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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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Support for Caltrans Statewide Mobile Terrestrial Laser Scanning (MTLS) System Usage

Deployment support of Caltrans MTLS systems usage throughout California with training and pilot studies for surveying and other geospatial applications.

WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) acquired two Mobile Terrestrial Laser Scanning (MTLS) systems, a Trimble MX8 and a Riegl VMX-1HA. Maintaining a trained pool of Caltrans professionals to operate these MTLS systems and process data from either system remained an on-going challenge.

Continued successful MTLS deployment requires MTLS operation and data processing skills, as well as keeping personnel current with latest industry developments. With project delivery as the primary role, district surveyors experienced significant limitations in resources for peer / mutual support, and system maintenance and upgrades after the Trimble MX8 maintenance agreement expired.

Caltrans needed new resources and materials for in-house training, education and outreach, and updates to manuals and procedures on emerging MTLS applications for virtual design/construction, digital highways, and transportation asset management. Caltrans also needed a Geospatial Technology Proving Ground (GTPG) to verify mobile mapping data from vendors or other geospatial technology platforms elsewhere in the Department. Without a GTPG, Caltrans couldn't calibrate and verify system performance before system acceptance or after component changes, and lacked a basis to determine whether equipment or third-party data met Caltrans' design specifications and requirements. Finally, Caltrans required added MTLS training and deployment support for escalating MTLS operations as current MTLS personnel promoted or retired.

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WHAT WAS OUR GOAL?

The goal was to provide MTLS operator and post-processing training for new MTLS Caltrans personnel, and refresher training for existing personnel. The research was also to provide education and outreach, ongoing MTLS deployment support, and new MTLS pilot studies supporting the Caltrans Geospatial Strategic Direction and the Caltrans Office of Land Surveys' (OLS') leading role in creation, management, and visualization of geospatial data. This included documenting cost and operational benefits of MTLS via emerging applications, standardizing new workflows and procedures, and sharing best practices and lessons learned throughout the industry. Finally, the research was to establish the GTPG for use in research and in everyday Caltrans' operations.

WHAT DID WE DO?

This research supported deploying the MTLS systems on Caltrans survey projects. Efforts included a literature review of MTLS research in private and educational holdings, survey journals, trade publications, and government institutions, along with researcher engagement in MTLS-related webinars, Caltrans Survey Management Board meetings, and Caltrans MTLS user meetings. The third and fourth tasks involved continued deployment support for both Caltrans MTLS units and support for Caltrans in training personnel and updating documents on MTLS operations.

Along with significant technical advice in the development of Caltrans MTLS Guidelines, the research assisted Caltrans in updating documents developed in a prior MTLS project, including: MTLS workflow, best practices, and operational recommendations; documentation for Caltrans in-house MTLS training materials (data collection and post-processing); MTLS system specifications, and standards on MTLS operation for Chapter 15 of the Surveys Manual.

The research also supported OLS' statewide MTLS data management effort and associated Information Technology (IT) infrastructure deployment. Finally, the research established a GTPG for calibrating MTLS systems and verifying geospatial data.

WHAT WAS THE OUTCOME?

The research established and confirmed that documenting best practices, workflow, and lessons learned is vital for deployment of any technology to maintain institutional knowledge as personnel retire or are promoted. The Caltrans MTLS Guidelines will be used for future on-the-job training. This extensive document provides the best repository of lessons learned by both the researchers and Caltrans with respect to MTLS.

The research further illustrated that MTLS data storage and management need further development to create a usable and consistent system across all Caltrans districts. Caltrans must consider Geospatial Information System (GIS) integration and data sharing (point clouds and georeferenced images) solution(s) to address MTLS data storage and management deficiencies. Other stakeholders will have to be involved in the discussion, including and especially the Caltrans IT division. MTLS can be used for asset management as well as pavement marking and sign reflectivity measurements, but further development is necessary to improve feature extraction automation to make statewide asset management data extraction viable and cost effective.

Although comprehensive in scope, the current Caltrans MTLS Guidelines do not address GIS data integration and pavement analysis workflow. The GIS data integration must include georeferenced images from other data sources such as historical photolog images and advanced pavement survey images. MTLS has much potential to exploit these benefits for Caltrans, but lack of automation currently limits wider-scale MTLS deployment for other Caltrans customers.

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WHAT IS THE BENEFIT?

Caltrans benefited by continuing to expand the value of geospatial survey data as the foundation of project development and asset management. In addition, Caltrans obtained a GTPG that enables the Department to improve its capabilities to use geospatial data. In particular, the GTPG enabled Caltrans to increase the spacing of MTLS control points, which improves the safety of personnel and California motorists. This research also acts as the basis for future research on optimal target spacing, registration of uncontrolled point clouds, and other emerging geospatial techniques and technologies. Finally, the new and updated MTLS-related documents produced in this research provide an invaluable set of guides and resource documents for Caltrans' MTLS operations.

LEARN MORE

To view the complete report:

https://dot.ca.gov/-/media/dot-media/programs/
research-innovation-system-information/
documents/final-reports/ca21-3179-finalreport-
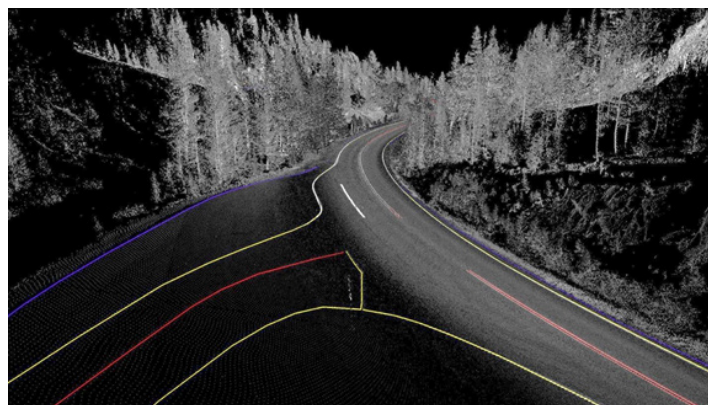a11y.pdf

IMAGE

Image: 3-D MTLS point cloud with an extraction base map overlay at Tioga Pass (SR 120 east of the Yosemite National Park gate)