ANNUAL REPORT 2015–2016

THE UNIVERSITY OF TEXAS AT AUSTIN
CENTER FOR TRANSPORTATION RESEARCH

What Starts Here Changes the World

Contents

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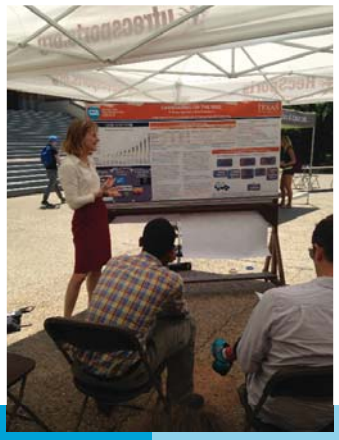
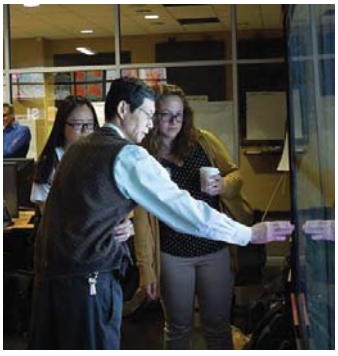




Director's Message

Dear Friends of CTR,

Now celebrating 54 years of research excellence, CTR has yet another exciting year to report. A year full of collaborations and research that truly changes the world due to the expertise, creativity, and resourcefulness of our researchers, students, and the funding organizations that help make all this possible.

Let me take this opportunity to first thank our major funding partners, which include the Texas Department of Transportation, City of Austin, US Department of Transportation, Capital Area Metropolitan Planning Organization, CapMetro, the National Science Foundation, Transportation Research Board, the North Central Texas Council of Governments, and many more. During the 2015-2016 academic year, CTR's total funding climbed to almost $16 million, the highest we have ever reached in any academic year. We truly could not do this without the support of such wonderful partners.

I would also like to thank our faculty, staff, and students for their many research and professional efforts, and I look forward to their continued impactful contributions during this new year.

An important effort I have pursued during my tenure as director of CTR is to foster multidisciplinary research. I have been pleased with the active involvement in TxDOT and non-TxDOT projects of researchers from other disciplines, such as computer science, electrical and computer engineering, geography, education, community and regional planning, management, communication, and public policy, in addition to various disciplines in civil engineering.

CTR provides a progressive vision to inspire new pathways to addressing safety, mobility, resiliency, and reliability considerations on our transportation systems, and ensure an equitable, inclusive, system that enhances the quality of life for all Americans. The recent USDOT designation of CTR as a "Beyond Traffic Innovation Center" as well as an "Autonomous Vehicle Proving Ground" (the latter in partnership with TTI and Southwest Research Institute) is testament to the cutting-edge research, education, and technology transfer activities undertaken by the community of CTR researchers and thought leaders.

Through CTR's various subcenters, events, role as a disseminator of new technology and ideas, and extensive research projects, CTR is revolutionizing the future of smart cities, connected and automated vehicles, infrastructure, materials, and design that will form the transportation landscape of the future.

The future looks bright, and CTR is proud to help drive that future forward.

Sincerely,
Chandra Bhat
Director, Center for Transportation Research

About CTR

The mission of the Center for Transportation Research is to provide transportation research, education, and public service to travelers from around the globe and particularly within the state of Texas.

The Center for Transportation Research (CTR) is a multidisciplinary and multimodal research institute at The University of Texas at Austin. Recognized as one of the leading university-based transportation research centers in the world, our researchers, faculty members, and students work together to promote cutting-edge developments in transportation science and technology.

CTR's research spans:

- economics
- multimodal systems
- traffic congestion relief
- transportation policy
- freight and rail
- materials
- bridges and structures
- public transit
- environmental impacts
- driver behavior
- accessibility
- wireless technologies
- autonomous vehicles
- big data

"We need to be thinking about the future—about how technology plays a role in transportation—and that kind of thought process is happening right here at UT."
— Anthony Foxx, former US Secretary, of Transportation, 2015

In 1963, Dr. Clyde Lee founded the Center for Highway Research in an effort to establish a transportation research program at the University of Texas. The program initially focused on transportation research for the Texas Highway Department, now the Texas Department of Transportation (TxDOT). From the beginning, the focus of the center was to provide a more fruitful education and research environment for students.

In 1979, the Center for Highway Research merged with the Council for Transportation Studies to form the Center for Transportation Research.

Subcenters:

D-STOP: The Data-Supported Transportation Operations and Planning Center (D-STOP), under the direction of Chandra Bhat, is a collaborative initiative between researchers at two research centers at The University of Texas at Austin: CTR and the Wireless Networking and Communications Group. Named a Tier-1 U.S. Department of Transportation University Transportation Center, D-STOP is dedicated to finding solutions to modern-day transportation challenges.

Network Modeling Center: The Network Modeling Center, under the direction of Dr. Jen Duthie, explores fundamental research related to network models with an emphasis on dynamic traffic assignment models and their application to determine the system-level impacts of changes to the transportation network infrastructure.

Other major CTR research initiatives and programs include:

- TxDOT Cooperative Research Program
- Austin Interagency (IAC) Project
- Dallas IAC Project
- Mega-region Freight Issues in Texas
- Strategic Research Program
- Texas Pavement Preservation Center
- UT SAVES

CTR received close to $16 million in funding for 2015–2016.

Spotlight: CTR Library

The CTR Library is one of the leading transportation-related research libraries, and it serves as the official repository of the TxDOT Research Program. Publications generated by TxDOT-funded research at research centers statewide are available at the CTR Library. It provides comprehensive online search functionality for users, and helps Texas engineers and researchers locate critical research results efficiently. The Library also acts as an archive for TxDOT materials. The Library also supports the Texas Legislature, the University community, and the general public by making the results of research easily available and accessible.

The Library is staffed by Louise Rosenzweig, Library Manager; Kevyn Barnes, Webmaster; and Michael Nugent, Library Technical Assistant.

As the Texas population grows and transportation needs change, demands for Library services have changed but continue to grow. Technologies are changing and we are committed to adopting technologies to strengthen the dissemination of research and improving dialog with our patrons.

Example from TxDOT Research Projects Database

Developing Library Web Initiatives

The Library has increased its presence online by using Twitter and Pinterest to provide alerts about new publications and share information about important tools and data that will help researchers. In addition, the Library made several updates to the online catalog and added important metadata to publication records to improve online search and discovery of relevant research. An important addition to the Library's online presence includes the new TxDOT Research Projects database, which provides information on all active research projects funded through the TxDOT Research and Technology Division, as well as projects completed since 2012. Real-time project updates are available via the TxDOT interactive research map located at http://maps.dot.state.tx.us/ORG/RTI/ResearchProjectsMap/

Developing Library Resources

Staff worked diligently on several projects to ensure online access to its archive of research publications. These projects included digitizing and adding online access to publications from the Council of Advanced Transportation Studies (1972-1979), the International Center for Aggregates Research (1988-2004), many pre-1979 TxDOT publications, and several videos from older TxDOT research projects. Library staff continued to digitize items in our TxDOT Archive collection, making our unique collection accessible for free. We currently hold over 2,000 PDF items in our TxDOT Archive collection.

Resource Networks

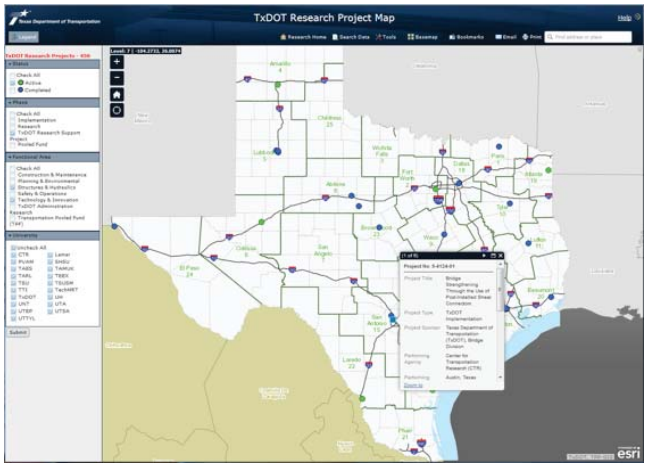
Library staff continued to be engaged in a number of professional outreach activities, including memberships in the AASHTO RAC Transportation Knowledge Networks Task Force, the Western Transportation Knowledge Network (WTKN), the Transportation Research Board's Library and Information Science for Transportation (LIST) Standing Committee, and TRB's Standing Committee on Transportation History and the Task Force on Knowledge Management.

Conference Participation

- 2015 & 2016 Transportation Research Board Annual Meetings
- 2015 & 2016 Special Libraries Association Annual Conferences
- 2015 TxDOT Environmental Conference
- 2015 & 2016 Texas Conference on Digital Libraries
- 2016 SXSWedu conference

Library at a Glance: FY 2015 and 2016

- Number of patron reference requests fulfilled: Nearly 1,800 patrons served.
- Number of items cataloged: Over 1,500 new items added to the online catalog.
- Visitors to the Library website: Over 36,000 patrons visited the CTR Library website.
- PDFs downloaded directly from Google: Nearly 250,000 downloads of documents from the Library server.



TxDOT Interactive Research Project Map

COLLABORATE

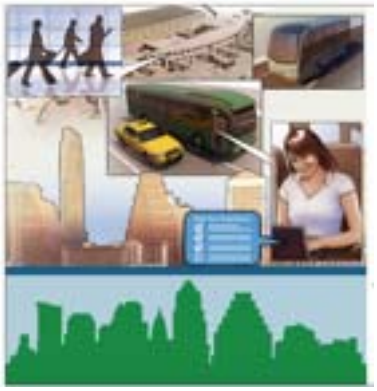
Through official partnerships and faculty affiliations, CTR maintains active research relations with many groups/schools within the UT Austin community, including the following:

- Civil, Architectural and Environmental Engineering
- Lyndon B. Johnson School of Public Affairs
- School of Architecture
- School of Electrical and Computer Engineering
- School of Mechanical Engineering
- GM Foundation Engines and Automotive Research Labs
- Community and Regional Planning Program
- Center for Sustainable Development
- Laboratory for Infrastructure Materials Engineering
- Urban Information Lab
- Modeling, Visualization and Evaluation Group
- Resilient Infrastructure and Smart Cities Lab
- Wireless Networking and Communications Group
- Center for Electromagnetics
- Center for Research in Water Resources
- Construction Industry Institute
- Construction Materials Research Group and Concrete Durability Center
- Geotechnical Engineering Program
- Phil M. Ferguson Structural Engineering Lab

Austin Smart Cities Proposal Top 7 Finalist in Nation

Austin is America's fastest-growing major city. Since 2010, the population has grown by over 100 people per day. With new cars and people constantly being added to the city's highways and commuter pathways, traffic, congestion and travel safety are ever-greater concerns.

These issues, however, are not limited solely to Austin, but are part of a larger, nationwide discussion about the future of transportation in the US that led to the envisioning of the Smart Cities movement. A Smart City is a city that uses cutting-edge technology to address mobility, safety, equity, and environmental challenges for all its residents.



Graphic created for the Smart Cities Proposal

To help propel the nation towards smarter and safer transportation futures, and foster the creation of Smart Cities, the US Department of Transportation (USDOT) pledged up to $40 million to one city to help it become the country's first to fully integrate innovative technologies—including self-driving cars, connected vehicles, and smart sensors—into their transportation network.

"The Smart Cities Challenge was a competition in two phases," CTR Graduate Student Kristie Chin states. "Phase one focused on cities developing a vision for the future of their local transport systems, anticipating evolving trends and how technology can identify solutions. Phase two focused on advancing a technical approach to support the execution of phase one."

The City of Austin, in partnership with CTR students and faculty, rose to the challenge. In a regional partnership that included Capital Metro, the Texas Department of Transportation (TxDOT), Austin Energy, CTR, the Texas A&M Transportation Institute, Southwest Research Institute, Central Texas Regional Mobility Authority, and the Rocky Mountain Institute, the City of Austin submitted a proposal that would propel the city to a more fully integrated, accessible, and efficient transportation future.

The six-month-long collaboration between industry, government partners, and local academia resulted in a 70-page plan that outlined the vision and background for the City of Austin. The plan covered the city's technical approach, program management methods and staffing and details concerning the city's capabilities for implementing such a plan and leveraging available and future infrastructure to successfully complete their vision.

The Austin Smart City vision laid out a variety of pilots and programs that leverage innovative technology to improve transportation. These pilots included transit access hubs known as **Smart Stations** that connect suburban areas to downtown transportation options; **Connected Corridors** through major access roads that allow for more rapid deployment of public transportation; and a **Mobility Marketplace** that connects travelers to their best possible commuting options and provides outreach and education through a Smart Ambassadors program.

"As engineers, we can become enthralled with data and models, but with this project we focused on the difference we can make in a community. Projects like these are part of why I chose transportation engineering, because we get to connect with people," Chin states.

Essentially, the City of Austin's transportation vision was to use public transport initiatives to provide ladders of opportunity that improve access to jobs, healthcare, education, healthy food and other areas of need. Even though the ultimate USDOT Smart Cities grant went to Columbus, Ohio, the City of Austin placed in the top seven finalists out of 78 submissions. And the effort was not wasted.

"The question became a matter of, well, we didn't win, but what's next? What legacy can we enable through this?" Chin mentioned. "People are now calling for a shift in paradigm so that we can reimagine new technology and make Smart Cities happen faster."

According to Chin, the original Smart Cities Austin team consisted of about 20 to 30 people and created new pathways towards deeper partnerships between public and private entities and a new model for delivery of services. In the wake of the USDOT Challenge, the once-regional partnership has expanded from a citywide to a statewide level. CTR is now working with TxDOT and other cities across the state to build upon the momentum of the Smart Cities challenge.

To keep the initiative moving forward, TxDOT's Texas Technology Task Force hosted the Texas Mobility Summit in December 2016. The Summit advanced the creation of a Smart State Consortium, encouraged public-private dialogue, and galvanized key leadership to develop innovative solutions to the state's mobility challenges.

"Collaboration between so many different groups can be difficult," Chin states. "You could say there were a lot of cats to herd, so we focused on how to work well together and it was so worthwhile. As City of Austin's Jim Dale says, 'if you want to go fast, go alone. If you want to go far, go together.'"

CTR, WNCG Launch UT SAVES Initiative

Envision an early cubist painting by Pablo Picasso. To the untrained eye, the painting can look like a jumbled series of boxes overlapping and intertwining with each other. But the art of cubism is about exploring the world from multiple perspectives. The painting, which at first looks like boxes, is actually a city seen from multiple perspectives.

"If you think about automated driving, that is the kind of perspective we want," SAVES Director and Wireless Networking and Communications Group (WNCG) Prof. Robert Heath states. "Except we want to see where cars and pedestrians, in addition to buildings, are located within those multiple perspectives."

This ability to sense a city's infrastructure, moving parts, and pedestrian traffic to enable a clearer path for automated vehicles is just one of the many challenges the **Situation-Aware Vehicular Engineering Systems (SAVES)** research initiative hopes to resolve.

Robert Heath Announces SAVES Initiative

In partnership with CTR, WNCG faculty recently launched the SAVES initiative to explore the emerging interconnection between wireless and transportation. SAVES combines WNCG's expertise in wireless networking and communications, data and signal processing, with CTR's experience in transportation, traffic modeling, policy, and planning to help reduce collisions, design faster commutes, and increase connectivity to make the automated aspects of driving more efficient.

"The collaboration between WNCG and CTR allows us to come together and ask tough questions," Prof. Heath states. "Between their faculty, researchers, and roughly 170 graduate students, combined with WNCG's faculty and student resources, we at UT Austin are well-positioned to exploit this emerging interconnectedness between wireless and transportation."

The three pillars of SAVES include **communications**, which seek to create higher data rates and lower latency, **sensing** to establish better sensing technology and fuse sensor data, and **data analytics** to combine sensor data and make it available for transportation departments and city planners so they can better manage transportation networks and commute times.

In conjunction with their founding partners Toyota ITC, Huawei and National Instruments, SAVES hopes to solve key technical challenges within these three pillars.

"The applications we're creating are worthwhile because we're working to reduce collisions and make commute times faster, which has an appeal for many people," Prof. Heath states. Higher data rates can enable greater connectivity between vehicles and infrastructure, which can improve safety and decision-making within a vehicle. With higher data rates, instead of relying on the car in front of you to run the necessary algorithms, identify pixels and find pedestrians, the car in front can ship any data it has to your vehicle, which can run algorithms and make decisions for itself based on more data than it otherwise would have collected.

Sensing allows cars to talk to each other and impacts the role of infrastructure. Taller sensing infrastructure allows a vehicle to see the full environment and provide better situational awareness. This could provide key visuals in cases where, for example, a large truck blocks the view of a small car behind it.

"Does the self-driving car hype reflect reality?" Prof. Heath asks. "We have a long way to go. Even though the field is really hyped right now, this is the time to come in, double down on investment, and really start looking at what wireless can do in this space."

City of Austin and CTR Partnership Helps Move Austin Forward

With rapid population growth comes urban growing pains. In March 2016, the City of Austin recruited CTR to help drive Austin's transportation systems into the future and help Austin attain its urban maturity. The resulting five-year technical services agreement creates a partnership that will address already identified issues as well as futureprojects.

Over the next five years, the research provided by CTR could help the City to better allocate their transportation resources, create system improvements that reduce cost and commute time for drivers, improve mobility and safety, and provide data to inform the City's decision-making and improve traffic flow in the Austin roadway network.


Randy Machemehl Leads the COA Project

"Our goals are to assist the City of Austin in solving transportation problems, use these opportunities to teach our students the newest methodological approaches to real problems and develop new methodology to enable solutions to problems that could not previously be solved," states Dr. Randy Machemehl,

CTR Professor and Transportation Engineer, as well as a leading faculty member on the technical services agreement.

In addition to helping the City improve traffic flow, the new project also increases opportunities for learning and career growth for CTR undergraduate and graduate students. According to Dr. Machemehl, the firm that operates the City's traffic control center has hired several CTR undergraduate students to assist with operations. "Our students have the opportunity to learn how the control center functions as well as how the City develops and implements signal timing functions and other things," Dr. Machemehl states.

The first issue involves developing a quantitative basis for rates the City charges to private developers to rent street lanes when they need extra space for development projects. To accomplish this, the CTR research team employs micro-simulation techniques to determine the delay travelers will experience as a result of the rented lanes being taken out of service. "This effort will also use dynamic traffic assignment techniques to determine how travelers will choose different routes to avoid locations with reduced capacity due to lane rentals," Dr. Machemehl states.

The second issue is to evaluate the effectiveness of bicycle signals. The first step of this process is to develop data from before the bicycle signals are in place. This data would help demonstrate the impacts new signals have on cyclist compliance with signals, interaction with other vehicles and pedestrians, and overall cyclist safety. CTR is currently gathering video of cyclists and cars at these intersections and characterizing how they function without bicycle signals.

Bicycle Signal at Austin Intersection

Once the baseline dataset has been created, the City of Austin plans to install an experimental version of bicycle signals at eight intersections in the downtown area. After the new devices are installed, CTR researchers will compare compliance and other characteristics of the "before" and "after" results.

"We hope to help Austin be a leader in developing and implementing innovative transportation system solutions," Dr. Machemehl states.

Data Rodeo Provides Transportation Tools to Central Texas

As a continuation of the Smart Cities Challenge, the Data Rodeo is envisioned to be a repository for transportation data and tools in the Central Texas Region. Now part of CTR's ongoing technological services collaboration with the City of Austin, the goal of the Data Rodeo is to facilitate data sharing, use, and management within a Smart City and beyond. CTR partners with UT's Texas Advanced Computing Center to obtain the high-power data processing capabilities this tool requires.

"We realized that a large percent of our time spent on travel modeling was spent obtaining and preparing data," Dr. Jennifer Duthie, head of CTR's Smart Cities Challenge sub-team on data and Director of the Network Modeling Center, states. "We conceived the Data Rodeo as a way to make our lives easier and to improve efficiency for others working on transportation challenges in Austin."

The data project, while specific to Austin in one sense, is scalable and replicable for other jurisdictions and agencies of all sizes and types.

Over the past several years, the City of Austin has collected large amounts of data concerning traffic patterns and commuting in the area. However, the City needs help to leverage this data to aid in future decision-making.

The Data Rodeo project will recruit CTR's expertise to analyze travel-related data, including traffic signal performance, crash data, demand management programs, transit models, and infrastructure plans to identify trends and create recommendations. The project will enable the City to use insights from data to develop priorities for infrastructure improvements, study the needs of critical travel arteries, document effects of changes on the transportation system, and develop a data management plan that will secure and share information and assess a system's vulnerability to attack and failure.

"The Data Rodeo is an important way to connect the university and the city, to bring positive changes to the community and create educational opportunities." Dr. Duthie states.

Dr. Jennifer Duthie Leads Rodeo (Photo: Miguel Gutierrez, KUT)

Innovate

Profs. Boyles and Claudel Pioneering Mobile Wireless Networks in UAVs


Dr. Stephen Boyles


Dr. Christian Claudel

On today's roadways, traffic conditions are currently monitored by using either fixed, static sensors or crowdsourced data. Using a combination of traffic sensor measurement data and past information about usual traffic, travel time information, or congestion patterns, these observations provide a sparse and often inaccurate traffic map that is not up to speed with real-time conditions.

On a normal day, these maps are typically accurate enough for the average commuter. However, when a disruption to usual traffic patterns occur, traffic maps need to become more responsive and alert travelers to current traffic conditions. To address this issue, the NSF recently awarded CTR Profs. Christian Claudel and Stephen Boyles $397,933 to pioneer the use of mobile wireless sensor networks in umanned aerial vehicles (UAVs).

"Disruptions to the transportation network can have large impacts on society and it's important to manage these disruptions as quickly as possible," Prof. Boyles states. "These disruptions can be things like natural disasters or terrorist attacks. We're proposing that UAVs can be used to quickly assess the state of a transportation network when it's disrupted, since drones can fly and are not affected by traffic congestion, collapsed bridges, etc."

With the opportunity for mobile sensing enabled, UAVs would be able to sense traffic conditions and roadway issues following a catastrophic or disruptive event. The NSF grant, entitled "Optimal Control of a Swarm of Unmanned Aerial Vehicles for Traffic Flow Monitoring Following Disruptions," will support the theoretical foundation research needed to implement and operate such a system.

"The optimal sensor placement problem solved by this research will allow the system to automatically compute the best path each UAV should take to sense traffic conditions and enable quick updates on the traffic situation," Prof. Claudel states.

This research could provide the means to sense traffic in real time at a lower cost than traffic sensors on fixed infrastructure could provide and open new horizons for mobile sensing systems. To achieve this goal, the CTR research team plans to develop an efficient simulation framework for networks based on a model of traffic flow. The team will model a way to optimally route a set of UAVs over a transportation network to decrease the uncertainty of traffic estimation and identify the current state of traffic. The team will also investigate the problem of optimal routing of ground vehicles with partial traffic sensor information.

"Improving the resilience of large cities to disruptions and natural disasters is critical. UAVs have tremendous potential to serve as a mobile sensor during network disruptions, since they may travel unimpeded over flooded areas or roads damaged by earthquake. By better managing disruptions and evacuations, we can improve public safety and allow the transport network to better serve society," Prof. Boyles states.

This project is made possible under NSF grant #1636154.

Bringing Smart Transport to Texans

Smart-driving technologies are changing the landscape of transportation by enabling greater mobility, safety, and environmental benefits. The new technology could transform the current roadway and economic landscape, and CTR research suggests that connected and autonomous vehicle (CAV) technology could reduce crash costs by about $390 billion per year.

However, technology alone is not enough. According to CTR Prof. Kara Kockelman, the lead investigator on one of TxDOT's Innovative Projects, technology should be paired with smart policy-making, infrastructure improvements, and operations strategies.


Dr. Kara Kockelman Investigates CAVs

"Connected vehicles and, specifically, self-driving vehicles, are new to the market and ever-evolving," Prof. Kockelman states. "There's a lot to consider in order to fully adopt this new means of transportation."

As part of a call from TxDOT's Research and Technology Implementation Office to address cutting-edge topics, CTR submitted research proposals with their most creative transportation ideas. Their proposal resulted in the TxDOT Innovative Project titled "Bringing Smart Transport to Texans: Ensuring the Benefits of a Connected and Autonomous Transport System in Texas."

The project work is taking place over 44 months, and is now in its second phase. Phase one included a legal review of state laws and concluded that CAVs are in fact legal on Texas highways. The team also compiled a set of recommendations for TxDOT, assessed public opinion and willingness to pay for automated vehicles, simulated network dynamics to monitor the effects of automated vehicles on congestion, anticipated safety and emissions impacts, and evaluated CAVs' economic impacts (published in report 0-6838-2).

"Our project helps system planners, designers, and other decision-makers make better transportation investments and pursue better policies," Prof. Kockelman states. "One key issue remains how to deal with the increase in vehicle-miles travel we expect. Tighter following distances on smart cars will have to be required, and credit-based congestion pricing or other incentives for thoughtful travel choices will be needed to avoid serious congestion impacts. But the safety and access benefits of self-driving cars are significant if we can avoid gridlock."

This comprehensive project has also reviewed vehicles instrumented with dedicated short-range communications devices for wrong-way driving alerts, vehicle guidance, and road surface-condition monitoring. The research team has created algorithms for more accurate vehicle positioning information and real-time traffic flow monitoring, produced state and national forecasts for household adoption and use of CAV technologies, simulated strategies for ramp merges and smart intersections, and estimated delay reductions.

In addition to Prof. Kockelman, the research team includes CTR Professors Stephen Boyles and Christian Claudel, CTR Research Scientists Lisa Loftus-Otway and Duncan Stewart, UT Austin School of Law Professor Wendy Wagner, UT Austin School of Natural Sciences Professor Peter Stone, University of Utah Professor Dan Fagnant, and Southwest Research Institute's (SwRI) Paul Avery, Purser Sturgeon, Cameron Mott, Stephan Lemmer, and Eric Thorn. The team has also included CTR postdoctoral researchers, graduate students, and undergraduate students, which enabled emerging researchers to play a big part in developing the nation's future transport systems.

Students have learned how to investigate evolving topics, program and apply new systems, survey and simulate consumer behaviors, recommend new transportation and related policies and practices, and comprehensively evaluate the benefits and costs of CAVs.

The project has hosted two smart transportation systems symposiums on the UT campus, bringing together over 120 researchers and stakeholders to chart a path forward for smart transport in Texas. These symposiums featured the work of researchers from across the state, presented by a diverse group of collaborators to determine mutually beneficial avenues of research and to coordinate early implementation of smart transportation projects.

Example of an Emergency Vehicle Alert Created by Project Collaborator SwRI

CAR-STOP Project Improves Transportation Safety

Over 80 percent of annual car crashes could be prevented by vehicular communications, a recent report from the National Highway Traffic Safety Administration demonstrates. To improve vehicular communications and substantially improve safety benefits for all, TxDOT funded the Communications and Radar-Supported Transportation Operations and Planning (CAR-STOP) project.

Under the direction of CTR's Dr. Chandra Bhat, the project also includes Co-Principal Investigators on the project from UT Austin's Department of Electrical and Computer Engineering, Profs. Robert Heath and Joydeep Ghosh. Other research team members include CTR's Jennifer Duthie and James Kuhr, as well as multiple graduate students.

CAR-STOP Vehicle Demonstrating How the Sensors Retrieve Data

"We are excited about this project because of its truly collaborative nature, which we believe is key to resolving many issues in the connected and automated vehicle space in terms of data collection, science, management, generalizability, and scalability," Dr. Bhat states.

The project will create a new framework to integrate radar sensing and vehicle-to-vehicle communications to improve safety for partially automated vehicles. Additionally, the project will develop the means for vehicles to exchange higher rates of sensor data using millimeter wave communication.

By sharing raw sensor data between vehicles, including non-motorized traffic such as bicyclists and pedestrians, more accidents can be prevented through better situational awareness.

The project includes two phases, the second of which began in September 2016. The first phase developed a framework using wireless technology to improve transportation safety that emphasized collision warning and avoidance systems, fusing data obtained from wireless and radar. It also established millimeter wave communication's potential for use in both communication and radar simultaneously.

The second phase involves further development of the data fusion algorithms to make them more robust, and also to consider additional data sources like LIDAR and cameras. It also considers a more expansive suite of millimeter wave communication techniques that improve communication between vehicles and the base station by leveraging additional sensor data.

Lastly, phase two will create a complete, functioning collision warning and avoidance software for field use by agencies such as TxDOT, various vehicle manufacturers, and other interested parties that will aid in automotive design and future strategic planning of road design and infrastructure.

Phase two will create working prototypes and equipment for collision warning and collision avoidance systems that use joint radar and communication technologies. This equipment will demonstrate and test the theories and algorithms developed during the first stage of the project. These technologies could help improve safety at urban intersections, areas with heavy bicycle and pedestrian traffic, and in the case of passing maneuvers on rural roads.

"If you want talk between vehicles or between a vehicle and some infrastructure," Dr. Bhat states, "it has to be reliable. "There's a balance between trust, privacy, and control."

Prozzi Spearheads Pavement Preservation Initiative

As of 2014, Texas had 675,580 lane-miles of roadway to maintain. (Lane-miles is what you get when you multiply road length by the number of lanes.) That's a great deal of pavement to wrangle by transportation agencies. The broad range of climates in the state make pavement maintenance even more complicated, as

Pavement Maintenance in Action: Application of Fog Seal

roads in Central or North Texas will age differently from those in the Panhandle or on the coast.

To stay ahead of pavement problems, CTR is leading the TxDOT project titled "Accelerating Innovation in Partnered Pavement Preservation," led by veteran researcher Dr. Jorge Prozzi. Running from March 2015 through August 2019, this initiative identifies innovative highway pavement preservation materials, technologies, and procedures to provide a new platform for accelerating innovation in highway pavement preservation. The research results shall lead directly to their implementation. For each project year, the research team prioritizes pavement preservation needs for investigation and then produces recommendations that can support the implementation of the new guidelines or policies. This focus on implementation means that the research findings can be implemented throughout the life of the project, rather than at the project end.

This first report (0-6878-1) summarized the work performed during the first five months of the project, from April to August 2015. During that period the researchers quickly got to work, determining the field performance of thin overlays relative to alternative preservation techniques and quantifying highway pavement surface micro- and macro-textures.

During the first full year of the project, Dr. Prozzi's team quantified the effectiveness of various popular preventive maintenance (PM) treatments under varying conditions toward optimizing their design and application (as documented in report 0-6878-2). After evaluating the effectiveness of different PM treatments through a model-based approach, the team estimated the effective life of PM treatments of in-service flexible pavements located throughout Texas through statistical analysis and modelling. Drawing on TxDOT databases that include more than twenty years of relevant design, construction, and performance data, the preliminary analysis focused on the three most popular PM treatment types: chip seals, microsurfacing, and thin overlays. Other such examples of implementable outcomes from this project include the following:

- Data to support preservation-related policy decisions
- Recommended standard sheets
- Recommended language for related manuals

One of TxDOT's Innovative Projects, this initiative promotes and streamlines research in the area of pavement preservation and leverages TxDOT's research and implementation resources through collaboration with the USDOT Center for Highway Pavement Preservation (CHPP). CHPP is a research and innovation partnership lead by Michigan State University; in addition to UT Austin, the other member universities include The University of Illinois at Urbana-Champaign, The University of Minnesota, The University of Hawaii at Manoa, and North Carolina A&T University.

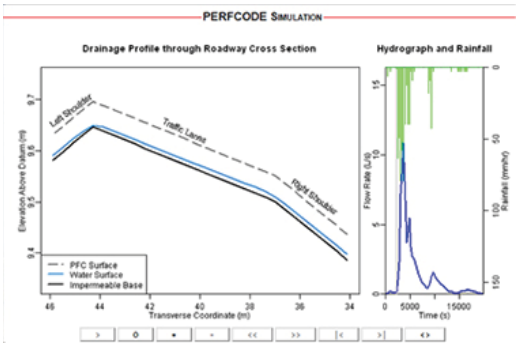
Netherlands Highway Administration Uses CTR Models for Motorway Design

The interaction between surface and subsurface drainage on roadways in the Netherlands is a crucial consideration, given the country's history with flooding. Thus, most roadways there are surfaced with single-layer or double-layer porous asphalt.

However, the Netherlands Highway Administration sought new models to update their roadways and determine guidelines for doing so by re-envisioning their Motorway Design Guide.

Enter CTR researchers Drs. Randall Charbeneau and Michael Barrett, whose two TxDOT-funded research projects could revolutionize the future of the Netherlands highway system by helping the Highway Administration manage its pavements.

Both projects used numerical models to assess water ponding in superelevation transitions and water flow in permeable friction course. "It would be of great help to us if we could use these models ourselves," Highway Administration representative Jacob Groenendijk noted when he requested access to the CTR models in late 2015.



For the first CTR project, TxDOT Project 0-4875, both a rainfall simulator and a roadway model were constructed to investigate the behavior of sheets of water on rough, impervious surfaces during storm events. Results from the project, entitled *Minimum Longitudinal Grade at Zero Cross Slope in Superelevation Transition*, helped identify locations where enhanced drainage treatments could help offset the effects of superelevation transitions.

Superelevation transitions are used to help balance centrifugal forces on vehicles moving through curved highway sections. These transition areas create longer drainage paths for stormwater runoff and increase ponding on roadway surfaces.

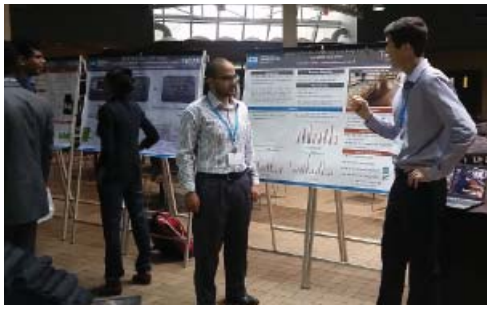
Then, under TxDOT Project 0-5220, *Investigation of Stormwater Quality Improvements Utilizing Permeable Pavement and/or the Porous Friction Course*, the researchers continued their assessment of permeable friction course (PFC). PFC is a two-inch overlay of porous asphalt placed on top of regular impermeable pavement. Rain water enters the porous layer and gravity helps direct the water to the side of the road, which helps improve visibility and reduce splash and spray for vehicles on the roadway. Results from the project team, which included CTR affiliate Center for Research in Water Resources (CRWR), used a model called Perfcode, which is short for Permeable Friction Course Drainage Code. The new model has already had direct and immediate implications for the state of Texas, and could have great impact in the Netherlands as well.

After receiving the new CTR research models and technology, Dr. Groenendijk installed the software and after successful trials transferred the files to the Dutch Ministry of Infrastructure for use in their operations.

CRWR alum Brad Eck, who developed the model for his doctoral thesis, is now a scientist at IBM Research in Dublin.

EDUCATE

2016 CTR Symposium Focused on Practice



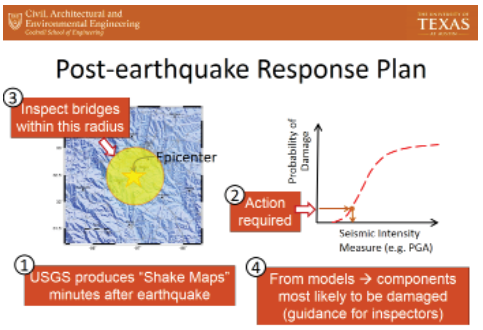
The 2016 event emphasized tools to improve daily operations as well as practical application of research to create the next generation of engineers. This approach was well-received, prompting one of the attendees to express "thanks for including content more suited for your audience (TxDOT practitioners)—less theoretical academic presentations." Complementing the day's presentations was a poster session that allowed participants to meet with more than a dozen UT Austin graduate student researchers and transportation faculty, who demonstrated progress and preliminary findings in active projects representing the cutting edge of transportation research.

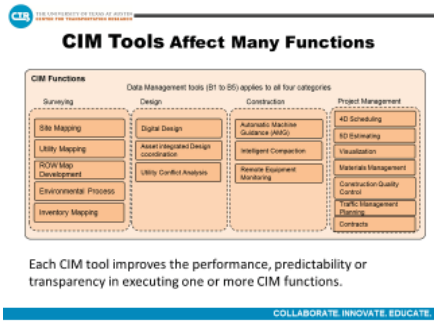
We also announced this year's winner of the Mac Shelby Award, which honors a TxDOT research staff member who has provided exceptional leadership, technical expertise, the ability to address special challenges, and dedication to research. That honor went to TxDOT Project Manager Darrin Jensen.

CTR researchers presented on these topics:

Project Delivery Method: Logic and Tool to Make an Informed Choice
Dr. Bill O'Brien teamed up with TxDOT's Chief Engineer Bill Hale for this look at a project delivery selection tool developed in response to TxDOT's receiving legislative authority to use the design-build (DB) approach to projects. The most effective use of DB necessitates an objective but Texas-specific analysis of the best project delivery method for any given project. As part of an interagency contract with TxDOT, Dr. O'Brien's team created an objective, flexible MS Excel-based decision-support tool that differentiates project goals and characteristics and gives quantitative measures to reach an informed recommendation for the project delivery method. Developed with the input of experienced TxDOT personnel, the team validated the tool with range of existing TxDOT project characteristics.

Seismic Vulnerability of Texas Bridges
Dr. Eric Williamson presented some preliminary findings from ongoing TxDOT project 0-6916, *Seismic Vulnerability and Post-Event Actions*. This multidisciplinary team, led by Research Supervisor Patricia Clayton, includes structural engineers, geologists/seismologists, and geotechnical engineers. Recent changes in Texas seismicity require characterization of earthquake hazards and soil conditions throughout the state, as well as the extent to which TxDOT-maintained bridges are vulnerable to these changes. The project, which concludes in December 2017, is helping TxDOT understand its exposure to seismic risk and create a clear plan of action for post-earthquake response.



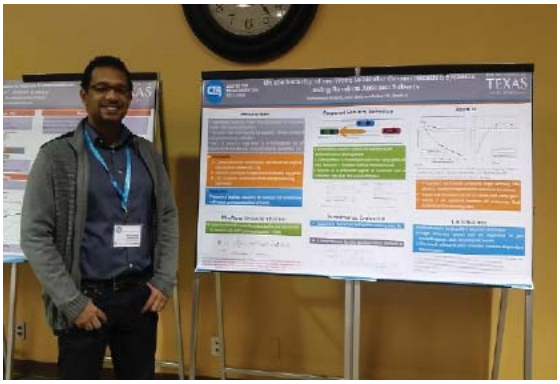


CIM – 21st Century Tools, Technologies, and Processes for Infrastructure Projects
Dr. Fernanda Leite filled us in on CIM (Civil Integrated Management) and BIM (Building Information Modeling), two techniques that enhance infrastructure project delivery. BIM is a digital representation of the physical and functional characteristics of a facility. Dr. Leite highlighted the use of BIM for highway construction projects, which tend to present unique challenges. CIM is the technology-enabled collection and organization of accurate data and information used throughout the life cycle of a transportation asset, which can also benefit highway infrastructure from design through operation and maintenance. Dr. Leite is a team

member on the recently completed NCHRP 10-96 project, which provides a guidebook for CIM implementation at DOTs.

Does the TxDOT Engineering Assistant Career Development Program Really Make a Difference?
Dr. Randy Machemehl partnered with TxDOT's Kelly Selman, the Dallas District Engineer, to present an examination of the development program for Engineering Assistants (EA). Mandatory for all EAs hired in the Dallas District since 2009, the program fosters the development of transportation engineers. Program features include mentoring, formal instruction, exam preparation for the Professional Engineer credential, and functional area rotations. CTR's analysis of the program identified its successes as well as potential areas for improvement, and compared its features to those of other DOTs' training programs.

Overview of the USDOT Smart City Challenge: A Collaborative Ecosystem
The day's final session was a panel discussion of the USDOT's Smart City Challenge, in which the city of Austin was one of seven finalists. The USDOT pledged up to $40 million to one city that will define the concept of a "Smart City" and become the country's first city to fully integrate innovative technologies—self-driving cars, connected vehicles, and smart sensors—into their transportation network. Dr. Mike Walton and Dr. Jen Duthie joined with TxDOT's Director of Strategy and Innovation Darran Anderson for this overview of Austin's participation in this challenge, highlighting CTR's role in the proposal, which is to create and host a Data Rodeo (a single point of access for regional transportation data and analytics).



Research Fellow Mohammed Eltayeb Presents Symposium Poster

CTR's Network Modeling Center Shares New Technology and Planning Tools with Central Texas Agencies

As part of a long-standing collaboration with the Capital Area Metropolitan Planning Organization (CAMPO), CTR developed a dynamic traffic assignment (DTA) tool to evaluate changes and predict future use on Texas roadway systems. As part of their agreement with CAMPO to build advanced modeling tools for and disseminate knowledge to the region, CTR offered trainings on the new technology to CAMPO agency staff and partner organizations.

"DTA is a planning tool used to compare possible future-year scenarios," CTR Research Associate Brandy Savarese states. "It models strategic driving behavior, or how drivers choose their routes at a typical time based on least-cost path selection. DTA differs from other models in that it considers the evolution of traffic conditions at small time intervals and captures changes in traffic conditions every 100 to 500 feet."

Approximately 40 people benefited from the trainings, which included one half-day workshop hosted at the newly opened Texas Advanced Computing Center (a key partner in the Data Rodeo initiative) on the Pickle Research Campus and CTR's offices. The trainings were provided to CAMPO agency staff, as well as members of their consultants and partner organizations, including Capital Metro, TxDOT, Austin Public Works, City of Austin, City of Round Rock, City of Cedar Park, City of San Marcos, City of Hutto, Williamson County, Travis County, Capitol Area Council of Governments, Central Texas Regional Mobility Authority, HNTB Corporation, and Jacobs Engineering.


NMC Staffers Were On Hand to Assist Workshop Participants

Several CTR students also benefited by attending the trainings. "The goal of these trainings was to educate agency staff on the benefits of using DTA as a tool to evaluate changes to the roadway system and introduce them to the tool we built for the Central Texas region," CTR researcher and Network Modeling Center Director Jennifer Duthie states.

During the workshops, attendees were trained in the basics of DTA and received hands-on experience in executing basic tasks within the new tool.

Key CTR researchers on the project included Dr. Natalia Ruiz Juri, Kenneth Perrine, and Dr. Mason Gemar (now with GM), with the help of research staff Heidi Ross and Itamar Gal.

"Educating agency staff about available tools will help the region as we plan for the rapid growth we're experiencing," Dr. Duthie states.

UT Civil Engineering Ranked #2 in U.S.

In the 2017 *U.S. News & World Report* rankings for graduate programs, CTR's academic unit, the Cockrell School of Engineering, maintained top-ten status. Several departments within the School rank among the elite of their kind—including the Department of Civil, Architectural & Environmental Engineering (CAEE).

UT's Civil Engineering graduate program moved from a 2016 position of #3 to a 2017 position of #2 (tied with the University of Illinois at Urbana-Champaign)—the highest this program has ever been ranked in *U.S. News and World Report*. The program's score was only 0.1 points from being tied with UC Berkeley for the #1 spot (4.6 vs. 4.7). We are also the best buy, with the lowest tuition of any top-ten program in civil engineering. CAEE is home to the Transportation Engineering graduate program from which CTR draws many of its graduate research assistants; this program features extraordinary levels of scholarship and accomplishment within the faculty and students.

The University of Texas has over 40 graduate programs rated in the top ten. Importantly, Civil Engineering is one of the five highest ranked programs on the UT campus by *U.S. News and World Report*. Notes CAEE Department Chair Rich Corsi, this ranking "reflects the tireless effort and support provided to our faculty and students by staff across our CAEE community, and the tremendous effort that our past faculty made in helping to build our community into what it is today."

Better Streets Week Comes to CTR

In today's fast-moving world, city transportation departments are concerned with how to make their streets safer, greener, more livable, more economically vibrant, and friendlier for all modes of city travel.

In October 2015, the City of Austin hosted the National Association of City Transportation Officials (NACTO) Designing Cities 2015 Conference to explore these issues. To bring the conference's topics into the public conversation, the Austin Transportation Department teamed up with various community groups to host Better Streets Week. Better Streets Week featured conference speakers, tours, and free events for the public.

As part of Better Streets Week, CTR, with additional support from the Texas A&M Transportation Institute (TTI), held a lunchtime presentation entitled "Fast-Paced Stories: What Transportation Data Tells us."

The event highlighted key findings that point to solutions for the mobility future and featured researchers from UT Austin, TTI, and Texas State University. Director of CTR's Network Modeling Center, Dr. Jen Duthie, and Texas State Representative Celia Israel, who serves on the House Transportation and Elections Committees and the Transportation Subcommittee on Long-Term Infrastructure and Planning, moderated the discussions.

Texas State Representative Celia Israel Addresses the Crowd at CTR

Each speaker gave a ten-minute presentation, including time for discussion and questions. Speakers included Greg Griffin and Joan Hudson from TTI, Todd Humphreys and James E. Pustejovsky from UT Austin, and Billy Fields from Texas State.

Over 100 people attended the event, where talks covered topics such as citizen planners, pedestrian, bicycle and traffic crash data, increasingly accurate mobile positioning, and engaging diverse communities.

In addition to hosting a Better Streets Week lunchtime presentation, CTR researchers also contributed to several official NACTO events, including moderating and speaking in various panel discussions.

RECOGNITION

CTR Welcomes Prof. Christian Claudel to Faculty

In January 2015, CTR welcomed a new faculty member, Prof. Christian Claudel, to its lineup of world-renowned researchers. Prof. Claudel, a member of UT Austin's Civil, Architectural and Environmental Engineering (CAEE) department, holds a PhD and MS degree in Electrical Engineering from UC Berkeley, as well as a MS in plasma physics from the École Normale Supérieure in Lyon, France. He comes to CTR from the King Abdullah University of Science and Technology in Saudi Arabia.

"I came to UT because of the mix of expertise available in the CAEE department and the multidisciplinary vision of the [CTR] group," Prof. Claudel states. "I particularly enjoy the opportunity to address fundamental societal problems by teaming up with people within and outside of the transportation department."

In 2010, Prof. Claudel received UC Berkeley's Leon Chua award for his work on the Mobile Millennium Traffic Monitoring System. His research focuses on solutions to traffic flow models, optimization-based traffic state estimation and control, the control and estimation of distributed parameter systems, wireless sensor networks and unmanned aerial vehicles.

"The most exciting element of transportation is the increasing availability of large quantities of data generated by users," Prof. Claudel states. "It will allow us to manage transportation systems more efficiently, though challenges remain on the integration and processing of this amount of data."

Prof. Claudel's expertise in wireless technologies and the use of unmanned aerial vehicles for real-time traffic flow sensing will add new dimensions to CTR's transportation engineering program.

Dr. Khali Persad Retires from CTR

After 14 years with CTR, former Research Engineer and Assistant Director Dr. Khali Persad retired at the end of the 2015-2016 academic year.

With over 30 years of construction, design management and research experience, Dr. Persad was known for being proactive in developing a range of projects and skilled in creating a balanced research program. He spent over 12 years as a special projects and research engineer at TxDOT before joining CTR as a researcher.

At CTR, Dr. Persad served as the research supervisor and primary researcher on diverse TxDOT projects. These projects included Intelligent Transportation Systems, tolling technologies, traffic operation issues, freight movement and infrastructure construction.

He received a BS in Civil Engineering and a MS in Construction Engineering and Management from the University of the West Indies in 1977 and 1983 respectively, and earned his PhD in Civil Engineering from UT Austin in 1989.

In addition to his research activities, Dr. Persad taught engineering courses as an adjunct professor, where many students benefited from his careful mentoring. CTR will miss Dr. Persad's sense of humor and grounded presence.

"Dr. Persad was not only a productive engineer in his own right, but was also instrumental in creating opportunities for CTR faculty members and students to contribute to the profession," CTR Director, Prof. Chandra Bhat states. "Indeed, he served the very important role of being the bridge among faculty members, researchers and students."

List of Faculty Awards

- Amit Bhasin received UT Austin President's Associates Teaching Excellence Award
- Bob Gilbert named to UT Academy of Distinguished Teachers
- Chandra Bhat granted honorary professorship at Hong Kong Polytechnic University
- Chandra Bhat recognized as top-cited civil engineering researcher in 2016 Academic Ranking of World Universities
- Chandra Bhat named to Eno Center for Transportation Top 10 Transportation Thought Leaders
- Chandra Bhat received Indian Institute of Technology Madras Distinguished Alumnus Award
- Chandra Bhat received American Society of Civil Engineers Frank M. Masters Transportation Engineering Award
- Chandra Bhat received Council of University Transportation Centers Lifetime Achievement in Transportation Education and Research Award
- Tricia Clayton selected for the American Institute of Steel Construction's (AISC's) Early Career Faculty Award
- Todd Helwig named AISC T. R. Higgins Lectureship Award winner
- Fernanda Leite selected to attend National Academy of Engineering's FOEE Symposium
- Fernanda Leite named 2015 Construction Industry Institute Outstanding Instructor
- Fernanda Leite received Fiatech's Superior Technical Achievement Recognition (STAR) Award at 2016 Technology Conference and Showcase
- Ken Stokoe elected to American Society of Civil Engineers (ASCE) Distinguished Members
- Mike Walton appointed to future interstate study committee
- Mike Walton named to American Road and Transportation Builder Association Foundation's Transportation Development Hall of Fame
- Oguzhan Bayak received TXDOT's Office of Research and Technology Implementation Recognition of Excellence Award
- Raissa Ferron named Top 20 under 40 of Construction Professionals in Texas and Louisiana
- Robert Heath moderated Brooklyn 5G Summit Panel
- Robert Heath received 2016 IEEE CommSoc Fred W. Ellersick Prize
- Robert Heath elected to IEEE Signal Processing Society Board of Governors
- Robert Heath and collaborators received $1million NSF Grant for mmWave research
- Robert Heath and Sriram Vishwanath named Thomson Reuters Highly-Cited Researchers
- Steven Boyles received UT Austin's Cockrell School of Engineering Dean's Award for Outstanding Engineering Teaching
- William O'Brien presented advanced work packaging at CMAA Symposium
- Zhanmin Zhang appointed Director of Center for Resilient Infrastructure and Smart Cities (CRISC)
- Zhanmin Zhang and graduate student received 9th International Conference on Managing Pavement Assets 2015 Best Paper Award

List of Researcher Awards

- Jen Duthie named to MetroLab Steering Committee
- Lisa Loftus-Otway named Woman of the Year 2015 by the WTS Heart of Texas Chapter
- Rob Harrison received 2015 Cockrell School Staff Excellence Award
- Jennifer Duthie and Mason Gemar, along with former student Zeina Wafa (M.S.E., 2014), won the 2016 TexITE Technical Paper Award for their paper, "Developing Design Guidelines for Right-Turn Slip Lanes"

Student Spotlights

UT Austin ITE Student Chapter Hosts Inaugural TexITE Student Leadership Summit

The UT Austin ITE Student Chapter—in collaboration with Texas A&M Texas State, UT San Antonio, and UT Arlington—co-founded the inaugural TexITE Student Leadership Summit. Fifty students and twenty professionals came together to network, collaborate, and compete in an event designed to prepare students in becoming the next generation of leadership.

The Summit kicked off the 2015 TexITE Fall District Meeting in San Antonio and featured three activities: First, in the Research Showcase, student representatives presented the latest research and technology initiatives from five of the top Texas universities. Second, in Speed Interviews, students strengthened communication skills and prepared for the job market in a series of small group mock interviews led by industry professionals. Finally, in the Transportation Hackathon, teams of students worked together to develop a concept solution to a modern transportation problem and pitched their ideas to a panel of industry judges. The top three innovative teams—including UT students Rachel Hure (first place team) and Patrick Jordan (third place team)—were awarded for their ideas regarding emergency response, logistics and distribution, and smart cities.

UT Austin was recognized as the Outstanding Student Chapter of 2015 for its critical role in the Summit's development. Alice Chu, Venktesh Pandey, and Kristie Chin served as the UT representatives on the organization committee. Key sponsors included Pape-Dawson, who hosted the event, Kimley Horn, CEC, Parsons Brinckerhoff, South Texas Section ITE, and Capital Area Section ITE. Building upon these partnerships, the student chapters look forward to working with TexITE in the future to put students on a path for professional involvement.

UT ITE Student Chapter Accepting Two Awards at the Recent TexITE Fall District Meeting in San Antonio.

List of Student Awards

- Alice Chu named D-STOP 2015's Outstanding Student of the Year
- Alice Chu presented at University Transportation Center Spotlight Conference in Washington, D.C.
- Kristie Chin received Southwest Region University Transportation Center (SWUTC) Dr. Robert Herman Award to the Most Outstanding Student
- Kristie Chin designated SWUTC Student of the Year
- Megan Hoklas awarded SWUTC Dr. Naomi Ledé Award to the Outstanding Master's Student
- Michael Levin received Council of University Transportation Center Milton Pikarsky MS Thesis Award
- CTR Alum Jeff LaMondia won Auburn College of Engineering's Excellence in Research Award for Junior Faculty

Alum José Holguín-Veras Inducted into Cockrell Academy of Distinguished Alumni

Nine alumni from the Department of Civil, Architectural and Environmental Engineering (CAEE) at UT Austin were inducted into the Academy of Distinguished Alumni on October 26, 2015. Among them was José Holguín-Veras, who received his Ph.D. in 1986.

The research of José Holguín-Veras emphasizes the integration of state-of-the-art economic princples into transportation modeling, so that a complete picture can be developed on the broader impacts of transportation activity on the economy and environment. At Rensselaer Polytechnic Institute, he is the William H. Hart Professor; Director of the Center for Infrastructure, Transportation, and the Environment; and Director of the Volvo Research and Educational Foundations Center of Excellence for Sustainable Urban Freight Systems. José has led more than 55 projects with the National Science Foundation, National Cooperative Freight Research Program, USDOT, and others funding more than $14 million.

José Holguîn-Veras with Gene Lawson, President of Academy of Distinguished Alumni

Dr. Holguín-Veras earned his PhD at UT Austin and was supervised by Dr. Michael Walton. And now, according to Google Scholar, he is the most widely published and cited freight researchers in the world. His research emphasizes the integration, synthesis, and projection of the knowledge that exists in multiple disciplines to produce solutions to the complex and multifaceted problems that impact freight transportation and humanitarian logistics.

Current research activities focus on three major areas: freight transportation demand modeling, sustainable freight systems, and disaster response logistics. His work on freight demand modeling has led to more realistic mathematical models and significant methodological improvement. His work on sustainable freight systems studies the interactions between agents involved in freight activity, to define ways to exploit these interactions to foster sustainable development and operations. The application of principles has resulted in more than 400 companies in Manhattan to switching operations to the off-hours, easing traffic congestion.

His work has received numerous awards, including the 2013 White House Champion of Change Award for his contributions to freight transportation and disaster response research. His research group has conducted detailed analyses of the most prominent disasters of recent times, including Hurricane Katrina, the Port-au-Prince earthquake, the tornadoes in Joplin and Alabama, Hurricane Irene, and the Tohoku disasters in Japan.

The CAEE department established the Academy of Distinguished Alumni to acknowledge the professional achievements and contributions of its graduates. Twenty-seven charter members were inducted into the academy in 2003, and 93 additional members have been selected since. The 2015 honorees are recognized for expertise in their fields, research and education advancements and strong leadership qualities.

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