



LiDAR

TOOLBOX

Three types of Light Detection and Ranging (LiDAR) equipment will be presented in the following pages, Mobile, Stationary, and Aerial.

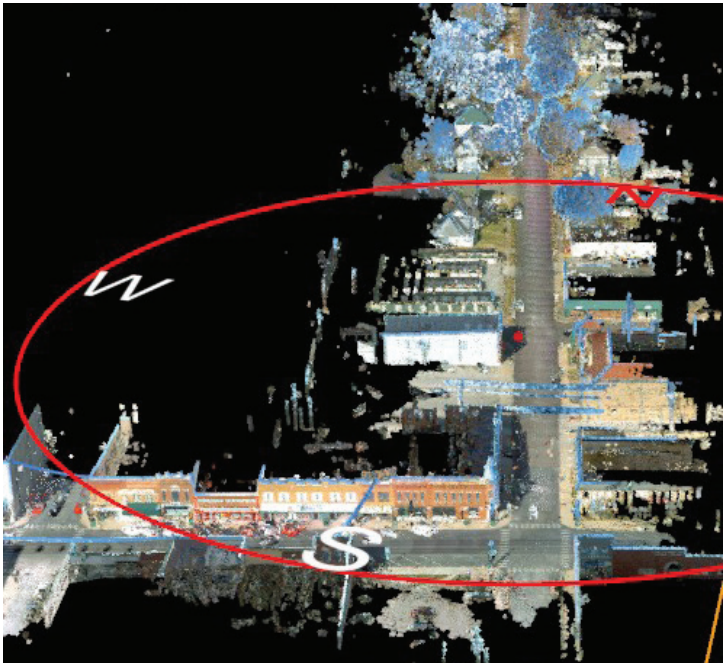
Mobile LiDAR is an effective solution for rapid data collection and it is a powerful mapping method that uses laser scanning to identify roadway assets and related infrastructure quickly, accurately, and cost-efficiently.

The rotating LiDAR sensor captures the environment with a rate of 700,000 pulses per second (may vary depending upon the type of unit). During each rotation, the internal lasers (some units have 32) cover the full 360 degrees around the system, each from a slightly different viewing angle. This minimizes gaps in the point cloud that arise from obstacles or dead-angles and removes the need to install multiple scanners.

Software and Data Processing: The scanner data consist of ranges, angles, and timestamps collected by the scanner and referenced from the scanner origin. These measurements then are converted to X, Y, Z coordinates as point cloud when combining other sensor data (GNSS, Inertial Measurement Unit [IMU], and Wheel encoder). For most uses of mobile LiDAR system data, four processing tasks need to be completed:

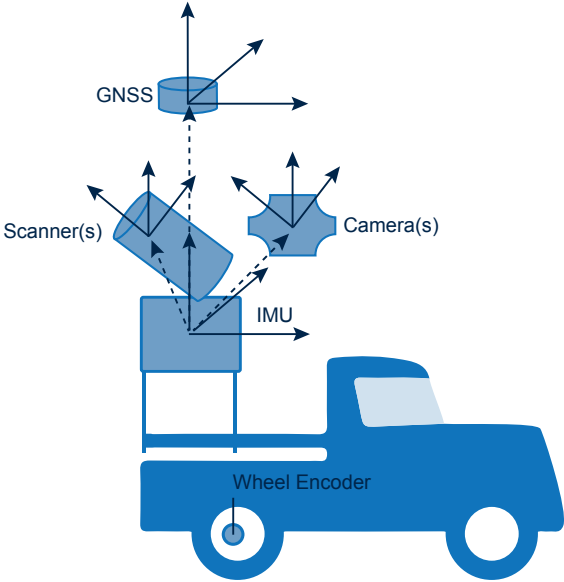
1. Georeferencing the data
2. Mapping color information
3. Filtering/cleaning points
4. Generating models or extracting features from the point cloud

Scan Deliverables: Common deliverables following laser scan projects include point clouds, computer-aided design (CAD) models, digital terrain models (DTMs), and georeferenced photographs.



Mobile LiDAR Components:

1. Mobile platform (vehicle)
2. Positioning hardware: GNSS (Global Navigation Satellite System), Wheel encoder and IMU
3. 3D laser scanner(s)
4. Photographic/video recording
5. Computer and data storage



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Benefits of Mobile LiDAR scanning:

Cost savings: Advanced mobile mapping technology gathers all required data point measurements in one pass, eliminating the need for additional mobilization costs.

Time savings: Mobile LiDAR gives the ability to collect up to 700,000 points per second, compared to one point every few minutes with traditional survey technologies.

Enhanced data: The system provides designers with a more complete picture of the project with survey accurate point measurements and the ability to locate features that may be inaccessible with other methods. Photographic/video recording provides historic data for use in verifying conditions/locations of objects without leaving the office.

Increased safety: The system also provides increased safety for project personnel and the general public because data can be collected remotely, day or night, removing the need for traffic diversion required by traditional surveying activities.

Limitations of Mobile LiDAR scanning:

- Cannot see through thick vegetation or water or leaves
- For tighter accuracy, space control points closer together and drive at a slower speed
- Objects along the roadway (e.g. parked car) can block or limit data acquisition
- Electronic files are large and require a computer with large memory and graphic card to manipulate and process

Stationary LiDAR uses a similar operating system to the Mobile unit mounted on a tripod. It has the same benefits and limitations as the Mobile unit listed above. An additional use for the stationary unit is on the inside of facilities where it can collect geospatial data of equipment and piping into one file which then can be used for planning routes for new piping or placing equipment and reducing construction issues. Another usage is for accident reconstruction by emergency services allowing them to collect information on the scene more accurately and in less time.

Aerial LiDAR uses a similar operating system to the Stationary unit in manned aircraft from fairly high altitude to create topographic mapping for use by assessors, planners, and engineers. Technology advancements are creating smaller equipment as the industry works toward having survey-grade data using unmanned drones.

The benefits and limitations are similar to those listed above for the mobile unit with a preference for acquiring data when limited snow and leaves are covering the ground to improve accuracy.

Summary

These tools have many applications for which their benefits are useful on projects and ultimately to the Owner of the infrastructure. Like all technology, the mobile and aerial equipment continue to improve with time and will likely become everyday tools soon. Stationary equipment has essentially become an everyday tool and also has improved over time.

Prepared by Gary Strack, P.E., F. NSPE, SECB and Nikolay Nedkov, PLS of Anderson Engineering, Inc.



Example of a Mobile LiDAR unit vehicle setup