



Caltrans Division of Research,
Innovation and System Information

Research



Results



Right of Way and
Land Surveys

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Project Title:
Evaluating Mobile Laser Scanning

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Task Manager:
Arvern Lofton
Transportation Engineer,
Electrical
arvern.lofton@dot.ca.gov

Application of Mobile Laser Scanning for Lean and Rapid Highway Maintenance and Construction

Mobile surveying improves the safety of surveyors and enables lean operations.

WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) requires survey grade measurements for many projects such as bridge and pavement construction, major accident investigations, and roadside asset management tasks. Caltrans has started the use of a relatively new technology called Mobile Terrestrial Laser Scanning (MTLS), which enables surveyors to work safely from within a vehicle. Utilization of this technology has introduced several technical challenges including understanding the most cost effective options (in terms of purchasing and operating versus contracting) for utilizing this new technology, the need for guidelines for control point spacing to achieve certain accuracy, understanding the technical issues in utilizing different associated software packages with such systems, and finally identifying best methods of post-processing laser scan data to improve efficiency that can lead to leaner operations.

WHAT WAS OUR GOAL?

The project targets resolving important technical issues related to MTLS technology implementation, clarifying the value of MTLS through cost-benefit analyses, and integrating the MTLS software and post-processing technology into Caltrans workflow with the ultimate goal of improving safety for Caltrans workers and the travelling public as well as achieving lean operations in maintenance, design, and construction. In addition, the research strives to improve accuracy, assure repeatability of the results, and visualize collected MTLS data.

WHAT DID WE DO?

Under the direction of Caltrans, the University of California, Davis Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center performed both applied and basic research components. The applied research



Caltrans provides a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability.

component compared the cost effectiveness of different options in utilizing MTLs technology for survey-grade projects, which resulted in a detailed cost-benefit analysis of various methods of using or contracting the use of this technology. Furthermore, experiments were performed and used to develop a set of guidelines for ground controls and targets to achieve a certain level of accuracy. Workflows for Caltrans use were also developed for several commercial software packages used in the MTLs systems. The basic research component evaluated the capabilities of reported point cloud processing techniques in the open literature and identified some methods for feature extraction applicable to highway operations. It adopted methods from the field of computer vision for feature extraction to highway applications and developed a method for kinematic registration of the laser scan data allowing data from laser scans of different highway sections to be integrated together. Furthermore, it addressed Information Technology (IT) requirements for handling and maintaining MTLs data and digital terrain models of the highway system.

WHAT WAS THE OUTCOME?

A cost-benefit analysis compared the cost effectiveness on different options for survey grade projects. As a result, the research task provided MTLs recommendations, limitations, and best practices to Caltrans. Caltrans received limitations and recommendations corresponding to control point spacing and MTLs data accuracy, kinematic registration, feature extraction from MTLs point clouds, and point cloud processing workflow development. In addition, this research task contributed towards the development of specifications for MTLs procurement and contributed to the Caltrans Surveys Manual, Chapter 15 for MTLs surveys.

WHAT IS THE BENEFIT?

Using the cost-benefit analysis, this research study

provided MTLs recommendations and limitations that would allow use of best practices by Caltrans in terms of using different options considering purchasing and operating a unit versus leasing and contracting out the operation. The benefit is a method for proper allocation of budgets and resources in making decisions on utilizing MTLs technology for survey applications within Caltrans. The guidelines developed for control point spacing that correlated to an expected level of accuracy in data collection leads to reduction in the number of control points in any MTLs project. The benefit is improved efficiency, reduced costs, and enhanced safety in terms of worker exposure to traffic in surveying the control points. The workflows for MTLs software and methods for feature extraction benefited Caltrans districts who utilized such software in improving their efficiency in processing the MTLs data. Development of IT requirements for handling and maintaining the MTLs data and digital terrain models can benefit Caltrans in their overall strategic planning on the use of Geospatial data.

LEARN MORE

To view the complete report:
<http://ahmct.ucdavis.edu/pdf/UCD-ARR-15-08-28-01.pdf>

IMAGES



IMAGE 1: Scan data at Highway 20 in Yuba County