



FEATURE

History in the Making: Intelligent Lidar Imaging and Surveying for Historical Site Preservation

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Anyone who has visited historical sites understands the importance of preserving them as landmarks for future generations. Historical preservation and reconstruction are challenging tasks based on the information available at hand. Advanced survey methods using cutting-edge technology are now aiding in these efforts. Light detection and ranging (Lidar) is one technology that has demonstrated its value in historic preservation. Although Lidar surveying has been practiced since the early 1990s, it has only recently proven its importance in this role.

A ground-based, tripod-mounted Lidar instrument employs a laser, a scanner, and optics to capture complete three-dimensional range and image data of large or small scenes. In most cases, millions of laser points are used to construct a highly-accurate spatial model of a scene in three dimensions: X, Y and Z. Most systems also record the intensity values for each point for material reflectivity analysis of the scene. Advanced systems can even collect RGB color values for each of the points with an integrated digital camera. The resulting image contains enhanced visual and spatial information in a digital format, meaning it can be viewed and analyzed from different perspectives.

Loomis Austin, Inc., a land surveying, engineering, and environmental consulting firm in Austin, Texas, owns and operates an Optech Intelligent Laser Ranging Imaging System (ILRIS-3D) (Figure 1). ILRIS collects



Figure 1 ILRIS-3D Lidar scanner on tripod

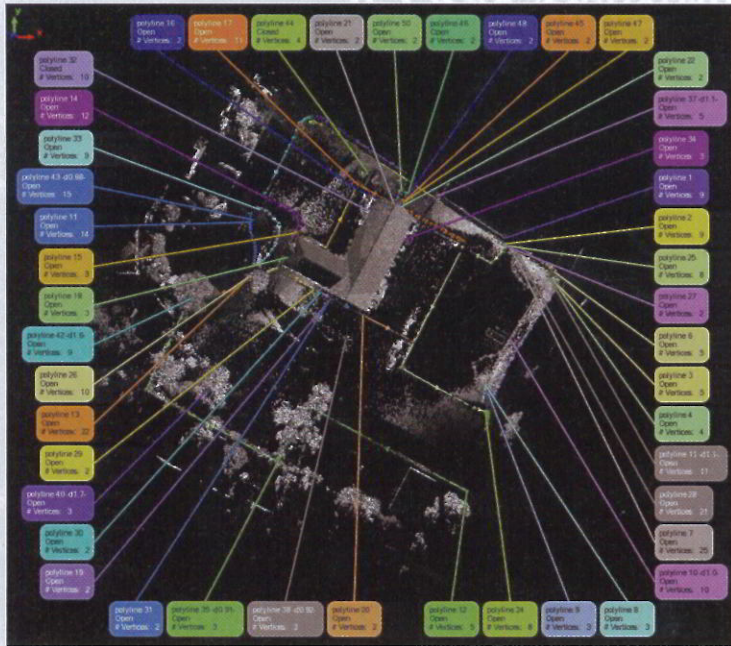


Figure 2 Plan view of church with parameters – The analysis consisted of generating polylines for features such as sidewalks, utilities, and buildings.

laser point data at a repetition rate of 2,000 laser points per second in a fixed field of view of 40°x40°, which can be extended to 360° coverage. Each point has a discrete intensity value associated with the light reflected from that position, along with an RGB color-captured from the on-board six-megapixel digital camera. The operational range of ILRIS varies from three meters to beyond one kilometer for highly reflective targets.

Advantages of Lidar Technology

One of the major advantages of using Lidar is its high level of detail when surveying large areas; 3D point clouds can be rapidly visualized and analyzed to aid in engineering efforts. Engineering requires survey methods at the high levels of accuracy and detail necessary for planning, design, and construction. Surveys of historical buildings and sites require data that thoroughly captures their design and construction. After the ILRIS-3D is set up, the operator can choose between collecting large areas to assess the survey boundaries or refined target areas that require finer detail.

In this example, Loomis Austin performed an engineering design survey of the First Baptist Church building and grounds located at 4805 Heflin Lane, Austin, Texas. The survey included tree, topographic, and as-built aspects.

First Baptist Church is the oldest African-American Baptist Church in Austin and has played a significant role in the Austin community since the 1860s. The congregation grew out of the slave membership of the First Baptist Church of Austin in 1864. Reverend Jacob Fontaine formally organized the church in 1867, with services held in the basement of First Baptist Church and a local blacksmith shop. In 1869, the City of Austin deeded a downtown tract to the church for construction of its first sanctuary, according to the Texas Historical Commission. The current church building was constructed in East Austin in 1966 and is slated for remodeling.

Loomis Austin deployed its ILRIS to capture the church and its surroundings. The project was estimated to take three days for data collection. The actual data collection process was recorded as:

Operators.....	1
Laser points collected.....	30.6 million
Average point resolution.....	2 cm
Data format.....	X, Y, Z, intensity
Collection time.....	1.5 days
Processing time.....	5 days

The project's statistics highlight the efficiency of collecting data using terrestrial Lidar versus conventional

means of surveying. The field workflow, from the initial steps of locating GPS ground control to the output of data, took half as long as conventional methods (1.5 days vs. three days estimated). More than 30 million georeferenced points were captured from an average range of 30 meters.

The data was taken back to the office for processing and analysis. The time to process in this case was longer than the original estimate, based on conventional methods, because of the number of points that had to be edited.

The workflow involved a few minutes of post-processing to render the raw scanner data into a format recognized by the analysis software (InnovMetric Polyworks). The data was then aligned using common feature algorithms. GPS reference points were registered to each of the five scanner locations, and data was georeferenced using GPS coordinates and elevations from differential leveling.

Generating a Model

The analysis consisted of generating polylines for features such as sidewalks, utilities, and buildings (Figure 2). Ground data was sub-sampled to a 10-foot grid. Polylines and ground points were then modeled and rendered into a triangulated irregular network (TIN) surface model.

