetings Planned

Task force meetings have already been planned. On January 18, 2006, the education task force will meet via video conference. According to Michael Kyte, this first meeting would not only provide the opportunity to discuss issues of substance, but would also provide the initial experience of working together by video.

The research task force plans a video conference for January 12, and may also meet at the national TRB conference in Washington, DC.

NIATT Planning Upgrade to Facilitate Collaboration

Recognizing that the ability to meet often without incurring the costs of travel and additional time, NIATT is planning a major upgrade to its conference room to allow for video conferencing with the other UTCs in the region and the newly formed task forces, with the Idaho Transportation Department, and even FHWA.



Will Your Airbag Work?

The Job of the Pyrotechnic Initiator

Airbags were responsible for saving 14,772 lives between 1975 and 2003. Currently, over 146 million vehicles in the United States are equipped with airbags, and the airbags are expected to function properly during a long vehicle life span. The pyrotechnic initiator within the airbag is responsible for deploying the airbag in crash situations. The initiator is a small electro-explosive device composed of a bridgewire for igniting the pyrotechnic material and two metal pieces, connected by the bridgewire and separated by a region of insulating glass.

These devices use an electrical current to heat a fine wire, resulting in the ignition of energetic material. The energy released from this reaction is then used to ignite other gas-generating materials, heat-stored gases, or actuate flow-control mechanisms.

Due to their critical role in airbag and other lifesaving applications, bridge-wire initiators are intended to be hermetic and impervious to the surrounding environment. The integrity of the bridge-wire itself and the surrounding pyrotechnic are of particular concern since moisture in the bridge-wire region is known to lead to corrosion of the bridge-wire and may also result in degradation of certain pyrotechnic materials. Degradation of the pyrotechnic or bridgewire can result in the initiator not functioning and thus failure of the airbag.

Identifying the Presence of Cracks

Radial cracks in the insulating glass portion of some initiators have been observed by Dr. Karl Rink. Such cracks have the potential to allow moisture to penetrate the initiator and degrade the pyrotechnic and bridgewire.

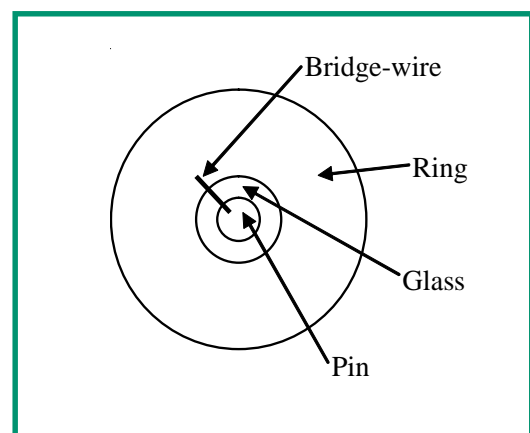
Design and assembly of bridge-wire initiators is quite complex, and significant variations in component geometry, materials of construction and assembly processes exist. Dr. Karl Rink suspects that thermal stresses during their manufacture are the cause of the cracks. The goal of his project was to develop models that could lead to determining the cause of the cracks with respect to the manufacturing process and to compare the

results of this model to cracks observed in actual initiators returned from field service. Closed form solutions were used to determine basic stress magnitudes. A three-dimensional finite element analysis was used to determine more exact stresses including the effects of transient cooling. The finite element analysis showed that if the manufacturing process involves pouring molten glass into the initiator, the likelihood of cracking is high. Further, if the surface of the initiator cools faster than the center, cracking could result. A push-out test was performed on one type of initiator, to determine the strength of the glass.

Conclusions

Rink's research showed that during manufacture it is possible for tensile stresses to occur in the glass of an initiator. The results of the models developed agree with photographic evidence of cracks in initiators. It is advised that manufacturers of airbag initiators use processes that will cool the surface and center of an airbag initiator as uniformly as possible and avoid large temperature differences between the materials of the initiator during manufacture.

The final goal of this continuing project is to reduce or eliminate the need to replace pyrotechnic devices on existing and future vehicles by being able to determine if these systems still adequately function. We expect the results of the work to dramatically change the way in which initiators are manufactured and maintained. This project will put the UI at the national forefront of pyrotechnic restraint systems.



Simplified Schematic of an Initiator

*Project: Safe Adaptive Supplemental Restraint Systems
For more information, contact Karl Rink (karlrink@uidaho.edu).*



Part B: Research Project Status

Projects Begun in FY06-Year 8

KLK102	Sustainable Transportation Conference Principal Investigator: Michael Kyte
KLK120	Development of New Actuated Signalized Intersection Performance Measurement Methodologies Using Traffic Controller Input and Output Data Principal Investigator: Michael Dixon
KLK121	Remote Access Hardware-in-the-Loop Simulation (RAHILS) Laboratory: Application Guide for Testing Software-Based Traffic Control Systems Principal Investigator: Ahmed Abdel-Rahim
KLK122	Conflict Monitor for Plug-n-Play Distributed Smart Signals and Sensors for Traffic Controllers Principal Investigator: Richard Wall
KLK124	Senior Design: Full Scale Implementation of Plug-n-Play Smart Traffic Signal Pedestrian Wait/Walk Display with Pedestrian Button Principal Investigator: Richard Wall and Brian Johnson
KLK125	Modeling and Assessing Large-Scale Surface Transportation Network Component Criticality Principal Investigators: Ahmed Abdel-Rahim; Paul Oman; Brian Johnson
KLK126	Traffic Signal Summer Workshop VII Principal Investigator: Michael Kyte
KLK410	Design and Construction of Turbo-Charged Direct-Injection Two-Stroke Snowmobile for Competition in the SAE Clean Snowmobile Challenge Principal Investigator: Karen Den Braven
KLK 411	Improved Transportation Performance and Emissions through Fundamental Studies, Engine Testing, and Demonstration Platform Development Principal Investigators: Judi Steciak; Steve Beyerlein
KLK412	Feasibility Study on Hydro-thermal Conversion of Low-grade Glycerol to Alcohols for Use in Biodiesel Production Principal Investigator: Brian He
KLK413	Integrated Batteries Principal Investigator: Donald Blackketter
KLK414	Thermal Stresses and Related Failure Mechanisms: Bridge-Wire Initiators Principal Investigators: Donald Blackketter; Karl Rink
KLK421	A Biodiesel Demonstration Plant Principal Investigatorz: Jon Van Gerpen; Brian He

Projects Completed

KLK201	Development of Controller Interface Device for Hardware-in-the-Loop Simulation
KLK202	Actuated Coordinated Signalized Systems: Phase I—Oversaturated Conditions; Phase II: Cycle-by-Cycle Analysis
KLK203	Development of Video-Based and Other Automated Traffic Data Collection Methods, Phase II
KLK204	Development of Internet-Based Laboratory Materials: Phase II—Computer-Assisted Traffic Analysis Training
KLK205	Traffic Signal Summer Workshop II
KLK206	Traffic Controller Laboratory Upgrade
KLK207	Development of Traffic Signal Training Materials Integrating Hardware-in-the-Loop Simulation
KLK208	Software Maintenance Support for Current Generation Controller Interface Device
KLK209	Next Generation Controller Interface Device
KLK210	Modeling Real-Time Highway Traffic Control Systems
KLK211	Traffic Signal Summer Workshop III
KLK212	Development of Guidelines for Designing & Implementing Traffic Signal Control Systems
KLK213	Engineering Design Problems
KLK214	A Remote Access Hardware-in-the-Loop Simulation Laboratory

KKK215 Assessing the Security and Survivability of Transportation Control Networks
 KKK216 CID Road Map
 KKK217 Traffic Signal Summer Workshop IV
 KKK220 Traffic Signal Summer Workshop V
 KKK230 Development of Traffic Signal Operations Case Studies
 KKK231 Applying the TRANSIMS Modeling Paradigm to the Simulation and Analysis of Transportation and Traffic Control Systems
 KKK232 Maximizing Data Quality to Optimize Traffic Signal System Performance
 KKK233 Applying Safety-Critical Fault Tolerant Principles to Survivable Transportation Control Networks
 KKK234 Assessing Intelligent Transportation System Educational Needs
 KKK235 Expanded Controller Interface Device I/O and Software Capabilities
 KKK236 Controller Interface Device Software Documentation
 KKK237 Area-Wide Performance Measures for Traffic Signal Systems
 KKK238 Experiments in Modeling Urban Surface Transportation Network Dependability and Security
 KKK239 Traffic Signal Operations Case Studies
 KKK240 Remote Access Laboratory for Testing Advanced Traffic Signal Systems: Operational Manual and Application Guide
 KKK241 Plug-n-Play Smart Sensor Traffic Signal Systems
 KKK242 Traffic Signal Summer Workshop VI
 KKK302 Advanced Vehicle Concepts Team Electric Vehicle: Phase II: FutureTruck 2000, 2001
 KKK303 Alternative Powered Snowmobile Development (FY01)
 KKK304 Alternative Power Snowmobile Development (FY02)
 KKK305 Vehicle Performance Simulation, Phases I-II
 KKK306 Vehicle Performance Simulation, Phase III
 KKK308 A Parallel-Hybrid Sport Utility Vehicle (FutureTruck 02)
 KKK309 Clean Snowmobile 03
 KKK310 Biodiesel Fuel from Yellow Mustard Oil, Phase I
 KKK311 Biodiesel Fuel from Yellow Mustard Oil, Phase II
 KKK312 Modeling and Application of Catalytic Ignition in Internal Combustion Machines
 KKK314 Mentorship and Performance Assessment of Design Teams in Transportation-Related Projects
 KKK315 Spark Ignition Engine Conversion to Aquanol Fuel
 KKK317 Diesel Engine Conversion to Aqualytic Fuel—Phases I-II (Homogeneous Charge Combustion of Aqueous Ethanol)
 KKK318 Reactor Studies of Water-Alcohol Mixtures, Phase II
 KKK319/KKK320 Catalytic Ignition of Aquanol in Reactor, Engine and Vehicle Environments
 KKK321 Optimal Design of Hybrid Electric-Human-Powered Lightweight Transportation
 KKK323 Idaho Engineering Works
 KKK325 FutureTruck 03
 KKK327 Essential Elements in Teaming: Creation of a Teaming Rubric
 KKK328 Comparison of Esterified and Non-Esterified Oils from Rapeseed, Canola and Yellow Mustard as Diesel Fuel Additives
 KKK330 Advanced Lead Acid Battery Development
 KKK331 High Performance Auxiliary Power Units, Phase II
 KKK340 A Novel Continuous-Flow Reactor Using Reactive Distillation Techniques for Economic Biodiesel Production—Stage 2
 KKK341 Design and Construction of a Direct-Injection Two-Stroke Snowmobile for Competition in the 2004 SAE Clean Snowmobile Challenge
 KKK342 Small Engine Laboratory Support for Multi-Fuel Performance and Emissions Testing
 KKK343 A Novel Continuous-Flow Reactor Using a Reactive Distillation Technique for Economical Biodiesel Production
 KKK344 A Parallel-Hybrid Electric-Hydraulic Sport Utility Vehicle: FutureTruck 2004
 KKK345 Failure Mode Investigation and Ballistic Performance Characterization of Pyrotechnic Initiators Used in Automotive Supplemental Restraint Inflation Systems
 KKK346 Characterization of Catalytic Igniter Performance and Emissions
 KKK347 Construction of a Direct-Injection, Two-Stroke Snowmobile for Competition in the SAE Clean Snowmobile Challenge
 KKK348 Hybrid Heavy Weight Vehicles
 KKK349 Safe Adaptive Supplemental Restraint Systems