Next time you’re on the New Jersey Turnpike, a highway in Virginia, or a bridge in Washington, DC, you might see RABIT™ gliding, not hopping, down the road. The American Society of Civil Engineers (ASCE) deemed this creation so revolutionary that they selected it for the 2014 Charles Pankow Award for Innovation.

CAIT and FHWA invented the RABIT™ bridge deck assessment tool, the first fully automated device that simultaneously gathers quantitative data using several nondestructive evaluation (NDE) technologies and melds it into a comprehensive diagnostic representation of concrete bridge deck condition. The benefits are many, but the ultimate value is its ability to help bridge owners make better-informed decisions regarding maintenance, repair, and rehabilitation of vital infrastructure.

Candidates for the Pankow Award must be collaborative efforts that incorporate innovative design, materials, or construction-related research and are market-ready or commercially viable. In addition, winners have to show they will have a positive impact on the construction industry by reducing costs, waste, delivery
A year we’ll remember

Each new year we reflect on the past 12 months to take stock of our accomplishments and what we have yet to achieve in service of the transportation community and promoting state of good repair.

Undoubtedly, being named one of five National University Transportation Centers by USDOT’s Research and Technology Innovation Administration was the brightest highlight of 2013. It’s a milestone we’ve been steadily gaining ground on for more than 15 years.

Another proud moment was the news from the American Society of Civil Engineers that the RABIT™ bridge deck assessment tool—a revolutionary invention we developed with FHWA—had won the Charles Pankow Award for Innovation.

Many of you have experienced firsthand the inconvenience caused by sudden lane closures for emergency bridge repairs like those needed in December on the George Washington Bridge. RABIT™ not only automates collection of quantitative condition data, it gives bridge owners a more complete, in-depth picture of a structure’s health, faster and safer than traditional methods. The prospect of putting this tool in the hands of DOTs across the country could be the greatest leap forward in bridge condition monitoring in the last 50 years.

Our UTC consortium partners’ contributions compound our success. The recently announced Automated Vehicle Institute (AVI) at the University of South Florida is an initiative that exemplifies CAIT’s tradition of strong agency-industry-academic partnerships as well as our ability to anticipate and pioneer solutions for transportation needs in the near future. (See story on page 9.)

Giving transportation professionals information they need to meet the industry’s challenges is as important as being on the leading edge of new technologies and policies. Throughout this issue you will read about workshops, forums, courses, and other events that demonstrate CAIT’s commitment to invest in people and give them the best, most up-to-date information and tools they need to do their jobs as effectively and safely as possible.

In finding objective, data-driven solutions for the nation’s transportation network, CAIT is able to have a positive impact on local municipalities too. For instance, Woodbridge Township engineers turned to the center’s pavement management experts to help them get a handle on caring for their community’s roads. (See story on page 6.) The system CAIT’s PMS team customized for the town is already reaping rewards by giving them quantitative data to support decisions about how to maintain their streets more efficiently and economically.

Last, and certainly not least, I want to thank the generous industry partners who sponsored our networking reception at the TRB 93rd annual meeting. This is the fourth year we’ve hosted this event—a lively exchange of ideas in a relaxed atmosphere amid the intensity of TRB. We are very grateful to AID, Benesch, IDS, Innophos, MALA, and Pennoni Associates for their continued support.

We do so appreciate all of our partners and customers, their good work, and the opportunities they entrust us with. From agencies and industry, federal to municipal, seasoned professionals to young up-and-comers—we salute and thank you for all you do to help us make the country’s transportation infrastructure safer, more reliable, and more resilient. We look forward to inventing and re-inventing tomorrow’s infrastructure together.

I wish you a safe, productive, and happy 2014.

M. M.
Ali Maher, Ph.D., Director

Cover photo: RABIT™, a totally automated data-collection system, emerges from the command center van to begin scanning the bridge deck.

Below: FHWA Administrator Victor Mendez (left foreground) said of RABIT™, “It’s about innovation and bringing solutions to the real world... It’s so important that we’re able to solve problems today, not five years from today. ... What you have done here is really, really amazing.”

<< p1 RABIT™ is off and running times, worker injuries, and/or pollution and that they will increase safety and durability. RABIT™ meets all those criteria in spades.

In 2011, FHWA Administrator Victor Mendez challenged FHWA’s Long-Term Bridge Performance (LTBP) Program and CAIT to develop a system that would enhance and streamline condition assessment of the nation’s bridge inventory. (See Transportation Today Issue 11, January 2013 at cait.rutgers.edu/cait/publications.)

The team set to work, conceptualizing a way to deploy multiple NDE tools that have proven effective for detecting and characterizing the biggest culprits in bridge deck degradation: corrosion, delamination, and concrete quality. They wanted their invention to operate autonomously so it could systematically collect data faster than manual NDE methods, but without compromising data integrity or resolution. The end product had to
link the data points with their exact location, merge the data from all the different NDE tools, and deliver a comprehensive picture of deck condition—inside and out—in real time. Safety, efficiency, and ease of operation had to be part of the package as well.

It was a tall order, but about a year after Mendez’s challenge, in November 2012 RABIT™ made its public debut and functioned exactly as it should. Mendez and the other FHWA dignitaries there to witness its unveiling were duly impressed. Said Mendez, “This is what we’ve been talking about at USDOT and FHWA—it’s about innovation and bringing solutions to the real world. … It’s so important that we’re able to solve problems today, not five years from today. … What you have done here is really, really amazing.”

Since that demo on a bridge that carries Route 15 over Route 66 near Haymarket, Virginia, the team has been refining RABIT™ and putting it through its paces.

Dr. Nenad Gucunski, who heads up the Rutgers’ CAIT team, says they’ve had transportation agencies from around the country asking to use RABIT™ to test their structures. It has done scans on bridges in New Castle and Dover, Delaware; Middletown and Mount Joy, Pennsylvania; Leesburg, Virginia; and on the New Jersey Turnpike and other highways in the state.

FHWA estimates that to catch up on the nation’s deficient bridge backlog by 2028, we would need to invest $20.5 billion annually. It’s unlikely federal, state, and local governments can increase bridge investments by $8 billion a year—$76 billion total—to improve and keep all 600,000-plus bridges across the United States in good repair. So bridge owners and managers have to be especially vigilant about monitoring bridge condition and judicious with maintenance and rehabilitation budgets.

Traditionally, they have relied largely on the finely honed senses of experienced inspectors who use manual methods, such as chain drag and hammer sounding, to supplement eagle-eye visual inspections. But in the past several years, the growing use of NDE—technologies that help us actually see inside the structure—has provided bridge owners and managers with quantitative data that lets them “dig deeper” into bridge deck issues without actually digging up the roadway. NDE not only can catch potential problems earlier, it can make assessments more quickly, which in turn lessens traffic disruptions due to lane closures and improves safety by reducing the time both drivers and workers are exposed to the risks inherent in any work zone.

RABIT™ measures electrical resistivity, which senses the corrosive potential within
p3 RABIT™ is off and running

the concrete that could indicate rusting and expansion of rebar reinforcement that leads to internal cracking. It deploys ultrasonic surface waves to evaluate concrete quality and impact echo to detect and characterize delamination. It uses two high-definition cameras to capture images of the deck surface and 360-degree views of bridge features.

According to development team leader Gucunski, “In the past, we didn’t have a way to compile information on delamination, degradation, corrosion, precise location, visual, or load stress data all at once. Not only does RABIT™ help us validate data collected from individual machines, but it forms a meaningful picture of what’s happening inside the bridge deck in real time to help us arrest deterioration.”

The area to be scanned is preprogrammed with a highly accurate GPS unit, eliminating the

Snapshot of RABIT™ features and advantages

- **Provides comprehensive condition assessment on concrete bridge decks.** RABIT™ simultaneously gathers several types of geospatially tagged quantitative data via multiple NDE technologies and high-resolution imaging systems to locate and diagnose delamination, corrosion, concrete degradation, and visual condition.

- **Simplifies operation, data presentation, and analysis.** RABIT™ is easy to setup, runs autonomously, and soon will automate the majority of data analysis. Data integration and visualization modules enhance interpretation and provide an intuitive, comprehensive picture of all critical deterioration features.

- **Improves speed of data collection and analysis.** RABIT™ can gather data four times faster than it would take individual NDE probes/systems to cover the same area. The same van that transports the RABIT™ to testing sites doubles as a mobile command lab, adding speed and efficiency. The robot transmits information wirelessly, in real time, to computers in the van where it is compiled and shown on monitors for engineer-inspectors to see and analyze crack maps, surface images, and clear, accurate visual renderings of NDE condition data.

- **Reduces costs significantly.** RABIT™ saves time and money by increasing productivity, shortening time required to do a thorough inspection, reducing number of field inspectors/technicians required on site, and lessening traffic disruptions that can negatively affect businesses and commerce. Financial analyses show that a RABIT™ will pay for itself after inspecting less than 100 bridge decks of approximately 10,000 square feet.

- **Improves safety for inspectors and drivers.** By increasing data collection speed and decreasing the number of technicians needed on the bridge, RABIT™ lessens the risks that are inherent in any roadway work zone for both transportation workers and drivers.

- **Minimizes negative environmental impacts.** Because it reduces the number and duration of lane closures, RABIT™ alleviates work zone congestion and resulting traffic emissions. The robot also is powered by rechargeable batteries, so it runs clean.

**Global Positioning System** records and tags all data gathered with exact position coordinates and orients/guides the robot.

**High-Definition Imaging** captures detailed images of the deck surface and 360-degree views of bridge features.

**Ultrasonic Surface Waves** assess the quality and modulus of elasticity, indicators of the strength of the concrete deck.

**Impact Echo** detects and characterizes delamination (horizontal cracking) with respect to depth, spread, and severity.

**Electrical Resistivity** diagnoses the corrosive environment within concrete decks by detecting level of moisture.

**Ground Penetrating Radar** is used to detect suspected flaws or characterize apparent deterioration.
previously necessary and tedious step of manually marking a test grid. It can be controlled remotely by smartphone or iPad, so the operator doesn’t have to be in traffic. In addition, its internal laser scanning system prevents collision with barriers, vehicles, and people.

“With our platform, we’re able to tell bridge managers exactly where they need to apply repairs so they can do so more quickly and efficiently. In addition to reducing the cost of assessing deck condition and the time it takes to do it, this reduces lane closures, doesn’t hinder businesses or frustrate drivers, and helps keep everyone safer,” Gucunski said.

RABIT™ could bring about the most radical change in bridge deck condition assessment that the industry has seen in the last 50 years. CAIT and its partners are confident that qualifies it as a great leap forward.

RABIT™ was the product of a team effort exemplifying public-private partnerships and cross-disciplinary collaboration.

FHWA, CAIT, and Rutgers School of Engineering departments of civil and environmental engineering (CEE), electrical and computer engineering (ECE), industrial and systems engineering (ISE), and mechanical and aerospace engineering (MAE) participated in its development.

Core team members from Rutgers included Dr. Ali Maher (CAIT director/CEE), Dr. Nenad Gucunski (CAIT/CEE), Dr. Basily B. Basily (ISE), and CAIT research associates Dr. Hung La, Ronny Lim, and Hooman Parvardeh. Also contributing to the effort were Dr. Kristin Dana (ECE), Dr. Seong-Hoon Kee (CAIT), Dr. Jingang Yi (MAE), and former graduate students Parneet Kaur and Prateek Prasanna.

Contributors from FHWA’s Turner-Fairbank Highway Research Center were Dr. Hamid Ghasemi, Michael F. Trentacoste, Jorge E. Pagan-Ortiz, and Dr. Firas I. Sheikh-Ibrahim.

Industry collaborators included Dr. Mark Baker from Geomedia Research and Development and Giorgio Barsacchi from Ingegneria Dei Sistemi (IDS).

More on the web:
ASCE Pankow Award: content.asce.org/handa/PankowAward.html
LTBP Program: www.fhwa.dot.gov/research/tfhrc/projects/projectsite

Left: The RABIT™ development team at the demo for FHWA Administrator Victor Mendez in November 2012: (left to right) Ronny Lim, Jingang Yi, Ken Lee, Hamid Ghasemi (FHWA), Hung La, Basily Basily, Firas Ibrahim (FHWA), Ali Maher, Nenad Gucunski, Hooman Parvardeh, Prateek Prasanna. Photo: ©2012 Drew Noel Photography/Rutgers CAIT

Right: In the past, six or more highly trained technicians were needed to do scans with all the different NDE tools the RABIT™ deploys. Now, four times faster, the robot gathers the same amount of data. Photo: Nenad Gucunski/Rutgers CAIT
Both politicians and transportation officials face tough choices when it comes to allocating shrinking resources and juggling competing demands. This is particularly true when it comes to keeping infrastructure in good repair.

Poor road conditions increase vehicle owner costs $325 to $700 annually, damaging shocks and suspension systems, throwing wheels out of alignment, ruining tires, and contributing to general vehicle wear and tear. The national average is $333 per motorist—adding up to as much as $67 billion per year. In addition to the toll they take on vehicles, poor road conditions are a contributing factor in as much as 30 percent of crashes yearly according to some studies.

So when roads start to deteriorate, what is the optimal time to fix them? How do we track the condition of each street? When is the best time to invest in maintenance? Are there alternatives? What is the cost-benefit for each alternative? At what point do you get the most “bang for your buck” in road maintenance or rehabilitation? These are complex questions even for pavement experts, much less public works managers and elected officials who have to answer to their constituents.

A pavement management system (PMS) is the solution. A PMS is a set of defined procedures and tools for collecting, analyzing, maintaining, and reporting pavement condition data, and using that data to help find optimum strategies to keep roads in serviceable condition over a defined period of time for the lowest possible cost.

CAIT’s New Jersey Local Technical Assistance Program (NJ LTAP) sent a questionnaire to counties and municipalities all over the country to gauge interest in pavement management and offer CAIT’s in-house pavement expertise.
Woodbridge Township, the sixth largest municipality in New Jersey, responded that they wanted to learn more about what a PMS could do. This suburban community of almost 100,000 people is home to one of the state’s largest shopping malls and the region’s busiest rail station, Metropark, a hub for Amtrak and NJ Transit, so its roads see a lot of traffic.

A CAIT PMS team—senior research engineer Dr. Nicholas Vitillo, research engineer Carl Rascoe, P.E., and research assistant Michael Boxer—met with the Woodbridge municipal engineer Scott Lee Thompson a few times over a period of weeks to hammer out what would meet the township’s needs, what kind of training would be required, and how they would determine what shape the town’s roads were in to start with.

One of the first tasks was to get an accurate read on the condition of Woodbridge’s roadways. Rascoe and Boxer inventoried more than 500 lane miles, collecting and recording detailed data on the network.

When that was complete, data were loaded into Cartegraph PMS software, which makes it possible to numerically rank roads in categories. Once the data is there, users can input various alternatives—treatments, investment timing, costs, etc.—to predict the outcomes of any number of options.

The PMS gave public officials quantitative information about how the roads in their wards were faring and how different maintenance choices would impact budgets years down the line—and gave them data to back up their decisions if queried by citizens.

Every resident in any town tends to think their street is the worst, noted Woodbridge municipal engineer Thompson. “But with a pavement management system, subjective impressions are turned into objective data,” he said.

“There’s a ‘sweet spot’ where you can catch a road right on the cusp of needing major work and extend its life for five or eight years, and then invest in it again at the five- to six-year mark and get another five years out of it, and so on,” says Rascoe.

And what happens if you don’t do maintenance near the sweet spot? The same thing that might happen if you delay maintenance on your home or car: What may be a relatively inexpensive repair now can cost four to six times more later.

“Keeping roads in a state of good repair means not letting them deteriorate to the point they need reconstruction or even major rehabilitation to bring them back to an acceptable service level,” says Vitillo. “It’s not just about a smooth ride or an infusion of tax dollars. Rough roads can be dangerous, drivers have to spend more on vehicle maintenance, and even fuel consumption can be affected.”

Moreover, added Thompson, the system is allowing Woodbridge’s 2014 road program to be put into place ahead of schedule because the new process facilitated much more efficient use of staff time.

“It gives us an excellent tool for maximizing conditions of our roads while minimizing costs to the taxpayer,” said Thompson. “You can’t move a mountain if you don’t have a shovel. Our new pavement management system is that shovel. We made huge strides over the last several years in improving our road network, but we were really using a brute force approach. Now I believe we have the tool that will make a real difference.”

“In the end, these systems are only a tool, people still have to make the decisions,” added Vitillo. “A PMS just helps them make the best decision.”

CAIT spreads the word on pavement management at League of Municipalities

Senior research engineer Dr. Nicholas Vitillo and research engineer Carl Rascoe preached the benefits of a pavement management system (PMS) to mayors, local and county engineers, and public works professionals during a special event at the 96th Annual New Jersey League of Municipalities held in November 2013.

A PMS database and software provides managers with quantitative information on local road condition and how different maintenance decisions will impact budgets now and years from now.

“We’ve been making ‘house calls’ to individual towns that have expressed interest in a PMS. Events like the League of Municipalities give us the opportunity to spread the word about a very beneficial tool to a large number of people at once. Some know very little about PMSs, and some know a lot but don’t know where to turn for help,” Vitillo said. “The important thing for them to understand is that a PMS is a tool; it’s based on hard data and can suggest alternatives, but the tool can only do so much without their experience and judgment.”

Vitillo and Rascoe recounted how they helped public officials in two large New Jersey townships—Woodbridge and Howell—develop and maintain a PMS to plan roadway repair investments. Addressing minor repair issues can extend a road’s service life up to eight years; Vitillo and Rascoe’s PMS helps road managers identify those areas and weigh the pros and cons of various treatment options, investments, and timing.

The worse condition a road is in, the more extensive—and expensive—the work needed to bring it up to a serviceable condition. As the graph above shows, the cost per square yard for various treatments rises sharply as the condition of the pavement declines.

“Investing a fraction of money in minor repairs is much more cost-effective than waiting until they become major issues,” Rascoe said. “Major issues lead to road closures, longer construction times, and cost taxpayers much more.”
Research for recovery

NJDOT research showcase coincides with Sandy anniversary

October 23, 2013—just six days shy of the one-year anniversary of Superstorm Sandy—the Annual NJDOT Research Showcase celebrated research projects that have yielded significant recovery solutions for municipalities, counties, and states affected by the storm. CAIT’s New Jersey Local Technical Assistance Program (NJ LTAP) hosts the event each year on behalf of the NJDOT Bureau of Research.

“We rarely have a specific title or theme at the research showcase,” said Janet Leli, director of NJ LTAP. “In light of recent natural disasters and the amazing research efforts that have contributed to restoring devastated areas we decided an appropriate title for this year’s showcase was ‘Infrastructure and Resilience: Infrastructure Recovery.’”

Nearly 250 researchers, engineering consultants, and NJDOT staff attended the full-day conference. David Kuhn, assistant commissioner of NJDOT, delivered opening remarks and reflected on past research success. He presented Camille Crichton-Sumners, manager of the NJDOT Research Bureau, and three NJDOT-funded researchers with an AASHTO Sweet Sixteen High-Value Research Project Award.

Lawrence Cullari Jr., assistant division administrator of the FHWA–New Jersey Division, looked forward to new collaborations, such as those he anticipates will come from CAIT’s recognition by USDOT.

“Rutgers’ Center for Advanced Infrastructure and Transportation was recently named a USDOT National University Transportation Center,” Cullari said. “This puts the center in a unique position to form strategic national partnerships that will address critical issues like bridge scour, condition monitoring and health, and safety.”

Jerry DiMaggio, P.E., Second Strategic Highway Research Program (SHRP2) coordinator with the Transportation Research Board (TRB), and Amy Lucero, FHWA technical services director, shared the keynote address, speaking not only about research initiatives and best practices, but also about the practical application of those findings.

“We offer incentives to transportation organizations that adopt research applications first,” Lucero said. “We expect that research products will be refined, and we reward those who may take on certain costs and risks in order to sustain progress.”

“We look to get research products into widespread commercial and practical use ... the measure of our success is getting to that point,” Lucero continued. “From the first round of SHRP2 funding, 108 projects are now underway [and will] be implemented in 34 states, with 18 more states to participate in research application in the next round of funding. ... New Jersey is a leader in implementation.”

The panel discussion on the conference theme featured three post-Sandy recovery research projects. Dr. James Bryant, a maintenance and preservation engineer with the TRB technical division, CAIT faculty researcher Dr. Jie Gong, and Dr. Lazar Spasovic, a civil engineering professor at New Jersey Institute of Technology—which is a member of the CAIT National UTC consortium—spoke about truly innovative tools and projects that improve infrastructure resilience.

“When we talk about resiliency, we’re talking about our ability to respond to multi-hazard threats with minimal impact to society and commercial activity,” Bryant said. “Those response efforts include getting transportation infrastructure back in operation [and serving] the best interests of business and the public.”

Gong discussed his New Jersey Alliance for Action Award-winning project that employed mobile light-detecting and ranging (LiDAR)—a sensing technology that uses millions of points of light to capture three-dimensional data points of physical objects-surfaces in seconds. Using mobile LiDAR units mounted on a van, Gong was able to archive structural and topographic damage in communities severely affected by Sandy. Emergency management officials can use these data to gain a deeper understanding of Sandy’s impacts and to create more effective disaster response plans.

“New technology advancements in LiDAR can penetrate structures so we can see through walls, dust, and smoke for high-quality modeling output,” Gong said. “It’s very promising.”

Traffic cameras help officials respond to crashes and breakdowns, identify alternate routes, and relieve congestion in the event of a traffic incident, severe weather, or other service outages. Spasovic outlined a NJDOT-funded video analytics project that can simultaneously monitor feeds from traffic cameras all over the state to zero in on a disruption. This can improve incident reporting/response times and help both engineers and emergency management officials craft traffic plans.

Afternoon breakout sessions featured expert speakers in four research areas: infrastructure, mobility, environment, and safety. Topics in disaster recovery included assessment of pavement lifespans, work zone safety analyses, climate adaptation, and evaluation of urban infrastructure resiliency.

The Bureau of Research also honored exceptional contributors at the event. NJDOT project engineer Paul Thomas presented the Outstanding Student in Transportation Award, the Research Implementation Award, and three Best Poster mentions to proud recipients from Rutgers and other universities.
AVI is the first research institute in the country that will focus on planning and policymaking behind automated vehicles as opposed to the technology itself.

Automated vehicles are equipped with a suite of emerging technologies that can preset navigation as well as establish and streamline communications between vehicles and the roads they drive on. Computerized parking assistance, intuitive signaling, and automated taxi services can ease congestion, while technologies that assist driving—like adaptive cruise control and braking—can reduce crashes.

Florida is only the third state to allow automated vehicle testing on its roadways. Led by CUTR director Jason Bittner, in partnership with the Florida Department of Transportation and the Tampa-Hillsborough Expressway Authority, the AVI will examine obstacles to implementing automated vehicle technologies in the state’s urban areas and all the policy and planning intricacies this may entail.

“Our goal is not [the perfection of] the technology, but the implementation of those technologies from the policy and planning side,” Bittner said. “What are the opportunities? What are the key barriers? What are the legal implications? What are the policy implications? Do we program [these vehicles to drive at] the same speed as everybody else in traffic? What are the land-use implications? All of these are going to be big questions soon.”

The state is looking to reduce costs from traffic congestion, Bittner said, so understanding these issues can make automated vehicles a safe and viable mobility solution. The institute also will investigate public perception of automated vehicles and their impact on driving culture and safety.

“Automated vehicle technology has been emerging at a rapid pace over the last several years,” Bittner said. “It becomes a pretty high-value proposition when you look at the data. Thirty-two thousand people are killed on the roads every year, and 95 percent of those are caused by driver error. If we could just cut that in half, that’s a lot of lives. If we can get to 95 percent and save that many lives each year, it’s pretty hard to make an argument against it.”

More on the web: usfav.com
Workshop on the bright future of LiDAR

CAIT is engaged with countless partners who are advancing the use of quantitative data to improve infrastructure. Last November, our colleagues at CCICADA (Command, Control, and Interoperability Center for Advanced Data Analysis) hosted a half-day workshop on the future of LiDAR.

LiDAR (light detection and ranging) is a 3-D geospatial mapping technology. It has been deployed from aircrafts for many years and can be used for ground-based surveying as well, but developments in mobile LiDAR mounted on a van or truck are improving the speed and resolution of data gathered.

Workshop organizers included Dr. Mitchell Erickson, Department of Homeland Security (DHS); Dr. Jie Gong, Rutgers’ CAIT researcher and civil engineering faculty; Dr. Fred Roberts, director of CCICADA; and Hank Mayer and Jennifer Rovito, both from Rutgers Bloustein School of Planning and Public Policy.

The day started with a general overview of LiDAR technology given by Dr. Richard Lathrop, director of Rutgers’ Grant F. Walton Center for Remote Sensing and Spatial Analysis.

Gong—who won widespread recognition for his use of LiDAR to survey and collect data in the New York and New Jersey communities hardest hit by Superstorm Sandy—discussed the uses of the technology for disaster management, such as resilience visualization, debris quantification, and vulnerability and post-disaster assessment. Gong was honored with a Distinguished Engineering Award from the New Jersey Alliance for Action for his post-Sandy work. (See Transportation Today Issue 12, May 2013.)

Alan Leidner from DHS gave New York City’s perspective on opportunities for resilience improvement post-Sandy, and Andy Rowan, director of the New Jersey Office of Geographic Information Systems, gave the Garden State’s view.

Next up were Roger Barlow, the U.S. Geological Survey LiDAR liaison for New Jersey, and Ted Woodward from Applied Communication Sciences who gave research status updates and reported on what technological advancements may be available in 2018.

The day ended with breakout sessions on LiDAR sensing capabilities and LiDAR data analytics. More on the web: ccicada.rutgers.edu

New Jersey at a crossroads for safety

As a Federal Highway Administration (FHWA) pedestrian and intersection focus state, addressing safety in New Jersey’s conjoined roadways is a top priority for transportation agencies. The most successful safety solutions result from combining education, enforcement, and—of course—engineering.

On November 7, 2013, nearly 100 local, county, and state transportation and structural engineers attended “Designing Intersections: An Engineering Symposium,” which explored engineering approaches to improve intersection safety. The event was hosted by New Jersey Local Technical Assistance Program with support from FHWA’s Accelerating Safety Activities Program.

Dr. John McFadden, technical director of the FHWA Office of Safety Research and Development, gave the keynote address on intersection treatment options and the value of the focus state designation.

“New Jersey is both an intersection and pedestrian FHWA focus state,” McFadden explained. “So, it’s critical for us to understand what treatments are effective or not effective. When we work on road projects, we’ve entered into a public partnership with every driver that travels on our roads … it is our responsibility to know which roads operate at an acceptable level of risk.”

Pavement and roadway geometry affect how drivers navigate intersections. Mike Plath of Traffic Calming USA, discussed a pavement surfacing that can increase friction to reduce skidding, and Dewberry engineer Matt Witkowski spoke on slimming lane widths and eliminating roadside distractions.

Roundabouts have only been in use for about 20 years as intersections that encourage constant traffic flow. VHB engineer Robert Dennison III, P.E., explored their history and how they mitigate intersection crashes and congestion.

The afternoon sessions focused on proven safety applications from public agencies. Larry Bucci, a Pennsylvania Department of Transportation safety and mobility engineer, shared innovative intersection treatments in his state. Michael Becker, transportation planner with the Delaware Valley Regional Planning Commission, discussed highway access ramps—another type of intersection—in Pennsylvania’s Delaware Valley region.

Leah Picone, a transportation safety specialist with 3M, and Jim Pinelli, a representative with Signal Control Products, explored intersection signage and its role in driver behavior, and presented newer, more visible materials, like retroreflective backplates and marking materials.

Choosing the most effective intersection treatments is the first step to improving safety issues; finding funds to install those countermeasures is the second. FHWA–NJ safety engineer Caroline Trueman closed the event with a presentation on funding options and the future of New Jersey’s intersection safety programs.

“Under the new transportation law, performance metrics help us to justify the implementation of countermeasures,” Trueman said. “As engineers, we can look forward to more data-driven, systemic improvements to our intersections that will have lasting effects on safety.”
Extended construction periods carry indirect price tags too: driver frustration, increased risk of accidents in work zones, impacts to businesses and residents in surrounding communities, and the myriad other detriments of reduced mobility.

Utilities have to be moved before construction proceeds, but that’s not as simple as it may seem. Why? The reasons are many and often intertwined. Sometimes it’s a utility owner’s shortage of resources, such as available labor, or the low priority they assign relocations when weighing them against other business demands and interests. In other cases, it’s a matter of timing or how projects are phased: mismatched sequencing of construction tasks and/or a plan-and-design timeframe that’s too short versus the time it takes to relocate utilities. Another source of delay is inaccurate location and marking of existing underground utilities. Difficulty obtaining right-of-way (ROW) can slow progress, or inadequate coordination among multiple utilities sharing poles or duct banks … The list goes on and on.

In an effort to alleviate construction delays related to moving pipelines, buried cables, transmission poles, and other infrastructure, New Jersey and a few other states reimburse utility companies for the costs associated with relocation. Unfortunately, this policy hasn’t always worked as intended. For example, a year-and-a-half delay in the Tonnelle Avenue widening project in North Bergen and the Route 3 widening near MetLife Stadium in Rutherford, New Jersey, prompted New Jersey state senator Nicholas J. Sacco to seek a legislative remedy that would hold public utilities liable if they fail to meet the agreed-upon schedule to move their equipment.

A CAIT team is helping the New Jersey Department of Transportation (NJDOT) sort out the hiccups, conflicts, and grinding halts in this complicated process. Instead of legislative action, they are going to “enact” the use of quantitative data, effective incentives, technologies, and tools.

Over the past 20 years, more than a dozen possible incentives have been considered and/or tested. Financial incentives in the form of reimbursements and cash...
bonuses, or low-cost/no-cost inducements such as ROW acquisition, lump-sum agreements, multilevel memorandums of understanding, and utility coordination during construction, are some of the strategies that have been tried with varying degrees of success.

More quantitative data and analysis are needed to figure out the best approach, and that’s where CAIT’s expertise comes in.

“This study will examine all past approaches that have been tried to resolve these conflicts on the construction site,” said Dr. Jie Gong, the principal investigator on the project. “We’ll determine the best possible mix of incentives to persuade all the players in this process, especially utility owners, to finish road and bridge projects as quickly as possible. Or maybe we’ll even uncover a new solution.”

“In a state still rebuilding its infrastructure after Superstorm Sandy, completing construction as expeditiously as possible would be a benefit to everyone,” noted Gong, who is a CAIT-backed researcher and assistant professor of civil engineering. “This includes the unimpeded progress of other large-scale non-transportation development,” he added.

Gong and co-PI Dr. Trefor Williams, CAIT’s construction management expert and a Rutgers civil engineering professor, will work on quantifying costs and impacts of utility relocation delays for NJDOT and the New Jersey Turnpike Authority (NJTA). CAIT research project manager Brian Tobin and graduate student Yi Yu will support the effort.

In the first of several project phases, the team will review past projects to estimate the negative impacts of utility-related delays. They will then examine how incentives have been used and where they have successfully sped delivery of critical construction projects, and identify incentives/disincentives for NJDOT and NJTA to consider. The researchers also will look at what practices other states in the Northeast employ to see what has and hasn’t worked, and will interview highway construction contractors, design consultants, and utility owners in New Jersey to get their take on the problem.

Armed with this knowledge, CAIT will develop a suite of technologies and products to improve the process.

One of those will be a web-based geographic information system (GIS) tool for analysis of utility conflicts and relocation costs. This is in direct support of NJDOT’s commitment to coordinate, cooperate, and communicate with utility owners over the lifespan of the project—starting in the earliest planning stages and continuing regularly throughout construction.

The GIS program will provide visualization of utility location records and relocation sequences, and also allow all the players to visualize progress, track the status of ROW acquisition, and send reminders according to established milestone dates.

“We’re also going to look into whether the use of technologies—for example GIS, along with subsurface utility engineering (SUE), computer aided design (CAD), and LiDAR—can bring utility owners, construction contractors, and transportation agencies together to make the relocation process more objective, reliable, highly visible, and transparent, and subsequently reduce discord during the project,” said Gong.

Another product the team will develop for NJDOT is a cost database.

“We’re developing a database in which NJDOT can record projects and then use the data to better anticipate costs on future transportation improvement projects,” said Williams. “We’ll use data-mining techniques from artificial intelligence research to analyze the data, and produce predictions identifying a project’s likelihood of having utility relocation problems. Data mining applied to the historical data gives you 20/20 foresight instead of hindsight.”

“The right combination of data, products, and policies ought to improve timely utility relocation and save everyone a lot of money and headaches,” Williams added.

The study’s results will be disseminated in a half-day workshop at Rutgers and through training programs, and will be made available to the highway construction industry in conference presentations, journals, and other publications. NJDOT will release technical reports and make the results available through its Right-of-Way Management Bureau.

Left: Major road construction, like this project in Florida, often suffers from schedule conflicts and cost overruns. A CAIT team is helping mitigate construction delays by examining how quantitative data, effective incentives, technologies, and tools can be applied to smooth the process and ensure accountability. Photo: iStock
Safety from the bottom up
9th Annual New Jersey Safety Forum

On October 16, 2013, the Transportation Safety Resource Center (TSRC) hosted 200 transportation professionals from NJDOT, FHWA, local law enforcement, engineering offices, education systems, and planning organizations at the 9th Annual New Jersey Safety Forum. The forum theme, “Grassroots Efforts for Statewide Safety” focused on local and regional programs that can improve safety throughout New Jersey.

NJDOT assistant commissioner David Kuhn kicked off the event with an overview of MAP-21 and its new strategic, performance-based guidelines that encourage organizational partnerships. Members from AASHTO and DVRPC also discussed the national “Towards Zero Deaths” initiative during the opening remarks.

FHWA safety engineer Caroline Trueman, SJTPO traffic engineer Jennifer Marandino, P.E., and TSRC engineering researcher Mitra Neshatfar outlined several references and tools that can help satisfy MAP-21 performance metrics, like the Highway Safety Manual (HSM) and New Jersey crash analysis software, Plan4Safety.

In the two-hour feature panel, eight traffic safety experts explored effective engineering, enforcement, and education programs that achieve federal goals and make a difference right here at home.

Engineers from NJDOT, TSRC, Rutgers, and private consulting firms discussed state safety impact teams, CAIT’s road safety audit (RSA) program, acoustic ranging cell phone applications that inhibit distracted driving, and systemic intersection programs that involve teams of traffic safety experts from multiple agencies.

Safe Kids Middlesex County coordinator Diana Starace outlined “cradle to grave” educational programs that have a gradual, but positive, influence on road use behavior.

Pam Fischer, leader of the New Jersey Teen Driving Coalition, covered effective ways to create, maintain, and manage a unified safety task force.

Elizabeth Thompson, NJTPA transportation safety planner, unveiled a new pilot pedestrian safety advertising campaign in the state’s high-risk pedestrian crash areas.

Veterans of law enforcement, Burlington County Sheriff Jean Stanfield and Officer Joseph Abrusci from the Mount Olive Police Department, discussed pedestrian improvements on one of New Jersey’s most heavily traveled state roads and new approaches to curbing drunk/drugged driving.

Public consequences to crashes were also presented. Maeve Lopreiato, MPH, RN, of the New Jersey Medical School at Rutgers, discussed the public health consequences of crashes. Between hospitalizations, follow-up medical costs, loss of work, and psychological considerations, crashes cost the American people about $67 billion per year, Lopreiato said.

Gabriel Hurley, a 28 year-old New Jersey musician, talked about the emotional and physical costs of crashes. In a passionate address, Hurley reviewed the night a car crash shattered most of the bones in his face and completely blinded him.

A culture of safety doesn’t have to come from negative consequences, said keynote speaker Dr. Jay Otto of the Montana State University Center for Health and Safety Culture. Through a series of paid advertisements, Otto demonstrated that positive messages—like “Embrace Life: Wear Your Seatbelt”—are more effective than negative or graphic ones.

The Traffic Safety Excellence Awards Ceremony honored engineering, emergency response, and education programs that have continually demonstrated positive effects on safety. The New Jersey Division of Fire Safety, MONOC Mobile Health Services, the Hamilton School District Driver Education Program, and Jack M. Nata, manager of traffic signals and signs for the City of Newark, all received Traffic Safety Excellence Awards.

TSRC develops the Annual New Jersey Safety Forum with support from the New Jersey Department of Transportation and the Federal Highway Administration. Private sponsors Urban Engineers and AAA Clubs of New Jersey also contributed to the event.

TSRC gratefully acknowledges its sponsors of the 9th Annual Safety Forum:
Intelligent transportation just got even smarter

**UTC Student of the Year Patricia DiJoseph**

What better inspiration to pursue a career in intelligent transportation systems (ITS) than growing up in one of the most congested parts of New Jersey?

CAIT’s 2013 UTC Student of the Year, Dr. Patricia K. DiJoseph, grew up in the thick of it: in Woodbridge, in central New Jersey. As a child, DiJoseph was fascinated with the looping ramps and highways stretching between her hometown and around Newark Liberty International Airport. But it wasn’t until she got to Rutgers that she realized she could combine her long-standing passion for math with her interest in roads into a career in transportation.

Since a state like New Jersey can’t build its way out of traffic congestion, new approaches in ITS are key to reducing driver frustration and making traffic flow more efficiently. As a doctoral student at the New Jersey Institute of Technology (NJIT), one of CAIT’s national UTC consortium partners, DiJoseph pioneered mathematical research to optimize the number of path-based roadway sensors, which collect real-time travel data from passing vehicles. The sensors are already in place on some New Jersey roads.

These sensors predict travel times during traffic congestion, particularly during nonrecurring incidents such as crashes, disabled vehicles, or other random tie-ups. Accuracy derived from the sensors’ data is dependent on many factors, including the duration and location of an incident, the time of day it occurs, the severity of the incident, and the sensor spacing along the roadway.

For her doctoral dissertation, DiJoseph posed the question, “Does the accuracy of the travel time prediction increase with the number of sensors you put in place?” If so, it would be another way to let motorists know there’s a traffic disruption and plan accordingly.

As with many things, the answer is, “it depends,” she said, based on the type of incident. For example, accidents are often cleared quickly and are reported by radio stations and traffic alerts, giving travelers time to plan or switch to alternate routes. Having additional sensors in place has a marginal effect on travel time predictions for those types of delays. But for other types, such as holiday volume, having additional sensors does improve travel-time prediction accuracy.

“With this research, I hope to minimize the costs of congestion—such as lost productivity, gasoline consumption, and driver frustration—while taking into account the cost-benefit analysis to implement ITS,” she said.

State policymakers can then decide on an optimal number of sensors to use within their constraints.

In the application for the UTC Student of the Year award, NJIT professor Dr. Steven Chien, DiJoseph’s doctoral adviser, praised not only her academic prowess (she had a 4.0 GPA) but also her leadership in several student organizations, including serving as president of multiple transportation societies. Besides organizing a speaker series on industry topics, she also coordinated career advancement events. In recognition of her achievements, she received the 2013 Doctoral Excellence Award from the Department of Civil and Environmental Engineering at NJIT and the 2011 Dr. Louis J. Pignataro Transportation Engineering Education Award from the Institute of Transportation Engineers (ITE) Metropolitan Section of New York and New Jersey.

DiJoseph received her doctorate from NJIT in November 2013 and is settling into her new life in Mississippi working as a research scientist for the U.S. Army Corps of Engineers. She’s applying a lot of what she learned in her post-graduate studies to a different kind of traffic now, examining river freight traffic and looking at real-time data to see if there is a relationship between water level and timing of ship movements. In addition, she is looking at locks and dams and the weight of boats to see if travel times can be improved.

Transportation Today wins national awards

For the fifth year in a row, CAIT’s communications were recognized by Graphic Design USA in two national competitions. Thousands of entries are submitted from international corporations, educational institutions, non-profits, and advertising and design agencies and chosen regardless of size or budget. The American Inhouse Design Awards selects the best work done by internal departments rather than contracted design consultants and agencies. The American Graphic Design Awards contest is broader and even more competitive.

Entries are divided into categories such as annual reports, identity and logos, environmental graphics, posters, and internet design. *Transportation Today* was selected for two awards in the editorial design category.

More on the web: View all the winners at gdusa.com/contests/agda13/winners
People-watching people

CAIT collecting behavior data for outreach campaign to improve pedestrian safety

In early 2013, the North Jersey Transportation Planning Authority (NJTPA) selected marketing firm McAndrew Company and its research arm, PROvuncular, to develop, pilot, and evaluate a pedestrian safety education campaign in at least four geographically and demographically diverse communities in its 13-county region.

CAIT is working with the consultant team to evaluate the campaign’s impact on safe walking behaviors. The NJTPA, one of the state’s three metropolitan planning organizations (MPOs), in partnership with the New Jersey Department of Transportation, was authorized by FHWA to use $500,000 in Highway Safety Improvement Programs funds for the initiative. This is the first time the state has flexed monies typically earmarked for infrastructure improvements to fund an education project focused on reducing pedestrian and motorist conflicts.

Using crash data culled from Plan4Safety—a crash data analysis product developed at CAIT—and input from local law enforcement officials, planners, and engineers, the NJTPA selected five diverse communities—Newark, Jersey City, Woodbridge, Long Beach Island, and Hackettstown—to pilot the initiative. Before and after the campaign, CAIT visited select locations in these communities to document road use behaviors that put pedestrians at risk, including:

- Jaywalking or crossing against the signal
- Stepping outside of the crosswalk to avoid right- or left-turning vehicles that fail to yield
- Stepping outside of the crosswalk to avoid vehicles that fail to make a complete stop when turning right on red
- Stepping outside of the crosswalk to avoid a vehicle running a red light

The branded campaign urges all roadway users to be “StreetSmart” and “Check Your Vital Signs.” For motorists that means stopping for pedestrians in the crosswalk and obeying posted speed limits. Pedestrians are reminded to use crosswalks and wait for the walk signal. Outdoor, transit, and online advertising along with grassroots public outreach were used to convey the message.

The four-week campaign, which also included an enforcement component funded by the New Jersey Division of Highway Traffic Safety, ran through the month of November in Newark, Jersey City, Hackettstown, and Woodbridge. The Long Beach Island pilot is scheduled for June 2014.

CAIT researchers recorded and tallied pedestrian behaviors for six-hour intervals prior to the start of the campaign in each community and immediately after it concluded to determine impact on behavior.

More on the web: bestreetsmartnj.org

Transportation Today is published by the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers, The State University of New Jersey.

Editor-in-Chief/Art Director: Allison Thomas, Associate Director of Marketing and Communications

Staff Writer: Carissa Sestito, TSRC Outreach Coordinator

Editorial Contributors: Jie Gong, Allison Inserro, Janet Leli, Andrés Roda, Scott L. Thompson, and Brian Tobin.

For questions or comments, contact a.thomas@rutgers.edu.

CAIT is a National University Transportation Center supported by the Research and Innovative Technology Administration (RITA) at the U.S. Department of Transportation.

©2014 CAIT/Rutgers. All rights reserved. NL14/01-2014/5.25M
cait.rutgers.edu
facebook.com/RutgersCAIT
CAIT publications are printed on paper that contains a minimum of 30 percent post-consumer waste recycled content.