

## Applications of 3D Laser Scanning for Construction and Maintenance

**Outcome** — Produce standards and specifications for the use of laser scanning (stationary ground-based LIDAR) in projects for Caltrans and its contractors. Delivery: June 2007

**Benefit** — Enable large-scale deployment of 3D scanning into survey operations, improving efficiency and safety. 3D as-built models will enhance highway design, construction, and maintenance.

*AHMCT researchers have developed a coordinated set of standards and specifications for the use of laser scanning in Caltrans. Guidelines clarify the common limitations of 3D laser scanners and recommend mitigation methods, and will help engineers and surveyors to select the right scanner and determine optimum scanning settings for survey applications in diverse situations. The standards also outline the CAD data format that should be used for archival and exchange purposes. The project also developed recommendations for LIDAR-based workflows. In the research, controlled tests were conducted on laser scanner hardware and software to compare features and performance, and the scanners were evaluated in pilot tests in Caltrans survey projects.*

### Why We Are Pursuing This Research

Traditional survey instruments are limited to locating one point at a time. In addition, surveyors are often exposed to all manner of environmental hazards in the traditional survey process. DOTs and private contractors have used laser scanning in highway survey applications and found that it reduces lane closures, decreases the risk of casualties, and increases productivity. The resulting high-resolution detailed 3D models allow engineers to extract all the required data, decreasing or eliminating the need for surveyors to return to sites for additional measurements. This will enhance highway design, construction and maintenance.

Using 3D laser scanners will dramatically improve safety and efficiency over current survey methods. However, to fully realize the benefit of using 3D laser scanners, they must be used properly and in appropriate applications. Like any instrument, the 3D laser scanner has limitations, and may not be appropriate for every application. Furthermore, the postprocessed CAD model data must support export to other Caltrans CAD software, e.g. CAiCE and MicroStation. Prior to this research, there were no standards and guidelines specifying the use of 3D laser scanners in Caltrans survey applications. Without standards and guidelines, the 3D laser scanner can only be used on a trial-and-error, *ad hoc* basis, which is costly in time, money, and safety. Therefore, a set of Caltrans standards and specifications defining the appropriate use of 3D laser scanners for different types of Caltrans applications is needed to enable deployment of this important technology. These standards will promote consistent and correct use of 3D laser scanners throughout Caltrans and by its contractors.



### What We Are Doing

AHMCT researchers have developed standards and specifications for 3D Laser Scanning that will enable large-scale deployment of this technology into Caltrans day-to-day survey operations. The research project included detailed vendor-neutral hardware and software evaluation of systems from major LIDAR vendors. This evaluation focused on issues that are of significant concern to Caltrans applications, workflows, and data flows.

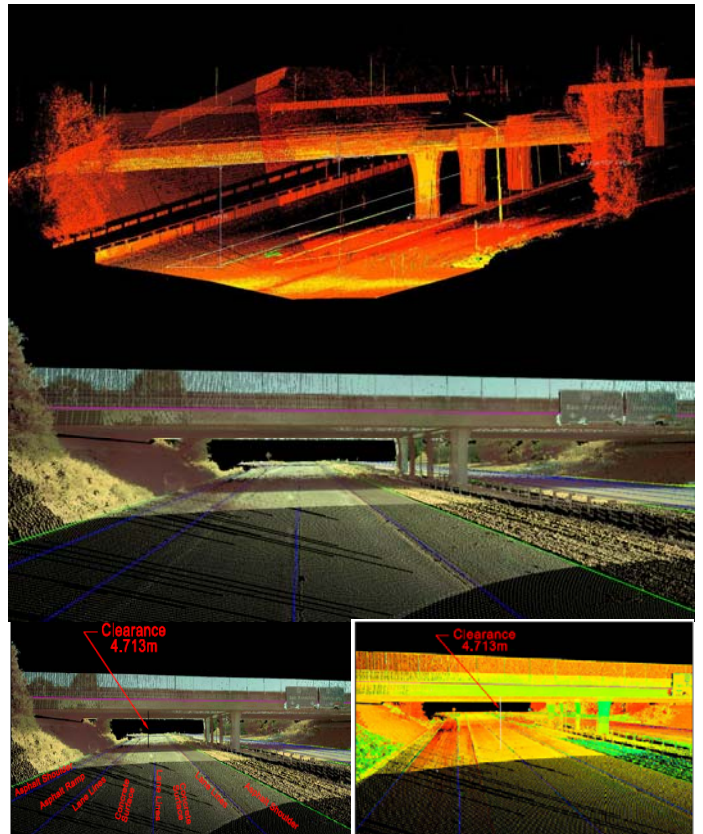


Figure 1 – 3D laser scan output

Key project deliverables include:

- Development of vendor-neutral evaluation criteria standards, and specifications,
- Controlled testing of major LIDAR vendor hardware and software,
- Field pilot studies of major LIDAR vendor hardware and software
- Fixtures for Caltrans in evaluation of commercial laser scanners,
- Standards and guidelines on the use of 3D laser scanners in Caltrans surveying applications,
- Work flow and QA/QC procedures recommendations on the use of 3D laser scanners survey,

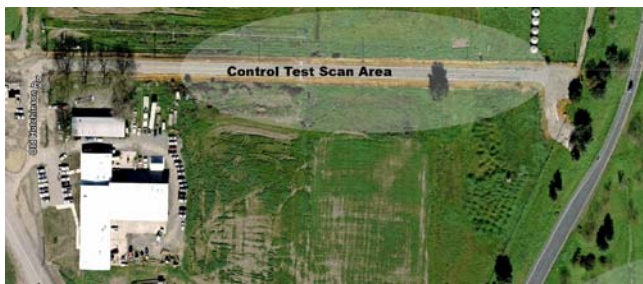


Figure 2 – Control Test Sites



Figure 3 – Pilot Study Test Sites

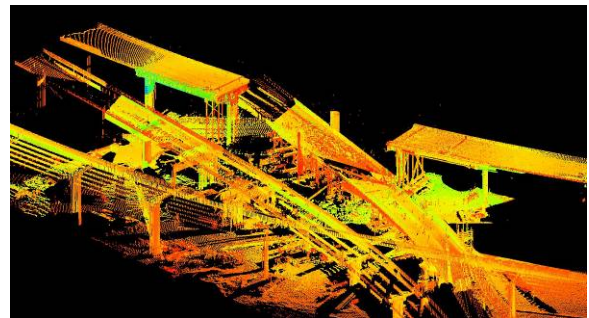


Figure 4 – Scan of the MacArthur Maze interchange collapse

### Current Status

The research project, including the controlled tests and pilot studies, is complete. In the controlled tests, we validated key technical specifications of the 3D laser scanners. The pilot studies involved surveying in real-life Caltrans highway applications. Data analysis and software evaluation are complete, as is the draft project report. AHMCT researchers continue support for Caltrans field trials and case studies of 3D laser scanning, including a recent scan of the collapsed section of the MacArthur Maze. Reports for this and other case studies are available on request from AHMCT.

### For Additional Information

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