

Center for Transportation Infrastructure and Safety
NUTC NEWS
at Missouri University of Science and Technology



NATIONAL
UNIVERSITY
TRANSPORTATION
CENTER

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A MESSAGE FROM THE DIRECTOR — JOHN J. MYERS

The bustle of spring and a winding-down semester has begun here at Missouri S&T. At CTIS we are happy to welcome warmer weather and to announce some exciting new research and transportation-related activities.

Can you imagine using plant-based materials in highway construction? Well, Dr. David Richardson could and with CTIS support, he is currently investigating the feasibility of using extractions from the Guayule plant in flexible pavement mixtures. Read more on page 2.

In this issue, we are pleased to feature Missouri S&T faculty member Dr. Scott Grasmann, an internationally recognized researcher on alternative energy and sustainable development. Learn more about Dr. Grasmann's work on page 6.

This issue's "What Are They Doing Now?" series features former UTC-student Dr. Yumin Yang of Kimley-Horn and Associates, Inc. in Houston, Texas. Catch up with Dr. Yang and learn about his work in bridge and transportation structures design on page 5.

Our education focus includes a profile of graduate research assistant Qian Li, on page 7 and an overview of Missouri S&T's summer educational institutes related to transportation, on page 4.

I've mentioned just a few of our features, keep reading to learn more about current activities at CTIS. Enjoy!

Warm Regards,
John

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**UPCOMING
EVENTS**

**Missouri Concrete
Conference**

May 5-6, 2009
Rolla, Missouri

More info at [http://
concrete.mst.edu/](http://concrete.mst.edu/)

GeoMo 2009

May 8, 2009
Rolla, Missouri

More info at [http://
geommo.mst.edu/](http://geommo.mst.edu/)

**19th Annual
ANNIE
Conference**

Nov. 2-4, 2009
St. Louis, Missouri

More info at [http://
annie.mst.edu/](http://annie.mst.edu/)

**Developing
a Research
Agenda for
Transportation
Infrastructure
Preservation and
Renewal**

Nov. 12-13, 2009
Washington D.C.

More info at [http://
www.TRB.org/
calendar](http://www.TRB.org/calendar)

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GREEN HIGHWAY CONSTRUCTION

LOWERING COSTS AND DEPENDENCE ON CRUDE OIL WITH PLANT-BASED MATERIALS

Due to the rising price of crude oil, flexible pavement costs have significantly increased. Flexible pavement is implemented by layering several types of materials, including petroleum-based materials, so that the total pavement structure can flex under loading. Each layer receives and distributes loads from above before passing the load to the layer below. Flexible pavements comprise about 93 percent of U.S. paved roads.

With support from CTIS, Dr. David Richardson will determine the feasibility of using materials extracted from the guayule plant in the design and production of flexible pavement mixtures. A flexible pavement mixture produced with little to no virgin petroleum-based materials will be created and a thorough experimental program to assess the limits of the use of guayule rubber and resin will be undertaken.

The guayule (pronounced 'why-YOU-lee') plant grows in the arid and semi-arid regions of the southwestern U.S. and Mexico and is a source of natural rubber. Currently, guayule is processed primarily for the manufacture of hypo-allergenic latex products like medical gloves and personal hygiene products. Depending on the process used, many materials can be extracted from guayule. However, there are three basic products commonly extracted: rubber, resin and bagasse.

The guayule rubber and resin, which are natural biopolymers, could prove to be a source of renewable and environmentally friendly binder materials for flexible pavement mixtures. Limited preliminary testing showed that the resin could potentially be used as a recycling agent, or viscosity modifier, when designing flexible pavement mixtures with a high percentage of reclaimed asphalt pavement (RAP), a small percentage of processed roofing shingles and some virgin aggregate.

Using guayule rubber and resin in flexible pavement mixtures could potentially result in eventual lower costs for highway construction, though until demand and technology increase, guayule-based materials may not initially be an economically attractive alternative. However, implementing guayule materials in highway

construction would be a boost to the guayule processing industry, which could benefit from the opening of another market for its products, and would decrease dependence on foreign oil, thereby enhancing national security.

The possibility that guayule-based materials could perform better than petroleum-based materials in flexible pavement mixtures is an exciting prospect. Based on a search of current literature, the use of guayule products in this context seems to be a new concept. The prospect of developing a new and better product makes this research both exciting and important.



Above: A field of guayule plants. Left: A close-up of a guayule plant. Far Left: Purified guayule latex.



LONG-TERM REMOTE SENSING SYSTEM FOR BRIDGE PIERS

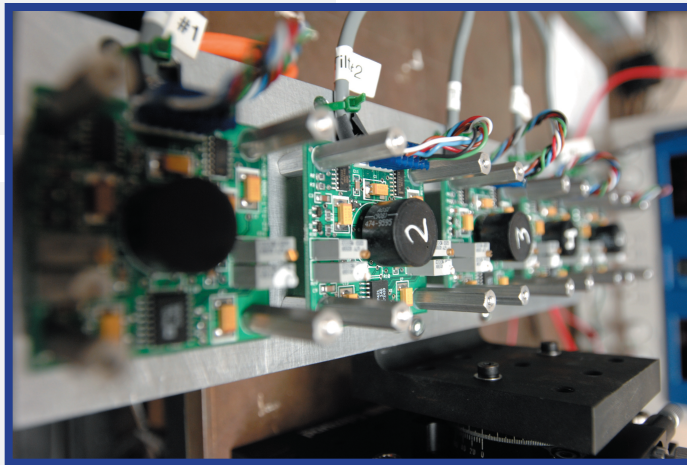
Under the sponsorship of the CTIS National University Transportation Center, National Cooperative Highway Research Program (NCHRP) and Innovations Deserving Exploratory Analysis (IDEA) Program, a team at the University of MO-Columbia (MU) has been working to develop and test a long-term sensing system for remote monitoring of bridge piers. The team is led by Dr. Glenn Washer (MU) and includes Dr. Paul Fuchs, of Fuchs Consulting, Inc. in Leesburg, VA, and MU graduate students Kathy Masterson and Caleb Philipps.

BACKGROUND

Bridges are an essential aspect of the current U.S. highway transportation system. As with any structure, regular monitoring and repairs are imperative to the continued strength, stability and health of a bridge. Natural hazards, subsurface erosion, unexpected settlement and scour all have the potential to undermine the strength and stability of a bridge by causing unexpected displacements of the bridge pier that can lead to structural collapse.

OBJECTIVES

With these dangers in mind, this NUTC-sponsored project will develop improved long-term structural health monitoring technologies. The project is focused on methods to monitor critical structural behavior with cost effective sensor technologies that improve system reliability and provide improved data on structural behavior.



movements in three dimensions. The developed algorithms will utilize multi-sensor logic to improve signal to noise ratios, identify erroneous readings and sensor failures and reduce the long-term effects such as sensor drift. Initial development involved the construction of a test bridge on which the selected electrolytic tilt sensors were placed. Initial evaluations of sensor behavior, data acquisition and test bridge performance were conducted to develop the algorithms using multi-sensor logic. The system of sensors and supporting algorithms will be installed on a test bridge in New York State later this summer to field test the technology.

BENEFITS

The completed system will allow State transportation officials and structural engineers to employ a more effective system of long-term structural monitoring, increasing safety and potential for the prevention of dangerous situations. Additionally, the system will allow for better measurement and understanding of long-term bridge rotations and displacements over time.

APPROACH

The sensing concept being developed utilizes an array of low-cost sensors to monitor structural



OPPORTUNITIES FOR FUTURE TRANSPORTATION PROFESSIONALS

Each summer, Missouri S&T offers middle and high school students educational opportunities to explore various math, science, engineering and technology careers. With support from CTIS, the summer 2009 offerings include several opportunities for students to explore the world of transportation, creating a mutual investment for both the future of participating students and the future of transportation infrastructure and safety.

EcoCAR SUMMER CAMP

July 6-10, 2009 • *For rising high school sophomores, juniors and seniors*

This week-long residential camp will allow students to learn first-hand how Hydrogen Fuel Cell Plug-In Hybrid Electric Vehicles (FC-PHEV) reduce global environmental impact by minimizing the vehicle's fuel consumption and reducing its emissions while retaining performance, safety and consumer appeal.

At camp students will take a mini course on energy and the environment; visit Missouri S&T's E³ Commons; perform total fuel cycle well-to-wheel modeling; conduct fuel cell vehicle simulations; and participate in a hydrogen vehicle design contest.

For more information, visit <http://dce.mst.edu/noncredit/precollege/ecocar.html>.

SUMMER TRANSPORTATION INSTITUTE (STI)

July 12-24, 2009 • *Rising high school sophomores, juniors and seniors*

Through hands-on laboratories, seminars and field trips students will learn about a variety of aspects of the transportation industry. The curriculum includes activities such as seminars on career opportunities in transportation; field trips to St. Louis Transportation Museum; a tour of the Black Hawk Helicopter facility at Fort Leonard Wood; and recreational activities including a ropes course, pool parties and picnics. This program is sponsored by the U.S. Department of Transportation.

For more information, visit <http://dce.mst.edu/noncredit/precollege/sti.html>.

MINORITY INTRODUCTION TO TECHNOLOGY AND ENGINEERING (MITE)

May 31-June 5 and June 14-19, 2009 • *African American, Hispanic and American Indian rising high school juniors and seniors*

An introduction to the world of engineering, this one-week program will help students with an interest in engineering, mathematics, science or technology explore a wide variety of job fields and gain first-hand knowledge of what engineers actually do. Group design projects; hands-on activities; laboratory and industry visits; and informational discussions with professionals will give students a taste of potential careers.

For more information, visit <http://dce.mst.edu/noncredit/precollege/MITE.html>.

IT'S A GIRL THING!

June 8-12, 2009 • *Rising 7th and 8th grade girls*

This week-long residential program is designed to provide a fun and introductory engineering, science and technology experience for girls entering 7th and 8th grades. Attendees will be exposed to the various science, technology, engineering and mathematics (STEM) careers and encouraged to explore their personal interests through group projects and design competitions.

For more information, visit <http://dce.mst.edu/noncredit/precollege/iagt.html>.



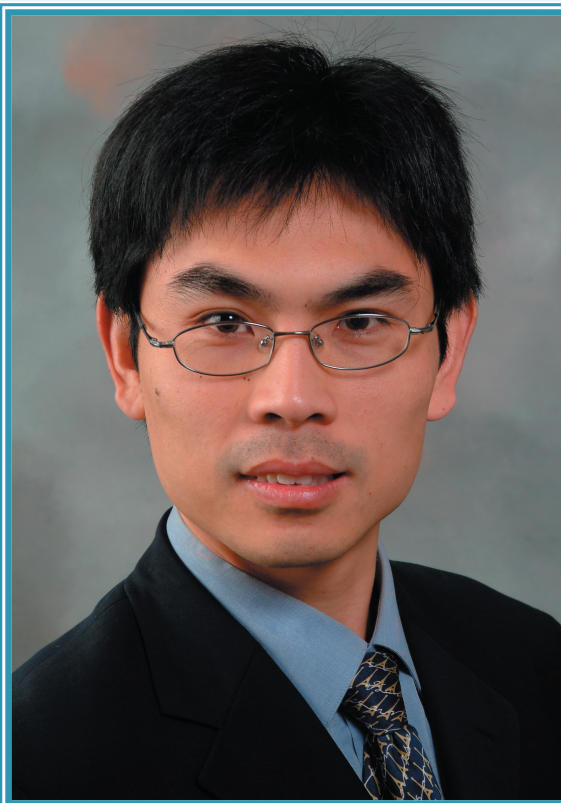
CATCHING UP WITH FORMER UTC STUDENT YUMIN YANG, PH.D.

As a Senior Structural Engineer and Project Manager in the Houston, Texas office of Kimley-Horn and Associates, Inc. Yumin Yang works on the design of bridges and other transportation-related structures such as retaining walls, box culverts, tunnels and overhead structures. His responsibilities include analysis for all aspects of preliminary planning, cost estimation, bridge layouts, working drawings, planning, specifications and structural designs.

Yang earned a Ph.D. in Civil Engineering in 2003 from the University of Missouri – Rolla (now Missouri University of Science and Technology). He earned a M.S. in Bridge Engineering in 1999 and a B.S. in Structural Engineering in 1996 from Tongji University in Shanghai, China.

As a graduate student working with the UTC, Yang helped Dr. John J. Myers implement Missouri's first fully instrumented high-performance concrete bridge. The challenge of working on an innovative bridge helped Yang to discover his passion for bridge-related research and design. Additionally, the

work has provided him with a background in high-strength and high-performance concrete which has helped him with projects involving many disciplines, including roadways, traffic planning and operating, transit and land developing.



His work at the UTC has helped him to prepare for and rise to the day-to-day challenges of his work on such a diverse set of projects. Currently, Yang is working on two large, high-profile, four-level interchange roadway projects.

Yang cites the support and creativity of the UTC faculty, along with the research itself, as key reasons for getting involved with UTC research. In the future, Yang hopes to design some high standard, aesthetically amusing and unique bridges and, of course, to continue with research.

Yang and his wife of seven years have a three year-old son and are currently expecting a baby girl! He encourages current students to get involved with research and professional organizations as they uncover their own interests and career paths.



SCOTT GRASMAN, PH.D.

ENGINEERING MANAGEMENT AND SYSTEMS ENGINEERING AT MISSOURI S&T

Dr. Scott Grasman is an Associate Professor and Associate Chair of Engineering Management and Systems Engineering at Missouri S&T. Dr. Grasman's research focuses on modeling and optimization of supply chain, logistics and transportation systems as well as the development of alternative fuels/energy infrastructure policy and analysis. He is currently working on stationary and portable fuel cell applications; public-private partnerships for technological innovation in transportation and energy systems; and serves as an advisor to the Missouri S&T EcoCAR team.

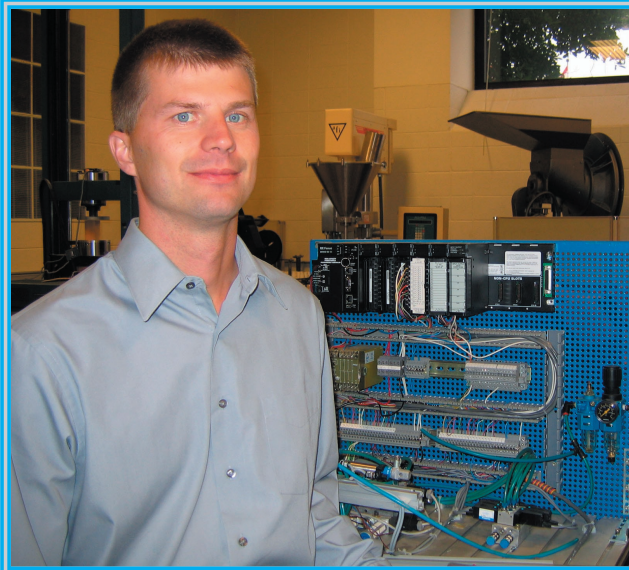
Dr. Grasman's recent work on alternative energy has received widespread publicity in national media, resulting in numerous invitations to speak as well as a research sabbatical in Europe. His work on sustainable development in public-private partnerships has been recognized by the United Nations Economic Commission for Europe Committee on Economic Cooperation and Integration.

As author or co-author, Dr. Grasman has published more than 75 technical papers for publications such as Computers and Industrial Engineering, International Journal of Advanced Manufacturing Technology, IIE Transaction, ASCE Journal of Professional Issues in Engineering Education and Practice, Mathematical and Computer Modeling, European Journal of Operational Research and Decision Sciences Journal of Innovative Education.

He has served as Regional Director of the American Society for Engineering Management, a Division Officer of the American Society for Engineering Education and is a member

of the Institute for Operations Research and the Management Sciences and the Institute of Industrial Engineering. He has recently joined the editorial board for a new journal and has been a reviewer for various technical journals.

Dr. Grasman has been recognized on several occasions for his excellence in research and teaching. He received a Faculty Excellence Award from Missouri S&T in 2008, an Outstanding Teaching Award of Excellence in April 2007, an Outstanding Teaching Commendation Award in April 2006 and the Lambda Chi Alpha Teacher of the Year Award for 2006-2007. He has been a supervisor for dozens of graduate and undergraduate research students.



As principal investigator, Dr. Grasman's research has been supported by the U.S. Department of Energy, U.S. Department of Transportation, Missouri Department of Transportation, SAP America, Missouri Research Board, TranSystems, Wal-Mart Logistics and the Bi-State Development Agency.

As co-investigator, his research has been supported by agencies such as: National Science Foundation, Argonne National Labs, Boeing, Defense Logistics Agency, Ford, General Motors, U.S. Department of State and others.

Dr. Grasman received his Ph.D. in Industrial and Operations Engineering from the University of Michigan in 2000. He received a Master's Degree in 1995 and a Bachelor's Degree in 1994, both in Industrial and Operations Engineering from the University of Michigan. He joined the faculty at Missouri S&T in May of 2001.

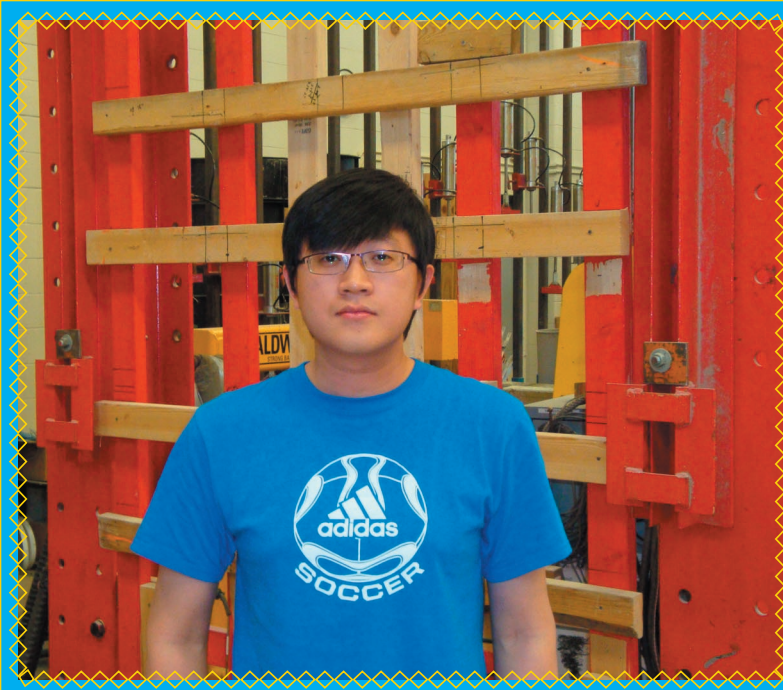


NUTC STUDENT SOLUTIONS: QIAN LI

Qian Li has been awarded a one-year graduate assistantship from the Center for Transportation Infrastructure and Safety to pursue doctoral studies in a transportation-related field. The award was made based on an exemplary academic career and the merit of his proposed research.

Under the supervision of Dr. Abdeldjelil “DJ” Belarbi, Qian Li’s research at Missouri University of Science and Technology focuses on determining the direct interaction of bending moments, torsion and shear under constant axial load on concrete bridge column performance and to establish analysis and design procedures which consider these interactions.

Combined actions/loadings caused by events such as earthquakes can significantly impact the force and deformation capacity of reinforced concrete columns, resulting in unexpected deformations and extensive damage. Due to a scarcity of experimental data and a lack of behavioral understanding, current analysis methods, behavior theories and design practices do not consider the full range of such interactions, making this research both vital and significant.



The leadership in teaching, research, learning and public service at Missouri S&T was attractive to Li when considering doctoral studies. The diversity and international recognition at Missouri S&T “encourages a truly global approach to intellectual and academic life,” says Li, “[this] is the exact environment I desire to be in.” Completing

his research and Ph.D. at Missouri S&T will allow Li to become a successful researcher. Through his research, Li endeavor’s “to make people’s lives easier by solving existing problems relative to civil engineering.”

Li completed a Bachelor of Science in Civil Engineering in 2005 and a Master of Science in Structural Engineering in 2008 at Tongji University in Shanghai, China. There, Li was involved in a variety of research and

field observation projects, including the planning and construction of underground spaces and tunnels and analysis of high-performance steel and concrete composite structures.

In the past, Li has been the recipient of a Design Research Institute Scholarship, the Tongji University Excellent Student Award, the Hong Kong Guoxiebiying Scholarship and a Tongji University Outstanding Student Scholarship for three consecutive years.



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EcoCAR: THE NeXT CHALLENGE



The States Department of Energy (DOE) and General Motors (GM), and is being managed by Argonne National Laboratory.

The competition challenges engineering students from 17 universities across North America, including a team at Missouri S&T, to re-engineer a GM vehicle for reduced environmental impact, including minimizing energy consumption, reducing emissions and greenhouse gases while retaining the vehicle's performance, safety and consumer appeal.

Using a real-world engineering process to design and integrate advanced propulsion technology solutions into a 2009 Saturn Vue, students will gain valuable experience in real-world engineering practices, resource allocation and meeting deliverables.

Student solutions will explore a variety of cutting-edge clean vehicle solutions, including full-function electric, range-extended electric, hybrid, plug-in hybrid and fuel cell technologies. In addition, students will incorporate lightweight materials into the vehicles, improve aerodynamics and utilize alternative fuels such as ethanol, biodiesel and hydrogen.

GM will provide the teams with production vehicles and parts, seed money, technical mentoring and operational support throughout the three-year program. The DOE and Argonne National Laboratory will provide competition management, team evaluation, technical guidance and logistical support.

Building on the strengths of CTIS, Missouri S&T's team is developing a hydrogen fuel cell plug-in hybrid electric vehicle, which complements other ongoing research and demonstration projects on campus working toward realizing a hydrogen-powered society of the future by studying the entire process of hydrogen production, storage and end use.

Visit <http://ecocarchallenge.mst.edu> for more about the team at Missouri S&T. Visit <http://www.ecocarchallenge.org> for more about the competition.