

SURVEYING AT SPEED

By Tim Van Gelder and
Marty Stoughton

An engineering and surveying firm takes the plunge with a mobile mapping system and finds it pays dividends, especially on transportation projects.

We have seen the future, and in the surveying world, it comes in the form of mobile scanning. In fact, you could call it a revolution! What is it? Mobile scanning combines 3D laser scanning, GPS, inertial measurement, and video technologies. The equipment can be mounted on a variety of vehicles such as SUVs, vans, trucks, sedans, RTV utility vehicles, vessels, and rail trucks.

This technology offers many benefits. It is less expensive than traditional surveying technologies. Data collection is much faster because massive amounts of data can be collected while traveling at posted speeds. With fewer personnel working beside busy roadways, mobile scanning creates safer job sites. It does not impede traffic flow. And the dense data collected lends itself to future data extraction without additional field visits.

Sporting two lidar sensor heads, the rooftop mobile scanning system collects data while traveling at posted speeds.



This point cloud from a scan taken along a neighborhood street gets converted to a CAD deliverable.



We believe mobile scanning is changing the entire landscape of surveying. Instead of numerous crews in the field transmitting data to a few office personnel who process it, a single survey mobile scanning crew can collect tremendous amounts of data in a fraction of the time. An entire team of surveyors in the office, who process the data, compile the CAD deliverables, and create models and simulations supports that crew.

McKim & Creed first invested in 3D laser scanning technology in 2006 when we purchased our first time-of-flight, or pulse, system. We use it for planimetric and control mapping, high-accident areas along highways, bridge substructures, utility substations, and volumetric scans.

In July 2009, we expanded our 3D laser scanning capabilities to include phase-based scanning. This technology has proven most effective for energy facilities, processing plants, manufacturing facilities, amusement and theme parks, civil engineering projects, and architectural/MEP applications.

But we first became acquainted with mobile scanning in the summer of 2008. It was nearly love at first sight, but we wanted to get to know the technology before we made a lifelong commitment. The “old school” comes out in us when it comes to trusting new technology. We needed to perform various tests

and quality control checks and compare lots of data before we trusted this technology.

One test we performed was on the accuracy and reliability of mobile scanning. Working with equipment provider Terrapoint, based in The Woodlands, Texas, we scanned a three-mile area of highway using static scanning, re-scanned the same area using mobile scanning, and compared the results. With static scanning, two crews worked for one week to collect the data, while with mobile scanning, the data was collected in less than half a day. The DTM (digital terrain model) data collected using mobile scanning was within less than 0.10 feet, with an average accuracy of less than 0.05 feet. This spurred us to present this amazing technology to NCDOT (North Carolina Department of Transportation), hoping to convince them that mobile scanning is the safest, fastest, and most cost-effective method of collecting and mapping DTM and planimetric data for transportation projects.

Trying a New Technology

NCDOT needed design-grade pavement DTMs for design to widen five sections of interstate highway. The sections to be surveyed were located along divided highways with high-traffic volumes. Typically, NCDOT uses a combination of helicopter mapping and aerial photography to gather DTM data. This re-

quires that surveyors work along heavily traveled roadsides to place survey controls on the ground, creating safety issues. Helicopter photogrammetry can also be costly and time consuming.

McKim & Creed offered mobile scanning as an alternative method to capture the topographic and planimetric data NCDOT needed. The agency had never used his technology.

We shared the results of our test scan, and based on those results, NCDOT agreed to implement mobile scanning technology on one project. This was conducted along U.S. 74/76/17 between Leland and Wilmington, North Carolina, and our purpose was to designate pavement limits and other features. Working with Terrapoint, we collected mobile scans for the entire project site, then supplemented those scans with static scans every mile as a quality-control measure. Survey data showing edges of pavement, travelways, and curb/gutter features was extracted from point clouds generated by the laser scanners. The data was then processed in the office, mapped, and delivered to NCDOT in CAD format.

NCDOT was satisfied with the results and authorized McKim & Creed and Terrapoint to complete four additional mobile scanning projects for sections of highway throughout the state. Deliverables for each assignment included:

- MicroStation 3-D DTM design files
- MicroStation TIN files
- MicroStation 2-D planimetric design files
- Geopak files, including all extracted linework
- QA/QC TIN-to-TIN comparison design files
- QA/QC comparison spreadsheets
- Complete scan database
- Video and .jpeg files of the entire data collection

Then NCDOT asked if the McKim & Creed/Terrapoint team could mobile scan railroads. The answer: “Absolutely!” Data from three sections of railroad encompassing approximately 33 miles of railway needed to be collected, so the McKim & Creed/Terrapoint team retrofitted the mobile scanning vehicle to NCDOT’s high-rail truck. The truck traveled all the project areas in at least one direc-



Geomatics project manager Donald White spot-checks data collected by MoDaC.

tion and most in both directions to ensure full scanning coverage. The team completed the field data collection for all three projects within two days, scanning approximately 18 miles of rail per day and providing accurate rail surveys with maximum safety and minimal disruption of rail service.

NCDOT is pleased with the cost, safety, efficiency, and quality of the data and is investigating the potential use of mobile scanning technology for future

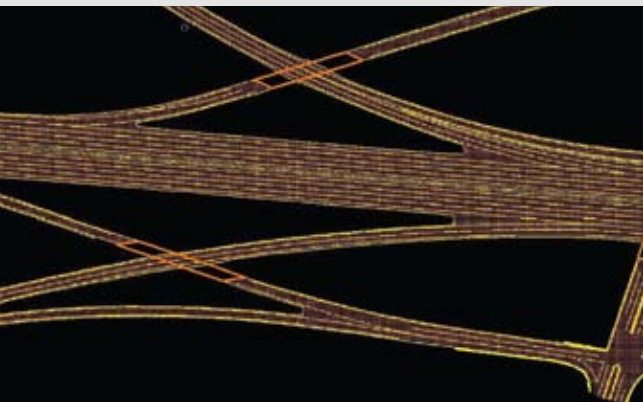
per system. This is the heart and soul of McKim & Creed's MoDaC (Mobile Data Collection) system, which we launched in fall 2009. The orientation of the scanners, along with the incredible speed (200 kHz) per scanner head, allows our system to collect survey-grade data at over 400,000 points per second while traveling at roadway speed, thereby increasing our ability to provide base mapping information in the most efficient manner. An on-board passive imag-

every surveying application. You can't drive through a dense forest or inside a steam plant to collect data. But even though it probably won't replace all our conventional collection technologies, we believe mobile scanning represents a significant shift in the industry and, in many areas, represents the wave of the future.

As with any emerging technology, we are learning more each day. We have performed numerous mobile scans



▲ McKim & Creed's MoDaC (Mobile Data Collection team, left to right): Marty Stoughton, PLS; Tony Alford, PLS; Tim Van Gelder, PLS; and Bryant Turner.



▲ Digital terrain modeling of highway pavement scanned in Charlotte, NC includes edges of pavement, travel ways, and curbs and gutters.

projects. In November 2009, McKim & Creed was awarded the top honor for engineering excellence, the 2010 Henry A. Stikes Grand Conceptor Award, from the American Council of Engineering Companies of North Carolina for these mobile scanning projects.

Launching MoDaC

While we completed our first projects using the Terrapoint technology, we did more research and ultimately decided to invest in the Optech Lynx Mobile Map-

ing system enables surveyors to check the data as it is being collected. The MoDaC system is also easy to retrofit onto various modes of transportation.

At first we saw only the numerous opportunities within the highway and railroad industries to use mobile scanning. Now that we've launched MoDaC, we see limitless possibilities in a variety of industries. We see applications for beach erosion monitoring, within the racing industry, and even in the film industry. Mobile scan-

ning has great applications for GIS asset management and can work hand-in-hand with subsurface utility engineers to quickly locate underground utilities. The scanned point clouds, with the aid of digital imagery, enable us to map the reflective paints used for marking underground utilities. This allows our virtual surveyors in the office to map the lines accurately without having to collect the data with conventional survey methods.

Of course, MoDaC won't work for

throughout the southeastern United States since launching our MoDaC system. The clarity of the point cloud data is amazing, and the accuracies have all been within design survey tolerances.

Working with our clients, we are looking at the compatibility of the entire data set within existing design software. Engineers and designers are concerned about the size of the files and the learning curve of using the data, and it appears major software companies are developing their software to accommodate the data. With all this going on and the success of mobile mapping, welcome to the future! ▼

TIM VAN GELDER, PLS is a regional manager with McKim & Creed, an engineering, surveying, and GIS firm headquartered in Wilmington, North Carolina.

MARTY STOUGHTON, PLS serves as the firm's director of business development for mobile scanning services. For more information about mobile scanning, visit www.mckim-creed.com or contact Marty Stoughton at mstoughton@mckimcreed.com.