

NIATT

ANNUAL REPORT



PREPARED FOR UNIVERSITY TRANSPORTATION CENTERS PROGRAM

RESEARCH AND INNOVATIVE TECHNOLOGY ADMINISTRATION

U.S. DEPARTMENT OF TRANSPORTATION

FUNDING PERIOD JULY 1, 2006 THROUGH JUNE 30, 2007 - FY07



THEME: ADVANCED TECHNOLOGY FOR SUSTAINABLE TRANSPORTATION

MISSION

Our mission is to develop engineering solutions (knowledge and technology) to transportation problems for the state of Idaho, the Pacific Northwest, and the United States, and to prepare our students to be leaders in the design, deployment, and operation of our nation's complex transportation systems.

VISION

Our vision is to be one of the premier transportation research and education programs in the United States.

- We are a national leader in developing technology to reduce congestion on arterials, improve the quality and economic viability of biofuels, and reduce the environmental impacts and improve the fuel economy of motorized vehicles (including passenger cars, transit vehicles, and recreational vehicles).
- NIATT faculty and students engage in multidisciplinary research to solve challenging, practical, and relevant transportation problems that have regional and national significance. We create interdisciplinary research and development teams of undergraduate and graduate students, mentored by expert faculty. To ensure our work is relevant and responsive to stakeholder needs, we seek collaborative partnerships with organizations such as FHWA, FTA, the Idaho Transportation Department, and others committed to our values to work on problems of mutual interest. This practice engages our students in meaningful, experiential, learning-centered environments that add value to their education.
- By taking this approach, we integrate our research with the educational mission of the University. At the same time, our research results in technology that satisfies the needs of our customers, both by informing their actions and decisions and by providing them with useful products. We also provide life-long learning opportunities for transportation professionals in Idaho and the Northwest at all levels of practice.
- NIATT's work is carried out in the context of a commitment to preserving and protecting natural and pristine environments. Our research on, and development of, clean vehicles, alternative fuels, and efficient traffic control systems contributes to the sustainability of these environments.

Andrew Findlay maneuvers the NIATT sled through the handling portion of the Clean Snowmobile Competition. The team captured first place in the 2007 SAE competition (also see p. 22).

Rendering of the Sustainable Energy and Transportation Laboratory planned for the UI campus (drawing by Jessica Friend).



We at NIATT proudly celebrate our ninth year as a University Transportation center. As a UTC, NIATT was originally funded under TEA-21 in 1998. We were successful in competition in 2002 and again in 2006, when NIATT became one of ten Tier I University Transportation Centers in the nation.

Our research institute has made significant and lasting local, state and national contributions over its nine years as a UTC. This Annual Report celebrates those achievements as reflected in the thoughts of the researchers, students and partners involved in these activities.

To access this report on the Internet, please visit NIATT at <http://www.NIATT.org>

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TABLE OF CONTENTS

| | |
|---|----|
| NIATT Theme, Mission and Vision..... | 2 |
| Director’s Message | 4 |
| Management Structure | 10 |
| Section 1: RESEARCH, EDUCATION and TECHNOLOGY TRANSFER— FACULTY VIEWPOINT | 13 |
| Section 2: RESEARCH, EDUCATION and TECHNOLOGY TRANSFER— STUDENT VIEWPOINT | 49 |
| Section 3: RESEARCH, EDUCATION and TECHNOLOGY TRANSFER— STAFF VIEWPOINT | 53 |
| Section 4: RESEARCH, EDUCATION and TECHNOLOGY TRANSFER— RECOGNITION BY AND OF OTHERS | 55 |
| Section 5: RESEARCH, EDUCATION and TECHNOLOGY TRANSFER— FINANCIAL VIEW..... | 61 |
| Section 6: RESEARCH, EDUCATION and TECHNOLOGY TRANSFER— RESEARCH PROJECT STATUS | 62 |



Michael Kyte, NIATT Director

DIRECTOR'S LETTER

On September 30, 2006, we received the wonderful news that we, along with nine other universities, had been selected from among 36 applicants to receive funding through the U.S. Department of Transportation's University Transportation Centers Tier I program. Coupled with our success in 2002, we will have received over nine years of funding through UTC competitions by the time that this current grant is completed. We have a lot to be proud of. You will see some of the sources of our pride as you read through this year's annual report.

After a two-year planning process, our new strategic plan was approved by the U.S. DOT in July 2007. The excerpts that follow will give you an idea both how we intend to spend our time and how we intend to invest our research funding during the next four years.

The National Institute for Advanced Transportation Technology (NIATT) at the University of Idaho is poised to become one of the premier transportation research and education programs in the United States. During the past eight years, we used the UTC investment of \$6.2 million to develop a comprehensive program of education, research, and technology transfer. While NIATT's work encompasses a broad range of transportation activities, we directed our UTC funding toward our original theme of "Advanced Transportation Technology," supporting our efforts in traffic operations/control and clean vehicle technology. With \$14 million in external research funding and \$5.6 million in University of Idaho support, we grew from a program of 13 graduate students in 1999 to 73 in 2005.

Our faculty and students engage in research to solve challenging, practical, and relevant transportation problems that have regional and national significance. Federal partners guide our research priorities. Our work covers several modes of surface transportation: public transit, highways, pedestrians, and recreational vehicles. Faculty integrate their research into their course work. Our research is carried out in the context of a commitment to preserving and protecting natural and pristine environments.

Our students earned nearly 90 graduate degrees in transportation since 1999 and now work in government agencies, with private consultants, and in the automotive and recreational vehicle industries throughout the U.S. They are considered leaders by their employers as they make important contributions to the profession. According to former students, our program provides the level and quality of education needed by today's transportation professionals.

We are especially proud of the way in which we have integrated undergraduates, graduate students, and faculty on teams that produce innovative technology and new knowledge. Many of these teams are part of our College of Engineering senior design and graduate research programs in which interdisciplinary groups of students and faculty develop prototypes, extend these prototypes through research and development, and license the products to industry. These programs have been instrumental in our ability to attract new graduate students.

We have established four **objectives** that we intend to meet during the next three years using the UTC program investment. The specific **strategies** that we will use to meet these objectives and examples of the **activities** that we will undertake are described in our new Strategic Plan. These objectives, strategies, and example activities were developed as a result of a two year planning process that engaged more than 40 NIATT researchers, staff, Advisory Board members, and other external reviewers. The strategies and example activities will guide and inform all UTC investments made during the next three years.

- **Objective 1.** Develop arterial traffic management tools that can be used by practitioners and researchers to manage congestion and improve safety
- **Objective 2.** Improve the quality and economic viability of biofuels and reduce the environmental impacts and improve the fuel economy and safety of motorized vehicles (including passenger cars, transit vehicles, and recreational vehicles) to protect the natural and built environment
- **Objective 3.** Increase the number of faculty and students in our research and education programs to enhance the transportation workforce
- **Objective 4.** Transfer the results of our research program to practicing professionals in forms that are usable to them to improve the quality and performance of the workforce

From the dream of a few faculty and administrators in 1991, to the construction of our new center building in 1995, to UTC research funding in 1998, we have become leaders in our community, university, state and nation. With the support of the U.S. DOT to achieve the program presented on the following pages, we are indeed poised to become one of the premier transportation programs in the nation.

My sincere thanks to you for being a part of our program of transportation education, research, and technology transfer.

Sincerely yours,

A handwritten signature in black ink that reads "Michael Kyte". The signature is written in a cursive, slightly slanted style.

Michael Kyte, Director



KAREN DEN BRAVEN, DIRECTOR, CENTER FOR CLEAN VEHICLE TECHNOLOGY

This past year has proven to be an exciting time of transition for NIATT and the Center for Clean Vehicle Technology (CCVT). It has been a year full of excitement and success, with several areas of research reaching completion, and new areas emerging.

The most exciting time, of course, was receiving notification that NIATT was once again chosen as a Tier I UTC, in a very competitive process. While difficult, the application process allowed us to take a long, insightful look at both our past and future, and to plan for evolution as a Center and Institute.

Recent exciting success stories include the victory of the student-led Clean Snowmobile Team in the national Clean Snowmobile Challenge, sponsored by the Society of Automotive Engineers. These students have brought the new technology of direct-injected two-stroke engines to the forefront of recreational vehicle development for pristine environments. A number of former team leaders and graduate student mentors and researchers are now employed with engine and vehicle manufacturers ranging from Bombardier Recreational Products, makers of the Evinrude outboard and Ski-Doo snowmobile, to Western Trailer, designers and manufacturers of unusual over-the-road trailers.

Our biodiesel group continues its work into improving the refining of biodiesel from oil-bearing crops. They continue to try to “close the loop” by creating raw products required for production from waste glycerin.

Ethanol fuels continue to be a area of increasing interest and activity. Work continues in detailing the combustion kinetics of catalyzed ignition of ethanol and ethanol/water fuels. These activities continue to reduce the pollution production and improve the fuel economy of engines using these fuels.

An exciting new area of research involves the design and reliability of air bag inflators. A new laboratory has been completed to investigate hermeticity of the bridge-wire initiators used to set off the inflators. As the initial work nears completion, connections have been made with the military, who use this technology in ordnance, and plan to fund the next phase of research. The hope is that results in this area can impact the civilian, vehicle safety arena.

Another exciting initiative is the ongoing design and installation of the new IDEAWorks Advanced CAD Laboratory. NIATT and the CCVT are assisting in supporting this new lab with computer equipment and software, which will be used for advanced structural vehicle and engine modeling.

You will read of our successes in this report. I hope that you will also gain a sense of what we envision for the future. We are excited about continuing our movement into the 21st century, with our activities in research, education and outreach services.





TIM WHITE, PRESIDENT, UNIVERSITY OF IDAHO

2007 has been an exciting and productive year for both the University of Idaho and one of its premier research institutes, the National Institute for Advanced Transportation Technology (NIATT). I sincerely congratulate director Michael Kyte and the NIATT team of research faculty and students on their many achievements these past months. They are evidence of how, on so many important fronts, our University is *leading*-leading in research that truly makes a difference in Idaho, the nation and the world.

After an intense national competition, NIATT was selected as one of the U.S. Department of Transportation's Tier I University Transportation Centers. This honor recognizes the University's faculty and students for producing quality, nationally important work in a variety of key transportation sectors.

NIATT's team won the 2007 Society of Automotive Engineer's Clean Snowmobile Challenge by engineering an innovative, two-stroke engine. This was the team's third victory in the competition since 2002. Their challenge was to re-engineer a stock snowmobile to reduce emissions and noise while maintaining or enhancing performance. The team won awards for best paper, best presentation, best design, best value, best handling, best ride, best performance, best fuel economy, most improved, and most sportsmanlike. What an impressive list! It is this kind of achievement, in which students excel in hands-on opportunities to engineer sustainable technology, that shows why the University of Idaho is a nationally recognized, globally relevant transportation research center.



IDAHO TRANSPORTATION DIRECTOR, PAM LOWE

The Idaho Transportation Department (ITD) has entered a crucial phase in the design, construction, and maintenance of the state's transportation system. A critical juncture in the state's history, as well as rapidly climbing costs and expanding needs, have come together to challenge ITD as never before.

As we have for the past twenty years, we will continue to depend on the University of Idaho's National Institute for Advanced Transportation Technology for their help in bringing the most relevant research results and transportation technologies to our staff and partners.

We have just hired a new research manager, Ned Parrish. Ned will work with NIATT, the Idaho Technology Transfer (T2) Center and others from the University of Idaho to continue moving ahead with our joint research program. Our program will continue to be focused on our most important needs, making sure that our research investments meet the department's most important outcomes.

NIATT and its T2 Center will also continue to serve a vital function in educating our staff to make sure that we all have the latest information to best serve the citizens of the state of Idaho.

Our partnership is not limited by our current thinking, only by our ability to move forward using the best available knowledge and technology to assure customer satisfaction and efficient governance. For those many reasons, we are optimistic that NIATT and ITD can produce a mutually beneficial series of outcomes for Idahoans.

DON BLACKKETTER, CHAIR, MECHANICAL ENGINEERING DEPARTMENT

NIATT's success as a University Transportation Center adds significantly to the success of the University of Idaho's Mechanical Engineering Department. The UTC grant has been a primary catalyst for helping the ME Department become nationally recognized in clean vehicle research. UTC funds have provided resources that have allowed our research to continue and mature.

One example of this is our research in alternative-fuel vehicles. Before NIATT received its first UTC grant, our students were working on hybrid electric cars. In 1992, working with NIATT when it was a national "center"—NCATT—we (students and faculty) established the Hybrid Electric Vehicle (HEV) Club to educate the public on current developments in hybrid electric technology through demonstrations and participation in HEV competitions. In 1996, their work was beginning to be noticed and the team was invited to participate in the Arizona Public Service Company and Electric Vehicle Technology Competition, where they set a record and won two first place honors.

As with all our vehicle competitions, the students focus on increasing efficiency, reducing emissions, educating the public, and improving consumer appeal. In 1999, the first year of UTC funding, 28 undergraduate and graduate students re-engineered a stock Camero that took top honors at the prestigious Arizona Electrics Race, proving that a long-range electric vehicle was technically possible.

Based on that win, we were awarded the opportunity to compete in the Department of Energy's FutureTruck Competition. The students, now having formed the Advanced Vehicles Concept Team (AVCT), received a 2000 Chevrolet Suburban and two years later, a 2002 Ford Explorer, which they modified for the FutureTruck competitions. The AVCT received major financial support from Schweitzer Engineering of Pullman, WA, and other significant financial, technical, hardware, and software support from numerous national, state, and local manufacturers and automotive businesses. More than 200 students—not just from mechanical engineering—contributed to various aspects of the design and manufacturing of parts over those four years, and a great majority of them found positions in the automotive and related industries.

The UI administration uses the student vehicles as a prime example of the University's research and education programs. Potential students, their parents, legislators, University Board of Regents, and other visitors find the vehicles and the student design area the first or only stop on a campus visit. The student teams have been invited to demonstrate their vehicles at the Idaho state capitol, the SAE Congress, and numerous other state and local events.

We've been able to at least double the number of graduate and undergraduate students who graduate with practical experience in engineering and teamwork. The UTC funds have helped create a sustainable infrastructure that will help us educate students for years into the future. And, the vehicle research has influenced national policy in both the environmental and recreational areas.



SUNIL SHARMA, CHAIR, CIVIL ENGINEERING DEPARTMENT

The strategic plan of the Department of Civil Engineering, at the University of Idaho, calls for a strong focus on transportation research, which is closely aligned with the research goals of the National Institute of Advanced Transportation Technology (NIATT). This has allowed the department to contribute financial resources to support faculty interests in the area of transportation research. Areas of interest have included traffic controls, transportation planning, pavements, materials, infrastructure and geotechnical research.

The opportunity to conduct research through NIATT has been welcomed by the department. At this time, eight of our twelve faculty members have actively worked on research projects funded through NIATT. The opportunity to collaborate on innovative and practical research has also benefited our undergraduate and graduate students in their preparation for a career in transportation engineering.

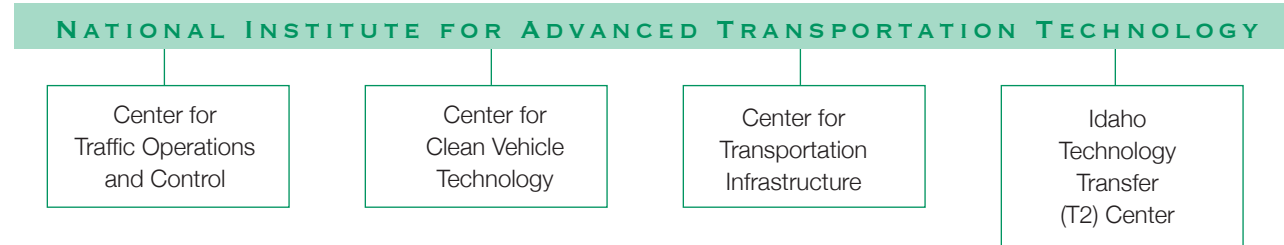
The department wholeheartedly supports NIATT's activities and has certainly benefited from the national exposure provided by the Institute excellent work. We look forward to continuing this partnership in the future.



Civil engineering graduate students working in one of NIATT's traffic labs

MANAGEMENT STRUCTURE AND PRINCIPAL CENTER STAFF

The National Institute for Advanced Transportation Technology (NIATT) is one of six research institutes on the University of Idaho campus. Institute status was granted to NIATT in July 1998 in recognition of its university-wide, multidisciplinary activities. The institute, originally known as NCATT, was established in 1991 under the Intermodal Surface Transportation Efficiency Act (ISTEA).



Although the University Transportation Centers (UTC) program primarily supports the work of NIATT's Center for Traffic Operations and Control and the Center for Clean Vehicle Technology, the UTC funding has a positive impact on the entire institute and our ability to deliver transportation technology. UTC funds are supplemented from a variety of sources, including the Idaho Transportation Department (ITD), Idaho Department of Water Resources, the U.S. Departments of Energy and Defense, and the Federal Highway Administration. The research in the Center for Transportation Infrastructure is supported mainly by the cooperative agreement between NIATT and ITD. The Idaho T2 Center receives major funding from the Federal Highway Administration's Local Technical Assistance Program.

MANAGEMENT STAFF

Michael Kyte
 Director, NIATT
 Professor, Civil Engineering

Donald Blacketter
 Director, Center for Clean Vehicle Technology
 Professor, Mechanical Engineering

Judy B. LaLonde
 Assistant to the Director, NIATT

Deborah Foster
 Financial Technician, NIATT

Steven C. Taylor
 ITS Integration Analyst, NIATT

Karen Faunce
 Research Proposal Writer

Douglas Moore
 Director
 Idaho Technology Transfer (T2) Center

Bruce Drewes
 Training and Research Manager
 Idaho Technology Transfer (T2) Center

Ruthie Fisher
 Administrative Assistant II
 Idaho Technology Transfer (T2) Center

NIATT ADVISORY BOARD

In 1999, we established two peer review panels (one each for our traffic and clean vehicle groups) to help establish our research priorities, evaluate research proposals, and review final project reports.

As we prepared for the 2006 University Transportation Centers competition, we merged these two panels into a single Advisory Board. The members represent all levels of government, the academic community, consulting engineers, and private sector transportation companies. Besides helping guide our activities, the Advisory Board members also champion our technology developments and identify potential partnerships.

Members of the newly-formed Advisory Board met on the University of Idaho campus on April 12 and 13, 2007. Amy Stearns, NIATT's grant officer from the Research and Innovative Technology Administration of the US Department of Transportation, and Matthew Moore, Idaho Transporta-



tion Department Planning and Programming division Administrator, also participated. Ms. Stearns conducted an official USDOT site visit following the formal Board meeting.

The Board reviewed a draft of NIATT's new *Strategic Plan* and proposals for funding for the 2008 fiscal year. NIATT research faculty made presentations concerning their completed and proposed research and two graduate students talked about their experiences with NIATT (see pp.49-50) .

Listening to a student presentation, Amy Stearns, RITA program specialist, with three Advisory Board members (from left), Tom LaPointe, Bruce Christensen and Jerry Whitehead.

Bruce Christensen
*Traffic Engineer, District 4
Idaho Transportation Department*

James Colyar
*Highway Research Engineer
Federal Highway Administration*

Gregory W. Davis
*Associate Professor, Mechanical Engineering
Kettering University*

Gary Duncan
*Sr. Vice President and Chief Technology Officer
Econolite Control Products, Inc.*

Jim Evanoff
*Environmental Manager
Yellowstone National Park*

Gerry D. Galinato
*Principal Energy Specialist, Energy Division
Idaho Department of Water Resources*

Peter Koonce
*Associate Engineer
Kittelson & Associates*

Tom LaPointe
Valley Transit

Jim Larsen
*Congestion Management Supervisor
Ada County Highway District*

George F. List
*Professor and Head of Construction and
Environmental Engineering
North Carolina State University*

Paul Olson
*ITS Technology Engineer
Federal Highway Administration*

Stan Teply
*Professor Emeritus, Civil Engineering
University of Alberta*

Zong Tian
*Assistant Professor, Civil and
Environmental Engineering
University of Nevada, Reno*

Jerry Whitehead
*President
Western Trailers*

A special thanks to our “retiring” peer review panel members, Basil Barna, John Boesel, Mark Cherry, John Crockett, Sen. McClure, Pat Moseley, Tim Murphy, Rogelio Sullivan, Harry Townes, David Walrath, Ken Courage, Raj Ghaman, Wayne Kittelson, William Kloos, Greg Laragan, Jim Pline, and Carlton Robinson for their efforts and support during our first nine years.

NIATT AFFILIATE FACULTY

Ahmed Abdel-Rahim
Assistant Professor, Civil Engineering

Fouad Bayomy
Professor, Civil Engineering

Steven Beyerlein
Professor, Mechanical Engineering

Donald Blackketter
Chair, Mechanical Engineering

Karen DenBraven
Professor, Mechanical Engineering

Michael Dixon
Associate Professor, Civil Engineering

Brian He
Associate Professor, Biological and Agricultural Engineering

Brian Johnson
Professor, Electrical and Computer Engineering

James Kingery
Associate Professor, Range Resources

Axel Krings
Professor, Computer Science

Stanley M. Miller
Professor, Geological Engineering

Richard J. Nielsen
Associate Professor, Civil Engineering

Edwin Odom
Professor, Mechanical Engineering



Ahmed Abdel-Rahim shows Traffic Signal Summer Workshop participants how to set traffic control timing.

Paul Oman
Professor, Computer Science

Karl Rink
Associate Professor, Mechanical Engineering

Edwin R. Schmeckpeper
Associate Professor, Civil Engineering

Judi Steciak
Associate Professor, Mechanical Engineering

Jon Van Gerpen
Chair, Biological and Agricultural Engineering

Richard Wall
Professor, Electrical and Computer Engineering

SECTION 1: RESEARCH, EDUCATION AND TECHNOLOGY — FACULTY VIEWPOINT

Over the past nine years, NIATT has strived to integrate the three components that underpin the University Transportation Centers program—research, education and technology transfer—into all of our work. Our research not only results in useful knowledge and or products transferred to industry, transportation engineers, practitioners, and other researchers, but also taught in University of Idaho classrooms. That knowledge emerges as a result of the cooperative efforts of NIATT faculty working hand-in-hand with graduate and undergraduate students, and often industrial or academic partners. Those same students, armed with this practical education, having already put their classroom learning to work solving real-life problems, are valued by their future employees and have brought valuable skills to the US workforce. We improve and expand our research infrastructure, not only to enable the faculty and student researchers to complete their projects, but also to be used in the University curriculum.

It was not only with great pleasure, but with pride that we were notified by US DOT in the fall of 2006 that we were successful in our competition to continue funding as a Tier I University Transportation Center. We are proud that our work is recognized as significant to the University of Idaho, to the State of Idaho, and to the nation. We are proud that our students are carrying with them into a variety of transportation fields the knowledge and experience to become future leaders in the workforce. We are proud that our research results in new products and better methods and has caused changes in several industries.

Last year, NIATT celebrated 15 years as a research institute. As we prepared for our Advisory Board meeting, Michael Kyte, NIATT director, asked faculty to reflect on what they felt were the most significant outcomes from their work with NIATT, those achievements of which they were most proud. We are proud of their work, and we are confident that as you read what they had to say, you will see why we feel justified in being proud of the results of those nine years worth of effort.

WE ARE DELIGHTED TO SHARE WITH YOU THEIR THOUGHTS.

- Ahmed Abdel-Rahim —p. 14
- Steven Beyerlein—p. 18
- Karen Den Braven—p. 22
- Michael Dixon—p. 26
- Brian He—p. 28
- Brian K. Johnson—p. 31
- Edwin Odom—p. 34
- Paul Oman—p. 37
- Karl Rink—p. 40
- Judi Steciak—p. 43
- Richard Wall—p. 46



Dr. Ahmed Abdel-Rahim, Assistant Professor of Civil Engineering

AHMED ABDEL-RAHIM

"I am most proud of . . .

The development of the Hardware-in-the-Loop lab with its remote access capabilities."

"TRAFFIC CONTROLLER LABORATORY UPGRADE"—KLK206

"REMOTE ACCESS LABORATORY FOR TESTING ADVANCED TRAFFIC SIGNAL SYSTEMS:

OPERATIONAL MANUAL AND APPLICATION GUIDE"—KLK240

"REMOTE ACCESS HARDWARE-IN-THE-LOOP SIMULATION LABORATORY: APPLICATION GUIDE FOR TESTING SOFTWARE-BASED CONTROL SYSTEMS"—KLK121

To most effectively use UTC funds, NIATT researchers have built on each preceding years' work and have incorporated funding from other sources when possible. The Remote Access Hardware-in-the-Loop Simulation project demonstrates this approach this quite well, as we can trace its history back to a project that began nine years ago—the "Development of the Controller Interface Device (CID) for Hardware-in-the-Loop Simulation." That was the first of two projects completed at the request of the Federal Highway Administration (FHWA) that led to the licensing of the CID to McCain Traffic Supply and its release on the market (see also p. 31).

The CID provides engineers with a tool to study traffic networks using hardware-in-the-loop (HILS) simulation. The CID provides the real-time linkage between simulation models and the traffic signal controller, relaying detector information from the simulation software to the traffic controller and traffic control information from the traffic controller to the simulation software. This provides researchers and practitioners with a more realistic representation of real-world traffic operations.

Microscopic simulation models, such as FHWA's CORSIM, simulate a real-world traffic network by moving individual vehicles across a combined surface street and freeway network using accepted vehicle and driver behavior models and simulating various traffic control devices. HILS is different—instead of using CORSIM simply to simulate controller features, the control strategy is run on an actual traffic controller. The CID provides the real-time linkage between CORSIM and the traffic signal controller, relaying detector

information from the simulation software to the traffic controller and phase information from the traffic controller to the simulation software and making HILS possible.

The development of the CID was a significant foundation for NIATT's success in receiving funding from FHWA and the Idaho Transportation Department for a traffic signal integration project in the City of Moscow (the Moscow ITS project). The project has three objectives:

1. Provide a test for the implementation of NTCIP standards in a small-town traffic control system,
2. Develop and implement a plan to improve traffic flow and safety in the City of Moscow by upgrading and integrating the city's traffic signal control system, and
3. Develop and apply a protocol for the design, implementation, and testing of traffic signal timing plans using real-time hardware-in-the-loop simulation.

With a combination of funds from the Moscow ITS project, donations and discounts from vendors of hardware and software, and the UTC grant, we upgraded our traffic controller laboratories and expanded our capability to allow for modeling and analyzing traffic networks with up to twenty signalized intersections. The lab provides the needed infrastructure for the application of CID technology to test and deploy the traffic signal systems for the Moscow ITS project. In addition, it provides a state-of-the-art facility for transportation students in the use of traffic controller systems for classes conducted by the University of Idaho as part of its civil engineering program and in special programs such as NIATT's Traffic Signal Summer Workshop, a training site for transportation professionals in the use of traffic controller systems, and support for NIATT's on-going research.

In the meantime, NIATT researchers used other Idaho Transportation Department funding to further develop procedures for using HILS to develop and test signal timing plans, to develop guidelines for selecting appropriate signal control systems for medium-and small-sized cities, to design, implement and operate centralized and closed-loop control systems, and to develop and present training materials for ITD personnel to use in the design, implementation and operation of these advanced control systems. Subsequent UTC-funded projects supported documentation of the software and development of the Controller Interconnection Network (CIN), a senior design project that was the key to providing remote access to the lab to model advanced traffic control systems.

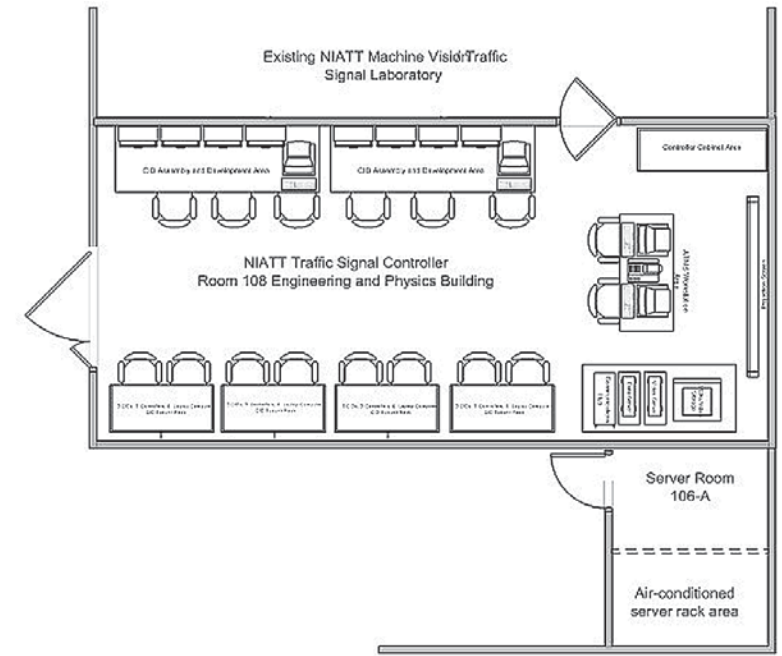
Total investment value of the lab exceeded \$3 million. The lab consists of four groups, or banks, of traffic control devices. Each bank includes five traffic controllers, one USB hub, and one CIN connected to a host computer, one laptop and one workstation. All of the workstations have the software needed to perform engineering activities ranging from introductory to advanced learning levels, including a range of traffic simulation tools.

Beta-testing of the remote access tools, known as RAHILS (or remote access hardware-in-the-loop simulation) began in 2005. The objectives of the beta test were to verify the security of the system and to give the remote beta users the opportunity to access to the computers and conduct six different simulations. E-mails were sent out inviting participation as a beta-user and those



Students working in the upgraded Traffic Controller Lab

Layout of the RAHILS lab.



responding were sent a manual that gave them directions for registering as users and scheduling times, and instructions for completing any or all of six beta-test case studies.

Six case studies were provided:

1. Running a simulation without HILS for one intersection with CORSIM
2. Running HILS for one intersection with CORSIM and Aries
3. Running HILS for three intersections (time-based coordinated system) with CORSIM and Aries
4. Running HILS for three intersections (master-base coordinated system) with CORSIM and Aries
5. Running a simulation without HILS for one intersection with VISSUM
6. Running HILS for one intersection with VISSIM and Aries

PAPERS AND PRESENTATIONS

Abdel-Rahim, A., P. Oman, B. Johnson, and L. Tung, "Survivability Analysis of Large Scale Intelligent Transportation System Networks," presentation at the Transportation Research Board Annual Meeting, Washington, D.C., January 2007.

Dixon, M., A. Abdel-Rahim, M. Kyte, P. Rust, and H. Cooley, "Field Evaluation of Roundabout Turning Movement Estimation Procedures," *Journal of Transportation Engineering* Vol. 133(2), pp. 138-145, 2007.

Kebab, Wassim, M. P. Dixon, and A. Abdel-Rahim, "Field Measurement of Approach Delay at Signalized Intersections Using Point Data," presented at the Transportation Research Board 86th Annual Meeting, 2007 and accepted for publication in the *Transportation Research Record*.

Benke, M., A. Abdel-Rahim, P. Oman, and B. Johnson, "A Case Study of a Small Urban Intelligent Transportation System Survivability Analysis," *Transportation Research Record*, pp. 98-106, 2006.

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- Abdel-Rahim, A., and A. Ismail, "Modeling Accessibility in Urban Transportation Networks: A Graph-Based Hierarchical Approach," Ch. 18 in *Access to Destinations*. Amsterdam: Elsevier, 2005.
- Li, Z., B. Johnson, A. Abdel-Rahim, and R. Wall, "An Automated Tool to Test Traffic Signal Controller Functionalities" in Proceedings of the Transportation Research Board 84th Annual Meeting, Washington, DC, 2005.
- Abdel-Rahim, A., and A. Ismail, "Modeling Accessibility in Urban Transportation Networks: A Graph-Based Hierarchical Approach," Access to Destinations Conference: Rethinking the Transportation Future of our Region, President's 21st Century Interdisciplinary Conferences, University of Minnesota, Minneapolis, Minnesota, November 2004.
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"Being able to use the system remotely and run HILS experiments in such efficient way is just great; it's a great research and educational resource."

An anonymous beta tester of the RAHILS lab.

STEVEN BEYERLEIN

“I am most proud of . . .

The learning environment we’ve created for project learning outside the traditional classroom. This consists of social networking among faculty/staff, graduate students, and undergraduates surrounding physical prototyping in a well-equipped and well-maintained machine shop, virtual prototyping with industry-based CAD tools, and comprehensive engine testing in the Small Engine Research Facility. This environment has produced vertically integrated design teams and web-based learning objects for just-in-time learning in lean manufacturing, internal combustion engines and solid modeling. We’ve established a can-do culture and an assessment mindset that adds value to innovative engineering products and promotes professional growth for all members. The environment we’ve created for project learning: social networking among faculty/staff, graduate students, and undergraduates that involves both physical (design suite) and virtual prototyping (Mindworks and IDEAWorks) as well as hands-on experimentation. This environment has produced vertically integrated design teams, interactive learning activities and web-based learning objects for lean manufacturing (ME 410), machine design (ME 325), internal combustion engines (ME 433), senior design (ME 424/426), and solid modeling (ME 301 revision in fall 2007).”

“MENTORSHIP AND PERFORMANCE ASSESSMENT OF DESIGN TEAMS IN TRANSPORTATION RELATED PROJECTS”—KLK314

“ADVANCED VEHICLE TECHNOLOGIES FOR EFFICIENT POWERTRAIN PERFORMANCE”—KLK340

“IDAHO DESIGN ENGINEERING ANALYSIS WORKS (IDEAWORKS): COMPUTING RESOURCES, KNOWLEDGE MANAGEMENT, AND DESIGN OPTIMIZATION FOR NEXT GENERATION VEHICLES”—KLK430

Besides his interest and on-going research in engine testing and modeling, Steve Beyerlein has been active in the application of educational research methods to engineering courses. This combination of interests has helped NIATT make education and research so well integrated. In order to adequately prepare our student researchers to be productive members of today’s rapidly changing world, Steve recognizes that they need to develop state-of-the-art approaches to design and just-in-time methods for learning relevant tools, techniques and technologies. For many organizations, especially universities, this problem is accentuated by a large annual turnover of those who participate in research and development. Beyerlein and his colleagues in the Idaho Engineering Works (IEW) strive to integrate physical, virtual and human elements in knowledge transfer to overcome this challenge.



Steve Beyerlein, Professor of Mechanical Engineering, talks with the senior capstone design students displaying their Formula SAE car at the 2007 Engineering Expo.

Steve, along with Edwin Odom, Donald Blacketter, and Karen Den Braven, has been leading the effort to establish a learner-centered computing laboratory to complement the design infrastructure network NIATT has been able to build over the last ten years to support senior design projects, graduate research in transportation, and competition vehicle projects (i.e., FutureTruck, Clean Snowmobile, Formula SAE). IDEAWorks—Idaho Design Engineering Analysis Works—began in the 2005-06 academic year as a concept prototyped in ME504, a special topics course. Case studies, SnagIt videos, and technical papers from this class received many accolades at the 2006 Engineering Expo.

Beginning in the summer of 2007, using UTC funds, NIATT will be partnering with the ME Department, the Boeing Company, and Dessault Systems to turn the students' concept into reality. A substantial investment for Phase I (estimated at \$33,000) will add new computing hardware (high-end PCs, flat screen monitors, projection equipment), room utilities (power, internet, lighting), room finishing (wall surfaces, floor, windows), workstation furnishings (collaboration-friendly work areas, ergonomic surfaces for keyboards and books, moveable chairs, storage for students' personal effects). NIATT's initial share of the investment will come from returned indirect costs from the UTC grant.

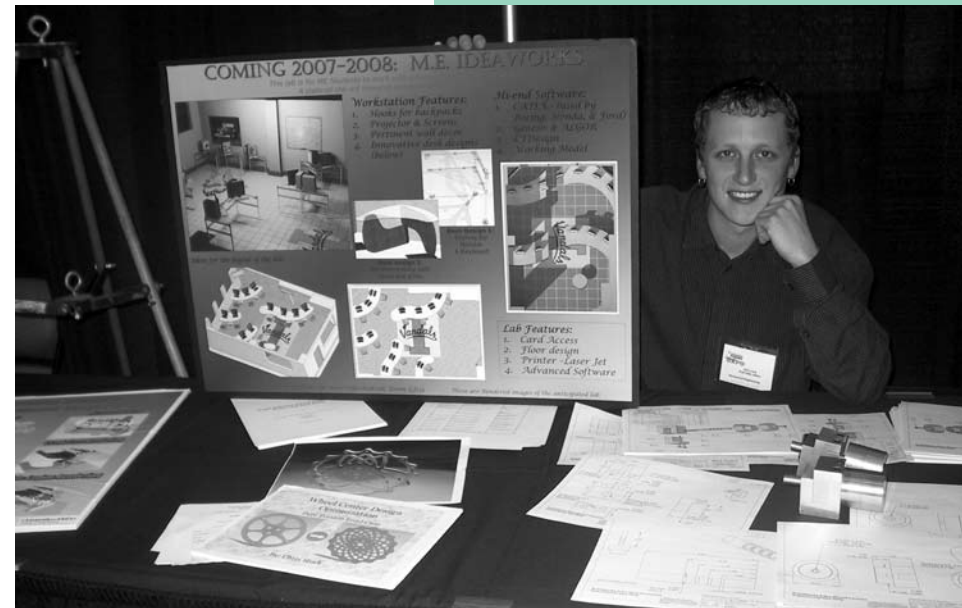
With the completion of IDEAWorks, UI students will have access to a unique learning environment for conducting mechanical design optimization in transportation research, attracting and training graduate students, and building capacity for future proposals.

The philosophy behind the IDEAWorks concepts can be applied to all adult learners:

- Learning is a shared responsibility between learner and teacher.
- Faculty should play a key role in guiding the learning process.
- Whenever possible, real-world linkages should be used to enhance learning.
- Learners must take time to prepare for learning activities.
- Learning is social, requiring group processing of new ideas.

Special emphasis developing materials to be used in IDEAWorks was placed this last year on applications in transmission design, structural design and intake/exhaust design. Four ME graduate students were supported in part by NIATT:

- Jason Sagan researched hybrid transmission design. Hybrid technology allows for lower fuel consumption and lower emissions compared to conventional drive systems. Sagan sought to design a hybrid transmission as part of a power train configuration much lighter and more efficient than series hybrids. The technology will be tested in a hybrid-powered formula style race car for the FSAE competition.
- Phil Arpke developed a set of mentor-directed and self-directed resources for using SolidWorks, which has a learning curve that can frustrate students. His work should enable a next generation engineering drawing course at the sophomore level that is better aligned with the demanding needs of large-scale vehicle research projects.
- Chris Huck continued the development of the evolutionary structures program (ESOP) created by a former grad student, defining a set of simple test cases that can be used for efficient frame configurations for use in future vehicle design projects.
- Charles Dean used advanced engine and thermofluid modeling packages to assist the Clean Snowmobile team in its development of a turbocharged, direct-injection, two-stroke engine



John Lacy, a member of IEW, is ready and willing to talk about the future of IDEAWorks at a 2007 Engineering Expo student booth.

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The NIATT converted van, the nation's first operational hydrous wet ethanol vehicle, a 1986 Ford Econoline van, made an appearance at the South Dakota Farmers Union convention, where Mark Cherry of Automotive Resources, Inc., talked about the water-ethanol technology (also see p. 43).



Dr. Karen Den Braven answers a visitor's questions about the winning snowmobile at the 2007 Engineering Expo display.

KAREN DEN BRAVEN, PROFESSOR, MECHANICAL ENGINEERING

"I am most proud of

Our results in the Society of Automotive Engineers' Clean Snowmobile Challenge. We are three-time winners in the seven years we have competed, using both four-stroke and direct-injected two-stroke technologies. We have developed what will likely be the first two-stroke snowmobile to meet National Park Service Best Available Technology (BAT) Standards. This year, we developed a team including freshmen to graduate students that captured first place and eight other awards. We've also had great success placing students in industry."

"DESIGN AND CONSTRUCTION OF A TURBOCHARGED, DIRECT-INJECTION, TWO-STROKE SNOWMOBILE FOR COMPETITION IN THE SAE CLEAN SNOWMOBILE CHALLENGE"--KLK433, KLK410

"UNIVERSITY OF IDAHO'S CLEAN SNOWMOBILE DESIGN USING A DIRECT-INJECTION, TWO-STROKE ENGINE"—KLK347

"DESIGN AND CONSTRUCTION OF A DIRECT-INJECTION TWO-STROKE SNOWMOBILE FOR COMPETITION IN THE SAE CLEAN SNOWMOBILE CHALLENGE"—KLK341

"ALTERNATIVE POWERED SNOWMOBILE"—KLK309, KLK303, KLK304

"The results that Idaho and other universities have produced in the SAE Clean Snowmobile have been very influential in the development of the Record of Decision regarding snowmobile use in Yellowstone. Results are also in current use in developing the Implementation Policy for this Record of Decision."

Karen Den Braven, Clean Snowmobile Team Advisor

Due in part to stringent noise and air pollution control measures recently imposed on snowmobiles by the US National Park Service (NPS), the Society of Automotive Engineers (SAE) instituted a student competition called the Clean Snowmobile Challenge (CSC). The Clean Snowmobile Challenge is unique among SAE student competitions because it addresses not only technology improvement, but also political challenges in the question of recreational vehicle use in sensitive environments such as Yellowstone National Park.

The SAE competitions are an excellent educational tool that helps promote a positive hands-on working environment for students. In addition, the students in the CSC learn not only the importance of teamwork and leadership, but also the discomfort and caution that can come from working on a solution to a politically sensitive issue. The student competitions are open to the public where various snowmobile manufacturers spend time visiting the student teams and observing what the students have done. Students on the UI team have received numerous internship and job offers from the snowmobile manufacturers Polaris, Arctic Cat, and Ski-Doo/Bombardier, as well as from other vehicle manufacturers such as Honda, International and Caterpillar. The companies have seen the quality of the UI students and actively seek them out during and after competition. The NPS, SAE and EPA also closely watch the performance of the student sleds while they are developing potential performance requirements for snowmobiles in sensitive areas.

The NIATT team won the 2002 and 2003 CSC competitions with a snowmobile powered by a four-stroke motorcycle engine. The snowmobile also won the World Championship Hill Climb in 2002 in Jackson Hole, Wyoming, and was named “King of the Hill” (taking home both the belt buckle and bragging rights). The UI was also invited to bring its winning snowmobile to the Southwest Research Institute (a certified emissions testing laboratory) for detailed emissions testing. The measurements taken at SwRI proved that the UI snowmobile was not only cleaner than the other student snowmobiles, but was also cleaner than the two commercially available four-stroke snowmobiles that were tested. In 2003, the Idaho team dominated the competition, bringing home the championship (with 1245 out of 1400 possible points). The team achieved first place in fuel economy, emissions, and sound, and also won the Best Value and Best Performance awards.

In 2004, the team obtained a stock two-stroke snowmobile and began the conversion to direct fuel injection. Technical challenges included proper design of the cylinder head and developing precise electronic control of the fuel pump and fuel injectors. Direct injection can lessen the effects of charge and exhaust gas mixing, and significantly reduce, if not eliminate short-circuiting. Cold start reliability and efficiency is also improved. In a gasoline direct-injection (GDI) two-stroke engine, fuel is injected into the cylinder when the exhaust ports are nearly or completely closed. Air-assisted or high pressure fuel injectors are used to ensure the fuel atomizes quickly for combustion.

In 2005, the UI GDI engine was not fully ready for competition; however, the team was first in Oral Presentation, second in the Static Display, second in Acceleration, and was the lightest snowmobile at the competition. In 2006, the team was first in Oral Presentation and Static Display, second in Design Paper, completed the 100-mile fuel economy endurance run with an average of 13 miles per gallon, and was again the lightest. The team was unable to completely tune the engine for competition conditions due to the inability of the UI dynamometer to maintain steady conditions during testing. This test equipment has recently been upgraded (with UTC funding) to improve the capabilities somewhat.

We made contact with the engineers at Bombardier/Ski-Doo responsible for developing their out-board engine direct-injection system and they agreed to begin assisting us. The 2004 and 2005 UI-CSC team co-captains had summer internships at Bombardier engineering headquarters, returning in fall 2006 to continue graduate studies.

Several years of intensive effort by the students to develop the GDI two-stroke powered snowmobile came to fruition in March 2007, when the UI CSC team once again brought home First Place in the Clean Snowmobile Challenge and numerous other awards, including:

- Gage Products Award for Best Fuel Economy with an average 19.6 mpg
- Polaris Industries Award for Best Handling
- SAE Award for Best Design
- Denso Corporation Award for Best Ride
- Emitec Award for Best Value
- Land and Sea, Inc. Award for Best Performance and
- Founder’s Award for Most Sportsmanlike Conduct.



Team captain Andrew Findlay interviewed at the 2007 SAE-CSC (Photograph courtesy of Dan Nehmer)



“We won because we had the most well-rounded snowmobile, with lowest weight, stock horse power, low emissions and improved fuel economy due to direct injection. When you put all that together, it’s a fun sled to ride. It takes a pretty tight team with a lot of dedication and devotion to put all that together and pull it off.” Justin Johnson, a graduate student mentor for the CSC team who received his MSME degree in May 2007 and is beginning his new career at Bombardier.

The CSC team accepts a trophy at the end of the competition. Left to right: kneeling: Ben Hanks, Brian Hanson, team captain Nick Harker, CSC Organizer Jay Meldrum; standing: Alex Fuhrman, Ben Armstrong, Dylan Dixon, Chris Tockey, C. J. Stock, Andy Findlay; Justin Johnson, Rachel Geerlings, team advisor Karen Den Braven, and David Polehn.

The Idaho two-stroke DI snowmobile was also the lightest by nearly 100 pounds. The snowmobile met NPS sound reduction requirements, and is very close to meeting their pollution emissions reduction requirement.

Mechanical Engineering students have the option to receive technical elective class credit for participation on the team. In the academic year 2005-2006, seven students received credit, while 14 students received credit in 2006-2007. The team consists of students ranging from new freshmen to graduate students, who act as mentors for the team. In addition, the clean snowmobile is one of the projects utilized in the Mechanical Engineering Department’s Senior Capstone Design sequence. This past year it involved two teams of three senior ME students and a graduate student mentor. The first team redesigned the engine head to incorporate pressure sensors that allow in-cylinder combustion process monitoring as we develop controls for the turbocharging. The second team designed an exhaust and emissions reduction system.

Other activities include our participation in the professional SAE Small Engine Technology Conferences. SAE meetings are attended by major manufacturers of engines, vehicles, government agencies, researchers and engineers focused on exchanging information about cutting-edge transportation vehicle technology. The team also participates in meetings and conferences of the Combustion Institute (CI), an international organization of researchers, educators, and engineers devoted to enhancing the understanding of combustion phenomena. CI publishes the leading journals in the discipline and encourages the participation of students by providing modest travel grants.

As winners for three of the seven years it has competed, the University of Idaho has taken the lead in developing clean, quiet and fuel-efficient snowmobiles. Plans for 2008 are to develop a practical ethanol-powered DI two-stroke snowmobile engine. This will further improve on the present competition snowmobile and show a possible future for the snowmobile tourist industry.

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Justin Johnson answers a question from a judge at the clean snowmobile static display. (Courtesy of KRC/MTU)

Visit the Idaho Clean Snowmobile Challenge Team: <http://www.uidaho.edu/uicsc/>

Read about the snowmobile competition on the web:

Competition: <http://www.mtukrc.org/snowmobile.htm>

SAE: <http://students.sae.org/competitions/snow/>

Ezine @rticle: <http://ezinearticles.com/?Snowmobiles-Going-Green&id=612265>

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Washington State Snowmobile Association: <http://www.wssa.us/>



Michael P. Dixon, Associate Professor of Civil Engineering

MICHAEL DIXON

“I am most proud of . . .

Our high quality intersection traffic data repository. With this, we have gained the highest understanding of data acquisition, processing, and analysis advancing the transportation engineering knowledge base that we are able to share with other researchers. At this point NIATT is poised for additional advancements using a new video data collection system and high resolution data.”

CURRENT AND PAST RESEARCH

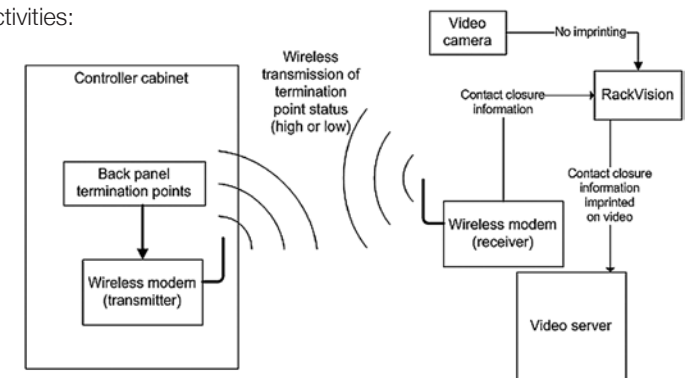
“APPLYING THE TRANSIMS MODELING PARADIGM TO THE SIMULATION AND ANALYSIS OF TRANSPORTATION AND TRAFFIC CONTROL SYSTEMS” — KLK231

“AREA-WIDE PERFORMANCE MEASURES FOR TRAFFIC SIGNAL SYSTEMS” — KLK237

“DEVELOPMENT OF NEW ACTUATED SIGNALIZED INTERSECTION PERFORMANCE MEASUREMENT METHODOLOGIES, PHASES I AND II” — KLK120, KLK133

Mike Dixon's work over the past few years has involved a variety of activities:

- Manual field data collection
- Automated delay measurement
- Phase failure detection
- Arterial travel time estimation
- Turning movement estimation at roundabouts
- Automated video processing testing
- Mobile video data collection system

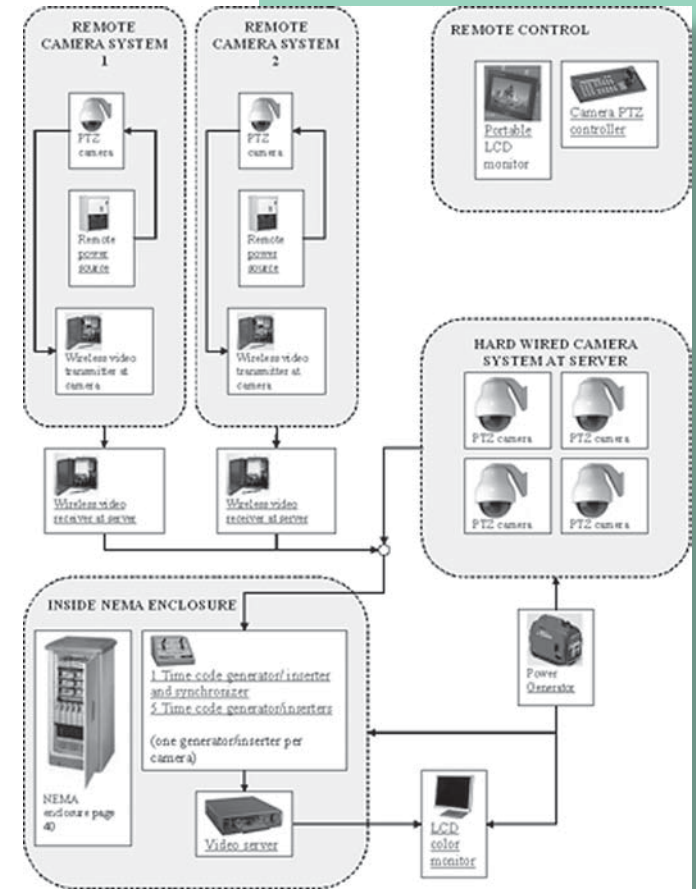


Much of Dixon's work involves the collection, organization and evaluation of data, all with the intention, in the long run, to improve transportation engineers' understanding of why, when, and how congestion happens and then the ability to alleviate the congestion.

The illustration here is an example of how traffic controller data can be integrated with video traffic data, enabling researchers to make connections between what vehicles are doing and what the controller is doing. All this also makes it easier to develop driver behavior algorithms to be used in simulation. With accurate predictions—models—researchers can learn how congestion starts, how it increases, and how it ends. The verified data can be implemented in commercial microsimulation.

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Portable traffic video system.



Dr. Binjun (Brian) He, Associate Professor of Biological and Agricultural Engineering

BRIAN HE

“I am most proud of . . .

The research on biodiesel fuels in which I’ve been involved over the past four years is the first of its kind that has yielded significant scientific and technologically-sound results and attracts interest from both the academic community and industry. We turned the thesis done by graduate student Arvinder Singh into a paper that won the 2007 Superior Paper Award from the American Society of Agricultural and Biological Engineers.”

“A NOVEL CONTINUOUS-FLOW REACTOR USING A REACTIVE DISTILLATION TECHNIQUE FOR ECONOMICAL BIODIESEL PRODUCTION, PHASES I AND II” — KLK340; KLK343

The ultimate goal of Dr. He’s research was to develop a technically- and economically-sound reactor technology for large-scale biodiesel production. A bench-scale reactive distillation (RD) reactor for biodiesel preparation was designed, fabricated, and tested. Experiments show that the process produces biodiesel at a production rate of about 0~15 gal/gal/hr (usual practice is 0.5~1.0 gal/gal/hr) continuously with an alcohol-oil ratio of 3.5:1, reducing by two-thirds the alcohol typically used in industrial practice. The retention time (reaction time) of the feedstocks in the column is less than 10 minutes compared to 60 to 180 min in existing processes used in industry. The conversion profile of the feedstock, which was monitored at multiple locations, clearly illustrates the progression of the reaction along the column. The reactor was easy to start up, operate, and control. There were no difficulties experienced in long-term operation. This technology not only greatly reduces the use of excess alcohol, but dramatically increases the productivity.

“BIODIESEL QUALITY AFFECTED BY SULFUR CONTENT ORIGINATED FROM DIFFERENT FEEDSTOCKS AND A DATABASE FOR THE SAME” — KLK432

June 1, 2006 was the deadline nationwide to start to comply with stringent limitations on the sulfur content of highway diesel fuel. The sulfur content in most diesel fuel will transit from low-sulfur diesel (LSD) to ultra-low sulfur diesel (ULSD). In other words, the sulfur content in the diesel fuel has to meet the 15 parts per million (ppm) sulfur standards. To ensure that the diesel sold at the pump still meets the standard, diesel refiners have to enforce a more stringent criterion to lower sulfur content far

below 15 ppm, even as low as 3~4 ppm, due to the concerns of possible contamination between the refinery's gates and retail pumps.

Biodiesel, used as transportation fuel, will have to meet the same standard. Generally, biodiesel contains lower sulfur than fossil diesel. However, currently the biodiesel industry does not have the capability, as petroleum refineries, of refining the fuel to remove sulfur to the level as specified by EPA. According to our preliminary study on six feedstocks for biodiesel production, the sulfur content in the raw materials was typically between 20 to 30 ppm, with the highest of 44 ppm. After processing, the sulfur content in the crude glycerol by-product was in the similar level as in raw oils, indicating that the sulfur content in the biodiesel product may be higher than 15 ppm.

There are many questions raised regarding how the sulfur content in the feedstocks affects the biodiesel quality. How does the sulfur content vary among the feedstocks? How does the sulfur distribute between the biodiesel product and the crude glycerol by-product? Is the sulfur content of a feedstock affected by its soil conditions where it is grown? Is there a correlation between the fatty acid profiles and the sulfur content? These are the very important questions. To comply with EPA regulations, biodiesel needs to meet the same ULSD standard as fossil diesel. However, to the best of the PI's knowledge, there is no published information that systematically

addresses these issues. As a leader in biodiesel research and utilization, University of Idaho has the responsibility to help the biodiesel producers, distributors, and consumers gain the knowledge on biodiesel quality as affected by the sulfur content of different feedstocks.

Therefore, the goal of Dr. He's project is to conduct a thorough research on the sulfur issues related to biodiesel feedstocks, sulfur distribution/accumulation, and its effect on fuel quality through the tasks specified above. Upon completion of the project, a database will be established to document the findings for use by the biodiesel industry, government agencies, consumers, and general public as a guideline in compliance with federal policy of ultra-low sulfur transportation fuels.



Set-up of the reactive distillation reactor for biodiesel preparation

“The Idaho Energy Division, a part of the Idaho Department of Water Resources (IDWR), is the state energy office. It has long been involved in alternative fuel programs and enjoys a close and rewarding working relationship with NIATT and the University of Idaho. We believe that NIATT fills a vital need. Alternative fuel technology has exploded into one of the most exciting segments of the international economic and industrial arenas. It combines national energy security strategies, environmental protection techniques, an engine for economic development, and other critical elements to make it a front burner issue in the United States. The University of Idaho is recognized worldwide as a pioneer and leader in biofuels research.

Our partnership with NIATT creates a win-win situation. The University and NIATT have strong technical and analytical expertise; the Energy Division has solid practical engineering experience and a strong record of public outreach for renewable transportation fuel. NIATT is an important element in the continuance of the University's vital influence on the advancement of alternative fuels.”

John Crockett, Bioenergy Manager,
IDWR

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BRIAN K. JOHNSON

“I am most proud of . . .

The development and licensing of the CID II and the CID software suite.

**“DEVELOPMENT OF CONTROLLER INTERFACE DEVICE (CID) FOR
HARDWARE-IN-THE-LOOP SIMULATION, PHASES I-III”—KLK201**

“NEXT GENERATION CONTROLLER INTERFACE DEVICE”—KLK209

**“SOFTWARE MAINTENANCE SUPPORT FOR CURRENT GENERATION CID”—
KLK208**

**“ROAD MAP FOR FUTURE CONTROLLER INTERFACE DEVICE PROJECTS’—
KLK216**

**“EXPANDED CONTROLLER INTERFACE DEVICE IN/OUT AND SOFTWARE
CAPABILITIES”—KLK235**

“CONTROLLER INTERFACE DEVICE SOFTWARE DOCUMENTATION”—KLK238

The development of the Controller Interface Device (CID) was one of the first projects that NIATT undertook when funding from the UTC program was awarded. The CID has been one of the key elements in FHWA's long-term ITS research and development agenda. FHWA asked NIATT to design a version of the CID based on the earlier work of Darcy Bullock of Purdue University. With Darcy Bullock and Tom Urbanik, then of Texas A&M, as partners, a multi-disciplinary team was formed of undergraduate and graduate civil, mechanical and electrical engineering students along with Richard Wells, Brian Johnson, and Michael Kyte.

In November 1999, a peer review evaluation of the initial work on the CID took place in Moscow, chaired by a member of NIATT's peer review panel. The evaluation considered the technical aspects of the CID, the review process itself, the marketing of the product and institutional and other issues. The review was positive; FHWA and state representatives on the evaluation panel indicated that the product did an excellent job of meeting their expectations. NIATT's first breadboard prototype was exhibited at the 1999 UI Engineering Expo. That summer, the second generation prototype was exhibited at the international meeting of the Institute of Transportation Engineers in Las Vegas. The CID II was licensed to McCain Traffic Supply, Inc., of California in 2002, and FHWA formally unveiled the device at its booth at the 81st Annual meeting of the Transportation Research Board in January 2002.



*Dr. Brian K. Johnson,
Chair, Electrical
and Computer
Engineering*



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New Product Helps Improve
Traffic Signal Timing



Controller Interface Device (CID II)

The CID II Allows Real Time Simulation of Signal Timing Plans

The CID II is a communications device that allows traffic engineers to link a traffic simulation program like CORSIM directly to a NEMA 170, 2070, future ATC traffic controller or any other type of traffic actuated controller. This link between software and hardware is known as real-time hardware-in-the-loop simulation. It allows an engineer to fine-tune a traffic signal timing plan using actual controller hardware, in real-time, in the convenience and security of the office, lab or signal shop. The traffic engineer can also fine-tune coordination, systems operation, traffic response or traffic adaptive control operation by interconnecting a number of controllers, each under CID II supervision.

How Does the CID II Work?

CORSIM simulates traffic flow based on traffic demand, street geometry and signal control plans for a given set of intersections. When vehicles approach a signalized intersection in the simulation, CORSIM sends a signal from the PC to the controller that vehicles have been detected. The controller reacts to these signals as it would react to real detector actuations, and sends CORSIM indications of the signal changes as well. Both the simulation and the controller run in real-time, i.e. one second of simulation takes one second of actual time. It is the CID II that makes this real-time exchange of data possible.

Subcase Tester Function

The CID II can also be used as a "virtual subcase tester" to test and evaluate the operation of various traffic controller functions. The CID II subcase tester function is an easy-to-use alternative to the traditional controller tester.

CID II Specifications

The CID II software (included with the hardware) runs on a PC or laptop computer running Windows 98, 2000, XP or Me.

Data transfer between the PC and the CID II is via a Universal Serial Bus (USB) cable. Data transfer between the CID II and the traffic controller is done over cables configured for the various controller input/output connectors or hard-wired to the detector inputs. A version to tie the CID II into the HDLC serial port is under development.

The CID II can connect to 64 inputs and 64 outputs on the traffic controller.

Power 120 VAC, 60 Hz (240 VAC, 50 Hz optional)
Dimensions Height - 8 inches (20 cm) width - 13 inches (33 cm)
Depth - 11 inches (28 cm)

Developed by NIATT at the University of Idaho, manufactured by McCain Traffic Supply, Inc.

McCain reserves the right to change product specifications without notice.
McCain 05/03

In their 1999 report, Peer Review members showed great foresight when they listed a number of traffic signal control applications that the CID could address:

- Bench testing of controllers and cabinets
- Optimization of intersection performance
- Testing new intersection applications or deployment
- Planning for the impacts of special events
- Training and education of students and practitioners
- Testing of existing and new controller features
- Research into alternative control strategies

The reviewers also noted that although the hardware could become obsolete with the development of new traffic control technology in the next generation of traffic signal controllers, the software development for use with the CID would remain viable. Five years later, the CID II remains the backbone of much of the research being done at NIATT in the field of traffic signals (see p. 15). In his PhD dissertation, Zhen Li summarized how the CID can provide a real-time link between a microscopic stochastic traffic simulation model and a traffic signal controller:

A CID has been successively designed that provides a real time link between the CORSIM model and a traffic signal controller. The new device solves most of the problems that had been identified with the first generation CID, including the number of CIDs that can be used in HILS, the low data communications speed, and the number of controller functions that can be used in HILS. The new device has been designed so that up to forty externally controlled intersections can be included in HILS. USB protocol allows for a significantly increased communications speed, using serial communications, over the first generation CID. The number of controller functions has been increased through the use of 64 input and output channels. A system engineering approach was used to develop a set of design requirements for the CID. The interface software was designed for real-time operations, high error tolerance, established timing constraints, timing synchronization, and ease of use. Several generations of the design, and the software tools that were necessary for the efficient working of the HILS environment, were tested by beta testers operating external to the University of Idaho. The CID was licensed to McCain Traffic Supply in 2002 and is now in use by a number of researchers and organizations throughout the U.S. In addition, a new laboratory has been completed at the University of Idaho that uses up to twenty CIDs in various and configurable traffic networks. . . .

A real time simulation system (HILS) has been realized with only minimal latencies. The inclusion of the data transmission speeds possible through the USB communications link is an important factor in meeting this objective. A thorough analysis, using three analysis tools and several tests that generated real data, was conducted on the various possible latencies that might exist in the new system, both software and hardware latencies. The total latency, from all sources and one CID in the HILS system, was found to be no more than 28 ms, clearly an insignificant value for one second time-step microscopic simulation models. . . .

For simple traffic control configurations, in which the traffic controller is not called upon to use any advanced features, the results produced by HILS are similar to the simulation results produced by CORSIM. For more complex traffic control configurations, in which advanced traffic controller features are used or in which manufacturer-specific features are used, the results produced by HILS are likely to be different (and better, more accurate) than the results produced by CORSIM.

Promotional material from
McCain Traffic Supply, Inc.,
about the benefits of the CID.

Johnson directed a 2004 UTC project in which one goal was to expand the capability of the CID II for applications where the number of input/output connections limit performance. The second objective was to investigate a new application area for CID technology, developing and testing a prototype to use the CID and CORSIM simulation to test traffic controller compliance to NTCIP communication standards. A synchronous data link control (SDLC) interface capability was developed, and a real-time playback system (RTPB) to test CID performance was completed. This procedure can be used to test the accuracy of hardware-in-the-loop simulations and test the effects of time-step size of the simulation, either in addition to or independent of communication latency. Use of the RTPB process has shown that the HILS process is not creating artificial timing errors in the simulation results.

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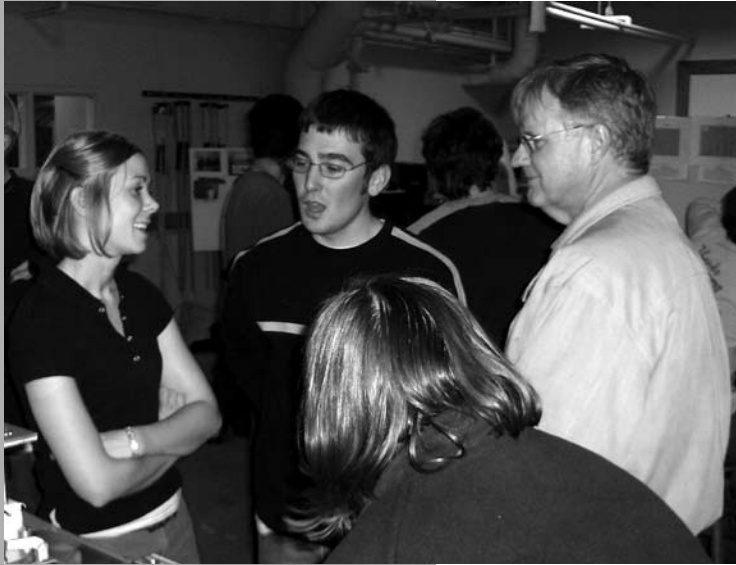
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Members of the first CID team: (front row, from left) Zhen Li, PhDCE; Dr. Brian Johnson; Ying Zhou, MSEE; Kenton and Tricia Veeder, MSME ;(back row, from left) Greg Klemesrud, UI electronics specialist; Barry Klaus, computer support; Ivan Anderson (MSEE); and Dr. Richard Wells.



*Dr. Edwin Odom,
Professor of
Mechanical
Engineering*

Students in the IEW program built three separate test beds as part of their design work: a hybrid electric vehicle for the Arizona Electrics Competition; the FutureTruck, sponsored by the Department of Energy, Ford, and General Motors; and snowmobiles for the SAE Clean Snowmobile Challenge. The test vehicles are regularly used as showcases for campus visitors and prospective students to illustrate the significant work conducted in the College of Engineering.

EDWIN ODOM

“I am most proud of . . .

Three things:

1. Removing the compartmentalization between undergraduate and graduate education and research
2. Creating an environment that asks and expects the best from our students, and
3. Significantly increasing the design infrastructure for our research.”

“IDAHO ENGINEERING WORKS (IEW)”—KLK323

“MENTORSHIP AND PERFORMANCE ASSESSMENT OF DESIGN TEAMS IN TRANSPORTATION RELATED PROJECTS”—KLK314

“ADVANCED VEHICLE TECHNOLOGIES FOR EFFICIENT POWERTRAIN PERFORMANCE”—KLK340

“IDAHO DESIGN ENGINEERING ANALYSIS WORKS (IDEAWORKS): COMPUTING RESOURCES, KNOWLEDGE MANAGEMENT, AND DESIGN OPTIMIZATION FOR NEXT GENERATION VEHICLES”—KLK430

Edwin Odom is the “father” of UI’s Idaho Engineering Works (IEW). IEW’s program involves senior design students, graduate student mentors, faculty and staff who work together on a variety of engineering projects. IEW stresses professional integrity, human dynamics, technical communication, and engineering leadership. An indication of the success of this program is that over 25 percent of mechanical engineering seniors choose to continue their formal education by enrolling in graduate school immediately following graduation. We believe that this rate can be attributed to the close interaction between graduate students, faculty, and professional staff in an energetic, innovative engineering culture.

Traditionally, graduate students are paired with a member of the faculty with similar interests of study to work on research and complete a thesis. Graduate students often work exclusively within a group that specializes in such research, minimizing exposure to other engineering disciplines and insights. In fact, this pairing often discourages interaction with other students and certainly other professors. Alternatively, IEW complements traditional graduate education that is highly focused on the development of technical and analytical skills by providing a challenging experience in team formation and interpersonal growth.

Each year, Dr. Odom articulates a simple and unique challenge to the 6-10 graduate students that comprise the next generation of the IEW. He then guides the team through a special topics course focused on technical leadership in the context of modern manufacturing, facilitates a variety of team projects that contain monumental technical and interpersonal challenges, and

encourages all participants to regularly reflect on their experience and share this with their colleagues. The close interaction between graduate students involved in this program allows shared learning of professional skills and a more detailed understanding of design for manufacturability than is possible in the traditional graduate student model. The resulting product is engineers who are not only technically competent, but also possessing skills in leadership, team dynamics, communication, customer relations, creative thinking and professionalism so much needed in the workforce of today.

Each year, as new graduate students leave the program and new students arrive, IEW must reform to meet the requirements of the new group. With the influx of new teammates comes and influx of new ideas and desires. Due do these new ideas, the IEW members establish goals that fit the new and unique team. Often, goals from previous years are adopted, but a new mission is established in the end that all of the members find important. Pursuit of elevated goals stems directly from Dr. Odom's personal commitment to technical excellence and carries over into the various projects that IEW undertakes.

A centerpiece of the IEW experience each year is a challenging project that will stretch the abilities of the students involved and foster individual and team growth. Commonly referred to as Big Hairy Audacious Goals (BHAG), these large-scale projects require the collaboration of the entire team in order to complete. An excellent example is a service project that the IEW accepted for Schweitzer Engineering Laboratory. This consisted of re-engineering a high impact tester that consisted of 398 unique parts. Originally designed by the Navy, this machine was used to shock test circuit boards for naval warships. Due to the incompleteness of the original blueprint, many of the components were redesigned for proper tolerance and stress constraints. Upon completion, the new design and was delivered as shown below. In return for IEW efforts, the Mechanical Engineering Shop received funds for a new Computer Engineering Shop received funds for a new Computer Numerical Control mill that is now heavily used for senior design and graduate research projects (e.g., milling the cylinder heads for the clean snowmobile).

That mill is one piece of equipment in the machine shop, part of a complex in the Gauss-Johnson Engineering Lab that was renovated in 2000 and includes a senior design suite, the Mindworks Community (www.webs1.uidaho.edu/ele/mindworks) and the Small Engine Test Facility. This building is also where the IDEAWorks will be located when finished (see pp. 18-19).



The 2006-2007 IEW graduate student mentors: (left to right) standing: Chris Huck; Andrew Findlay; Mike Severance; Jason Sagen; Lloyd Gallup; Ben Hanks; John Lacey; kneeling: Justin Johnson; John Dugan; Phil Arpke; Chuck Dean. All but three students were supported, at least in part, with UTC funds.

“The number of undergraduate and graduate students in the Mechanical Engineering Department continues to increase. This is the direct result of the partnership between NIATT and the Department in funding our senior design projects for the FutureTruck competition and Clean Snowmobile Challenge. Our students see the engineering challenges and the relevance of these projects to society. There are no better recruitment tools than their own positive experiences in our program.”

Donald Blackketter, Chair,
Department of Mechanical
Engineering

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PAUL OMAN

“I am most proud of . . .

Working in a multidisciplinary team to develop qualitative and quantitative approaches to assess the survivability of traffic control networks—and having one of our team members, Matthew Benke, being chosen NIATT student-of-the-year.”

“EXPERIMENTS IN MODELING URBAN SURFACE TRANSPORTATION NETWORK DEPENDABILITY AND SECURITY”—KLK238

“MODELING AND ASSESSING LARGE-SCALE SURFACE TRANSPORTATION NETWORK COMPONENT CRITICALITY”—KLK125

“A FRAMEWORK TO ASSESS THE SURVIVABILITY OF INTELLIGENT TRANSPORTATION SYSTEMS”—KLK132

As transportation systems face increasing traffic demands, intricate networks have been developed to signalize intersections and gather information in real time. These intelligent transportation systems (ITS) involve extensive interactions with other critical infrastructures such as communications and power. ITS designs have focused on safety and efficiency, while neglecting the equally important need of survivability. The reluctance to account for survivability is understandable, since it is costly to incorporate redundant designs as backup components. Therefore, engineers need to be able to understand and model the complex interactions in real-time control systems to identify the components that are both essential to the needs of the system and vulnerable enough to justify the cost of design improvements or redundant backups.

Over the past four years, Ahmed Abdel-Rahim, Paul Oman and Brian Johnson and three teams of undergraduate and graduate students have addressed this need by developing two strategies for assessing the survivability of transportation systems. One strategy is qualitative, accounting for needs of multiple stakeholders and allowing efficient identification of components that would most benefit from improvements to survivability. The second approach is quantitative—separating a transportation system into power, information and physical (transportation) systems, defining interactions among these systems, and measuring how important each component is to fulfilling the needs of the system. These approaches have been used to assess two ITS systems in the state of Idaho—those of the cities of Moscow and Boise. The complementary approaches identified many of the same critical threats. Their research demonstrates that the techniques they used are scaleable from small to large cities and can be applied to other ITS and critical infrastructures throughout the nation.

The ITS network is represented by three separate, but interrelated layers: (1) the electric power grid layer, (2) the communication network layer, and (3) the physical roadway and control (e.g., traffic signal) network layer. A power layer failure will affect both the communication and control layers and therefore affect what can transit on the physical layer. A failure in the communication layer will affect the control and, hence, the physical layer, but a failure in the physical (roadway) layer will affect only that layer.



*Dr. Paul Oman, Professor of
Computer Science*

Dr. Oman supplemented his NIATT research with grants from the National Science Foundation and the Defense Advanced Research Projects Agency (DARPA). The research of six students who received MS degrees in computer science and were paid from a combination of those grants, contributed to the network security/survivability research described in this report. Further, one of those students, Matthew Benke was selected as NIATT's 2007 student-of-the-year (also see p. 51).

To study the integrated networks, the NIATT researchers combined graph-based models of the interrelated layers with N-dimensional modeling of surface transportation networks. The analyses were based on a modification of Carnegie-Mellon University's Survivable System Analysis (SSA) and included seven steps:

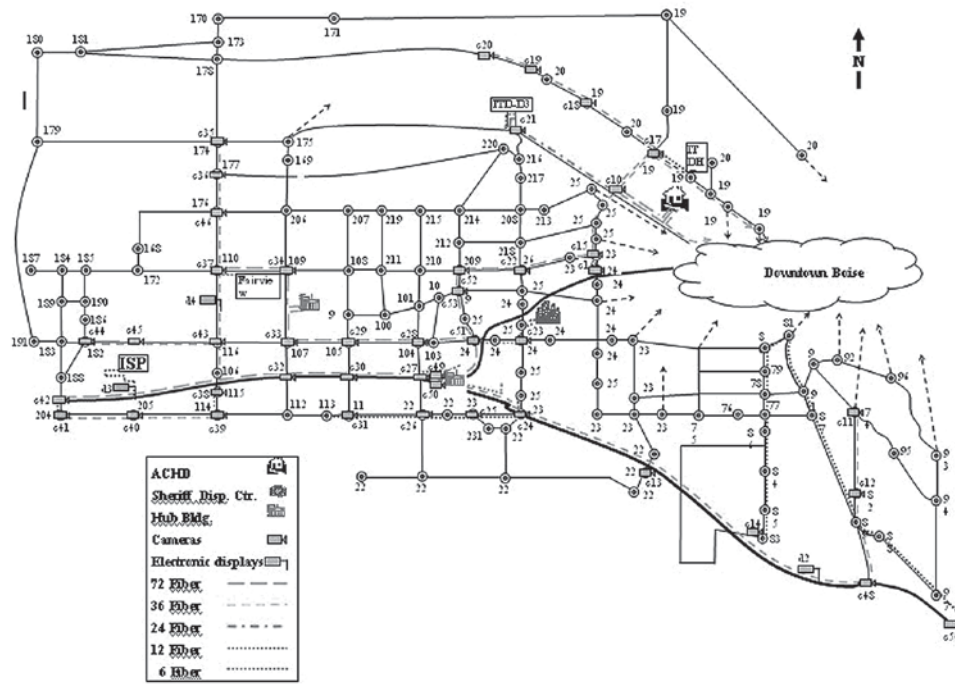
1. Defining the system's mission statement
2. Identifying stakeholder needs and responsibilities
3. Defining logical system components and architecture
4. Defining normal usage scenarios
5. Defining failure scenarios and attacks, including both physical and cyber attacks
6. Identifying threat mitigation strategies
7. Developing the system's survivability map, including *Resistance*, *Recognition*, and *Recovery* mechanisms for every threat to every logical component that affects the system's mission

The researchers' qualitative analysis concluded that a wide-scale power outage was the most serious common threat to the Moscow ITS. The quantitative multilayered analysis, based on microscopic VISSIM modeling, confirmed this fact, noting that the failure of a single transformer in the power layer would cause 9 of Moscow's 16 intersections (in downtown or connecting downtown to the highway system) to lose signalization, and during PM peak hours would lead to a failure to serve traffic needs at the rates needed to maintain traffic flow. A scenario similar to this one actually played out in Moscow when a severe wind storm caused a power outage that disabled most of the signal controllers. Furthermore, the qualitative analysis identified individual essential components, unlike the qualitative assessment which merely accounted for types of components.

To be able to better quantify the essentiality of each network component and hence to assess the survivability of the network in absence of one or more network components, essentiality values that are based on a more detailed modeling of network operations should be used. In the study of the city of Moscow with its 16 signalized intersections, VISSUM microscopic simulation was used to assess the essentiality of different components. For large scale urban ITS networks, similar to the city of Boise ITS network (Boise has more than 260 major signalized intersections and approximately 29 miles of urban freeways with 12 interchanges), actual run time for a single run of a microscopic model could exceed several dozen hours, especially if dynamic route assignment models requiring several iterations are employed. Accordingly, planning-level macroscopic models are more appropriate for this type of analysis. VISUM was used in this analysis.

The survivability analysis of the city of Boise ITS network proceeded as per seven steps described above, but the report is still a work in progress. Findings from both the qualitative survivability analysis and the VISUM macroscopic modeling showed that a loss of power supply at the Traffic Management Centers (TMC) or at critical network intersections could have a paralyzing effect on the ability of the network to provide several of its essential services. An operational-ready alternate TMC and effective traffic management plans for critical intersections during power outages were identified as possible mitigation strategies for these threats. Macroscopic modeling also identified the critical set of intersections needed to maintain expected traffic flows throughout the greater Boise area, for both nominal and event-based scenarios.

The macroscopic VISUM model for the Greater Boise communication network.



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*Dr. Karl Rink,
Associate
Professor of
Mechanical
Engineering*

KARL K. RINK

“I am most proud of . . .

First would be receiving our first contract with the Indian Head Division of the Naval Surface Warfare Center to support the study “Hermeticity of Selected Cartridge Assisted Devices.” In this study, we will be using both Krypton-85 and helium Mass Spectrometry method to understand the hermeticity of various devices. I’m also proud of being asked to be an invited speaker at the 2007 International Autumn Seminar on Propellants, Explosives, and Pyrotechnics to be held in Xi’an China.”

“A BALLISTIC GAS COMPRESSOR FOR AUTOMOTIVE AIRBAG INITIATOR RESEARCH AND AUTOMOTIVE ENGINE TESTING AND DEVELOPMENT”—KLK432

“THERMAL STRESSES AND RELATED FAILURE MECHANISMS: BRIDGE-WIRE INITIATORS”—KLK349

“FAILURE MODE INVESTIGATION AND BALLISTIC PERFORMANCE CHARACTERIZATION OF PYROTECHNIC INITIATORS USED IN AUTOMOTIVE SUPPLEMENTAL RESTRAINT INFLATION SYSTEMS”—KLK345

“THERMAL STRESSES IN PYROTECHNIC INITIATORS USED IN AUTOMOTIVE SUPPLEMENTAL RESTRAINT SYSTEMS”—KLK349

Karl Rink came to the University of Idaho from industry where he worked with automotive airbags and the pyrotechnic devices that make them work. As Rink has said, Airbags were responsible for saving 14,772 lives in the US between 1975 and 2003. Currently, over 146 million vehicles are equipped with airbags that are expected to function properly during a long vehicle life span.” That expected life span was a concern to Rink.

The airbag's pyrotechnic initiator is responsible for its deployment in crash situations. Cracks have been observed in the insulating glass that potentially can allow moisture to penetrate the initiator and potentially degrade the chemicals that cause the bridgewire to ignite and the airbag to inflate, a reaction that takes milliseconds. Degradation of either the pyrotechnic or the bridgewire can result in failure of the initiator. The goal of Rink's research was first, to determine the cause of the cracks with respect to the manufacturing process and then, to compare the results of this model to cracks observed in actual initiators returned from field service.

The research showed that during manufacture, tensile stresses can occur in the glass of an initiator. The results of the models developed agree with photographic evidence of cracks in initiators. Rink concluded that manufacturers of airbag initiators should 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.

Rink didn't stop there. He continued his research with the goal of understanding and quantifying the failure modes related to the lack of hermetic behavior so that leak rates could be properly specified and initiator design improved. Part of that research involved modeling the ballistic response of the initiators under differing conditions (e.g., temperature, pressure, composition). But to continue this work, he needed specialized equipment. UTC funds were used to establish a radioisotope leak detection laboratory, which is now complete and fully functional. A significant part of this effort involved measuring the rates of helium transport through cracked glass-to-metal initiator seals recovered from field service. Using helium mass spectrometry instrumentation, graduate student Chris Fischer measured the leak rates through a small population of the glass seals and found that the leak rates are often very high, thereby supporting concerns that moisture may be able to penetrate into the critical bridgewire regions of these devices.

This laboratory is unique to U.S. universities and provides a distinct competitive advantage for seeking external research funding, since the results of the research are of interest to the automotive, aerospace and defense industries. Rink and graduate student Russell Glass designed a ballistic gas compressor for the lab, which will be capable of replicating transient pressure characteristic as observed in airbag initiator ballistic testing and internal combustion engine operation. Fabrication was completed and testing is underway to verify initial performance measures. The two are also developing a mathematic model to describe the performance of the compressor.

Rink received an invitation to the 2007 International Autumn Seminar on Propellants, Explosives and Pyrotechnics to be held in October 2007 in Xi'an China where he will present a paper, "Advanced Studies Concerning the Hermetic Integrity of Pyrotechnic Initiators and Micro-Gas Generators." During the summer of 2007, he hosted guests from the U. S. Naval Warfare Center, who have agreed to fund a \$50,000 study entitled "Hermiticity of Selected Cartridge Actuated Devices." This is a direct benefit of UTC's support in establishing the laboratory.

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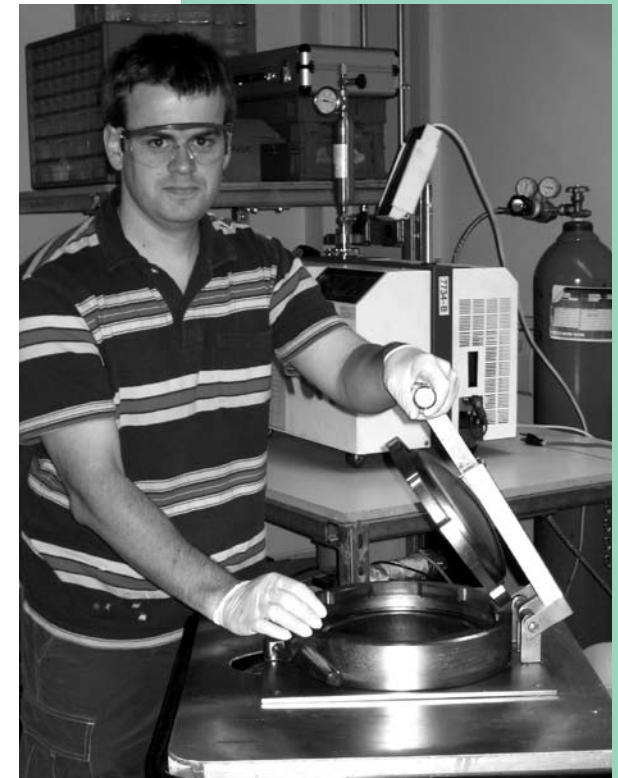
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JUDI STECIAK

“I am most proud of . . .

Personally there has been more than one high spot working with NIATT. Some feelings of satisfaction were as simple as finally getting consistent and reliable data in the laboratory. However, from an outsider’s viewpoint, I would have to say that the DEPSCoR grant we got to work with catalytic igniters, small engines, and heavy fuels would probably be seen as the success story. This project led directly to our industry partner Automotive Resources, Inc., winning Phase I and II SBIR awards and to a new product for the military. Note that we would not have been in a position to win the DEPSCoR grant had it not been for NIATT funding getting us off the ground first.”



“REACTOR STUDIES OF ALCOHOL-WATER CATALYSIS, PHASES I- III”---KLK317

“CATALYTIC IGNITION OF AQUANOL IN REACTOR, ENGINE, AND VEHICLE ENVIRONMENTS”—KLK319

**“MODELING AND APPLICATION OF CATALYTIC IGNITION IN INTERNAL COMBUSTION ENGINES”—
KLK312**

“CHARACTERIZATION OF CATALYTIC IGNITER PERFORMANCE AND EMISSIONS”— KLK346

“INVESTIGATION OF ENGINE AND COMBUSTION PARAMETERS FOR CATALYTIC IGNITION”—KLK434

Judi Steciak and Steve Beyerlein and their teams of graduate and undergraduate students have established an excellent working relationship with Automotive Resources, Inc., Sandpoint, Idaho, developers and manufacturers of the SmartPlug© catalytic plasma torch (CPT) igniter. The researchers, working with Automotive Resources, Inc., converted a Yanmar 1 liter diesel engine from compression ignition direct injection, diesel operation to a homogeneous charge compression ignition (HCCI) engine using 35 percent water, 65 percent ethanol fuel (aquanol). The SmartPlug system was used in place of the diesel injectors. Low pressure, automotive, multi-port, electronic fuel injectors supplied the fuel through the manifold.

HCCI engines have the potential for high efficiency because they combine constant volume combustion with high combustion ratio. As yet, no practical HCCI engines had been developed--attempts to burn aqueous fuels have been unsuccessful due to the difficulties in initiating combustion. This converted diesel engine will start and run on Aquanol at all temperatures. Aqueous fuels have the potential for lower emissions and higher engine efficiency that can be experienced with gasoline or diesel fuels.

*Dr. Judi Steciak,
Professor of Mechanical
Engineering*



AUTOMOTIVE RESOURCES INC
RESEARCH AND DEVELOPMENT

DIRECTORS

MARK A. CHERRY
MICHAEL R. TOOMEY

Judy B. LaLonde
Assistant to the Director
National Institute for Advanced Transportation Technology
University of Idaho,
EPB115A,
Moscow, ID 83844-0901

Dear Judy,

I would like to express my sincere gratitude and appreciation for the excellent support NIATT has provided for the SmartPlug Catalytic Ignition technology over the last 8 years. The assistance and professionalism of both Judi Steciak and Steve Beyerlein has been invaluable.

NIATT has supported critical fundamental research with both research equipment and grad student support that has proved pivotal to the progress of the Catalytic Ignition technology and the understanding of the benefits of dilute ethanol fuels.

With the help of the University, Catalytic Ignition technology has shown the ability to ignite inexpensive, dilute ethanol fuels in both Diesel and Otto cycle engines. The data collected by NIATT demonstrate that the combination of Catalytic Ignition and dilute alcohol fuels achieve major milestones in emissions, efficiency and power. I have included a Data Summary that highlights the major improvements achieved by this joint effort between ARI and NIATT. I believe this fundamental breakthrough in combustion technology shed light on how America can truly break its addiction to foreign oil and find clean, renewable, energy independence.

I also want to thank NIATT for the support and assistance that they provided ARI in the SBIR program with the Army. We now are ready to go into production or license to Honda the catalytic ignition system that enables Honda generators to start and operate on military fuels such as JP-8 and DF-2. This meets a critical need for portable power generation within the armed forces. NIATT has provided us with cold chamber testing, grad student research, and data analysis that has proven invaluable to this SBIR effort.

Since NIATT has demonstrated it ability to work with industry and validate such critical new technologies such as the SmartPlug catalytic ignition system, I strongly recommend and encourage continued funding of this successful program.

Sincerely,

Mark A. Cherry
President of Automotive Resources Inc.

1926 INDUSTRIAL DRIVE, SANDPOINT, ID 83864 TEL: (208)-265-2723 FAX: (208)-265-3580

| | Diesel | Conversion | |
|---|-------------|--------------|-------|
| Indicated efficiency | 27.1% | 42.1% | +55% |
| BSNOx (Brake Specific Nitrogen Oxide)[gm/kW*hr] | 2.48 0 | .478 | -81% |
| Particulate Matter | 30% Opacity | Zero Opacity | -100% |

Emissions and efficiency at 1750 RPM and 720 kPa

| | Diesel | Conversion | |
|---|-------------|--------------|-------|
| Indicated efficiency | 28.6% | 38.4% | +34% |
| BSNOx (Brake Specific Nitrogen Oxide [gm/kW*hr] | 4.24 | 0.265 | -94% |
| Particulate Matter | 17% Opacity | Zero Opacity | -100% |

Emissions and efficiency at 2750 RPM and 720 kPa

Further results showed:

- 8 percent gain in torque at 1750 RPM
- 20 percent gain in torque at 2500 RPM
- 40 percent Gain in Horsepower

Their work had several tangible results:

- A \$100,000+ grant from the Idaho Transportation Department to investigate the performance and durability of an alternative alcohol-water fuel and catalytic ignition system on a fleet vehicle operating under road conditions, supplying over-the-road durability data, and emissions monitoring, demonstrating the potential of using environmentally friendly vehicles in Idaho transportation.
- "Catalytic Ignition as a Tool for Converting Small Engines to Efficient JP-I Operation," a \$384,000 grant from the Department of Defense/Office of Naval Research catalytic ignition studies, advancing the Army's goal of a one-fuel military and improving the performance of heavy fuel engines operating under part-load conditions.
- SBIR I and II grants for Automotive Resources

The converted 15-passenger van is only one of several demonstration and teststands used by the researchers. Stand-alone engines set up to test fuel and technology innovations include a Yanmar engine modified to operate with CPT igniters and ethanol-water fuel; a turbo-charged, direct-injection Volkswagen engine that allows the researchers to integrate CPT technology with turbocharging; Evinrude port injection two-stroke engines reengineered for direct injection, and a Cooperative Fuels Research engine that allows them to vary compression. The various platforms are used to further understand in-cylinder catalytic ignition of lean fuel mixtures.

A specialized combustion laboratory built on the Boise campus of the University of Idaho has enabled Steciak and her students to study the reaction mechanism of the catalytic igniter and aqueous fuels. The lab is equipped with a plug-flow reactor that removes the constantly varying conditions inside an internal combustion engine and permits us to study fundamental combustion phenomena in steady-state.

Bob Lounsbury is the latest student to receive his MS degree as a result of the basic research using the plug-flow reactor. His thesis discusses the use of platinum (Pt), a well-known oxidative catalyst for hydrocarbons. A thin Pt wire is placed in cross flow within the plug flow region of the reactor. As a fuel-oxygen-nitrogen mixture is passes through the reactor, electrical current is supplied to the wire. Because the resistance of the PT changes with temperature, the voltage across the wire can be monitored. As electrical current is gradually increased, the wire temperature increases. The average wire temperature, catalytic ignition temperature, power at ignition, and rate of heat generation from surface reactions were deduced from experimental data for a 127 μm and 203 μm diameter Pt wire. These data were used to calculate parameters for a one-step surface heat release model.



Graduate student Bob Lounsbury working in the combustion laboratory.

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*Dr. Richard W. Wall, Professor
of Electrical and Computer
Engineering*

RICHARD W. WALL

“I am most proud of . . .

Seeing top quality ECE students become interested in traffic signals and to select those projects for senior design and graduate work. That gives me the greatest sense of accomplishment.”

“PLUG AND PLAY SMART SENSOR TRAFFIC SYSTEMS” KLK241

“CONFLICT MONITOR FOR PLUG-AND-PLAY DISTRIBUTED MART SIGNALS AND SENSORS FOR TRAFFIC CONTROLLERS,” KLK121

“FULL-SCALE IMPLEMENTATION OF PLUG-AND-PLAY SMART TRAFFIC SIGNAL PEDESTRIAN WAIT/WALK DISPLAY WITH PEDESTRIAN BUTTON,” KLK124

“SMART SIGNALS CONFERENCE”—NOVEMBER 2, 2006

“PILOT DEPLOYMENT OF PLUG-AND-PLAY SMART TRAFFIC SIGNALS”—KLK131

Richard Wall and then graduate student Andrew Huska began their research on “smart” traffic signals in 2004, knowing that the functionality of traffic controllers had not changed significantly over the last 60 years. Even controllers that meet today’s Intelligent Transportation System (ITS) standards are constrained to turning on or turning off single element displays. To test whether or not plug-and-play (PnP) technology could be used to expand the capabilities of traffic controllers, they built a demonstration system was built to explore the applicability of plug-and-play distributed sensor technology to traffic signals. The prototype based on 10baseT Ethernet communications connecting a simulated traffic controller to four nodes consisting of a single traffic signal and eight countdown pedestrian signals. A laptop PC simulated a simple semi-actuated traffic controller algorithm and provided network diagnostics.

The following year, Wall and Dr. Brian Johnson convinced four undergraduate electrical engineering students to build on the prototype work. The students built three plug-and-play devices: a pedestrian countdown timer, the pedestrian crosswalk signal, and a pedestrian button with a wireless module. At the 2006 UI Engineering Expo, the senior design team demonstrated how implementing the IEEE 1451 PnP standard for traffic signals and sensors communication is a feasible option for expanding the capabilities of a traffic controller. One of the demonstrations showed the PnP pedestrian countdown timer performed better and more accurately than the standard pedestrian countdown. According to the team, “The new PnP compliant pedestrian signals will always know how much time is left for crossing the intersection and will always give the correct information to the pedestrian. The new PnP network will also allow for new innovative devices to easily be implemented into a traffic control system.”

On November 2, 2006, approximately 60 people gathered at the University of Idaho to discuss the potential uses for Smart Signals traffic controller technology, particularly focused on serving the often overlooked needs of pedestrians. The purpose of the workshop was to consider how the technology could best serve the interests of efficient human transportation and safety, the technological and regulatory assets and barriers to its use and to help form a long-term vision for Smart Signals application.

CONFERENCE PRESENTATIONS

Presentations at the conference were made by

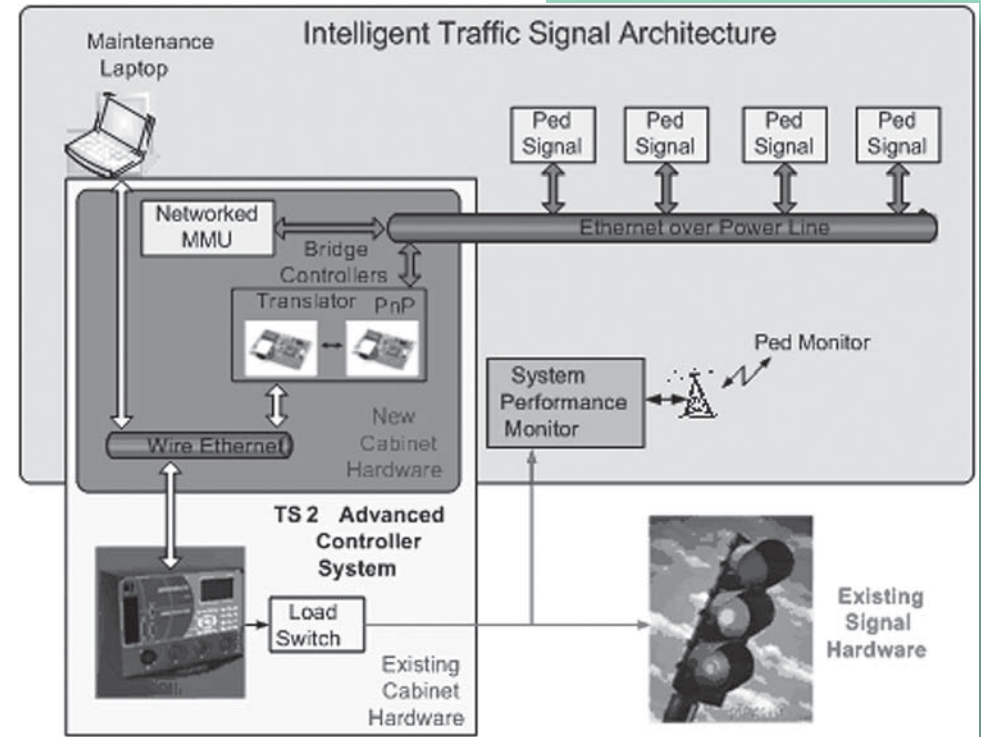
- Paul Olson, ITS Technology Engineer, FHWA
- Gary Duncan, Sr. Vice President and Chief Technology Officer, Econolite Control Products, Inc.
- Sarah Hubbard, Purdue University, graduate student
- Michael Graham (Mobility Specialist, Idaho Department of Vocational Rehabilitation)
- Jean-Marie Kopecky, Mobility Instructor, Idaho School for the Deaf
- Carol Baron, Outreach Director, Idaho School for the Deaf and Blind
- Dr. Tom Urbanik, University of Tennessee
- Dr. Darcy Bullock, Purdue University
- Dr. Ahmed Abdel-Rahim, University of Idaho

A report from the conference is available on the NIATT website at <http://www.webs1.uidaho.edu/niatt/Conferences/SmartSignals.pdf>

Attendees at the conference agreed that a pilot deployment of smart signals in the field would be a logical step. Researchers have selected the intersection of 6th and Deacon Streets for several reasons. The intersection is

- Isolated
- A major access point to the UI campus
- In close proximity to the UI campus
- One with a high volume of pedestrian and bicycle traffic
- One that will require a limited amount of equipment and a place to mount cameras
- A common approach for emergency vehicles.

Research in 2006-2007 has focused preparing for a field test—developing system specifications for the functionality, security, reliability, packaging for the installation and hardware, and verifying that the system will meet all state and federal electrical and traffic codes.



An overview of the smart traffic signal system: a TS2 traffic controller, a networked malfunction management unit, four Smart Pedestrian Signals, and an independent system monitor.



Researchers selected 6th and Deakin Streets as the test site for a pilot deployment of smart signals technology.

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SECTION 2: RESEARCH, EDUCATION AND TECHNOLOGY TRANSFER — STUDENT VIEWPOINT

WORKING TOWARDS A PHD: DAN CORDON

This fall, Dan Cordon will expect to complete and defend his PhD dissertation. He has been supported by UTC funds for most of his education. As read through this report, you'll notice that Dan's name comes up often—he is an integral part of the Center for Clean Vehicle Technology—a past undergraduate intern, a senior design team member, and IEW mentor, MS researcher, student-of-the-year, an instructor in three different mechanical engineering classes, and now, as he finishes his doctoral dissertation and holds the position of manager of Small Engine Research Bay, knows more about the operation of the equipment in that lab than anyone else on campus. He's worked on the NIATT's winning Electric Car, the FutureTruck, the conversion van that is used as a teststand, the snowmobiles, the Formula SAE car, and—well, the list could go on and on. That's why Dan was invited to address the Advisory Board meeting this past spring.

Dan put together a presentation—"A Decade in the Life of a NIATT Student"—for the Board that took them from his private life (the seventh of eight children and a first generation college student, married at 19, with a passion for automobiles), through his desire to continue teaching, retire sometime, and "give back to the system that gave" to him. Each of the 11 slides taking his through his development from sophomore to his current research highlighted what he identified as the opportunities provided by that particular point in his career and the lessons he learned, which brought several laughs from his audience. Some of the opportunities he listed were

- Teaming on a large, complex project
- Applying classroom principles to real problems
- Working with professionals in the automotive industry
- Working with a budget.
- Attending professional conferences
- Writing peer-reviewed papers

Some of the lessons were

- Communicating the idea is as important as the idea itself
- No bucks, no Buck Rogers
- Every team is composed of individuals with differing levels of commitment
- Public perception needs as much work as new vehicle technology
- You don't have to live in Detroit to be involved in top-quality automotive/transportation research
- BHAG (big hairy audacious goals build character)

We would like to say that Dan is a typical NIATT graduate, but he certainly represents the ideal towards which we work.

One of Dan Cordon's slides defining the opportunity he found and the lessons he learned as he conducted engine research as a PhD candidate.

Engine Research – Ph. D.

Opportunity Provided

- Detailed emissions analysis
- Publishing papers
- Presenting at conferences
- Participating in UTC proposal process
- Contribute to professional community

Lessons Learned

- Increased cost = better performance?
- Even data can't change some people's perceptions
- Longer you're here = more changes for student-of-the-year

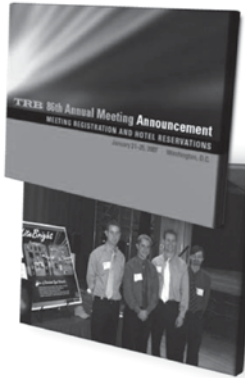


Experiences

Poster Presentation @ TRB
86th Annual Meeting in
Washington DC

Engineering Expo 2006
awards for innovation and
presentation

Summer Internship with
Econolite which focused on
NTCIP compliance for the
ASC3



ECONOLITE
CONSTRUCTION TECHNOLOGIES

*One of Dustin Devoe's slides
in which he describes those
experiences as a graduate student
he considers most significant.*

STUDYING FOR A MS DEGREE: DUSTIN DEVOE

Richard Wall brought Dustin Devoe into transportation engineering when he was a senior electrical engineering student and was looking for a senior design project (also see p. 46). The team of four electrical engineering seniors sought to determine whether or not the IEEE standard for plug-and-play (PnP) distributed networking could be a feasible option for expanding the capabilities of a traffic controller. By the end of the year, the team produced three PnP devices: a pedestrian countdown timer, a pedestrian crosswalk signal, and a pedestrian button with a wireless module. At the 2006 UI Engineering Expo, the senior design team demonstrated that the PnP pedestrian countdown timer performed better and more accurately than the standard pedestrian countdown. The team not only received an award for their technical presentation, but they also received the Idaho Research Foundation Innovation Award. (See the senior design website, with videos, at http://seniordesign.engr.uidaho.edu/2005_2006/lite-bright/index.html)

Michael Kyte and Tom LaPointe of Valley Transit (and an Advisory Board member) utilized Dustin's abilities and interest in transportation in a special project. Along with Richard Wall, Dustin directed the installation of a microwave tower and installation of GPS devices on some of the Valley Transit buses. Using Google maps, they created a website that shows the position of those buses in real time (<http://www.niatt.uidaho.edu/google/>). The project, still in testing, has not yet been opened to the public.

Dustin also made a presentation to the Advisory Board, which he called "The NIATT Experience," in which he detailed what he categorized as "creativity, education, experiences, and engineering." According to his slides, he looks forward to demonstrating the Smart Signals in public field tests this fall, the release of the bus tracking system, publication of research papers, and graduation!

PREPARING FOR GRADUATE SCHOOL: URIAH JONES

Uriah Jones will be completing his BS in civil engineering in fall 2007 and, with only a holiday break, starting right in on his MS work. But he has plenty of experience with real transportation issues already. He has been working with Michael Dixon as a NIATT undergraduate intern studying green time utilization. Green time is the length of time a traffic signal is green and the length of time until the light turns green again. He is using VAP or vehicle actuated programming along with VISSUM to study the relationship between the volume-to-capacity ration and green time utilization. The outcome of these studies, Jones says, could be more efficient traffic controllers because advanced measurements can be fed to controllers, which use this information to change settings more efficiently.

Uriah spent some of his internship time helping Dixon prepare for a unit of UI's CE115—Introduction to Civil Engineering—course, a course all freshmen civil engineering students are required to take. The CE faculty share the class's instruction, each introducing their own specialty in civil engineering to the students.



Dixon's unique unit, which introduces freshmen to basic signal timing, has undergone quite a transition since he and his students first devised it. The unit's first "trial" was during an American Society of Civil Engineers regional competition held at UI. Using remote controlled (toy) cars, large signal heads, and a course set out with duct tape, students were challenged to design a timing plan for the course through which they could negotiate the cars in the shortest amount of time, without going through red lights. Although students enjoyed the experience, more effort was needed to "drive" the cars well than for timing the lights. That was in 2004.

This past semester, Uriah put together a pre-manufactured "racetrack" for slot cars controlled by triggers. The course is approximately 50 ft. long and it winds up and around, imitating bridges and curves. Uriah made five miniature signal heads using LEDs that are set up along the track as traffic signals. Uriah instructed teams of students from the CE class what and how they were going to do and supervised the activity: "How can your car operate more efficiently based on appropriate signal timing?" Azizur Rahman, a CE grad student, wrote a VBA program in Excel into which the teams of students entered their timing plans after which they ran the cars on the course, stopping at red lights, using stopwatches to record their times.

"They struggled most with offsets," said Jones, "setting their timing so that each signal turned green at a different time, allowing their cars to travel without stopping." The teams could adjust their plans three times before the final run.

RECEIVING STUDENT-OF-THE-YEAR AWARD: MATTHEW BENKE



NIATT 2007 student-of-the-year Matthew Benke was selected in part because of his research with Dr. Ahmed Abdel-Rahim, Dr. Paul Oman, and Dr. Brian Johnson.

"Between Dr. Oman, Dr. Abdel-Rahim, Dr. Johnson and the many great students with whom I had the privilege of working at NIATT, I couldn't have hand-picked a better group. The professors are not only experts in their chosen fields, but were the perfect fit for me personally. Someone had to keep me focused and out of trouble, and provide some wisdom from personal experience that every graduate student needs . . . To this end they provided more than I ever could have asked.

"The professors represent three disciplines--computer science, civil engineering, and electrical engineering--at the highest level. They contributed a variety of perspectives to our research, and it was this interaction among various backgrounds that led to our most significant achievement in transportation survivability research: multilayered analysis that considers interaction among components in multiple infrastructures--communications, power, and transportation--on common ground in simple terms based on service to users. Thankfully, their diverse backgrounds rubbed off a little on me. I was happy to contribute to NIATT with my computer security knowledge, and pick up some pointers in power and transportation along the way!

"When you think about it, though, this is a microcosm of the future of transportation. Transportation systems, while traditionally a matter for civil engineers, continue to incorporate knowledge from a wide variety of disciplines, from recognized backgrounds like mechanical and materials engineering, to the aforementioned computer science and electrical engineering, to even more exotic disciplines like economics, psychology, and law. Mechanical and materials engineers will continue to play a prominent role by developing vehicle designs that become increasingly less reliant on gasoline and incorporate renewable resources.

"I really enjoyed my time over the last three summers that I have worked for Dr. Dixon. This summer in particular I have been given the opportunity to do some research into the use of performance measures for providing feedback in traffic control. Once I finish my undergraduate studies, I intend to focus my Masters work on traffic flow, and this summer's work has been a good introduction to that area."

Uriah Jones

“Computer scientists will contribute to the secure communications networks that will become ever more prolific in future transportation systems as it evolves into a system based on user- and vehicle-infrastructure integration, and to the secure embedded systems design that is necessary for vehicles to safely incorporate more advanced, even automated, technologies. Electrical engineers will continue to improve electric and hybrid vehicle design and provide improved energy service to the transportation infrastructure. Economists will contribute ideas for how the vehicular communications infrastructure can be utilized in electronic tolling systems and commercial endeavors, and even in the development of a vehicle-infrastructure information economy. Psychologists will continue to improve human-vehicle interaction and research the role of trust as more automated transportation technologies are introduced, taking much of the control away from drivers. And civil engineers will play as crucial a role as ever, as they develop safe roads and structures that can not only sustain increased traffic, but the infrastructural mechanisms alongside (and perhaps even embedded in) the roads to support communications among that traffic.

“I am humbled to even be considered among those students that continue to make amazing contributions to transportation safety, sustainable transportation, smart pedestrian signals, human-vehicle interaction . . . the list goes on. But advanced transportation is a truly multidisciplinary endeavor, and its continued success relies on the enormous diversity of its contributors. In accepting the student-of-the-year award on behalf of all the other students in these various disciplines with whom I worked, I’m proud to represent the potential that computer science brings to the transportation industry, and hope people of all backgrounds see copious opportunities to contribute their own unique ideas.”

— Matthew Benke

RECEIVING PROFESSIONAL RECOGNITION: ALUMNUS PHIL RUST

NIATT sends many graduate students into the transportation workforce. We believe we have given them a good education and valuable experiences. But when we receive letters like the one below about Phil Rust, our 2003 student-of-the-year, it confirms our achievement.

“I am writing today to express our appreciation for your development and mentoring of Phil Rust. The feedback I am getting back from our Area Traffic Engineer who hired Phil . . . is that we need to find more ‘Phil Rusts.’ I didn’t want time to pass us by without acknowledging the great work the University fo Idaho and you [Michael Kyte] did in developing Phil’s skills in the traffic engineering arena and that we are the recipients of your steady and dedicated work with students like Phil.”

Brian Walsh, Local Traffic Services Engineer,
Cities and Counties, WSDOT

SECTION 3: RESEARCH, EDUCATION AND TECHNOLOGY TRANSFER — STAFF VIEWPOINT



JUDY LALONDE, ASSISTANT TO THE DIRECTOR

I'm proud of so many things! But I'll mention our seventh Traffic Signal Summer Workshop, because I'm currently organizing it and the workshop gives me pleasure to make twelve new friends from around the country and to work with the group of instructors who seem to get as much pleasure from the teaching as the participants do from the learning. I know these participants leave the University of Idaho happy and tired "campers"! And they leave having experienced hands-on training, gained a great deal of knowledge, and made new contacts in the greater transportation world.

I'm also proud to have been able to be of assistance the other UTC administrators by being part of a group that has organized and led two meetings during the past two summer CUTC meetings.



KAREN FAUNCE, RESEARCH PROPOSAL WRITER

Though I've only been involved with NIATT for a short period of time, what is obvious to me is that NIATT offers applied solutions to some of the Nation's most urgent problems involving safety, mobility and efficient use of the world's precious resources. I am proud of my small contribution to support research that has the potential to improve the quality and sustainability of people's lives, and proud of the vision and integrity that exists here at NIATT.



DEBBIE FOSTER, FINANCIAL TECHNICIAN

I am proud to be a part of NIATT Team with a Director who truly values his staff, students, and faculty and the work they do, and who takes the time to communicate his thoughts and appreciation with us. It also is a great honor to be one of the ten Tier I University Transportation Centers who continue to obtain funding, especially when the competition can be very tough and challenging.

I also am very proud of our Clean Snowmobile Team for their hard work and success in the Clean Snowmobile Challenges throughout the years. It was very interesting to learn more about this project this year from several of the students who explained to me about how they were making their own fiberglass molds to fabricate a hood that would reduce engine noise, but also allow better engine cooling at the same time. I also really enjoyed having the opportunity to see the Clean Snowmobile project presentations that were shown at the Advisory Board Banquet.



STEVE TAYLOR, ITS AND RESEARCH SUPPORT

Here at NIATT, I have the opportunity to work on a variety of interesting and exciting projects with equally interesting and exciting people. I am proud to support the NIATT faculty, staff, and students in their efforts to keep NIATT at the forefront of transportation technology.



RUTHIE FISHER, IDAHO T2 ADMINISTRATIVE ASSISTANT

NIATT is very definitely a group to be proud of. Individuals from many areas, with many titles, come together under the NIATT “umbrella” to work on a daily basis to help others, from seeking and providing research opportunities for faculty and students to producing outcomes and solutions that improve the world of transportation from the university level, through governmental and private agencies, to the local agency. Sharing information and training is a key component. Behind each of the accomplishments of NIATT is a network of many who each actively strive to do their part and are dedicated in their efforts to be of help and make improvements. The investments are well worth it; the dollar is well spent. I am proud to be a part of NIATT!

SECTION 4: RESEARCH, EDUCATION AND TECHNOLOGY TRANSFER — RECOGNITION BY AND OF OTHERS

DONALD CRAWFORD GRADUATE FACULTY MENTORING AWARD RECIPIENT—MICHAEL KYTE

Michael Kyte's support for graduate students was recognized at a College of Graduate Studies reception in May 2007. Kyte received the Donald Crawford Graduate Faculty Mentoring Award, recognizing his extraordinary effectiveness as a major professor, committee member, and/or advocate of graduate students.

The award was established in 2006 to honor the efforts of graduate faculty who excel as mentors of graduate students and was named for its first recipient, Donald L. Crawford. This award is part of the College of Graduate Studies' continuing efforts to support excellent mentoring of graduate students at the University of Idaho. This includes demonstrated intellectual leadership to ensure that students master the content and skills of their subject area and are held to high standards; promotion of timely and successful completion of students' degree programs; and demonstrated advocacy in fostering an environment supportive of graduate student success. Letters of support for his nomination were written by Paul Coffelt, who was NIATT's student-of-the-year in 1999, Michael Dixon, Associate Professor of Civil Engineering, and John Tracy, UI Vice President for Research.

Mike received a less formal recognition from transportation engineering students at an end-of-the-year dinner sponsored by NIATT. Ahmed Abdel-Rahim and Guillermo Madrigal led a little ceremony in which Mike received messages of appreciation, both in candy and in words from some of the students, some of them quoted here:

- Dr. Kyte's teaching skills and methods of impacting knowledge are so special.
- Dr. Kyte has made all his classes interesting and enjoyable. I will always appreciate all of the wonderful information he has taught me.
- He is real eager to share his knowledge with all of us to better our understanding of concepts.
- I feel lucky to be Dr. Kyte's student. In my perfect world, he would teach at least two 500 level courses and one 400 level courses each semester in the future.
- Interacting with Dr. Kyte has been a good experience.
- Dr. Kyte always makes me feel like my learning is very important to him.



“I feel that Mike deserves great recognition in creating a culture within NIATT that value activities that truly engage students, provide them with opportunities to guide their own learning and growth experiences outside of the classroom, and expose them to career opportunities and challenges they may never have considered before. I believe that this example demonstrates that Mike is not only a great mentor, but through his leadership he is creating great mentors at the University of Idaho, and that this will be one of Mike's lasting impacts at the University of Idaho.”

John Tracy, Vice President for Research, in his letter of support for the nomination of Kyte for the Donald Crawford Faculty Mentoring Award.



Dan Cordon, center, with graduate students Jeffrey Williams (MSME 02) and Matthew Walker (MSME 02), with a TDI diesel test engine outside of the Small Engine Laboratory.

COLLEGE OF ENGINEERING OUTSTANDING GRADUATE— DAN CORDON

Dan Cordon was recognized at the Dean's Reception for the UI College of Engineering as the College's Outstanding Graduate for 2007. He received a plaque and a monetary award. Cordon completed his MSME in 2002 and is currently pursuing his PhD.

In his nomination letter, Dr. Steve Beyerlein explains why Dan, a NIATT student-of-the-year in 2004, was more than qualified for this recognition:

Dan has played a multitude of roles that have left a profound legacy for the Mechanical Engineering Department and the National Institute for Advanced Transportation Technology. These roles include mentoring senior design teams on numerous vehicle projects, teaching our project-based senior laboratory course, teaching our combustion engine course on video,

and supervising our Small Engine Research Facility. It is easy to forget that Dan is a graduate student, since many of our interactions with him are identical to those we have with other faculty and staff members.

Undergraduate students enjoy Dan's playful demeanor, his vast theoretical and hands-on knowledge of engine systems, his interactive learning activities, his informative lab exercises, his meaningful modeling assignments, his thoughtful integration of web technology, and his accessibility outside of class. His teaching evaluations are comparable to best instructors in our department. In addition to his primary research on alternative fuel combustion, Dan maintains an active interest in the scholarship of teaching and learning. He has invested the time to participate in numerous teaching workshops and has authored a variety of interesting, peer-reviewed, pedagogy papers.

Dan has been a prime mover for upgrading engine dynamometers, emissions analyzers, and data acquisition software in the Small Engine Research Facility. Under his watch, this resource has evolved from being a glorified instructional laboratory to being a regionally-renowned research laboratory. On an annual basis, Dan's services in the Small Engine Research Facility are critical to conducting over \$400,000 of externally sponsored research and design projects. As a result of his graduate research, he has authored numerous peer-reviewed papers that have been published by the Society of Automotive Engineers and delivered at meetings of the Western States Section of the Combustion Institute. Graduate students working with NIATT routinely look to Dan as a mentor in designing experiments, reducing data and writing technical papers.

“Dan is an excellent student, mentor, and leader. As a member of IEWorks, Dan has mentored a number of students that have followed in his footsteps working on NIATT research projects. A student with whom Dan worked describes him as a genuine “good person who is concerned with others’ problems.”

Michael Kyte and Judy B LaLonde, part of a letter of support for Dan's nomination as Outstanding Graduate Student

OUTSTANDING STUDENT EMPLOYEE—ASHLEY HOBBS

Ashley Hobbs, freshman civil engineering student and NIATT undergraduate intern was recognized at the University of Idaho 11th Annual Student Employee of the Year Award Ceremony. Ashley was recognized for her professionalism and quality of work. As part of her research with Dr. Ahmed Abdel-Rahim, she made calls to Idaho highway districts. Talking with Abdel-Rahim about Ashley, one of the persons surveyed had to say about her call to him: "Wow!"

Ashley is spending the summer in Boston, Massachusetts, interning with the Massachusetts Highway Department as part of US DOT's Summer Transportation Internship Program for Diverse Groups. She reports that she's working on safety issues there. During the last two weeks of her assignment, she will join all 2007 STIPDG interns in Washington, DC, where she will have the opportunity to make a presentation of her summer project.



SPORTSMANSHIP AWARD—NICK HARKER

The Founders' Award for the Most Sportsmanlike Conduct was one of several ways that Nick Harker (BSME07, Dean's List) has received special recognition. Nick, the clean snowmobile team leader, stopped and got off the NIATT snowmobile in the middle of the 100+ mile endurance race at the 2007 SAE Clean Snowmobile competition (see pp. 22-24). He stopped, not because there was a problem with his snowmobile, but to extinguish a fire in a competitor's vehicle. "We're always careful about safety," advisor Karen Den Braven said; so Nick had ready access to a fire extinguisher and used it to help a fellow competitor.

Nick's poster "Instrumented Head Design for the UI Clean Snowmobile Challenge" took first place and he received a check for \$200 at the District D 2007 ASME Student Professional Development Conference hosted by the University of Idaho in March 2007. The posters were critiqued by three industry judges. Nick was also selected by the Mechanical Engineering faculty as the senior-of-the-year.

Nick and the other team members displayed the snowmobile at the 2007 Engineering Expo, where they won two awards: a booth award and a technical session award, bringing recognition and cash to the team. Judging at the Expo is done by industry and engineering alumni based on four ABET competency areas for oral communication for the technical session and for discussion/responses to questions in the booth evaluation.

Nick is spending the summer of 2007 completing an internship at Bombardier and will return to UI this fall as a graduate student.



Nick Harker accepts the Clean Snowmobile Team award from Dean Elshabini at the 2007 Expo award ceremony.

BEST VISSIM ABSTRACT: YBETTE OCHOA HUAMÁN

Ybette Ochoa-Huamán was treated to trip to Park City, Utah, site of the 2002 Winter Olympic games by PTV America. Ybette is not a bobsledder, but a graduate student working with Dr. Ahmed Abdel-Rahim, Dr. Paul Oman, and Dr. Brian Johnson on a UTC-funded research project. Ybette submitted the abstract for the co-authored paper, "Modeling the Survivability of ITS Networks: A Simulation Based Approach," to the PTV America abstract competition, which won for her the complimentary trip to the 2007 PTV Vision International Users Group Meeting and Advanced Training.

Park City, Utah, hosted 67 PTV Vision® users and staff at the 2007 PTV Vision Users Group Meeting, including Ybette and three other NIATT graduate students. The two-day meeting consisted of valuable presentations by both PTV employees and PTV Vision users, including sessions on new developments in VISSIM and VISUM plus a wide array of software application presentations.

Kyle Ova of PTV America presents Ybette Ochoa with a plaque recognizing her achievement.





ITE Traffic Bowl winners (left to right): Dennis Ownbey, Kimberly Baird, and Nicholas Taylor, ITE chapter president with Chris Teisler of Kittelson & Associates, a sponsor of the competition.

TRAFFIC BOWL WINNERS: UI'S STUDENT ITE CHAPTER

Engineering students won top honors at the Traffic Bowl this year, beating out teams from Washington, Portland and Oregon State Universities and the University of Oregon. The annual Traffic Bowl is a Jeopardy-style competition organized by the Northwest section of the Institute of Transportation Engineers (ITE). The students, members of the ITE student chapter and undergraduate civil engineers, brought home a trophy and cash prize.

All three UI contestants contributed to the win. UI took the lead first when Nick Taylor, president of the chapter, correctly answered several questions about the "Green Book," the AASHTO highway design manual. Dennis Ownbey has worked with Dr. Michael Dixon, chapter advisor, on roundabouts, so he was able to help the team keep the lead by correctly answering most of the questions in the round that focused on roundabouts. Freshman Baird answered a question about colors of highway striping. The team held their lead with strategic betting in the final round in which no team had the correct question to the answer, "The 13 states through which I-90 passes, east to west or west to east."

The UI ITE student chapter hosted the annual TransNow conference in March. Because the Idaho Transportation Department was offering the opportunity for the students to see a Vehicle Infrastructure Integration (VII) demonstration a day before the conference, it was held at the UI Boise Center instead of in Moscow. The UI participants took morning before the demonstration to tour the Transportation Management Center at the Ada County Highway District. The VII Roadshow was presented by ITS America and a variety of other sponsors.

The student conference, held the following day, was meant to introduce students to the different areas of transportation being pursued at their various universities. Each student had an opportunity to tell the others about his or her research. Matthew Moore, Administrator of ITD's Transportation Planning and Programming Division, spoke to the students during lunch about possible careers in transportation. The day's activities ended with a Family Feud-style competition.

Michael Dixon, ITE chapter advisor, meets with the ITE officers in NIATT's library.



"University of Idaho engineering students' performance in the traffic bowl is a great example of how our transportation engineering students stack up against students from other universities throughout the Northwest," said Dean Aicha Elshabini.

ITE is a professional society of transportation engineers, planners and other professionals in more than 70 countries. The goal of the Idaho student chapter is to introduce students to the transportation profession and supplement their classroom and laboratory experiences.

MECHANICAL ENGINEERING SENIORS-OF-THE-YEAR — KATIE LEICHLITER AND NICK HARKER

Two students working on NIATT research projects were selected as seniors-of-the-year for UI's Mechanical Engineering Department. Katie Leichliter conducted catalytic ignition basic research along with graduate student Bob Lounsbury and Dr. Judi Steciak on the Boise Campus (also see pp. 43). Nick Harker was the team leader for the Clean Snowmobile Team (also see p. 22).

TOP PAPER — NATHAN BRADBURY, ANDREW FINDLAY AND KAREN DEN BRAVEN

A 2006 paper written by Nathan Bradbury (MSME 06) and Andrew Findlay (MSME 07), along with advisor Karen Den Braven, "Developing a Turbocharged Gasoline Direct-Injection Two-Stroke Engine for Snowmobile," was recognized as one of the "Top Ten Papers" presented at the 2006 Society of Automotive Engineers Small Engine Technology Conference.

SUPERIOR PAPER — BRIAN HE, ARVINDER SINGH AND JOSEPH THOMPSON

The American Society of Agricultural & Biological Engineers presented Brian He, Arvinder Singh (MSBAE 06) and Joe Thompson with the "Superior Paper Award" for their paper, "A Novel Continuous-Flow Reactor Using Reactive Distillation Technique for Biodiesel Production," published in 2006 in the *Transactions of the International Journal of the American Society of Agricultural and Biological Engineers*.

FACULTY EXCELLENCE AWARD — KAREN DEN BRAVEN AND EDWIN ODOM

Karen Den Braven and Edwin Odom were chosen to receive a Faculty Excellence Award by the students of the Naval ROTC battalion at the University of Idaho and Washington State University. Each academic year, the students nominate outstanding faculty whose innovative teaching and dedication significantly enhance their academic development and success.

SUCCESSFUL TECHNOLOGY TRANSFER: THE T2 ROUNDABOUT TECHNOLOGY WORKSHOP

When Scott Frey, Transportation Engineer with FHWA Idaho Division, received an email from Mark Sandifer at the FHWA Resource Center asking for success stories, he responded "Yes indeed. Idaho has a great Success story! Our Roundabouts Intersections Workshops (a 'market ready technology' no less)." According to Frey, the idea of conducting a Roundabout Workshop was first posed by Reid Dudley, Operations Engineer of the FHWA Idaho Division Office. Through discussions with the Division's Technology Transfer Program Manager the FHWA Resource Center, it was tentatively agreed that two one-day sessions would be conducted in Boise, Idaho. Due to the overwhelming interest in the course when it was first announced, however, Dudley proposed that additional sessions be added. As a result, four one-day sessions were scheduled in Idaho on November 15th and 16th, 2006 and February 27th and March 1st 2007. Coordination, scheduling and advertising of the workshops was greatly assisted by the efforts of Idaho's Technology Transfer (LTAP) Center.

Doug Moore, Director of the Idaho Technology Transfer Center, said that the T2 Center staff we pleased to be able to assist FHWA. "We offer more nearly 100 classes a year advertised to Idaho Transportation Department engineers and technicians, consulting firms, highway districts, and others."

"Idaho has very limited experience with roundabout intersections with only a handful currently in operation; none of which is on a state system route. As a direct result of this workshop transportation engineers throughout Idaho, including the Idaho Transportation Department, now possess the knowledge and skills necessary to identify suitable candidates for roundabout intersections and to properly design them to fit the conditions and demands of each particular location. The participants of the workshop were generally quite impressed with what this revitalized technology and are now much more willing to utilize this design concept than prior to having taken the course. As a result of these workshops the prospects for implementing safe and effective roundabouts in Idaho is very promising."

Scott Frey, Transportation Engineer,
FHWA

Dale's ITD supervisor, Dave Couch and District Engineer Jim Carpenter and his wife joined the Advisory Board at the banquet to recognize ITD's appreciation of Dale also.

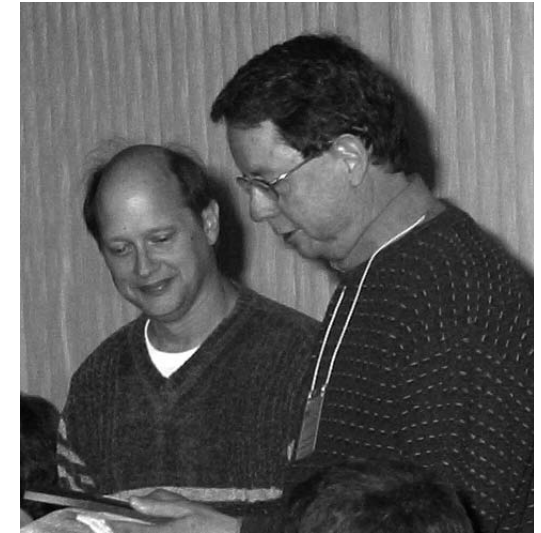
"Dale brings a positive attitude and a 'can do' approach to every project he is involved in. We count on Dale, and he never disappoints us, to break down complex problems and deliver a practical well thought out solution. When you work with Dale you always learn something new. He is very generous with his time and is genuinely interested in making sure that others understand how things work and why they are done in a certain way. Dale is a valuable guy"

Jim Carpenter, ITD District 2 Engineer.

SPECIAL RECOGNITION: DALE MOORE, IDAHO TRANSPORTATION DEPARTMENT

A dinner held for the Advisory Board in April provided the perfect opportunity to honor a special friend of NIATT: Dale Moore. Michael Kyte presented Dale with a plaque recognizing him "for unselfishly providing exemplary service to the National Institute for Advanced Transportation Technology, its students and research faculty." Dale has helped us with our signal controllers in our RAHILS lab, has played the valuable role as a sounding board for the smart signals and controller interface device projects, and serves as an active participant in the Moscow ITS project. He has also met with students from civil engineering classes, teaching about detectors and related electronics. He has been an instructor for the Traffic Signal Summer Workshops since its inception.

Dale Moore has been with the Idaho Transportation Department for the past 18 years and currently holds the position of Traffic Signal Electrician Foreman. His degree in Electronics comes from Lewis Clark State College Electrical Apprenticeship School. A licensed journeyman electrician, Dale has taught special electrical-related classes at the University of Idaho and Lewis Clark State College, and has been an instructor for the State of Idaho Electrical Apprenticeship Program.



SPECIAL RECOGNITION: AMY STEARNS, U.S. DEPARTMENT OF TRANSPORTATION

A summary of our nine years as a UTC would not be appropriate without a special nod of appreciative recognition to our grant officer in the Research and Innovative Technology Administration Office, Amy Stearns. Over the life of our grant, Amy has graciously answered our questions: "Is it allowable?" "What does this mean?" She has provided us advice and has smoothed the progress of our research: "Could you help us . . . ?" "We'd like to make a capital purchase of . . ." "We request foreign travel for . . ." She has shown kindness and patience: "We're sorry it's late, but . . ." "When will we get the strategic plan back?" She has encouraged us to show our best side and has supported us every step of the way. She's a jewel!

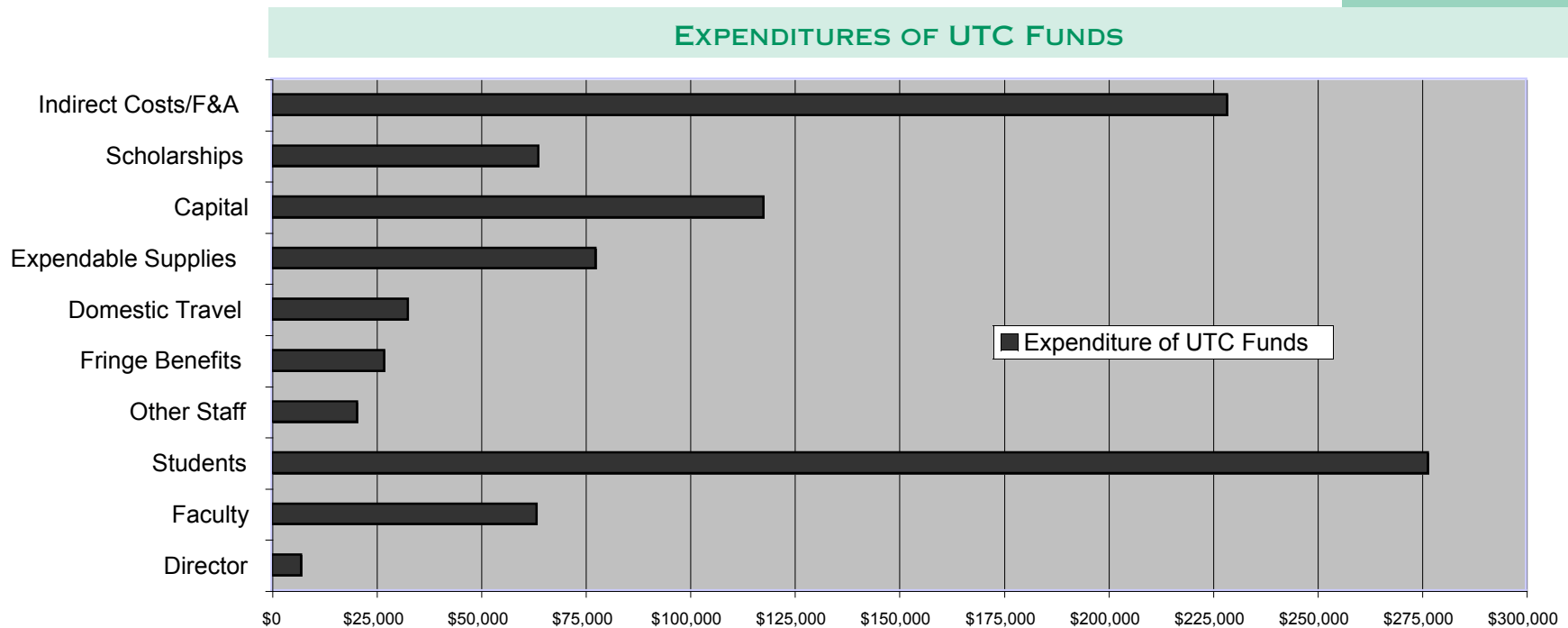
Thank you, Amy!

SECTION 5: RESEARCH, EDUCATION AND TECHNOLOGY TRANSFER — FINANCIAL VIEW

NIATT EXPENDITURES OF UTC FUNDS

When we make plans to spend the funding we receive through the U.S. Department of Transportation as a University Transportation Center, we do not make the decisions lightly. Our expenditures reflect the value we place on the intersection between research and education.

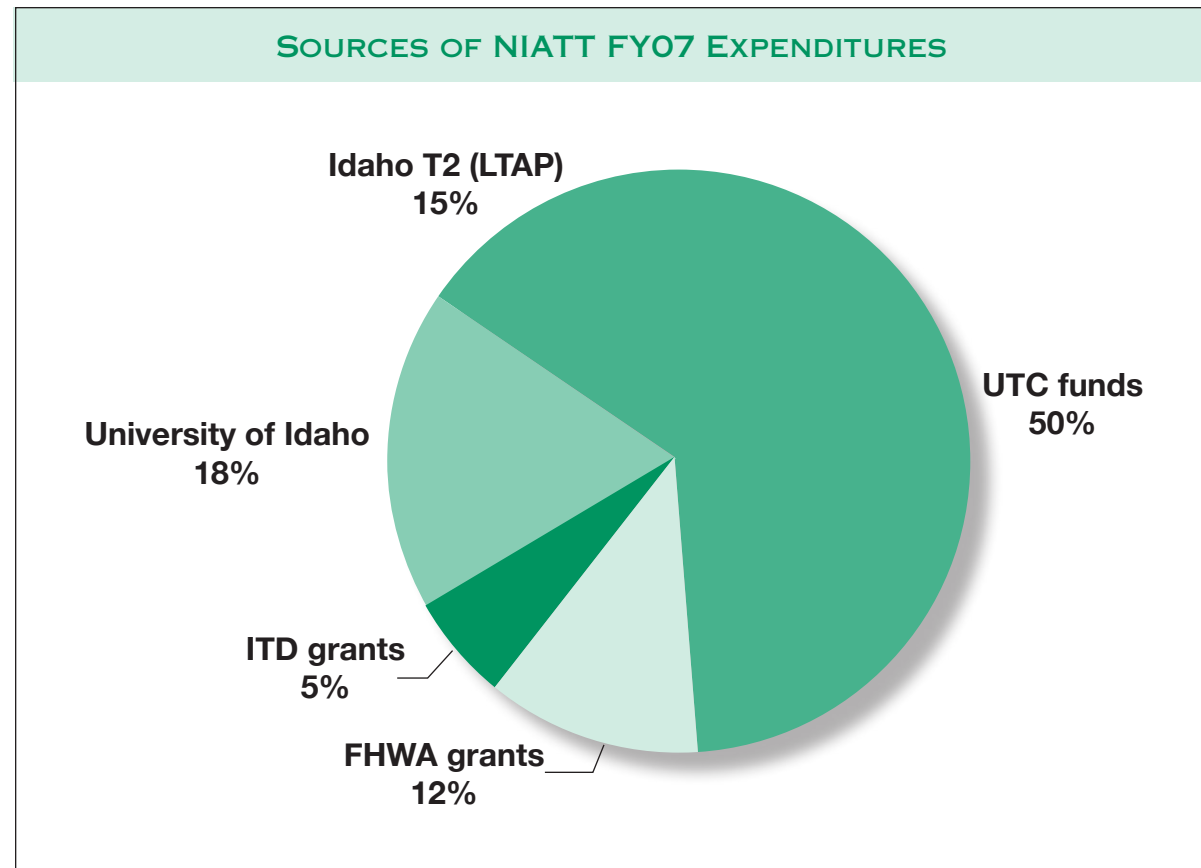
As the chart below shows, our highest expenditure is on student salaries. Expenditures in FY07 involved 23 research projects on which a total of \$276,584 was spent on graduate or undergraduate salaries and an additional \$63,806 for student scholarships in the form of fee payments—37 percent of our total expenditures; nearly 50 percent of expenditures when indirect costs are removed.



SOURCES OF NIATT FY07 EXPENDITURES

The pie chart shows the source of NIATT expenditures from FY07. The FHWA grant dollars came from the Moscow ITS Project (see p. 15) and the Mobile (Hands-On Traffic) Signal Timing Training (MOST) project, received, at least in part, because of NIATT's experience delivering the Traffic Signal Summer Workshop.

Expenditures from the Idaho Transportation Department (ITD) are lower than usual, reflecting a period of inactivity while the department was searching for a new research director after the year-long reevaluation and reorganization of its research program.



SECTION 6: RESEARCH, EDUCATION AND TECHNOLOGY: RESEARCH PROJECT STATUS

PROJECTS BEGUN IN FY07-YEAR 9

- KLK131 Pilot Deployment of Plug-and-Play Smart Traffic Signals
Principal Investigator: Richard Wall; James Frenzel; Brian Johnson
- KLK132 A Framework to Assess the Survivability of Intelligent Transportation Systems
Principal Investigators: Ahmed Abdel-Rahim; Paul Oman; Brian Johnson
- KLK133 Improved Signalized Intersection Performance Measurement, Phase II
Principal Investigator: Michael Dixon
- KLK134 An Intersection Traffic Data Collection Device Utilizing Logging Capabilities of Traffic Controllers and Current Traffic Sensors
Principal Investigators: Ahmed Abdel-Rahim; Brian Johnson
- KLK430 Idaho Design Engineering Analysis Works (IDEAWorks)
Principal Investigators: Edwin Odom; Steven Beyerlein; Karen Den Braven, and Donald Blackketter
- KLK431 A Ballistic Gas Compressor for Automotive Airbag Initiator Research and Automotive Engine Testing and Development
Principal Investigator: Karl Rink
- KLK432 Biodiesel Quality Affected by Sulfur Content originated from Different Feedstocks and a Database for the Same
Principal Investigator: Brian He; Jon Van Gerpen
- KLK433 Design and Construction of a Turbocharged, Direct-Injection, Two-Stroke Snowmobile for Competition in the SAE Clean Snowmobile Challenge
Principal Investigator: Karen Den Braven
- KLK434 Investigation of Engine and Combustion Parameters for Catalytic Ignition
Principal Investigators: Judi Steciak; Steven Beyerlein

PROJECTS CONTINUING

- KLK120 Development of New Actuated Signalized Intersection Performance Measurement Methodologies
- KLK121 Remote Access Hardware-in-the-Loop Simulation Laboratory: Application Guide for Testing Software-Based Traffic Control Systems
- KLK122 Conflict Monitor for Plug-and-Play Distributed Smart Signals and Sensors for Traffic Controllers
- KLK125 Modeling and Assessing Large-Scale Surface Transportation Network Component Criticality
- KLK126 Traffic Signal Summer Workshop VII
- KLK238 Experiments in Modeling Urban Surface Transportation Network Dependability and Security
- KLK328 Comparison of Esterified and Non-Esterified Oils from Rape-seed, Canola and Yellow Mustard as Diesel Fuel Additives
- KLK340 A Novel Continuous-Flow Reactor Using Reactive Distillation Techniques for Economic Biodiesel Production--Stage 2
- KLK241 Plug-n-Play Smart Sensor Traffic Signal Systems
- KLK342 Small Engine Laboratory Support for Multi-Fuel Performance and Emissions Testing

- KLK410 Design and Construction of a Turbocharged, Direct-Injection Two-Stroke Snowmobile for Competition in the SAE Clean Snowmobile Challenge
- KLK411 Improved Transportation Performance and Emissions through Fundamental Studies, Engine testing, and Demonstration Platform Development
- KLK412 Feasibility Study on Hydro-Thermal Conversion of Low-Grade Glycerol to Alcohols for Use in Biodiesel Production
- KLK413 Integrated Battery
- KLK414 Thermal Stresses and Related Failure Mechanisms in Bridge-Wire Initiators
- KLK410 Advanced Vehicle Technologies for Efficient Powertrain Performance
- KLK421 A Biodiesel Demonstration Plant

PROJECTS COMPLETED

- KLK102 Sustainable Transportation Conference
- KLK124 Full-Scale Implementation of Plug-and-Play Distributed Smart Traffic Signal Pedestrian Walk/Wait Display with Pedestrian Button
- KLK201 Development of Controller Interface Device for Hardware-in-the-Loop Simulation
- KLK202 Actuated Coordinated Signalized Systems: Phase I—Over-saturated 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
- KLK215 Assessing the Security and Survivability of Transportation Control Networks
- KLK216 CID Road Map
- KLK217 Traffic Signal Summer Workshop IV
- KLK220 Traffic Signal Summer Workshop V
- KLK230 Development of Traffic Signal Operations Case Studies
- KLK231 Applying the TRANSIMS Modeling Paradigm to the Simulation and Analysis of
- KLK232 Maximizing Data Quality to Optimize Traffic Signal System Performance
- KLK233 Applying Safety-Critical Fault Tolerant Principles to Survivable Transportation Control Networks

- KLK234 Assessing Intelligent Transportation System Educational Needs
- KLK235 Expanded Controller Interface Device I/O and Software Capabilities
- KLK236 Controller Interface Device Software Documentation
- KLK237 Area-Wide Performance Measures for Traffic Signal Systems
- KLK239 Traffic Signal Operations Case Studies
- KLK240 Remote Access Laboratory for Testing Advanced Traffic Signal Systems:
Operational Manual and Application Guide
- KLK242 Traffic Signal Summer Workshop VI
- KLK302 Advanced Vehicle Concepts Team Electric Vehicle: Phase II: FutureTruck 2000, 2001
- KLK303 Alternative Powered Snowmobile Development (FY01)
- KLK304 Alternative Power Snowmobile Development (FY02)
- KLK305 Vehicle Performance Simulation, Phases I-II
- KLK306 Vehicle Performance Simulation, Phase III
- KLK308 A Parallel-Hybrid Sport Utility Vehicle (FutureTruck 02)
- KLK309 Clean Snowmobile 03
- KLK310 Biodiesel Fuel from Yellow Mustard Oil, Phase I
- KLK311 Biodiesel Fuel from Yellow Mustard Oil, Phase II
- KLK312 Catalytic Ignition
- KLK314 Mentorship and Performance Assessment of Design Teams in Transportation-Related Projects
- KLK315 Spark Ignition Engine Conversion to Aquanol Fuel
- KLK317 Diesel Engine Conversion to Aqualytic Fuel—Phases I-II (Homogeneous Charge Combustion of Aqueous Ethanol)
- KLK318 Reactor Studies of Water-Alcohol Mixtures, Phase II
- KLK319/KLK320 Catalytic Ignition of Aquanol in Reactor, Engine and Vehicle Environments
- KLK321 Optimal Design of Hybrid Electric-Human-Powered Light-weight Transportation
- KLK323 Idaho Engineering Works
- KLK325 FutureTruck 03
- KLK327 Essential Elements in Teaming: Creation of a Teaming Rubric
- KLK330 Advanced Lead Acid Battery Development
- KLK331 High Performance Auxiliary Power Units, Phase II
- KLK341 Design and Construction of a Direct-Injection Two-Stroke Snowmobile for Competition in the 2004 SAE Clean Snowmobile Challenge
- KLK343 A Novel Continuous-Flow Reactor Using a Reactive Distillation Technique for Economical Biodiesel Production
- KLK344 A Parallel-Hybrid Electric-Hydraulic Sport Utility Vehicle: FutureTruck 2004
- KLK345 Failure Mode Investigation and Ballistic Performance Characterization of Pyrotechnic Initiators Used in Automotive Supplemental Restraint Inflation Systems
- KLK346 Characterization of Catalytic Igniter Performance and Emissions
- KLK347 Construction of a Direct-Injection, Two-Stroke Snowmobile for Competition in the SAE Clean Snowmobile Challenge
- KLK348 Hybrid Heavy Weight Vehicles



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