The Institute’s activities in education encompass a multidisciplinary program of coursework and experiential learning that reinforces the Institute’s theme. The educational program includes the disciplines of computer science and engineering, electrical and computer engineering, civil engineering, mechanical engineering, human factors, public policy, and others.

By sponsoring and supporting varied educational initiatives for students, the Institute is generating interest in its core ITS science and technologies. These initiatives include developing new curriculum and courses, involving undergraduate and graduate students in research projects, sponsoring students to attend national conferences, presenting awards that recognize outstanding students, and offering research assistantships to help attract more students to the study of transportation. This section of the annual report highlights some of our efforts in the area of education.

Teams geared up for Intelligent Ground Vehicle Competition

With funding and guidance from the ITS Institute and its NATSRL program in Duluth, two University of Minnesota teams competed in this year’s 13th Annual Intelligent Ground Vehicle Competition held in Traverse City, Michigan, for three days in June.

Thirty-seven teams from universities across the U.S. participated in three different segments of the competition: the autonomous challenge, vehicle design, and navigation. The first requires the driverless vehicle to negotiate an outdoor obstacle course under a prescribed time while staying within the five m.p.h. speed limit and avoiding the obstacles on the track. The second awards points based on the process the teams used to design their vehicles based on a written report, oral presentation, and inspection of the vehicle. The third requires the vehicle to navigate its way around obstacles in a field to reach as many waypoints as possible.

Students Eric Li and Shawn Brovold test their intelligent ground vehicle on campus before leaving for the national competition in Michigan.
Mechanical engineering students Shawn Brovold, Nathan Carlson, Eric Li, and Greg Rupp represented the University’s Twin Cities campus with their robot, “G2,” a redesigned version of the last team’s vehicle, “Gopher.”

G2 is equipped with three wheels: two snow-thrower tires for traction and steering in the front, and a pivot-mounted stabilizing wheel in the rear. Powered by two 1.1-horsepower servomotors, the 475-pound vehicle finds its way using an array of sensors. A forward-facing camera collects visual data, such as the location of potholes and boundary markers. A laser sensor scans in front of the vehicle and reports the location and size of obstacles, such as construction barrels, cones, and barricades. Navigation is achieved with the use of a DGPS unit and a digital compass. Collected data are then processed and interpreted by National Instruments’ LabVIEW software, all without user input.

The team, which hadn’t competed since 2001, was advised by ITS Institute director Max Donath, research scientist Vassilios Morellas of Honeywell, and Don Krantz, vice president of MTS Systems. While the $10,000 grand prize could have been put to good use, the project rewarded team members in other ways, Brovold said. “It gives the students who work on the robot a real-world learning experience.” Donath said the team should be proud of its top-ten place in the competition.

This year was the first in which students at the University’s Duluth campus attempted to build a vehicle for the competition. The fact that they even qualified for the competition was a big success, said team members Brian Linder and Tony Moua.

They and fellow undergrads in the Department of Electrical and Computer Engineering undertook the project as part of the ECE’s Senior Design Workshop. The workshop has been offered over the last four years by Drs. Rocio Alba-Flores and Fernando Rios-Gutierrez and other ECE faculty.

The vehicle, known as MARVIN (for Mobile Autonomous Robotic Vision-Aided Intelligent Navigator), consisted of a modified power-wheel base equipped with four ultrasonic sensors, a video camera, digital compass, GPS unit, power supply, a laptop computer, and HC12 Mini-Dragon microcontroller. Information from the sensors is processed by the microcontroller and sent to the laptop. Using MatLab, the laptop uses the data from the camera as well as the microcontroller to determine the best path for the robot to take, then tells the microcontroller how to drive the vehicle.

The vehicle was working well up until the day of competition, Linder said, when it developed several problems and could compete in only two of the nine runs.

“Our programs for navigation were working as expected, but the mechanical and electrical components were wearing out and failing on us,” added Moua. “I would definitely try to use higher-rated components next time around.”

Besides the technical skills they gained from the project, Linder and Moua reported learning much about teamwork, troubleshooting, perseverance, and creativity. In addition, they benefited from seeing other students’ projects and getting ideas to improve their own design, they said.
Bird named Student of the Year

The 2004 ITS Institute Outstanding Student of the Year award was presented to Nathaniel Bird, a master’s candidate in computer science at the University of Minnesota. Bird received his Bachelor of Science in Computer Engineering with high honors from Ohio Northern University, and is a registered Engineer in Training in the State of Ohio.

Bird has been a key asset to one of the Institute’s high-profile research topics: monitoring human activities at bus stops, led by computer science professor Nikolaos Papanikolopoulos. Bird is currently working on developing automated intelligent vision-based traffic monitoring systems that can aid a human user in the process of risk detection and analysis. His work was applied to the problem of detecting drug-related activities at bus stops and received great reviews from the transit community.

Bird has shown excellence in the classroom by earning a 4.0 GPA as a graduate student. His current advisor describes him as “very well-organized and able to view a problem from several different perspectives without any difficulties.” He has been involved in numerous honor societies, including the Tau Beta Pi Engineering Honor Society and the Sigma Pi Sigma Physics Honor Society. His classroom success has not only been recognized by being on the Dean’s List at Ohio Northern University for each of his 12 semesters, but also by being awarded scholarships such as the Robert C. Byrd Scholarship from the Ohio Board of Regents and a University of Minnesota Computer Science fellowship.

In addition, Bird has been an author for multiple journals and conference papers and received a nomination for the best International Conference on Robotics and Automation (ICRA 2004) Vision Paper Award.

Advanced Transportation Technologies Seminar Series

This was the fourth year that the Institute sponsored its multidisciplinary seminar series at the University. These seminars provide a way for students to learn about ITS technologies in areas outside their current field of study, for researchers to learn about other projects in progress, and for practitioners to learn about the technologies of the future.

The seminar series is available as a one-credit graduate-level course, or attendees can earn one professional development hour for each seminar. The series is also a required course in the Graduate Certificate Program in Transportation Studies at the University of Minnesota. Seminars are videotaped and available for loan by request; one presentation was also Web-streamed on the Internet.

The past year’s presentations were:
- “Evacuation Planning,” Qingsong Lu, Computer Science and Engineering
- “Maintaining Safe Headways While Driving,” David Shinar, Industrial Engineering and Management, Ben Gurion University of the Negev, Israel
- “Inexpensive Attitude Determination Systems for UAV Applications,” Demoz Gebre-Egziabher, Aerospace Engineering and Mechanics
- “Finding the Fountain of Youth for Snowplows and Other Fleet Assets,” David Wyrick, Industrial Engineering, University of Minnesota Duluth
- “The Minnesota Comprehensive Highway Safety Plan,” Bernie Arseneau, State Traffic Engineer, Minnesota Department of Transportation
- “Investing for Robustness and Reliability in Transportation Networks,” David Levinson, Civil Engineering
- “Proactive Crash Prevention Solutions,” John Hourdakis, Civil Engineering
Student designs new system for snowplow blades

In April, mechanical engineering undergraduate student Michael Etheridge presented to University and Mn/DOT maintenance and research staff an innovative technique he developed for changing snowplow blades.

This new system, dubbed the Quick Edge Rapid Underbody Plow Cutting Edge Changing System, offers an alternative to the current system of replacing cutting edges on snowplows, which must be done frequently due to wear. Currently, these cutting edges are bolted to the plow blade with three or four fasteners—a process that is time consuming, tedious, and risky for mechanics doing the work due to the weight of the edges and the awkward positions staff must work in.

The system Etheridge proposed is designed to reduce the time and effort needed to replace cutting edges as well as the risk of personal injury. During his presentation, he discussed his design process, described the design features, and demonstrated a blade change with the prototype.

Etheridge began working on the project, which was initiated and sponsored by Mn/DOT, about a year ago as part of his honors program. Dr. Craig Shankwitz, Intelligent Vehicles program director, served as Etheridge’s advisor on the project.

At the presentation, the system generated interest and enthusiasm from Mn/DOT personnel, several of whom remarked that they had not previously seen a design like it. (The system was subsequently featured in the May 11 issue of Mn/DOT’s weekly electronic newsletter, Newsline.)

The next step is to field-test the prototype on a maintenance truck in the fall, which will allow Etheridge to see how the design holds up, as well as get maintenance vehicle operators’ opinions, he said.

Students gather for career expo

Approximately 80 college students from Minnesota and Wisconsin gathered on campus in March for the 10th Annual Transportation Career Expo. The Institute partnered with CTS, the Minnesota Local Road Research Board, the Minnesota Local Technical Assistance Program, and the Women’s Transportation Seminar to hold the event, which provided students an opportunity to ask questions, receive seasoned advice, obtain feedback on their resumes, and network with more than 20 employers.

Employers promoted their organizations with booth displays, and several company representatives led informational sessions on transportation-related careers in areas such as intelligent transportation systems (ITS), engineering, policy and planning, and logistics management.

Huber Award goes to ITS students

The 2005 Matthew J. Huber Award for Excellence in Transportation Research and Education was given to

Student Michael Etheridge, far right, demonstrates the Quick Edge system he developed for Mn/DOT staff, left, and IV program director Craig Shankwitz, center.
Wu-Ping Xin, a doctoral student advised by Panos Michalopoulos of the Department of Civil Engineering, and Nathaniel Bird, a master's candidate in computer science under Nikolaos Papanikolopoulos.

Praising Wu-Ping's interdisciplinary research approach, Michalopoulos said he agrees with Wu-Ping's philosophy: “He addresses a problem that is real and important, investigates the nature of the problem, then finds practical solutions.” For example, Mn/DOT will shortly deploy a ramp-metering strategy for the metro freeway system that is based on Wu-Ping’s modeling and analysis. Wu-Ping said he is very excited to contribute his work to the challenging field of ITS.

Research associate and former Huber winner Osama Masoud, who works with Papanikolopoulos, said Bird shows dedication and commitment in his work. “We rely on him to do a lot of the research, and he does a very good job.” Bird’s research, which involves video techniques to detect loiterers such as drug dealers at bus stops, arose from an idea by Metro Transit but has broader applicability for transportation security. “All researchers like to think their research is the most interesting in the world,” he joked. “It’s nice to get an award to confirm that your research is interesting and important.”

Global Positioning System module released to Minnesota high schools

In an effort to educate high school students on the topic of ITS, the Institute developed a set of curriculum materials on the topic of Global Positioning Systems (GPS). The GPS Web module is a structured learning opportunity in which high school students investigate the topic of GPS and its impact on travel. The students’ assignment, while using the research cycle, is to search out information from given sources and demonstrate what they have learned.

The GPS Web module was developed by the Institute's K-12 coordinator, Mark Tollefson, an area high school science teacher. A CD-ROM containing the module and a poster explaining ITS were distributed to 160 high schools around Minnesota. The Web module is also available on the Institute Web site at www.its.umn.edu/education/gps, making it available to educators and students around the world.

Institute sponsors students to attend national conferences

The past year, the Institute gave travel awards to 13 University of Minnesota students so that they could attend and participate in various national conferences. The past year, the Institute gave travel awards to 13 University of Minnesota students (from both the Twin Cities and Duluth campuses) so that they could attend and participate in various national conferences. Students attending the National Rural ITS Conference in Duluth, Minn., were Wenling Chen, Paul Morris, Feng Qian, Jeffrey Sharkey, Lei Zhang, and Xi Zou.

Students who traveled to the national meeting of the Transportation Research Board (TRB) in Washington, D.C., were Baichun Feng, Vivek Deshpande, Lei Zhang, Nebiyou Tilahun, Feng Xie, Michael Corbett, Mathew Bevilacqua, and Nathaniel Bird.