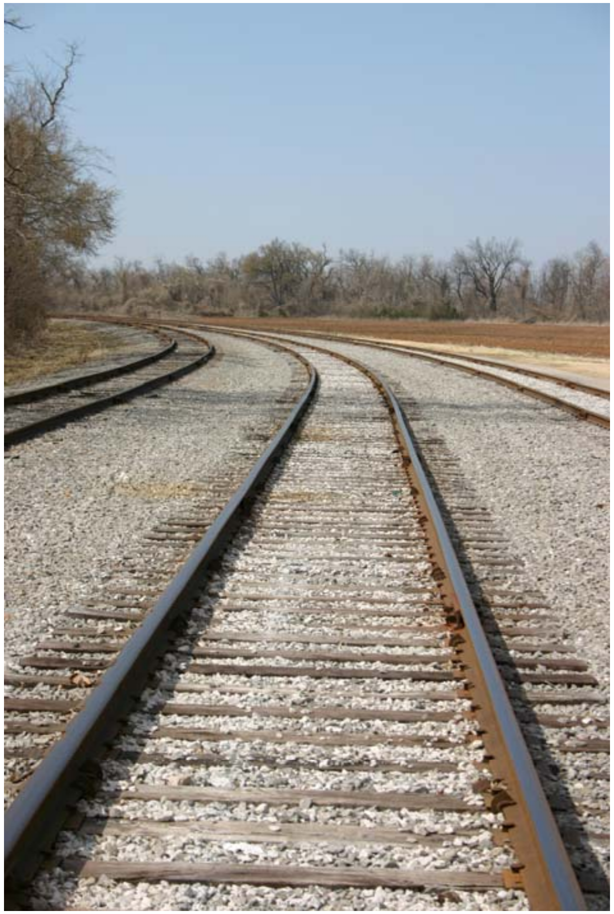
Optech

The Lidar Company™

LYNX MOBILE MAPPER™

Using Mobile Lidar to Survey Railway Infrastructure



A new stage of mobility…

Terrestrial lidar imagers have advanced from stationary tripod-mounted units, to a whole new stage of mobility, including land and marine vehicle-mounted platforms.

A new application…

Aerial Data Service, Inc. (ADS), of Tulsa, Oklahoma, contacted Optech to test the Lynx Mobile Mapper in an untried application: surveying railway infrastructure from a moving rail car.

Image Courtesy of Airborne Data Service Inc.

Proof of solution

ADS was interested in a "proof of solution": to determine whether the Lynx Mobile Mapper could provide 3D spatial data with enough detail and accuracy to extract rail information for use by maintenance and inspection services.

Image Courtesy of Airborne Data Service Inc.

Proof of solution

The customer wanted to examine Lynx Mobile Mapper data for its potential in:

- Monitoring track conditions
- Monitoring switch conditions
- Inventory
- Signage
- Obstructions such as vegetation encroaching on the rail right-of-way.

Untapped potential…

The gathered data showed that the Lynx Mobile Mapper offers untapped potential for multiple uses in railway surveying applications, including:

- Rail corridor design
- Rail corridor monitoring
- Hydrostatic & hydrokinetic monitoring

Rail corridor design

The design of new railway sidings is crucial to improving traffic flow along existing rail lines.

The addition of rail sidings to existing track requires a survey to ensure proper design.

Conventional survey methods are time-consuming and require that the line be shut down for safety reasons–or that data collection be interrupted to let traffic pass.

Test project

To test the performance capabilities of the Lynx Mobile Mapper, it was arranged to scan a 3.5-mile section of railway outside Tulsa, Oklahoma.

The Lynx was mounted on a speeder (track maintenance car), then scanned the area surrounding the rail line using one of its lidar sensors.

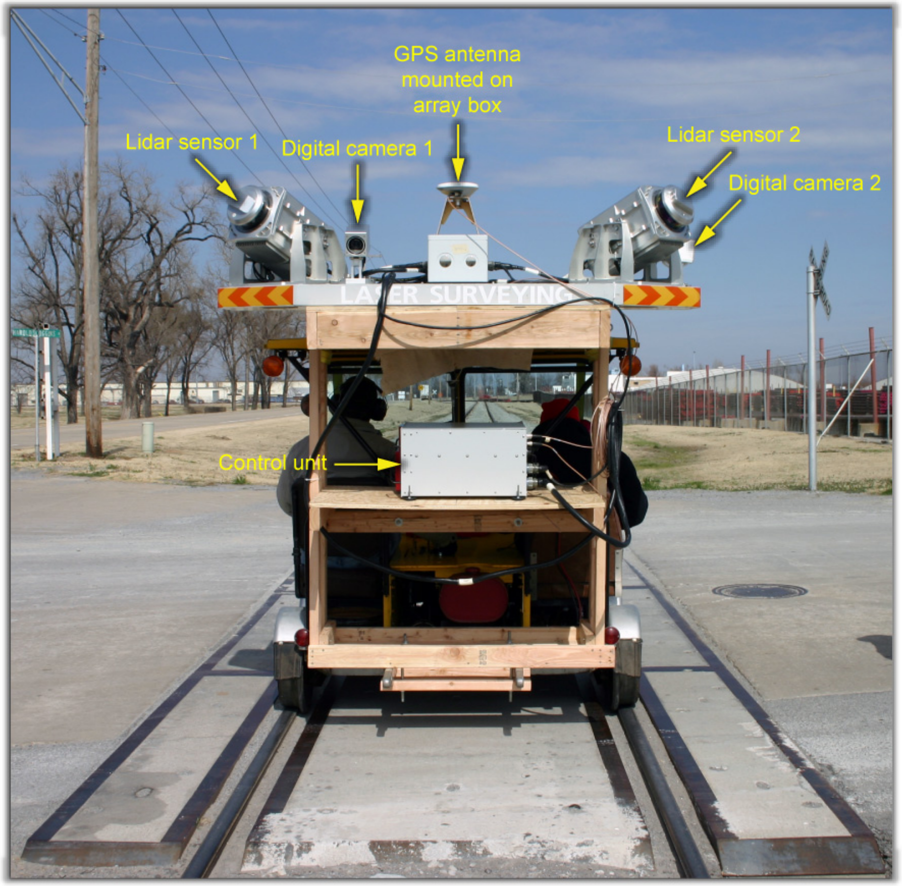


Image Courtesy of Airborne Data Service Inc.

Data output: topographic maps

From the data collected, portions were extracted from the resultant point clouds.

Topographic contour maps were output after processing the raw XYZi (Northing, Easting, Height, intensity) data using the commercially available software package, Terrasolid.

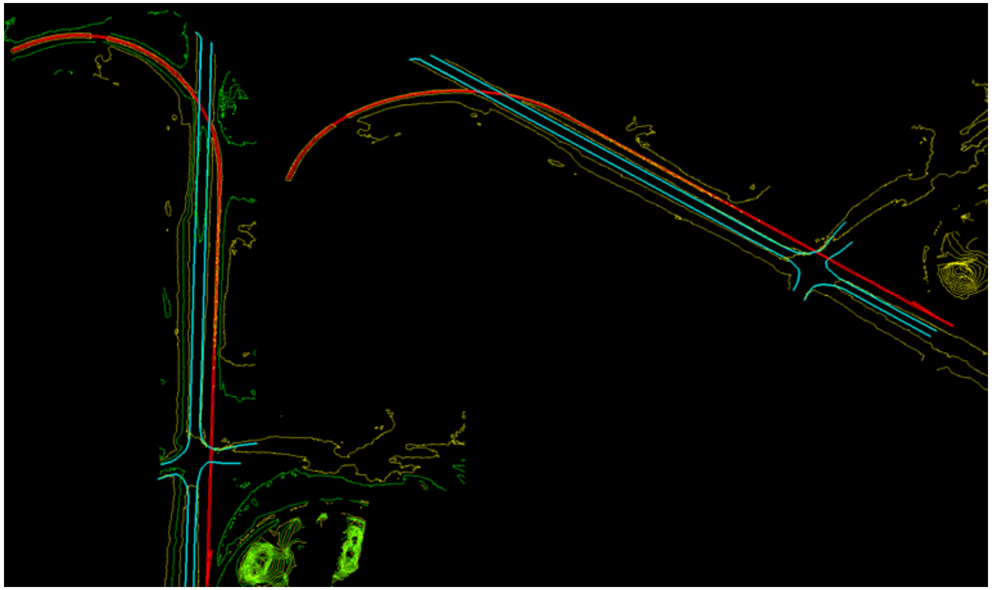


Image Courtesy of SAM Inc.

Data output: topographic maps

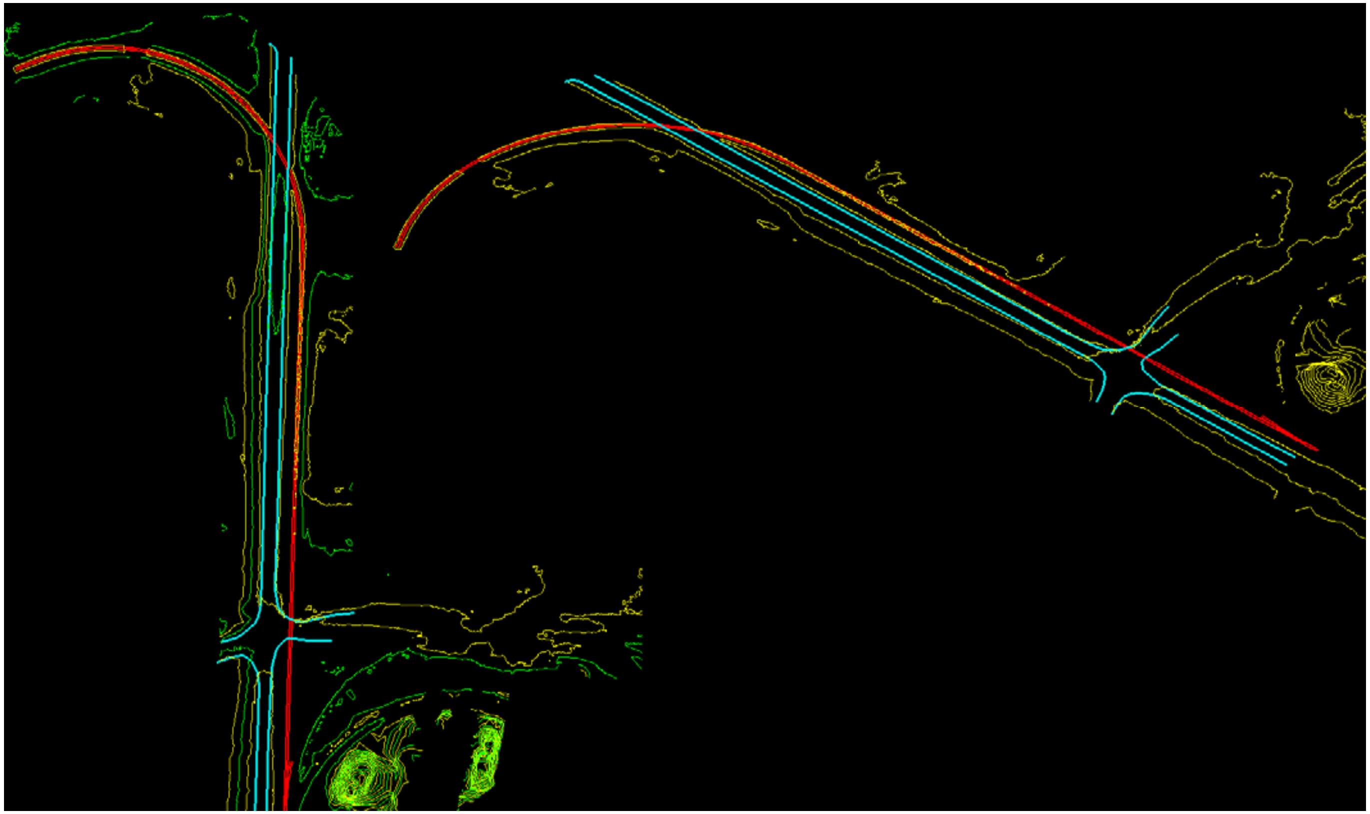


Image Courtesy of SAM Inc.

Contour lines made from Lynx Mobile Mapper data captured from a moving speeder on a section of railway track.
Contour separation 0.5 ft. (left), 1-ft. (right).

Data output: Triangulated Irregular Network (TIN)

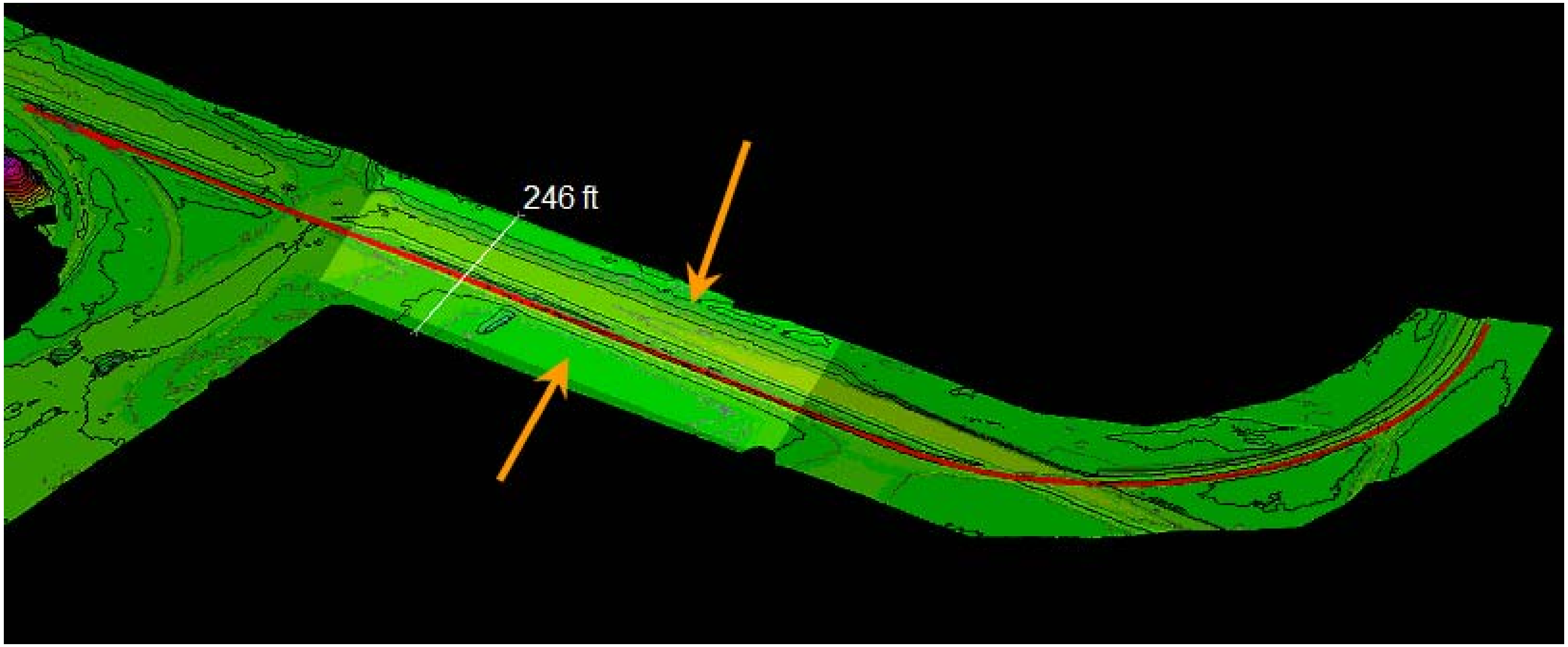


Image Courtesy of SAM Inc.

Triangular Irregular Network (TIN) model with 1-ft. contour lines showing a 246-ft corridor along a section of rail line.

Data output: Triangulated Irregular Network (TIN)

This topographic map can be used to estimate the volume of fill needed when adding a spur line.

The tightly banded contour lines above the (red) track reveal a pronounced change in elevation, a grade that may be too steep to accommodate a parallel set of tracks.

The more broadly spaced contour lines below the track suggest flatter terrain, more suitable for laying additional track.

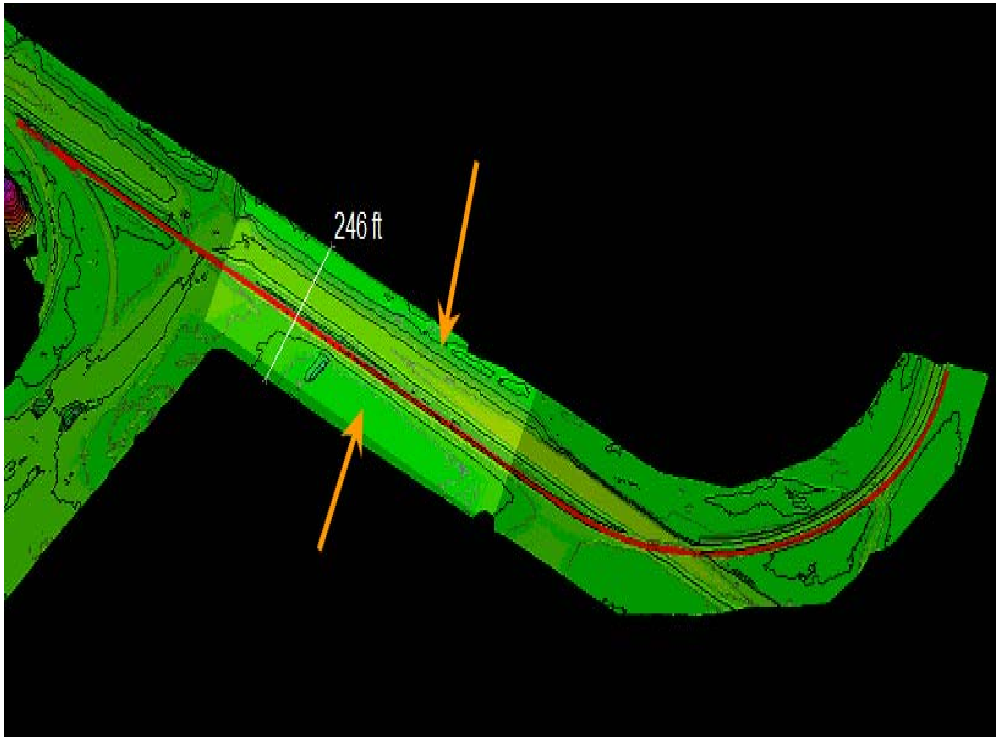
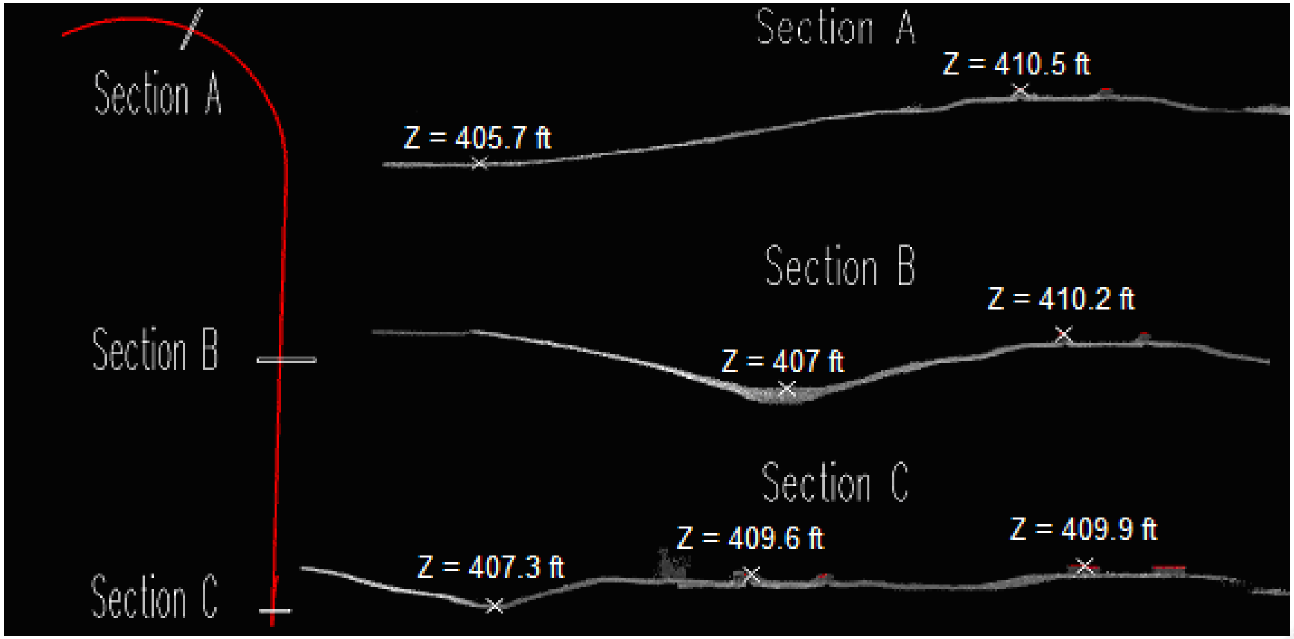


Image Courtesy of SAM Inc.

Data output: elevation cross-sections

- Elevation data was extracted for the top rail and low point on cross-sections along the rail corridor.
- The cross-sections can be placed at whatever position and frequency the user requires.
- The user can confirm elevation measurements at any point of interest along the scan by moving a cursor in the post-processing interface.
- A Lynx data set provides a permanently searchable data base after each survey.



Hydrostatic / hydrokinetic monitoring

The topographic maps generated from the Lynx Mobile Mapper can also be used to monitor existing drainage patterns along the track bed.

The sub-grade material beneath the railway tracks must be reasonably firm (a supporting capacity of 20 psi). Draining or pooling water can seriously undermine the supporting capacity of sub-grade material.

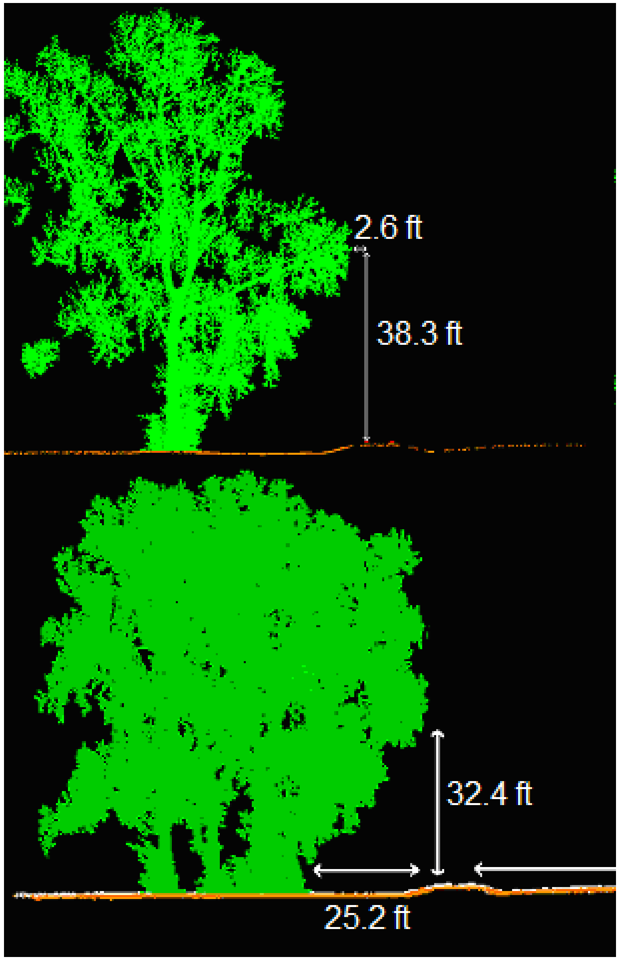
The topographic maps generated by the Lynx Mobile Mapper can serve as the basis for analyzing water flow patterns in the rail corridor.

Such flow patterns indicate where the sub-grade material is at risk of being undermined through erosion by flowing water or capillary action of water in the soil.

Rail corridor monitoring

- Every railway line is part of a site-specific ecosystem. Various components of an ecosystem can be problematic when they impinge on the safe and efficient use of the railway corridor.

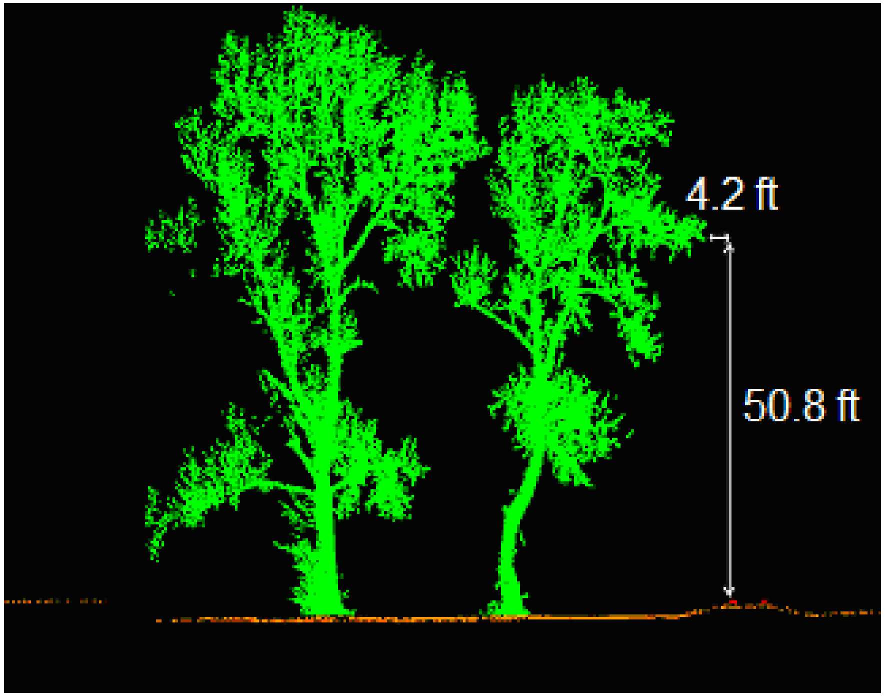
- Unchecked vegetation (e.g., massive tree roots) along the rail corridor can undermine the stability of the sub-grade material.



Rail corridor monitoring

Using the lidar data collected outside Tulsa, measurements of tree heights close to the rail line could be ascertained.

The measurements showed potential problems with vegetation alongside the track. Given the height and width dimensions of railway vehicles, it was discovered that some of the measured trees needed to be trimmed or removed.

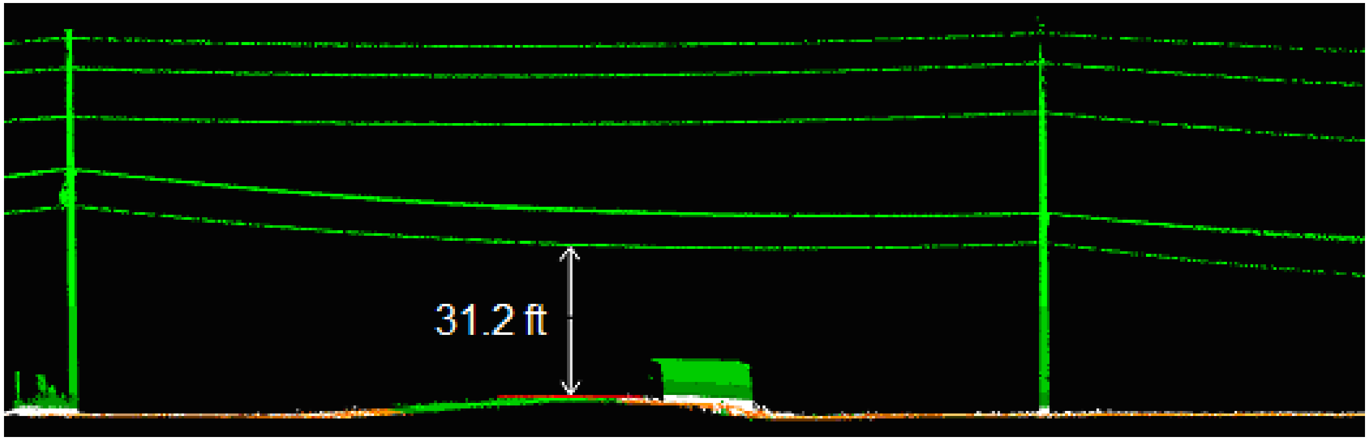


Rail corridor monitoring

Along with natural obstructions, man-made features overhanging the track may also pose a risk.

Below, Lynx Mobile Mapper data shows the distance measured from the top-center of a rail to overhanging electrical power wires.

The clearing between the tracks and the wires limits the height of rail cars that can travel along this part of the line.

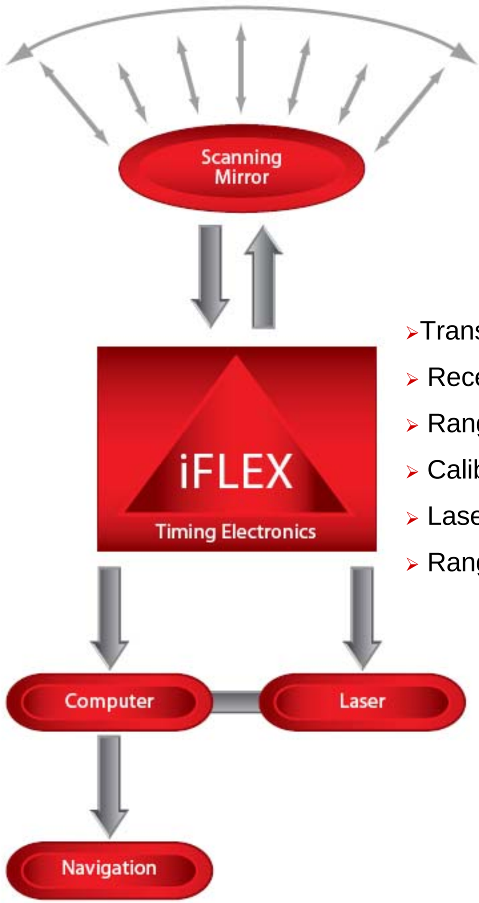


Adjusting scan rate to optimize data

The Lynx Mobile Mapper features a scanner with an adjustable scan rate. Depending on the requirements of the application—driving fast or slow, uniform point distribution, dense coverage of a specific area, or broader coverage of a wide area—adjusting the scan rate will optimize the data quality.

Image Courtesy of Airborne Data Service Inc.

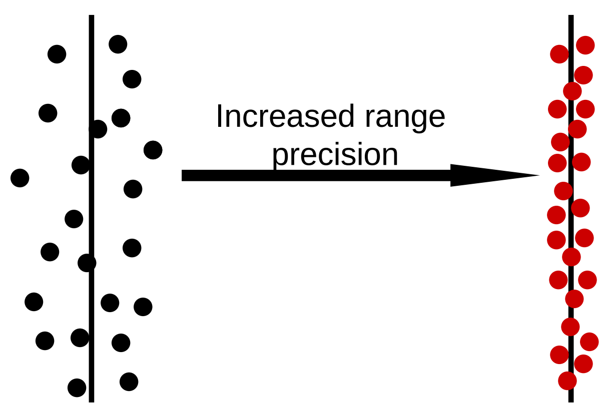
Integrated and **F**lexible **L**idar **E**lectro-Opti**X**



- Transmitter Electronics
- Receiver Electronics/Detector
- Range Calculation
- Calibration
- Laser Pulse Analysis
- Range Calculation

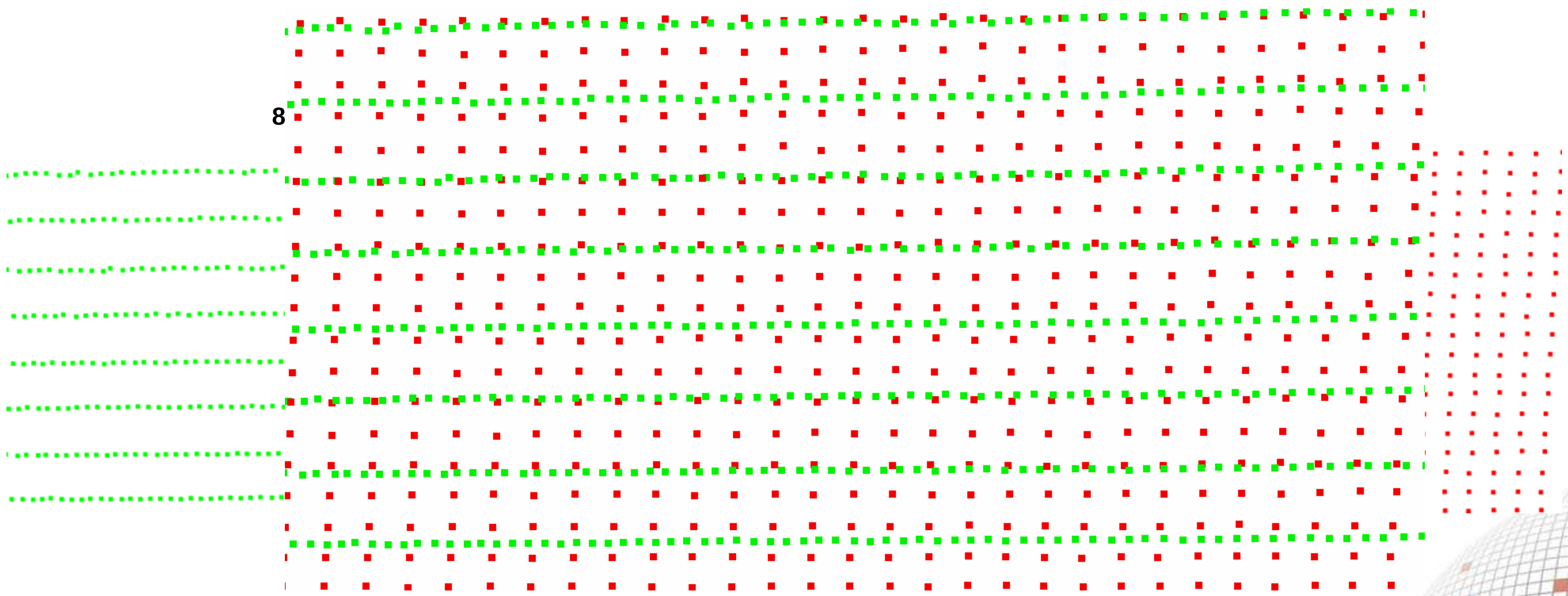
iFLEX technology – Essential for high-accuracy data collection

Optech's newest product family incorporates our proprietary iFLEX™ technology. We have leveraged decades of specialized expertise, honed in the commercial marketplace with rugged airborne, space borne, terrestrial and mining lidar products, to create a common platform for our next-generation lidars. Embedded in the Lynx Mobile Mapper, iFLEX captures the design of laser timing and receiver electronics, and high-speed data communications.



Why is the scanner speed user-definable?

- Scan rate directly affects point distribution
- Fast scan speeds minimize distance between “scan lines” but create bigger separation between points on the same scan line
- Slower scan speeds do the opposite
- Each application has different requirements – drive fast, drive slow, uniform point distribution, etc.
- Customization is critical for maximizing data quality for varying project types.



Adjusting scan rate to optimize data

Much denser data can be collected when the scan rate is set to a slower frequency, an option that is especially helpful in railway applications.

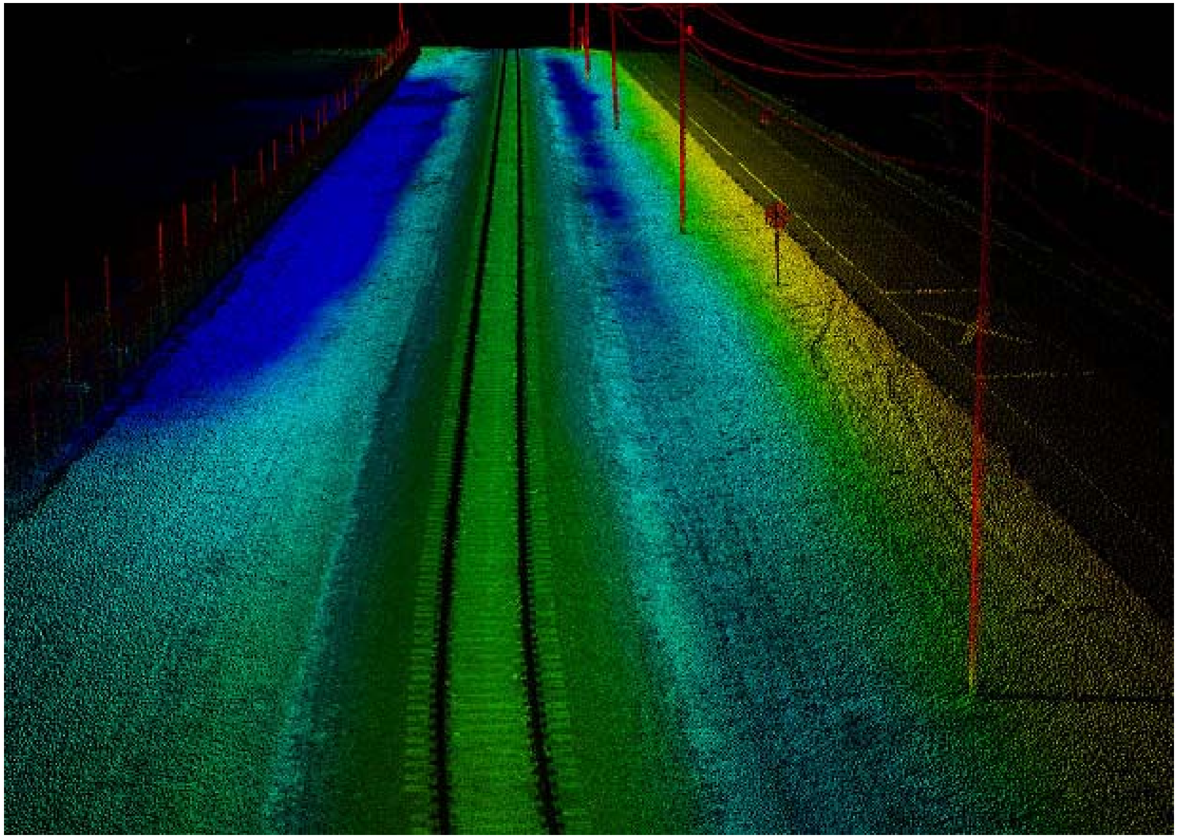


Image Courtesy of SAM Inc.

Adjusting scan rate to optimize data

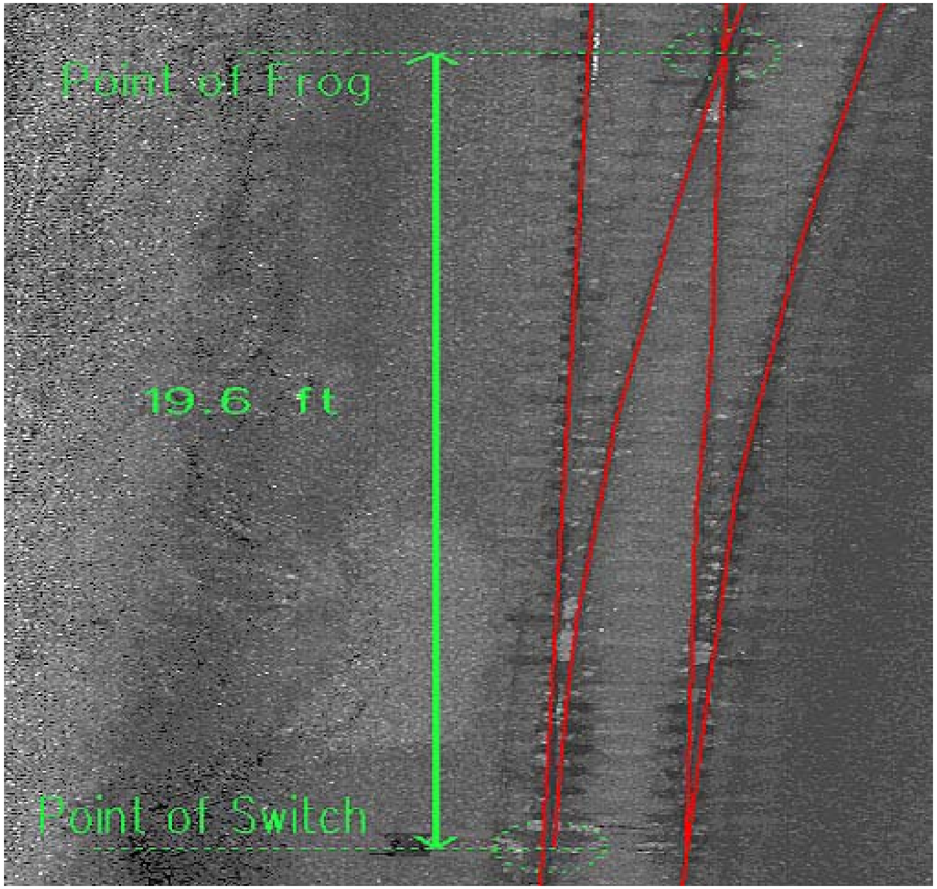


Image Courtesy of SAM Inc.

Analysis of rail length for off-site fabrication of replacement sections

Conclusion

This project demonstrated that the Lynx Mobile Mapper offers untapped potential for multiple uses in surveying railway infrastructure, including:

- Surveying an area of interest quickly, safely, efficiently and without the larger scale interruption necessitated by traditional surveying methods.
- Rail corridor design
- Rail corridor monitoring
- Hydrostatic & hydrokinetic monitoring
- Volume estimation (amount of fill needed to add for the construction of a new spur line)
- Extracting height differences repeatedly from one point cloud
- Measuring the height and proximity of trees and man-made objects surrounding the rail right-of-way.

This Project Was Carried Out With The Co-operation of

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