



National Institute for Advanced  
Transportation Technology  
PO 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**  
Michael Kyte

January 30, 2004

**Center for Traffic  
Operations  
and Control**

Michael Dixon  
Brian Johnson  
Zaher Khatib  
Michael Kyte  
Richard Wells

Amy Stearns  
Research and Special Programs Administration  
US Department of Transportation  
400 7<sup>th</sup> Street, SW, Room 8417  
Washington, DC 205909-0001

**Center for  
Clean Vehicle  
Technology**

Donald Blackketter  
Steven Beyerlein  
Karen R. DenBraven  
Erik S. Drews  
Dean Edwards  
Edwin Odom  
Charles Peterson  
Judi Steciak  
Joseph Thompson

Dear Amy:

I am pleased to transmit to you our semi-annual report for the second half of fiscal year 2003.

We believe this report illustrates our continuing success in using UTC funding to meet the goals we set in our *Strategic Plan* and to work towards making the enhancements we outlined in our recompetition application.

What we hope is evident to those who read this report is that researchers in both our Center for Clean Vehicle Technology and the Center for Traffic Operations and Control

We pledge to continue our efforts to train and educate new leaders who are prepared to meet the nation's need for safe, efficient and environmentally sound movement of people and goods:

**Center for  
Infrastructure  
Technology**

Fouad M. Bayomy  
Karl Chang  
James F. Frenzel  
Donald F. Haber  
James Hardcastle  
James Kingery  
Jim C. P. Liou  
William McLaughlin  
Stanley Miller  
Richard Nielsen  
Nick Sanyal  
Ed Schmeckpeper

Enclosed in this report, as required, you will also find Part B, our Research Project Status, and Part C, the Financial Status.

Sincerely yours,

Donald Blackketter  
Director

DB/jb

**Technology  
Transfer  
Center**

Eugene Calvert

# Improving Traffic Signal Design Skills



## Professionals Attend Fourth Workshop

Four professional engineers joined eight students as participants in Traffic Signal Summer Workshop IV held during the week of August 10, 2003, on the University of Idaho campus.

*James Gattis*, an Associate Professor at the University of Arkansas, is affiliated with the Mack-Blackwell Transportation Center. When he applied to TSSW, he said that all he knew about signals was what he learned from books. He believed that attending TSSW would make him better informed as he prepared to teach an engineering transportation graduate class in the spring of 2004. Now he reports that he will be able to incorporate notes from the TSSW into the class. Gattis said he expanded his knowledge of signal hardware, video detection, and he learned how timing plans are “installed” onto hardware.

Having attended the workshop conducted by NIATT staff at the 2003 ITE Intermountain meeting in Jackson, Wyoming, *Craig Herndon* said his interest was raised regarding traffic timing in his jurisdiction (Ada County Highway District, Boise, ID). As assistant traffic engineer, he found it informative to learn how traffic signal controllers work and wanted to learn more about how they are programmed. Following the week, he said he was not disappointed: “This class was well worth my time. The workshop increased my knowledge of traffic signal operations and gave me hands-on experience in programming traffic signal controllers.”

*Gene McHale* cited his new role as technical oversight of Adaptive Control Systems Lite Project as his motivation for attending TSSW. This fall, he verified that the TSSW was “an extremely rewarding experience.” The hands-on experience with the actual traffic signal controllers, video detection software, and loop detectors, he said, provided an “unparalleled learning environment.” McHale is an engineer with Federal Highway Administration Office of Operations Research and Development.

## Participants’ Evaluations Positive

As we have done during the previous three workshops, we asked participants to complete not only a daily evaluation, but also a final evaluation, giving us feedback on how they believe their knowledge has increased and their skill levels have changed.

They are asked each day to estimate what they believe their skill level is in the topics to be covered that day, and then after the day’s activities, to reassess to see if they have improved or not.

The response choices range from strongly disagreeing that they understand the concept to strongly agreeing that they understand the concepts or are able to perform certain tasks that they were not able to do before.

For each of the nineteen areas they were asked to evaluate, the overwhelming response was that their knowledge improved and their skills increased.

The results of the evaluation are shown on the following page.

### Samples from daily evaluations

*Based on your experience today, was this objective achieved (yes or no)?*

I really enjoyed the day, for it combined both lecture and hands-on activities, which enabled us to learn important principles and apply creativity.

*What suggestions would you make to improve the presentation of this material in the future?*

Overall, I thoroughly enjoyed the day. I thought there was a good balance between working in class and out in field, as well as lecture and activities.



National Institute for Advanced Transportation Technology

*Traffic Signal Summer Workshop V  
will be held August 9 - 13, 2004*

For more information, contact Michael Kyte  
[mkyte@uidaho.edu](mailto:mkyte@uidaho.edu) or visit the website  
[http://www.webs1.uidaho.edu/niatt\\_tssc/](http://www.webs1.uidaho.edu/niatt_tssc/)

Semi-Annual Report—July 2003—December 2003

# Clean Snowmobile Research On A New Path

## Graduate Student Works on Hybrid Snowmobile

Forrest French, graduate student in mechanical engineering, takes clean vehicle technology seriously, which is why he is developing a four-stroke, parallel-hybrid snowmobile.

He and advisor Karen Den Braven knew that even though the NIATT two-stroke Arctic Cat Sno-Pro was recognized as the “cleanest” (see below), a four-stroke snowmobile would be even more effective at lowering emissions and noise from the popular recreational vehicle.

Although hybrid electric vehicles have demonstrated their ability to reduce fuel consumption and emission formulation, the technology has not been previously implemented on a snowmobile. The Polaris French is modifying will be powered both by an electric motor and by 10 percent ethanol--making it a parallel hybrid.

## Clean Snowmobile Research Provides Baseline

Because the Clean Snowmobile team has been working with a four-stroke engine for three years, French will have access to a great deal of data to compare against his hybrid two-stroke. That data comes not only from testing done by the 2001 and 2002 Clean Snowmobile teams at UI, but also from tests completed at the Southwest Research Institute (SwRI), San Antonio, Texas, after the CSC 2002. The results of those tests showed that the NIATT snowmobile also had lower NOx and particulates than all sleds tested, including commercial snowmobiles, so French faces a large challenge to beat the record.

He also has data from a 2003 Arctic Mountain Cat, similar to that which is rented in environmentally sensitive areas, such as Yellowstone and Grand Teton National Parks. These data were gathered with funds NIATT received from a Federal Highway Administration grant, which involved the design, development, and demonstration of clean and sustainable, small engine technologies for recreational vehicles.

To test his four-stroke, French will also make use of the snowmobile dynamometer and software purchased with those FHWA grant funds.



National Institute for Advanced Transportation Technology

## Rendezvous Snow Rentals Sponsors Study

Impressed with the work of the Clean Snowmobile Team, Randy Roberson of Rendezvous Snow Rentals in Yellowstone National Park contracted with NIATT to modify and then perform engine dynamometer tests on a 2003 Polaris Frontier Touring Snowmobile.

Nathan Bradbury, an undergraduate on the 2002 Clean Snowmobile team and now a graduate student, added a catalytic converter to the rental snowmobile and made further modifications to prevent melting due to the extra heat generated from its chemical reactions.

Subsequent testing showed a slight decrease in HC emissions, a 23 percent reduction in CO, and a 96 percent reduction in NOx.

The National Park Service (NPS) is requiring that recreational snowmobiles entering Yellowstone National Park be “BAT”--Best Available Technology. While the Rendezvous’ Polaris currently meets those standards, the addition of a catalyst for approximately \$100, with a mere 3 percent reduction in power output, would appear to be a cost effective way to run an even cleaner vehicle.

## Donation of Software

Both French and members of the 2004 Clean Snowmobile Team will take advantage of a generous donation of software from Optimum Power Technology of Pennsylvania. For an administrative fee of \$100, they have donated use of the professional version of the Virtual Two-Stroke Formula SAE Optimization software, valued at \$18,000.

Two senior design teams, one directed by Bradbury and the other by graduate student Patrick Hess, are continuing work on the direct-injection, two-stroke snowmobile that will compete in the CSC 2004.

## Den Braven Presents at SAE Conference

Karen Den Braven, Clean Snowmobile Team advisor and professor of mechanical engineer, and was invited to present “Improving the University of Idaho Clean Snowmobile,” a paper written with Nathan Bradbury and Forrest French, at the 2003 UI Clean Snowmobile at the SAE Small Engine Technology Conference in Madison, WI, in September 2002.

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

Semi-Annual Report—July 2003—December 2003

# An SUV That Runs Cleaner !

## The Paradoxical SUV

The Advanced Vehicles Concept Team (AVCT) prepares for their fourth FutureTruck competition, knowing that reengineering an SUV--a 2002 Ford Explorer--to run cleaner and more efficiently could have an impact on the area in which they live and study.

Sport Utility Vehicles--SUVs--are very popular in the Pacific Northwest. Perhaps the general population envisions the SUV as it seen in commercials: driven by happy families on mountain roads, avoiding falling rocks and enjoying the wilderness in leather-seated comfort.

However, SUVs represent a paradox to these same consumers. Driving an SUV has a much greater impact on the environment than driving other passenger cars. For example, current federal regulations allow SUVs to have far worse fuel economy than other vehicles. The federal corporate average fuel economy (CAFE) standards set the fuel economy goals for new passenger cars at 27.5 miles per gallon (mpg). But under the law, SUVs are characterized as light trucks and only have to achieve 20.7 mpg.

So, although SUVs are advertised as a way to return to nature, they actually accelerate existing environmental problems, contributing to the destruction of our natural resources.

This makes the possibility of having a clean SUV, the goal of the FutureTruck competition, attractive to those who want the advantages of larger vehicles, but worry about their impact on the environment.

## UI FutureTruck is a Triple Hybrid SUV

The UI FutureTruck Summit, a 2002 Ford Explorer, runs on hydraulic power, electric power and E-85 (ethanol) fuel. Having three sources of power is what makes the SUV a triple hybrid.

The FutureTruck is configured so it can run on both hydraulic and electric power, or only hydraulic, or only electric, or with no hybrid systems running. This permits unique testing of different systems on the same vehicle under the same conditions.

The multidisciplinary AVCT has 67 student participants this fall--the highest number ever.



National Institute for Advanced Transportation Technology

## Research Continues over the Summer

Because of the increased number of students who are interested in working on the FutureTruck project, a special course was developed to complete on-road testing of the modified Ford Explorer during the summer of 2003. Two students received internships and course credit for completing the testing and analysis.

The purpose of the on-road testing was to provide data to compare with predictions made before the FutureTruck competition in spring 2003. Fuel economy and aerodynamic drag measurements were successfully completed. Findings showed that fuel economy increased by 41 percent compared to the stock vehicle. The computer model ADVISOR had predicted a 23 percent improvement. Aerodynamic drag with the current version of our roof-mounted passive cooling system is now very close to that of the stock vehicle. This data is consistent with the wind tunnel predictions.

## AVCT Receives Industrial Support

A senior design team led by student Jeremy Forbes wrote a white paper and, as a result, successfully secured corporate support to improve the electric power system on the competition vehicle. Maxwell Technologies donated 75 percent of the value for a larger ultra-capacitor energy storage system.

National Instruments provided an afternoon training session at the UI campus on October 16th to instruct students on the use of \$26K worth of donated software and hardware.

For more information, visit the FutureTruck website  
<http://www.idahofuturetruck.org/>  
or contact Frank Albrecht ([albr9652@uidaho.edu](mailto:albr9652@uidaho.edu))

Semi-Annual Report—July 2003—December 2003

# FHWA TRANSIMS Used at NIATT

## Using TRANSIMS for Microscopic Modeling of the City of Moscow

Michael Dixon, assistant professor of civil engineering, and Karl Chang, professor of geography, have initiated a new research project using TRansportation ANalyses and SIMulation System (TRANSIMS) software.

A set of integrated transportation and air quality analysis and forecasting models, TRANSIMS was developed at the Los Alamos National Laboratory (LANL) with funding from FHWA and then licensed to IBM. The software models the travel and driving decisions of individual travelers on large-scale multi-modal systems. TRANSIMS is part of FHWA's Travel Model Improvement Program (TMIP), a multi-year, multi-agency program designed to improve both the analytical tools and the integration of these tools into the transportation planning process.

NIATT is the first licensee of the software from IBM.

Traffic operations and transportation planning have long been viewed as separate fields of transportation engineering, where their respective activities are performed with little regard for the other. One of the primary reasons for this is that no tools were available to solidify the relationship between the two fields beyond simple concepts such as intersection spacing. This causes problems when congested conditions exist and/or assumptions are made such as travel patterns staying constant when operational improvements are made or when travel information has been disseminated.

Using TRANSIMS, Dixon and Chang will be able to model the actual activity on a detailed level for every intersection and traffic signal in the City of Moscow. Chang has designed a population synthesizer database to capture information from the 1990 U.S. Census. Using these data with TRANSIMS, the researchers will be able to stimulate travel behavior of each individual in the city. This is a significant improvement over current planning models, which are severely limited when modeling individual behavior.

The models that Dixon and Chang use will be put to use in the NIATT/FHWA/Idaho Transportation Department \$3 million Moscow ITS project.

“This project will result in laying the foundation for a research program in advanced transportation systems and travel demand simulation, which has become a new NIATT priority.”

Dr. Michael Dixon  
Assistant Professor, Civil Engineering

## Establishing Experience and Expertise

This research will place investigators at NIATT and the University of Idaho in a unique position for studying applications and advancements of the TRANSIMS modeling paradigm. The objectives of this UTC-funded project are to

- ✓ Initiate a sustainable research program into the modeling of transportation systems and Intelligent Transportation System (ITS) services.
- ✓ Demonstrate some of the potential uses of TRANSIMS in the planning and evaluation of Intelligent Transportation Systems.
- ✓ Increase student exposure to, and understanding of, exciting innovations in transportation engineering and planning.

To date, TRANSIMS has only been deployed at a few sites and its capabilities and limitations have yet to be fully explored from the perspective of intelligent transportation systems and traffic control. Since TRANSIMS is in its formative stages and as such, its underlying technology will require modifications and improvements, NIATT will be in a unique position to assist with its development.

Other benefits to be gained are that NIATT will be in a unique position to win grants and contracts at a national and regional level and will be in a position to support implementation of the TRANSIMS technology in the Northwest. Also, NIATT will have the capacity to model ITS services and establish their benefits.



National Institute for Advanced Transportation Technology

For more information about the project, Applying the TRANSIMS Modeling Paradigm to the Simulation and Analysis of Transportation and Traffic Control Systems, contact [mdixon@uidaho.edu](mailto:mdixon@uidaho.edu) or visit <http://www.webs1.uidaho.edu/niatt>

Semi-Annual Report—July 2003—December 2003

# Look at this FutureTruck !

## Summit--The Center of Attention

When the FutureTruck is on display, people want to see it, want to learn how it works, and if they can get a chance, want to drive it. This includes the Governor of Idaho, Dirk Kempthorne. After participating in a ground-breaking ceremony at Gritman Medical Center in Moscow, Idaho, where the FutureTruck, nicknamed Summit, was on display, the governor asked if he could drive the SUV. The team was happy to comply, and the governor drove the vehicle to the airport and right up to his plane.

Tamara Cougar, vice president and publicity director, of the Advanced Vehicles Concept Team (AVCT) was able to spend some time with the governor explaining how the triple hybrid systems works. She emphasized to him that the use of the biofuel E-85 in regenerative braking systems would not only decrease emissions, but also could open a new market in an agricultural state such as Idaho. The farming industry also uses large vehicles and would benefit greatly from this technology.

The governor enthusiastically agreed to give the AVCT letters of support as the team tries to expand its research.

## On the Way to Competition!

Yes--when the FutureTruck is on display, people want to see it, want to learn how it works, and if they can get a chance, want to drive it. So the AVCT members have decided to take advantage of the public's curiosity on their way to the FutureTruck competition in June 2004. The team planning a major publicity campaign.

The team is carefully plotting their week-long trip across the country--Idaho to Detroit, Michigan, planning to make stops in major population centers. They will contact television and news agencies to alert them of the UI's FutureTruck appearances on the way to the Ford Proving Grounds, hoping to attract as much media coverage as possible.



National Institute for Advanced Transportation Technology

I think it's safe to assume Governor Kempthorne had fun and wanted to drive the FutureTruck as long as possible. We agreed to stay in touch and keep him updated on the project."

Tamara Cougar  
Advanced Vehicles Concepts Team  
Publicity Director

## Two Vehicles Under Development

The AVCT members are not only working on improvements to the Summit as they prepare for the 2004 FutureTruck competition. They are also converting a 1998 Ford pickup truck into a hybrid. The pickup will be used as the tow vehicle for the SUV. It is being reengineered to run on alternative fuel (ethanol) with regenerative braking from hydraulic power.

The new tow vehicle will add to the interest surrounding the hybrid SUV itself as the two vehicles cross the country.

A portion of the pickup truck's value was donated by an interested seller in Missouri. Wholesale Hydraulics of Moscow, Idaho, is donating an estimated \$50K worth of shop space, machine shop time, labor, hydraulic parts, and technical support; other community businesses are donating a windshield, window tinting, paint, wheels, tires, and parts.

## NIATT Participates in H-TUF

The Hybrid Truck Users Forum (H-TUF) is a national, multi-year, user-driven program to assist the commercialization of heavy-duty hybrid technologies. Operated by WestStart-CALSTART and the U.S. Army's National Automotive Center (NAC), H-TUF works to find applications and generate demand for hybrid vehicles in the commercial market to help speed the development and reduce the cost of such vehicles.

Frank Albrecht, FutureTruck advisor, attended H-TUF's third national meeting held in October in San Antonio, Texas. Currently UI is the only university member of H-TUF. The hydraulic technology developed by the AVCT members is of interest to the group of truck fleet users, truck and system makers, and researchers.

For more information, visit the FutureTruck website  
<http://www.idahofuturetruck.org/>  
or contact Frank Albrecht ([albr9652@uidaho.edu](mailto:albr9652@uidaho.edu))  
H-TUF website: <http://www.calstart.org/programs/htuf/>

# Technology Transfer provides Educational Experience

## Two Birds with One Stone?

Remember when you were a graduate student and you attended the first conference in your field? It was invigorating just to be with people who understood your research and were talking about the same areas of study. You sat next to that person who wrote the textbook you were using! You met the researcher you recently footnoted! You realized you were part of the academy!

Dan Cordon, research assistant in mechanical engineering, recently recalled his first experience like that. According to Cordon, the Western States Section of the Combustion Institute guarantees experiences like that for the students who attend.

This October was Cordon's fifth trip to this annual regional meeting. Cordon traveled to UCLA with advisor Judith Steciak and fellow graduate students Xiangyang Wang, Jeremy Olberding, and Jeffrey Williams, using UTC funds for part of their travel. The four students each made a presentation at the two-day institute (see second column).

The regional institute is the place to try out early drafts of technical papers and begin the process of technology transfer. Abstracts of papers are reviewed before acceptance at the institute. Papers NIATT students give at this conference are usually fine-tuned before presentation at the national conference.

But according to Cordon, the best parts of this regional institute are the many opportunities students get to sit down at a table with a top researcher who is interested in their work, who has made a special point to come to their presentation and hear about the advances made in their work over the past year.

The program in October included talks by invited speakers: Prof. Christopher Cadou, University of Maryland; Prof. Ronald Fedkiw, Stanford University; Dr. E. Douglas Lynch, Boeing/Rocketdyne, and Prof. Michael Zachariah, University of Minnesota.

## Combustion Institute Presentations/Publications

Walker, M., Cordon, D., Beyerlein, S., Steciak, J., and Cherry, M., "Catalytically-Assisted Combustion of JP-8 in a 1 kW Low-Compression Genset," Western States Section of the Combustion Institute Meeting, UCLA, October 2003.

Williams, J., Cordon, D., Boles, J., Olberding, J., Beyerlein, S., and Steciak, J., "Steady-State Dynamometer Results Comparing Operation of a Passenger Van on Gasoline and Aqueous Ethanol," Western States Section of the Combustion Institute Meeting, UCLA, October 2003.

Patel, A., Williams, J., Olberding, J., Steciak, J., and Beyerlein, S., "Modeling Catalytic Ignition Conditions of Propane/Air Mixtures over Platinum Wires," Western States Section of the Combustion Institute Meeting, UCLA, October 2003.

Wang, X., Steciak, J., and Beyerlein, S., "Theoretical Study of Aqueous Ethanol-Air Combustion in Plug Flow," Western States Section of the Combustion Institute Meeting, UCLA, October 2003.

The logo for the National Institute for Advanced Transportation Technology (NIATT). The letters "NIATT" are rendered in a large, bold, black, sans-serif font. A thick, black, horizontal bar is positioned below the letters, extending slightly beyond the left and right edges of the text.

National Institute for Advanced Transportation Technology

For more information, contact Judith Steciak ([jsteciak@uidaho.edu](mailto:jsteciak@uidaho.edu)) or Steven Beyerlein ([sbeyer@uidaho.edu](mailto:sbeyer@uidaho.edu)) or Dan Cordon ([cord4530@uidaho.edu](mailto:cord4530@uidaho.edu))

Semi-Annual Report—July 2003—December 2003

# New ITD Director Visits NIATT

## ITD Director Visits Moscow, Idaho

After Dave Ekern took up the reins of the Idaho Transportation Department in July 2003 as its new director, he began touring the state and meeting with a variety of ITD personnel, legislators, and other leaders in transportation.

On October 23, 2003, he made NIATT one of those stops, along with ITD Chief Engineer Jimmy Ross and Charles Rountree, Administrator of ITD's Transportation Planning Division.

Ekern's visit included greeting the conferees at the 43rd Idaho Asphalt Conference held in Moscow, Idaho. More than 130 registrants attended the annual conference, held in October every year under the auspices of the University of Idaho, the Asphalt Institute and the Idaho Transportation Department. The conference addresses issues related to asphalt pavements that are of concern to local and state governments as well as consulting and engineering firms. Attendees including contractors and material suppliers have found this conference to be a good forum to address design, construction and management issues.

## Ekern learns about NIATT

Ekern's visit gave us the perfect opportunity to inform him about the various types of research being done in NIATT's three centers, the Center for Clean Vehicle Technology, the Center for Traffic Operations and Control, and the Center for Transportation Infrastructure.

During the day, he attended a presentation summarizing NIATT's research projects, he toured the NIATT labs, had lunch with researchers and students, and had individual meetings with the Dave Thompson, Dean of Engineering; Sunil Sharma, Chair of the Civil Engineering Department. He also met with Doug Moore, Director of NIATT's Idaho Technology Transfer Center.

Director of the Minnesota Department of Transportation for 33 years, Ekern was on assignment to the American Association of State Highway and Transportation Officials from , 2001--2003. In that role, he focused on initiatives and policy development that are changing the face of our nation's transportation agencies, such as Intelligent Transportation Systems, traffic incident management, and helping shape congressional reauthorization proposals.



National Institute for Advanced Transportation Technology

## Improving an Important Partnership

Ekern explained his vision for transportation systems of the 21st center: they should be International in scope; intermodal in form; intelligent in culture; and inclusive in service. "That's our new mission. That's what we're all about. That doesn't mean we're not going to build new highways... but we'll combine roads, technology and the information process."

When he talked about a focus on maintaining the transportation system we have in the state of Idaho, and through technology, making it better and more responsive to the demands of today's travelers. This is music to the ears of NIATT researchers, whose work has the same focus.

As he hosted the visit, Michael Kyte, NIATT director, was looking for direction from Ekern for ways to strengthen the ITD-NIATT partnership.

Kyte referred to the draft document, *Idaho's Transportation Future: Getting There Together*, a result of a vision process begun by ITD in November 2002 that included . Asked to state what they thought was the most significant transportation issues in Idaho, 35 percent of the respondents in regional workshops chose a combination of "Condition/Quality of the Roads/Lack of Road Repair/Maintenance/ Traffic Congestion Reduction/Less Crowding." Twenty-seven percent of the respondents chose these same issues as likely to remain the most significant problems 25 years from now.

Specifically, Kyte sought to begin conversations that would help NIATT answer the following questions:

- √ How do we improve the quality of our research?
- √ How do we more directly involve ITD staff on the UI campus?
- √ How do we improve the educational level of ITD's engineers and technicians?
- √ How can we involve UI students with ITD earlier in students' careers?
- √ How can we partner to seek funding for our research initiatives?
- √ How can we leverage or build on our research successes?

# Milestones in Catalytic Reactor Studies

## Steciak and Beyerlein Report “What We’ve Learned”

Researchers Judith Steciak and Steve Beyerlein report some milestones in their studies of engine performance with catalytic reactors. They have collected and analyzed long-term performance data. The research has generated a base of experimental and analytical data that can be used to support the implementation of new low-emissions engine concepts on vehicle platforms.

*We have learned the following through engine testing:*

√ Engine torque and power output is not compromised by use of catalytic igniters or by aqueous fuel.

√ Stock engines need to be equipped with total-seal piston rings when the engine is retrofitted for catalytic igniters and aqueous fuel. Combustion of aqueous fuel occurs at temperatures too low for stock piston rings to undergo thermal expansion and prevent blowby.

√ Monitoring cylinder pressure indicated erratic ignition timing of the original catalytic igniters. Poor timing was found to be caused by the length of the igniter, which permitted ignition too early. A shorter and narrower igniter design achieved consistent timing.

√ While CO and especially NO emissions from aqueous fueled engines are low, unburned hydrocarbons are high. A post-combustion catalytic converter will be needed to oxidize unburned hydrocarbons.

*We have learned the following through analytic work:*

√ A first-order ignition timing model was reasonably accurate in predicting ignition timing. We used the model for parametric studies to see which variables affected timing the most. These variables included igniter length, igniter surface temperature, compression ratio, and fuel water content.

√ Cold starting difficulties are the result of heat losses from the igniter element that prevent it from achieving surface ignition temperatures.

√ Reaction pathways have been hypothesized for ethanol such that pollutant emissions can be approximated through a detailed kinetic model. This is expected to lead the way to a second-order combustion model that can help optimizing ignition timing.



National Institute for Advanced Transportation Technology

*For more information, contact Judith Steciak (jsteciak@uidaho.edu) or Steven Beyerlein (sbeyer@uidaho.edu).*

Semi-Annual Report—July 2003—December 2003

# Bits and Pieces

## “Recycling” UTC Funds

Receiving US DOT funds through the University Transportation Center program provides money a “second time around” for NIATT. The University of Idaho returns to the Institute a share of the facilities and administration (overhead) charges on the UTC grants.

In the fall of 2002 and 2003, 12.5 percent of the overhead return was placed in a pool and allocated to the centers under which the principal investigators did their UTC research. Over \$50,000 was reserved for use in the Centers for Clean Vehicle Technology and Traffic Operations and Control.

An RFP was issued to solicit proposals from those same PIs for the use of those pooled funds. The intention is to use these funds to support up to three activities in each of NIATT’s research centers to further the work of NIATT affiliated-faculty and the academic departments and colleges in which they reside. We are especially interested in using these funds to leverage or attract new externally funded research grants.

The RFP specified that two types of projects were eligible for funding. The first was one in which a group of center faculty would purchase equipment or other capital items that will support a specific transportation research objective and in which the equipment or capital item would be used to help attract new external funds. The second type of project was one expected to result in a submitted proposal to an external funding agency by a group of center faculty.

This “recycled” money helps NIATT achieve some of the long-term goals outlined in the *Strategic Plan*, such as receiving support and new grants from FHWA and other state and federal agencies, and encouraging strong working relationships between the researchers.

## Dan Cordon Selected as Student-of-the-Year

Each fall, UTC centers select an outstanding student to represent their research institute at the January Transportation Research Board Meeting. When faculty choose the NIATT student-of-the-year, we feel proud, not only of the student, but also of what they represent—our successful program of education. Each one of our students has been truly outstanding.

Dan Cordon, who is currently working towards his PhD in mechanical engineering, is no exception. Dan received his BS and MS in Mechanical Engineering from the University of Idaho.

Mr. Cordon’s MS thesis focused on modifications of a transit van to operate on either gasoline or aqueous ethanol, and development of a test protocol that uses the NIATT steady-state chassis dynamometer to approximate emissions and fuel consumption. While working on his MS degree, Mr. Cordon was a member of Idaho Engineering Works—a small team of graduate student mentors who work closely with the Capstone Design students to improve understanding and implementation of the engineering design process.

Along with his academic studies, Dan runs NIATT’s small engine test facility to support several University Transportation Grant university projects like the FutureTruck, Clean Snowmobile Challenge, and Formula SAE. His work in the engine research facility has helped produce a two-time winning Clean Snowmobile, a 75 HP Formula SAE engine, and a Ford DOHC 3.0L V6 that runs on E85 fuel. Through interaction with the users of the facility, he has influenced many students to pursue careers in the automotive and transportation industry.

Dan is teaching a mechanical engineering course this semester that focuses on various aspects of modeling including: engine design parameters, vehicle road-load, chemical thermodynamics, combustion kinetics, heat release, and engine testing.

He has published papers with the Society of Automotive Engineers and *Frontiers in Education*.



# Continued Development and Utilization of NIATT's CID

## CID Central to Remote Access Hardware-in-the-Loop Simulation Lab

One of three focus areas identified in NIATT's *Strategic Plan* is to develop traffic control system technologies that are essential to national intelligent transportation infrastructure. The successful development and licensing to McCain Traffic Supply of the Controller Interface Device (CID) illustrates our success in this area.

The CID, however, is only the beginning of the story. By combining funds from the UTC program and FHWA, NIATT has been developing a state-of-the-art traffic controller lab. As reported in the *2003 Annual Report*, the lab will provide the infrastructure researchers will use to test the implementation of NTCIP standards in a small town traffic control system and to develop and apply a protocol for the design, implementation, and testing of traffic signal timing plans using real-time hardware-in-the-loop simulation.

The lab's importance extends beyond its significance for the research and education programs at the University of Idaho. When completed, both practitioners and researchers from across the country will be able to access the traffic controller lab to test traffic control plans using the CID technology developed by NIATT.

Such remote access will not only greatly minimize the cost of running controller simulations, but will also encourage and permit practitioners and researchers to develop more efficient and cost-effective traffic signal systems.

Seniors from Electrical and Computer Engineering developed a secure web server as part of a senior design course. The server was part of a remote access power systems lab in the ECE department. In tandem with that project, graduate student Jennifer Westburg worked with Dr. Brian Johnson on a UTC project to identify the differences between what is applicable to a power lab and to a traffic controller lab. The development of a web server for the new lab is proceeding.



National Institute for Advanced Transportation Technology

## Four Areas Improved in Next Generation CID

Researcher Brian Johnson, along with teams of undergraduate and graduate students, have been improving the implementation of NIATT's Controller Interface Device (CID). The work generally falls into four areas of research that are being conducted in parallel:

### *Developing SDLC implementation of the CID*

A breadboard prototype of an improved microcontroller board was completed, and required firmware and software is near completion. Testing will begin soon. The new board will enable the CID to communicate with those traffic controllers that utilize the TS2 type 2, or SDLC, connections. While using this method of communication the CID will be able to support all of the available inputs and outputs of the traffic controller as defined in the TS2 standard, an improvement over the previous method.

### *Developing USB driver with shorter read and write times*

The current CID driver completes the read-write cycle in 12 milliseconds. A new USB driver developed by graduate student Manjunatha Reddy-Jayarma and used with one CID is capable of achieving a 2 millisecond cycle. The next stage in testing is to use multiple CIDs.

### *Correcting USB error under Windows XP*

Windows XP initially failed to identify the CID as a proper USB device. A CID II firmware revision, subsequently delivered to producer McCain Traffic Supply, solved this problem.

### *Verifying accuracy of real-time hardware-in-the-loop simulation*

The data transfer between the simulation on the PC, the computer itself, and the CID each have some small time delays that can introduce errors as the delays build up. Graduate student Zhen Li made extensive comparisons on the latencies within the PC, tracking down the sources of the delays and made corrections. The most significant latencies were within CORSIM itself.

For more information, contact Brian Johnson ([bjohnson@ee.uidaho.edu](mailto:bjohnson@ee.uidaho.edu)) or Ahmed Abdel-Rahim ([abdelrah@uidaho.edu](mailto:abdelrah@uidaho.edu))

Semi-Annual Report—July 2003—December 2003

# Faculty Join Center for Clean Vehicle Technology

## *Meeting Stated Goals from Strategic Plan*

As part of its Human Resource goal, NIATT stated that it would work with university departments to encourage the hiring of new faculty members with interests in transportation engineering and to provide opportunities for faculty to get involved in transportation activities by funding projects. Two new UI faculty members, Brian He and Karl Rink, have joined the ranks of the Center for Clean Vehicle Technology and are involved in UTC projects.

## **Brian He Joins Biodiesel Team**

Brian He, Assistant Professor in the Biological and Agricultural Engineering Department is the second new member of the CCVT research faculty. His research interests are biological/biochemical/chemical processes for value-added agricultural and food products from renewable resources, bioreactors for microbial and plant cell cultures, bioproduct separation and purification, biological processes for agricultural/food waste management, and renewable energy from biomass.

Dr. He's PhD in Agricultural Engineering was completed at the University of Illinois at Urbana-Champaign in 2000. He also holds MS degrees in Biosystems Engineering and Chemical Engineering and has published several research papers in the areas of biomass conversion and bioreactor and plant cell culture. Publications include an ASAE paper, "Preliminary Investigation on Glucosinolates Extraction from Yellow Mustard Meal," coauthored with Chunchang Tao.

Recently he received a five-year grant of \$950,000 from USDA Biodiesel Education Program.

The ultimate goal of Dr. He's UTC research project is to explore a technically and economically sound reactor technology for biodiesel production. The construction and testing of a lab-scale reactive distillation column for continuous biodiesel production from seed oils is underway.

Dr. He joins the team of pioneering researcher Charles Peterson, whose research has shown that biodiesel from seed oils such as rapeseed and mustard are viable substitutes for fossil-based fuels due to its environmental advantages and renewable resource availability. Peterson has also shown that seed oils have certain advantages for biodiesel over other vegetable oils, among them are better cold-flow properties.

## **Rink Brings Industrial Experience to CCVT**

Assistant Professor of Mechanical Engineering Karl Rink is the other new member of the Center for Clean Vehicle Technology (CCVT).

His UTC research project involves studying the reliability of automotive inflatable restraint systems (airbags), in particular, pyrotechnic initiators and detonators. So far, he has constructed and verified the proper operation of a radioisotope leak detection test facility. The first task of the experimental program--measurement of the flow rate from a set of small cavity standards--is now underway.

Rink received his BS degree in Aerospace Engineering and Mechanics from the University of Minnesota. He then attended Purdue University to study combustion, gas dynamics, and thermodynamics as applied to jet engines, earning his Master of Science in Mechanical Engineering in 1986.

After two years as a staff combustion engineer at Solar Turbines Incorporated, a leading manufacturer of industrial gas turbines, Karl returned to the University of Utah to earn his Ph.D. in Mechanical Engineering in 1994, based on his work concerning the incineration of hazardous wastes in circulating fluidized bed combustion systems. In his role as manager of compressed gas research at Autoliv ASP, Karl was active in diverse areas of research including the combustion of gaseous, liquid and solid phase propellants, gas dynamics, and thermodynamics.

Karl holds 39 U.S. patents--one of which led directly to the internationally-recognized and automotive industry sponsored PACE award. He is also the author of eight peer-reviewed technical publications, and was named a Purdue University Outstanding Mechanical Engineer in 2000.





**Michael Kyte, Director**  
**Donald Blackketter, Assistant Director**  
**Judy B. LaLonde, Assistant to the Director**  
**Deborah Foster, Finance Technician**  
**Melissa Lines, Technical Writer**

*Center for Clean Vehicle Technology*

**Donald Blackketter, Director**  
**Steven Beyerlein**  
**Karen R. DenBraven**  
**David C. Drown**  
**Brian He**  
**Edwin Odom**  
**Charles L. Peterson**  
**Karl Rink**  
**Judith A. Steciak**  
**Joseph Thompson**

*Peer Review Panel Members--CCVT*

**Basil Barna**  
**John Boesel**  
**Mark Cherry**  
**John Crockett**  
**Donald Durkee**  
**Gerry D. Galinato**  
**Tom LaPointe**  
**James A. McClure**  
**P. T. Moseley**  
**Tim Murphy**  
**Rogelio A. Sullivan**  
**Harry Townes**  
**David E. Walrath**  
**Jerry Whitehead**

*Idaho Technology Transfer Center*

**Douglas Moore, Director**  
**Bruce Drewes**  
**Ruthie Fisher**

*Center for Traffic Operations and Control*

**Michael Kyte, Director**  
**Ahmed Abdel-Rahim**  
**Michael Dixon**  
**Brian K. Johnson**  
**Axel Krings**  
**Paul Oman**  
**Richard Wall**  
**Richard B. Wells**

*Peer Review Panel Members--CTOC*

**Ken Courage**  
**Raj Ghaman**  
**Wayne Kittelson**  
**William C. Kloos**  
**Greg M. Laragan**  
**Jim Larsen**  
**George List**  
**Jim Pline**  
**William Reilly**  
**Carlton Robinson**  
**Stan Teply**

*Center for Transportation Infrastructure*

**Fouad M. Bayomy**  
**Kang-Tsung (Karl) Chang**  
**James F. Frenzel**  
**James Kingery**  
**Stanley M. Miller**  
**James R. Nelson**  
**Richard J. Nielsen**  
**Edwin R. Schmeckpeper**