Western Transportation Institute
Montana State University
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Message from the Director:

"Location, Location, Location!"

In commercial real estate, there is an old saying that the three most important indicators of future success are "location, location, and location." At WTI, I'm excited to report that our new location offers promising new opportunities for our future as well.

In December, WTI moved into a newly renovated building with more than 20,000 square feet of space for our core research and administrative staff. The most exciting aspect of this expansion is that we now have 6,000 square feet of dedicated space for on-site research laboratories. These laboratories are equipped to focus on emerging needs in rural transportation, as well as capitalize on the technical expertise of in-house investigators:

• Driving Simulation Laboratory:
This high-fidelity facility allows testing of driver performance and behavior in a variety of customized scenarios.

• Materials Corrosion Laboratory:
This facility allows WTI to evaluate the corrosion rate of transportation construction and maintenance materials, and the performance of corrosion inhibitors.

• Transportation, Research, Applications and Integration Laboratory (TRAIL):
The TRAIL laboratory is a simulated small urban/rural traffic management center that enables comprehensive research for ITS technologies being used in the transportation field. Future expansions could include a test facility for transit-specific applications.

• Systems Engineering and Integration Laboratory:
The goal of this facility is to utilize multi-discipline education and research to develop integrated skills and systems that produce best management solutions for small urban and rural environments.

• Geosynthetic Materials Laboratory:
The Geosynthetic Materials Laboratory provides state-of-the-art materials testing equipment that is used for projects focused on the use of geosynthetics in rural highway infrastructure such as pavements.

These laboratories will greatly expand the hands-on research we can conduct for our own projects, as well as the types of services we can offer to our partners. In addition, since we retain a location on the Montana State University campus, we continue to have ready access to additional research laboratories, as well as top-notch faculty with a full range of specialized academic and technical expertise.

If you'd like to come tour our new facilities and discuss potential research collaborations, please contact me at (406)994-6126 or at stevea@coe.montana.edu

Steve Albert
Director

Advancing rural transportation through research and education...

MONTANA STATE UNIVERSITY
College of ENGINEERING

"For The Enjoyment of Future Generations..." Innovative transportation planning helps National Parks to promote visitation while protecting resources

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National parks attract millions of people to visit them every year, with each of these visitors expecting a wonderful visitor experience. The park service strives to accomplish this, while at the same time protecting the park resources so that future generations can enjoy the park as well. The U.S. National Park Service has recognized these two objectives and incorporated them into their mission.

National parks in the western states include some of America's most iconic scenic wonders: the geysers and buffalo of Yellowstone, the domes and waterfalls of the Yosemite Valley, and the cliffs and gorges of the Grand Canyon. In addition to protecting unique natural resources, these parks protect archeological, cultural and historic resources, and provide outstanding recreational and educational opportunities for visitors from all over the U.S. and other nations.

Park visitation levels are increasing throughout the country, and the corresponding impact on the transportation system may adversely affect both visitor experience and resource protection issues at the parks. The parks depend on this "three-legged stool" of visitor experience, resource protection and the transportation system to fulfill their purpose. If any one of these legs breaks, the entire system will deteriorate.

The transportation system plays a key role in the careful balance between these previously mentioned "legs." In order to have a pleasant visitor experience, people expect that they can go through the park without waiting in congested conditions, that they will be able to drive their own vehicles, and that there will be a parking spot waiting for them when they arrive. Unfortunately, with visitation increasing, these demands are becoming harder to fulfill. Widening park roadways and expanding parking lots would be detrimental to park resources; therefore, solutions other than construction need to be considered.

By identifying, testing, and evaluating innovative transportation solutions in national park settings, research centers like WTI are helping NPS fulfill its sometimes conflicting mission of protecting resources while making the parks accessible to a growing number of visitors. For nearly ten years, WTI has conducted a large number of projects to improve the visitor experience by enhancing mobility and communication within National Parks and throughout the surrounding region. More recently, WTI has taken a leading role in road ecology projects that focus on the resource protection needs of the National Park ecosystems.

Visitor Experience: keeping people moving and informed

Visitors expect to easily navigate their way through the National Parks, and to move efficiently

from one site to the next. If congestion is unavoidable, up-to-date information can help visitors anticipate delays or move on to less crowded roads or locations. Many parks are also looking to expand alternative transportation options to relieve congested road conditions.

In 1999, WTI sponsored and hosted a conference entitled "National Parks: Transportation Alternatives and Advanced Technology for the 21st Century." Co-sponsored by the National Park Service, the U.S. Department of Transportation, and

other federal and state agencies, this event highlighted issues such as regional planning, transit options, traveler information and alternative fuels, and served as the catalyst for numerous research projects.

In the area of alternative transportation, WTI conducted a multi-phase project for Yellowstone National Park to explore the features of an alternative transportation system, especially the information system component. Researchers conducted surveys and interviews with visitors, and used the findings to develop prototypes for a portable information system that could provide transit and interpretative information.

Transportation alternatives are also being explored between national parks and gateway communities. On U.S. 89 north of Yellowstone National Park, WTI is working with park officials and the Montana Department of Transportation to develop a ride-sharing program that will encourage carpooling among park employees. These efforts are consistent with a new emphasis on transportation alternatives at the federal level: the National Park Service has received funding from the recently enacted highway bill to create a new Alternative Transportation in Parks and Public Lands program, which will support public transportation projects in parks, public lands, and surrounding areas.

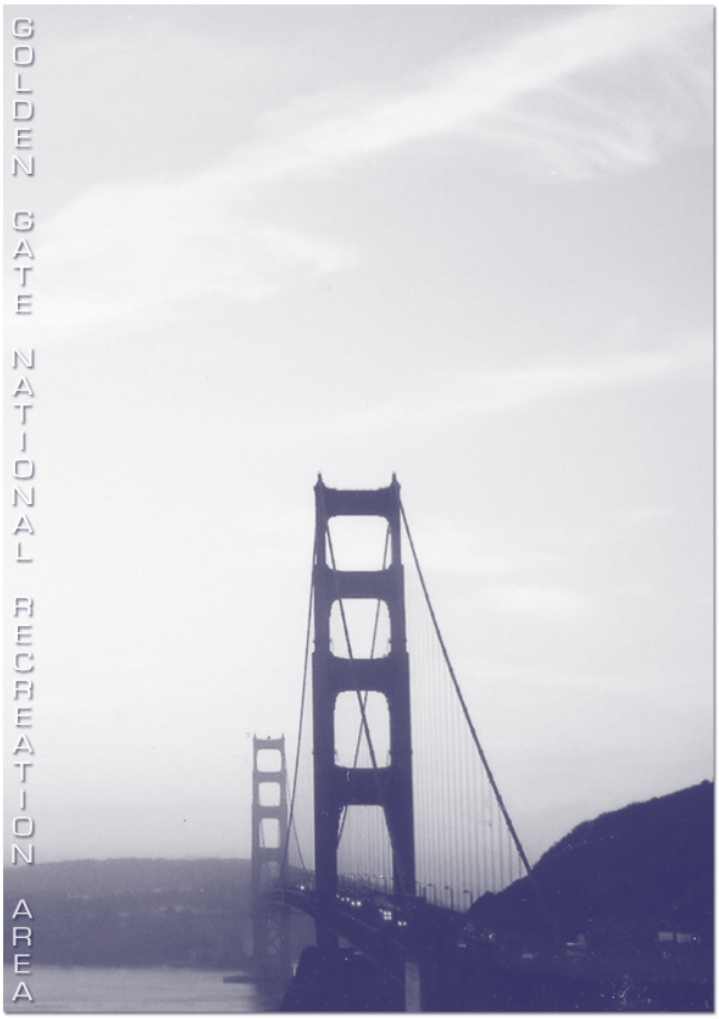
Over the years, WTI has also conducted numerous projects to help National Parks identify and put into use Intelligent Transportation Systems (ITS) that can address transportation challenges faced by visitors. In 2003, researchers facilitated peer-to-peer outreach meetings for the Great Smoky Mountain National Park to help officials investigate the potential of deploying advanced technologies.

In California, WTI conducted a major study to explore how ITS can help the many national parks in that state. Using two case study parks, researchers identified needs through outreach and surveys, then matched them to potential ITS solutions. In the final report, findings were presented with planning

guidelines and recommendations, so that any National Park in California with transportation challenges could find a potential solution and plan for implementing it. WTI also produced an ITS outreach video based on the report to make the findings available to park officials throughout the state, as well as an ITS architecture memo that will help integrate park systems with regional traveler information systems.

In Yellowstone National Park, WTI worked with numerous regional partners to deploy innovative technologies that would ease the transportation challenges of a rural National Park that borders three different states. Through the Greater Yellowstone Regional Intelligent Transportation Systems (GYRITS) project, researchers developed a strategic plan to facilitate interagency coordination and identify potential technological solutions. In a second phase, numerous pilot projects were deployed and tested, including dynamic message signs with road condition warnings, interactive touch screen kiosks with visitor information, multi-state incident management and coordination guidelines, and automated vehicle identification at Park entrance gates to shorten wait times.

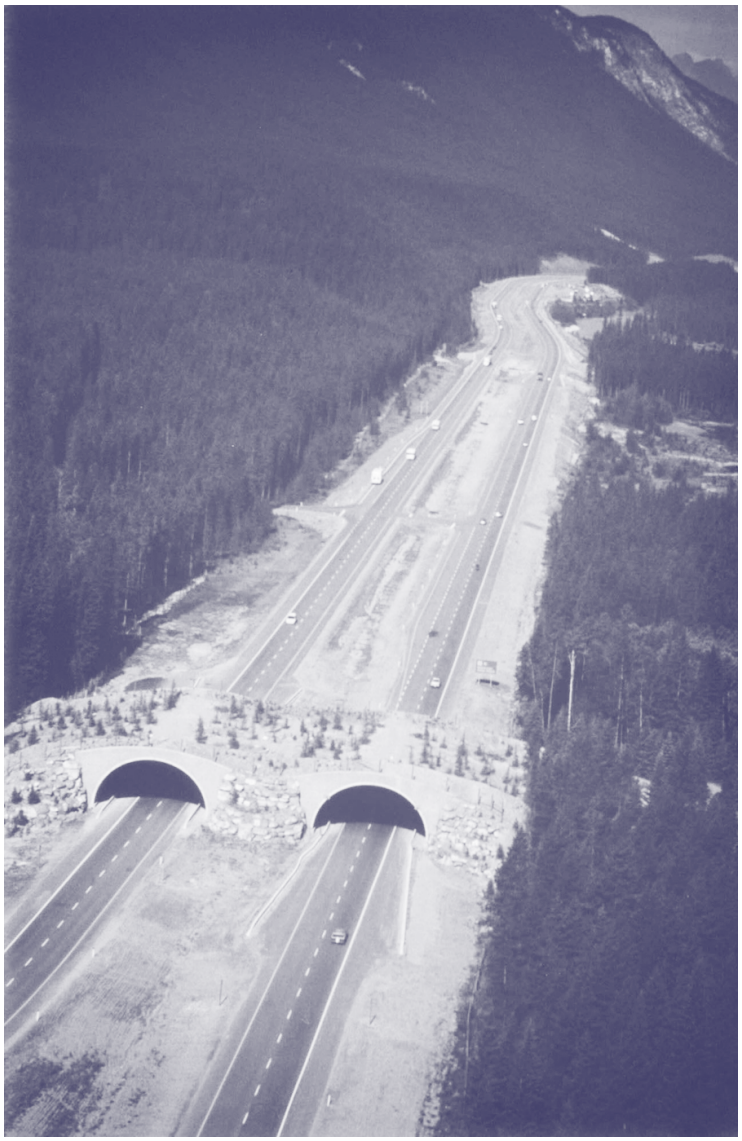
Currently, WTI is working in and around several National Parks to improve access to visitor information. For example, WTI is working with Yellowstone National Park and Glacier National Park to automate the collection of road condition and other data, so it can be made available on the 511 phone system in Montana and surrounding states. Through a separate project, WTI is also helping Glacier National Park to select ITS technologies and other measures that will keep visitors informed of work zone activities, alternate routes, and travel delays during the reconstruction of the Going-to-the-Sun Road. "We need tools that help us remove enough congestion to enable construction, but that also sustain visitation throughout a multi-year project," said Gary Danczyk, Mitigation Project Manager at Glacier National Park.



Other current WTI projects seek to improve visitor experience by decreasing congestion. In California, WTI worked with Sequoia and Kings Canyon National Parks to install and upgrade highway advisory radio systems on access roads leading to the park. At the Golden Gate National Recreation Area, researchers are evaluating whether portable Changeable Message Signs with real-time parking information, combined with expanded transit signage, are increasing the use of park shuttles. "The most useful element of the project was how well the signs interacted with a pilot shuttle service to Muir Woods," said Paul Bignardi, a GGNRA transportation planner. "When the signs went on that read 'Parking lot full,' shuttle ridership increased by 300%," Bignardi explained.

These collaborations can also help agencies to

begin collecting data that is useful for long-term planning and analysis. "We were able to use WTI traffic counters along with our own traffic counters to collect traffic data at key roads and entrances," said Bignardi; "we hope to establish a baseline of data that will help us see the impact these ITS tools have on traffic congestion and park visitation."



Road Ecology: promoting safe coexistence of wildlife, resources, and travelers on rural highways

National Parks strive to conserve and protect the natural wonders that visitors come to enjoy. With its nationally recognized expertise in the field of road ecology, WTI is conducting numerous projects in and around national parks to reduce the potentially harmful impacts of roads on wildlife, habitats, and natural resources. This research also helps enhance safety for motorists by reducing the number of animal-vehicle collisions.

WTI's work is not limited to national parks in the United States. In Canada's Banff National Park, Dr. Tony Clevenger has led a landmark six year study to evaluate the effectiveness of wildlife crossing structures. The Banff-Bow Valley is home to the largest number and greatest variety of wildlife crossing structures designed to reduce wildlife-vehicle collisions along the Trans-Canada Highway (TCH). Twenty-two wildlife underpasses and two wildlife overpasses were constructed between 1980 and 1998 to permit wildlife movement across the four-lane section of TCH, and other sections of the highway are bordered by large-mammal wildlife exclusion fence. Dr. Clevenger's monitoring studies indicate there have been over 70,000 passes thru the 24 wildlife crossings. Of these, over 55,000 have been ungulate (large hoofed animals), of which 77 have been moose. Carnivore totals include 3672 wolf passes, 915 cougar, 906 black bear and 296 grizzly bear. Another unique aspect of the project is that usage of the crossing structures by wildlife has been documented in 13 hours of video clips. The data and lessons learned yielded by the six-year monitoring program are providing design guidance and technical support to transportation planning and highway construction projects in both Canada and the U.S.

Also in Banff National Park, WTI aquatic specialists are studying the Bow River Watershed. Researchers will take an ecosystem approach to identify the factors that may be influencing the ecological integrity of the watershed, as well as bull trout and westslope cutthroat trout populations.

In U.S. national parks, WTI is conducting an assessment of road impacts on wildlife populations within national parks. Through an extensive

survey of 194 park units, researchers are synthesizing current conditions and identifying future wildlife/transportation conflicts.

Through other projects, WTI is working with national parks to test leading edge technologies that may help protect animals and motorists from collisions. On U.S. 191 near Yellowstone National Park, researchers installed and evaluated an experimental animal detection system that activates a flashing warning to motorists when large mammals are near the road. There is significant nationwide interest in developing a reliable animal detection technology: the eleven state departments of transportation that funded the original study recently authorized a second phase of the project to allow further testing and refinements to the system.

Integrated Projects: working toward a comprehensive approach

As more innovative transportation and road ecology projects are successfully implemented in national park settings, NPS management and research centers like WTI have begun to incorporate the technologies and best management practices into large scale and long term planning for the parks' future. This allows a more comprehensive approach to planning where growth, transportation and environmental concerns are considered together, and in advance.

For example, in Glacier National Park, WTI will soon begin a pre-construction study of the Going-to-the-Sun Road, which is scheduled for a major, multi-year rehabilitation. Researchers will review the Park's road design plan in advance to provide guidance on environmental protection, restoration, and connectivity issues.

Other national parks are coming to WTI to request recommendations for new ways to address increased congestion on roads that are environmentally sensitive. New projects under development will test non-invasive traffic monitoring techniques that enhance motorist safety while protecting wildlife and maintaining scenic views. Other parks are investigating the possibilities of shuttle fleets powered by alternative fuels.

As the NPS, transportation departments, and research centers like WTI work together to improve their planning methods, these partners are making important progress toward the long-term viability of our most treasured national parks. "It's a reflection of modern government," said Danczyk, "coming together to meet needs and partnering to stretch limited resources help us get to win-win solutions."

Do Traditional Warning Signs Improve Safety on Montana Roads?

Unexpected, occasional situations along roadways such as railroad crossings, icy bridges, falling rocks, and wildlife crossings are the cause of many traffic accidents. Although static warning signs often are used to warn drivers of these impending hazards, data is not available on the effectiveness of these warnings on Montana roads to reduce the number or severity of incidents.

Ahmed Al-Kaisy is leading a WTI project that will synthesize existing information related to the effectiveness of static warning signs as well as alternative measures that are proven effective in alerting drivers to impending hazards. The study will focus on warning signs that are used for occasional highway hazards common in the state of Montana, such as wildlife crossings, ice, and falling rocks.

Dr. Al-Kaisy's research will include a survey of state departments of transportation to determine their practice and experience in using static warning signs and other non-conventional devices to warn drivers of roadway hazards. A synthesis of his findings will be prepared for the Montana Department of Transportation, to guide the use of signage and other highway safety warnings throughout the state.

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Habitat Connectivity Project Focuses on Endangered San Joaquin Kit Fox

The San Joaquin kit fox is listed as a federal endangered species and a threatened species in the state of California. It currently can be found in 16 California counties. The California Department of Transportation (Caltrans) plans to expand more than 300 miles of highways in the habitat of the San Joaquin kit fox. In preparation, WTI and the California State University - Stanislaus, Endangered Species Recovery Program are conducting a study to determine what underpass (culvert) design and adjacent habitat features are the most effective to maintain habitat connectivity for San Joaquin kit foxes.

The highway projects involve widening two-lane highways to four lanes that run through increasingly fragmented and remnant San Joaquin kit fox habitat. The increasing barrier effects of highways can increase the potential for local population extinctions and reduce the foxes' potential for recolonization. As mitigation, highway widening projects will increasingly incorporate underpasses for kit fox habitat connectivity. However, there have been no studies to determine what type of structures kit foxes will use, and which design parameters will encourage use.

Anthony Clevenger of WTI is co-leading a research project that will address these questions, resulting in science-based information for designing underpasses for the kit foxes and measures of their ecological performance. Clevenger said the framework will also be applicable to similar small carnivores and wildlife in arid landscapes; something which is lacking at the moment.

Research will involve using monitoring devices such as track-pads and infrared cameras to observe the frequency of use of existing underpasses designed for drainage. From this data, researchers will be able to identify features that kit foxes prefer or avoid when needing to cross busy highways. Some of these variables might be the size of the underpass structures, the amount of light, visibility, and/or the proximity of vegetative cover.

Non-invasive methods will sample DNA from kit fox populations bisected by highways in Southern California to provide baseline information on population genetics. DNA will help identify the sex and familial relationships of the foxes using the underpasses and assess the impacts of highways on kit fox movements. This data will lead to development of a framework and criteria for evaluating the conservation value of culverts for kit foxes based on levels of connectivity, genetic interchange, and their potential to enhance long-term population viability.

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WTI will Study Effectiveness of Animal Warning Systems

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Animal detection systems are designed to provide a warning to drivers that large animals are approaching the roadway. If a system is effective, drivers will respond by reducing their vehicle speed and becoming more alert, both of which can lead to fewer and less severe collisions.

Data on the effectiveness of these systems is scarce, according to Marcel Huijser, the principal investigator for a WTI project that will evaluate the effectiveness of animal warning systems in California.

This project involves working with the California Department of Transportation to install an animal detection system on a section of road near Eureka, California, where elk are frequently hit by vehicles. WTI researchers and Caltrans will monitor the reliability of the system and evaluate its effectiveness on speed reduction and animal-vehicle collisions. Currently a flashing warning light in this area alerts drivers to the general presence of elk hazards; however, Huijser said the constant flashing, whether or not elk are in the area, renders it ineffective in reducing the number of collisions.

Animal detection systems use sensors to detect large animals as they approach the road. When an animal is detected, signs are activated that warn drivers that large animals may be on or near the road at that time.

Animal detection systems are largely experimental, Huijser said, so it is important to collect more and better data on system effectiveness. WTI researchers have identified 29 locations with animal detection systems in Europe and North America but only four are currently in operation. Typically, technological problems occur after the systems are installed, Huijser noted. The reliability of different animal detection systems from different vendors is being tested in another WTI project in Lewistown, Montana, and will provide Huijser with helpful information for his California project. A WTI project that evaluates driver response in relation to animal-vehicle collision information messages on dynamic warning signs will also benefit Huijser's project.

In the United States, more than 1 million deer-vehicle collisions occur each year, resulting in 211 human fatalities, 29,000 human injuries, and more than $1 billion in property damage.

Advanced Collision Avoidance Techniques to be Studied in WTI's Driving Simulation Laboratory

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Roadway departure fatalities, which include run-off-road and head-on collisions, accounted for 55 percent of all roadway fatalities in the United States in 2003. In an effort to reduce the number of roadway departures, many transportation agencies have introduced static rumble strips in shoulder and/or centerline sections of the roadway. Recently, more advanced technology has been developed in the form of in-vehicle advanced lane departure systems.

Using the WTI Driving Simulation Laboratory, fifteen subjects will drive a simulated road segment during which time they will each receive three alerting sensory modalities: haptic (seat vibration), auditory ("rumble strip" sound), and combined auditory and haptic sensory warnings. A pilot study will be conducted prior to testing to establish proper intensity levels (decibel of auditory signal, frequency and amplitude of vibration) for the sensory modalities and to control sources of error.

Based on the Driving Simulator testing and completed follow-up questionnaire, WTI Researchers will determine driver perception and acceptance of the different modalities as a collision avoidance warning technique during run-off-road and head-on collisions on rural roads.

Sensor Technologies for Winter Maintenance: the State-of-the-Practice and the State-of-the-Art

An extensive list of sensor technologies exists that departments of transportation (DOTs) can use for winter road maintenance. It is difficult, however, for transportation officials to research and evaluate every technique that is available to determine which are the most effective in a particular location.

Thanks to funding by the National Cooperative Highway Research Program (NCHRP), WTI is currently synthesizing all of the information that is available on vehicle-based winter maintenance technologies so that states will have a guidance document to determine which technologies best fit a location, available staff and existing vehicle inventory. The research results are expected to allow state DOTs to implement better winter maintenance practices with respect to providing safe, reliable winter highways in a cost-effective manner.

"In the northern states and Canada, in particular, snow and ice control operations are crucial tools to ensure the safety of motorists on winter highways," according to Dr. Xianming Shi, WTI's Principal Investigator of the project.

Chemicals such as road salt are commonly used to melt ice and snow on roads but the effects that chemicals have on motor vehicles, the transportation infrastructure, and the environment have been a concern. To reduce the direct and indirect costs of highway winter maintenance, it is important that state DOTs improve their snow and ice control strategies and tactics, Shi said.

Shi's research team will identify all vehicle-mounted winter maintenance technologies. For instance, Automatic Vehicle Location (AVL) is an on-board device that uses global positioning system (GPS) capabilities to locate the vehicle. WTI engineer Chris Strong is currently leading a project that is researching the best AVL technology to use on snow plows in Montana, particularly for providing timely and precise information to travelers. His findings will be incorporated into Shi's synthesis of vehicle-based winter technologies.

Additional technologies that will be researched include:

- On-board freezing point and ice-presence detection systems,
- Surface temperature measuring devices,
- Millimeter wavelength radar sensors that emit millimeter waves and use their reflections to detect vehicular motion and collect obstacle data,
- Salinity measuring sensors,
- Visual and Multi-Spectral sensors that monitor road surface conditions, and
- Fixed Automated Spray Technology (FAST) which uses sensors embedded in pavement to determine the freezing point of moisture on the road and spray discs that dispense anti-icing chemicals over targeted areas.

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WTI Explores Electrochemistry Solutions to Transportation Issues

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WTI's Materials Corrosion Laboratory will be instrumental in a new project that is researching ways to apply electrochemistry to resolve transportation problems.

According to Xianming Shi, the principal investigator of the project, many emerging problems in the transportation industry are electrochemical in nature. A key electrochemical issue is corrosion, which costs the transportation and infrastructure sectors nearly $52 billion a year, Shi said. Employing optimum corrosion management practices could reduce this cost by almost 30 percent.

Corrosion of pre-stressed and normally reinforced concrete structures is a major and increasing problem worldwide, often leading to the premature failure of structures. There are serious economic and safety implications of this premature deterioration, Shi said. In cold regions, the problem is complicated even further when freeze-thaw cycles, wet-dry cycles, and the application of anti-icing and de-icing chemicals impact the rate of corrosion.

WTI has already conducted extensive research on corrosion and materials integrity issues in transportation. Areas of research range from the evaluation of corrosion-inhibited deicers to the effect of concrete mixes and surface treatments on the chloride-induced corrosion of steel reinforced concrete.

Shi plans to use WTI's research infrastructure and expertise to investigate other fields of electrochemistry, such as electroactive polymers, electrochemical sensors, fuel cells and rechargeable batteries for motor vehicles.

While fuel cells, electric vehicles (EVs) and hybrid electric vehicles offer promising solutions to the energy problems facing the transportation industry, Shi said a major challenge in implementing the hybrid EV technology is the pursuit of a lightweight, high capacity, and long-life battery. Electrochemical studies such as this WTI project will be the key to perfecting the EV technology, Shi said.

Motor Carrier Safety Assurance Program will be Evaluated by WTI

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The effectiveness of a five-year pilot program that provides safety training for new interstate motor carriers in Montana will be evaluated by researchers at the Western Transportation Institute.

The state of Montana implemented its "New Entrant Safety Assurance Program" to teach new interstate motor carriers applicable safety laws and regulations. The program is in response to a federal mandate for states to provide safety training to motor carriers prior to the Department of Transportation's required Safety Audit.

"If Montana's safety training pilot works here, it will be rolled out to other states," according to Michael Cole, WTI's principal investigator for the project. The WTI evaluation is being funded by the Federal Motor Carrier Safety Administration.

Over the course of the five-year program, WTI will assess whether the training program impacts such things as compliance with safety laws and regulations, long-term accident rates and out-of-service rates, and the pass rates for the official Safety Audit. In addition to assessing the impact of the new program on actual highway safety, the evaluation will look at factors such as program costs, which will include the time commitments required of the new carriers who participate in the program by attending training sessions.

Long Term Benefits of Wildlife Crossings Studied in the Rocky Mountain Region

Research conducted by the Western Transportation Institute suggests that transportation agencies using science-based information and a collaborative approach to planning can promote sustainable, ecologically sensitive infrastructure development. The anticipated growth in population and projected highway improvement plans in the Rocky Mountain range, coupled with the resounding concern for maintaining large-scale landscape connectivity will continue to generate interest in conservation tools such as wildlife crossings. Consistent empirical evidence regarding population level effects of wildlife crossings is needed to support their continued and growing implementation by transportation and resource management agencies.

Numerous studies have documented wildlife use of crossing structures; however, the actual number of individual animals using them is largely unknown. Healthy functioning ecosystems require viable wildlife populations. Thus, it is critical to know how the crossings benefit populations, not just individuals. To do this, researchers would have to directly measure gene flow across the highway.

Through a new project, Dr. Tony Clevenger of WTI is studying the performance of wildlife crossings at the population level. Intuitively these measures should enhance population viability; however to date, there have been no specific studies that actually address their population level effects.

Dr. Clevenger has developed a DNA/hair-sampling technique which has the potential to significantly advance the understanding of wildlife crossings as conservation tools to enhance population viability while enabling the measurement and analysis of parameters related to the dispersal of individuals, viability of populations and ultimately the maintenance of local and regional biodiversity. Through this project, Dr. Clevenger and Dr Steven Kalinowski (a conservation geneticist at Montana State University) are directing a PhD study led by Ecology Department grad student Mike Sawaya to begin researching the conservation value of crossings using the DNA-based technique. In addition, Dr Clevenger will continue long-term research of wildlife crossings and develop science-based guidelines for transportation departments, land management agencies, and the conservation community.

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Billings Transit Provider Uses Software to Simplify Scheduling, Create Efficient Routes

A paratransit provider in Billings, Montana may soon know if advanced dispatching software can help increase the number of rides provided to clients or decrease the wear and tear on vehicles.

Since 2003, the Western Transportation Institute at Montana State University (WTI) has been working with Billings MET Transit to identify advanced technologies that could help the paratransit agency provide more coordinated and efficient service. MET recently decided to implement RouteMatch, a computer-aided scheduling software that tracks ride requests and generates routes and time-tables.

To determine if the software has had a positive impact on transit operations, WTI will collect data before installation, and then a second time six months after the software has been fully operational. Researchers will analyze the data, and identify how using the software may have made a difference in terms of decreasing workload for dispatchers, on-time performance, or the number of vehicles needed to meet client demand.

"Large urban areas have used computer-aided scheduling to decrease the number of vehicles they need by 10 percent or more," said Principal Investigator David Kack. "We want to know if this kind of software will have the same benefits in smaller cities and rural areas."

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Testing the Effects of Chloride-Based Deicers on Concrete Corrosion

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The corrosion of reinforcing steel in concrete has been a major problem in highway bridges and other reinforced concrete structures, leading to serious economic and safety implications.

Marine environments, with their salt-laden atmospheres, and deicing salt used to control snow and ice on roadways compound the corrosion problem; chloride ingress is one of the major forms of environmental attack on reinforced concrete bridges and roadways, according to Xianming Shi, a WTI research scientist.

When chloride penetrates concrete, it leads to corrosion of the reinforcing steel and a reduction in strength, serviceability, and aesthetics of the structure, he explained.

Shi is leading a WTI project that will evaluate the effect of chloride-based deicers on reinforced concrete structures such as roadways and bridges operated by the Washington State Department of Transportation (WSDOT). The research should determine whether reducing deicer corrosiveness helps to preserve the transportation infrastructure.

The Salt Pilot project conducted by WSDOT evaluated the effect of non-inhibited and inhibited chloride deicers on the corrosion of motor vehicles, however, little is known about the effectiveness of deicer inhibitors in terms of infrastructure preservation.

"Chloride ingress into concrete is a complex process," Shi said, "which is complicated further in the highway environment by the freeze-thaw and wet-dry cycles."

Corrosive agents, liquid or gaseous, penetrate concrete through capillary absorption, hydrostatic pressure, or diffusion. The ingress of these agents takes place through pore spaces in the cement paste matrix and paste-aggregate interfaces or micro cracks. Permeability, particularly chloride permeability, is believed to be the most important characteristic when evaluating the durability of concrete, Shi said.

Adequate concrete cover and high quality concrete are two important factors for guaranteeing the durability of structures. While a thicker concrete cover means less chance for corrosion, thickness cannot exceed certain limits for mechanical and practical reasons.

Shi's research will establish and use a pressure penetration test that is both accelerated and representative of the field conditions. This method forces the flow of chlorides and corrosion inhibitors into concrete by exposing one face of concrete to the deicer solution that is under pressure. All other faces of the concrete will be sealed. Before the pressure penetration test, samples of each type of deicer will be tested in the WTI materials lab for their corrosiveness.

Shi's research findings are expected to modify WSDOT's approach to winter highway maintenance and enable the department to make the best choices when selecting snow and ice control chemicals. With extended service life and reduced need for costly and difficult repair and rehabilitation of reinforced concrete structures, the implementation of better design and maintenance practices will positively impact Washington's highway system, including cost savings, traveler safety, reduced traveler delays, and the environment, Shi said.

Shi is expected to complete phase one of this research project in June 2007.

Study of Aggregates will Help Road Designers

The engineering characteristics of three aggregate materials used on highway projects in Montana are being studied by WTI engineers so that more informed decisions on what type of aggregate to use can be made by road designers.

Designers will be in a better position to refine and optimize pavement sections if the performance parameters of the most commonly used aggregates are better quantified, said Robert Mokwa, a co-principal investigator of the WTI project.

"Having a better understanding of the engineering properties of various aggregate options will alleviate confusion among designers and district personnel regarding differences in customary practices," Mokwa said.

The three aggregates that will be studied are Crushed Base Course (CBC) Type A Grade 5, CBC Type A Grade 6, and Crushed Top Surfacing (CTS) Type A Grade 2. All of these will be examined for strength, permeability, compaction, durability, and stiffness. Based on test results, comparisons will be made to evaluate the suitability of the three aggregate types for use as base course materials in Montana highway pavement. Laboratory tests will be conducted on five samples of each aggregate type, for a total of 15 different materials.

The final report from the research will include recommendations to the Montana Department of Transportation regarding the use of the three aggregates.

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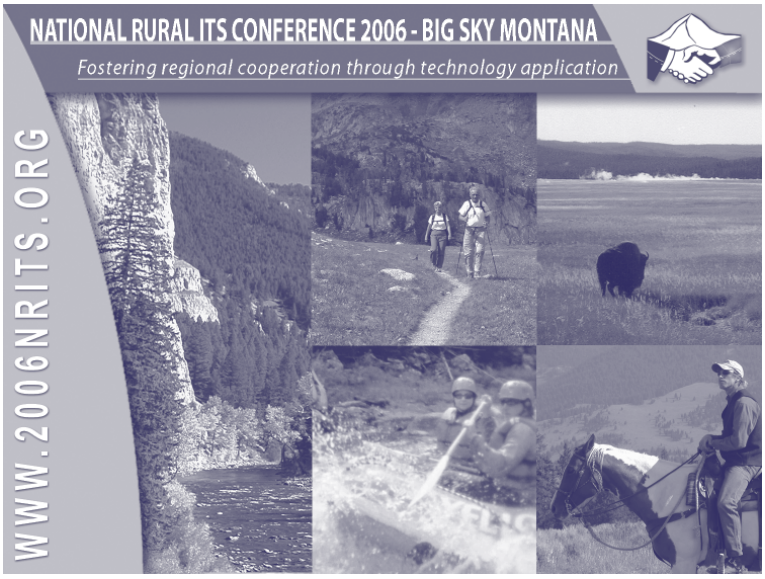
Packed Agenda for NRITS 2006 - Don't Miss It!!!



WTI is pleased to report that the National Rural ITS Conference (NRITS) - to be held this August in beautiful Big Sky, Montana - promises to be an enriching, productive and enjoyable conference for transportation professionals and their families.

Thanks to an enthusiastic response from sponsors, researchers, and vendors, the program will be packed with informative activities and valuable networking opportunities. The planning committee received a record number of 119 abstracts, which are now under review with the assistance of 32 technical advisors. Nearly 30 concurrent sessions and 1 super session have been identified to date. A pre-conference NHI training course entitled ITS Procurement will be offered, allowing attendees to maximize their travel dollars and training time. Professional Tours to view Animal Vehicle Warning Systems and Innovative Communications deployments are also planned. Even now, with the early registration deadline for vendors still more than 2 months away, exhibit space is nearly 50% reserved.

On the fun side, there are dozens of different activities offered at a discounted rate; attendees and their guests will be treated to the best in western hospitality. Some of the choices already scheduled include a tour of Yellowstone National Park; gondola rides over the Big Sky Resort; evening horseback rides and hayrides; whitewater rafting and scenic floats; and recreational sports such as flyfishing, golf, mountain biking and hiking.

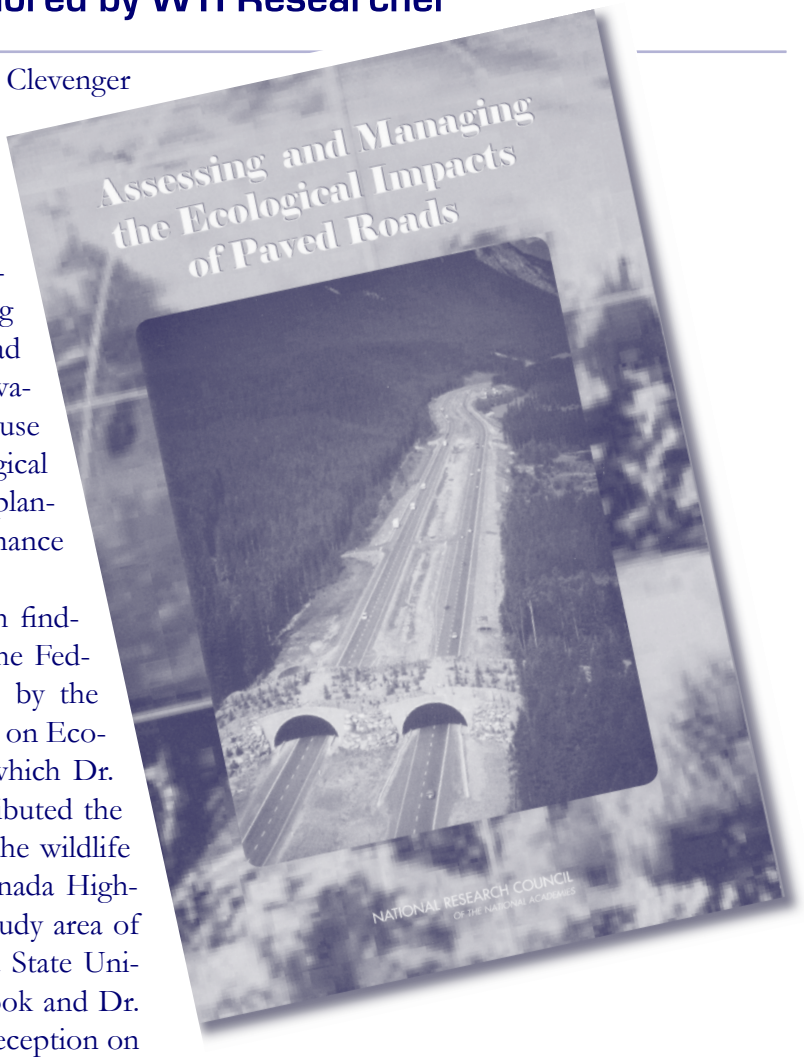
NRITS 2006 is scheduled for August 13 through August 16, 2006. A preliminary agenda will be available in April, with registration materials to follow shortly thereafter. The early registration deadline for vendors will be June 30. For more information, go to www.nrits2006.org or call Traci Ulberg, Conference Coordinator, at (406)273-7224.

NRITS 2006 is sponsored by ITS America, the Federal Highway Administration, the Institute of Transportation Engineers (District 6), the Critical Illness and Trauma Foundation, the Montana Department of Transportation, and ThomTech Design. The Western Transportation Institute at Montana State University serves as this year's hosting agency.

This conference is not to be missed, we look forward to seeing you in Montana, "The Last Best Place" in the summer of 2006.

See opposite page for news about Professional Development Funding

Road Ecology Book Co-authored by WTI Researcher



WTI Research Scientist Anthony Clevenger is the co-author of a new book entitled *Assessing and Managing the Ecological Impacts of Paved Roads.* Published by the National Academies Press, the book provides guidance to transportation agencies on new approaches for reconciling the seemingly conflicting goals of road development and environmental conservation. Transportation practitioners can use this information to identify the ecological effects of roads to be evaluated in the planning, design, construction, and maintenance processes.

This book summarizes the research findings of a major study conducted for the Federal Highway Administration (FHWA) by the National Research Council's Committee on Ecological Impacts of Road Density, of which Dr. Clevenger is a member. He also contributed the book's cover photo, which showcases the wildlife crossings structures over the Trans Canada Highway in Banff National Park, a major study area of his for the past decade. The Montana State University Library recently honored the book and Dr. Clevenger at its annual MSU Author's reception on April 13.

Professional Development Funding News

According to information from FHWA, Section 5204(e) of SAFETEA-LU (the newly enacted highway bill) allows funds from five core programs to be used for workforce development activities, such as employee education and training and other career outreach and preparation initiatives to develop the future transportation workforce. The five core programs are Surface Transportation Program (STP), National Highway System (NHS), Interstate Maintenance and Bridge Programs, and Congestion Mitigation/Air Quality (CMAQ). In contrast to TEA-21, the new legislation no longer requires a 20% state match. Funds can be used for travel; however, travel must be directly related to a defined employee training or professional development need, program or activity, or directly associated with a student transportation career awareness or preparation activity.

A fact sheet about training and education programs funded by SAFETEA-LU is available at:

http://www.fhwa.dot.gov/safetealu/factsheets/traininged.htm

Laura Stanley selected as "Student of the Year"

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Each year at the Transportation Research Board annual meeting in Washington, DC, the U.S. Department of Transportation Research and Innovative Technologies Administration honors the most outstanding student from each University Transportation Center (UTC). The UTC Students of the Year are selected based on their accomplishments in research, academics, professionalism, and leadership. The Western Transportation Institute selected Laura Stanley as its 2005 Outstanding Student.

Laura Stanley is from Abingdon, Virginia and is currently a Ph. D. Candidate in Industrial Engineering at Montana State University studying Human Factors, Transportation Engineering, and Applied Statistics. Laura earned a B.S. in Industrial & Systems Engineering from Virginia Tech and a M.S. in Industrial & Management Engineering from Montana State University. She is also a recipient of the Western Transportation Institute's Professional Fellowship Award, where she conducts research in the area of human factors. At WTI, her focus has been on designing and conducting research in the high fidelity driving simulation laboratory. Ms. Stanley provided key support in the installation and testing of the Simulation Laboratory, as well as in the administration of the first study. Laura's academic interests also include web development applications.

Her recent conference papers include *Driver Responses to Enhanced Wildlife Advisories in a Simulated Environment* presented at the 2006 Transportation Research Board Annual Meeting and *Driver Performance While Interacting with the 511 Travel Information System in Urban and Rural Traffic*, presented at the Third International Driving Symposium on Human Factors in Driver Assessment Training and Vehicle Design Proceedings held in June 2005 in Rockport, Maine, *Development of a Web-Based Household Travel Survey*, presented at the 2005 Institute of Transportation Engineers District 6 Meeting, and *Assessing Opinions, Experiences, and Perspectives of Female Engineers Nationwide* Via a Web-Based Questionnaire, presented at the Women in Engineering Programs & Advocates Networks (WEPAN) 2004 Conference.

Laura Stanley is an active member of the Institute of Transportation Engineers (ITE) student chapter at MSU, a young member of the TRB Vehicle User Characteristics Committee, and she was selected as an Eno Fellow in 2005. Laura's past work experience includes working as a cost engineer/manager at IBM in Raleigh, NC and as a research assistant at the Virginia Tech Transportation Institute in Blacksburg, VA.

Congratulations, Laura!

Second Annual Girl Scout Engineering Day a Huge Success

The Western Transportation Institute commemorated "Introduce a Girl to Engineering Day" as part of National Engineering Week by hosting young Girl Scouts on the Montana State University (MSU) campus for a day of discovery. The girls, ages 9 to 13, learned about the different fields of engineering by participating in hands-on projects and demonstrations with engineering students from MSU. Nine engineering student chapters offered time and creativity to put together activities for the event. Girl Scouts traveled from as far away as Butte and Helena to attend. This year marks the second annual Girl Scouts Engineering Day held at MSU, with participation growing dramatically from 30 participants in 2005 to close to one hundred in 2006.

A Girl Scout troop watches a crash test egg careen down a ramp towards the crash attenuator they built to protect it.

Two girls test out the robot they programmed while an Electrical and Computer Engineering student looks on impressed.

A student chapter member of the American Institute of Chemical Engineers sports a Girl Scout sash as he demonstrates a polymer.

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WTI Alumni: Where are They Now?

WTI has supported a large number of students over the years that have since entered the professional workforce. Recently, WTI had the opportunity to catch up with a number of them and to learn more about some of the exciting contributions they are making in their fields. Tylar Bunger, a UTC Graduate Fellowship recipient, completed his thesis entitled Thermal Model of Highway Overpass Bridge in 2003 under the mentorship of Dr. Ed Adams. After graduation, he moved to Anchorage, Alaska with his wife Anne and has been traveling extensively throughout the state with RSA Engineering, a Mechanical and Electrical engineering consulting company. His work experiences have included design contributions to a new power plant at the McMurdo Station in Antarctica. An inspection trip to the site provided Tylar with an unexpected opportunity to catch up with his former thesis advisor, who just happened to be at McMurdo at the same time on a research trip.

Former Graduate Fellows Ben Shick (2003) and Peter Smolenski (2004) are also producing important and timely contributions. Ben, who recently passed his P.E. exam, currently works for a small water resource firm in San Francisco on a variety of projects, including FEMA flood studies. Peter was recently appointed mechanical design lead on his current project at Sandia National Laboratories in Albuquerque, New Mexico.

Erik Anderson, a UTC Undergraduate Fellowship recipient, worked for the Engineering Dynamics Corporation as an engineering technologist in the heavy Truck Testing Group after his graduation from Montana State University with a degree in Mechanical Engineering. His work involved field-testing semi truck trailer components. Erik has since returned to MSU to teach CAD classes for the Mechanical and Industrial Engineering department.

Trevor Iman received his Masters degree in Civil Engineering in May 2005. In the relatively short time since graduation, Trevor has had the opportunity to work on a number of large highway projects as a consultant for the WGM Group, Inc. in Missoula, Montana. His project experience includes a full highway redesign for US 93 near Whitefish as well as traffic impact studies in Browning, Montana.

UTC Graduate Fellow, Zach Newell, completed his thesis on Thermal Effects of Frost Susceptible Soils Subjected to Freezing Conditions in August 2005. Zach recently accepted a position with GeoEngineers, a geotechnical consulting firm in Redmond, Washington with a market focus in transportation, energy, development, government services, and water/natural resources. Prior to moving to Washington, Zach worked for Womack and Associates, Inc., a small engineering firm in Billings, Montana. While there he gained a once-in-a-lifetime experience working on the Beartooth Highway reconstruction project after a major landslide demolished the highway in spring 2005.

WTI is pleased that program alumni continue to make important contributions to the profession. To keep in better touch with former students, we have created an Alumni page on our website at: www.coe.montana.edu/wti/how/EducationnewED.htm where former students can keep us up to date on their latest activities. Look for more student updates on the website and in future issues of the newsletter.

Corrosion Scientist Joins Research Staff

WTI is pleased to welcome Wei Chu, Ph.D. to our staff as a research scientist. Wei brings more than 11 years of research experience with an emphasis on corrosion science, electrochemical and chemical engineering to WTI. Previously, he was a Research Associate for the Center for Marine Materials at Florida Atlantic University, where he developed and implemented software for a project protecting deep-sea pipelines from corrosion.

Wei will be working with Research Scientist Xianming Shi to design and implement the Materials Corrosion Laboratory at WTI's new location, supporting and developing corrosion testing and applications.

Wei earned his Bachelor of Engineering degree from Nanjing Institute of Chemical Technology in Nanjing China and his Master's Degree in Applied Chemistry from the same school. Wei obtained his Ph.D. from State Key Lab in Physical Chemistry of Solid Surfaces in the Department of Chemistry, Xiamen University, Xiamen, China.

Wei lives in Bozeman and enjoys studying ancient civilizations in his spare time. He looks forward to exploring the civilizations of Egypt and India.

Wei Chu can be reached at (406) 994-7643 or at wchu@coe.montana.edu.

WTI Researcher Named IEEE Montana Section Chair

Congratulations to WTI Senior Research Associate Doug Galarus, who was recently elected as 2006 Chair of the Montana Section of the Institute of Electrical and Electronics Engineers, Inc. (IEEE). According to the IEEE website (www.ieee.org), the non-profit organization is "the world's leading professional association for the advancement of technology." IEEE provides technical and professional information, resources and services to its members, who include both engineering practitioners and university students from around the world.

The Montana section serves members from eleven central counties, hosting monthly lectures, sponsoring engineering challenges and organizing other activities. Following the lead of IEEE USA, which has set forth goals of helping to strengthen education at all levels, the Montana section is strengthening its own relationship with college and pre-college students. Student participation in Section meetings has increased dramatically this year. The Section is also investigating programs to help enhance basic math and science education. For example, the guest speaker at the annual banquet in March was Dr. Johnny Lott, past president of the National Council of Teachers of Mathematics. In a partnership with CBS television and Texas Instruments, Dr. Lott is creating middle-school math lessons based on a popular T.V. series in which FBI agents use math to solve challenging crimes. The Section will also be looking into professional development opportunities such as workshops to assist members and other professionals.

For information about upcoming section activities, contact Doug Galarus at douggalarus@ieee.org

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