FUTUREVISION

The Future of Aerial Lidar and Emerging Technologies

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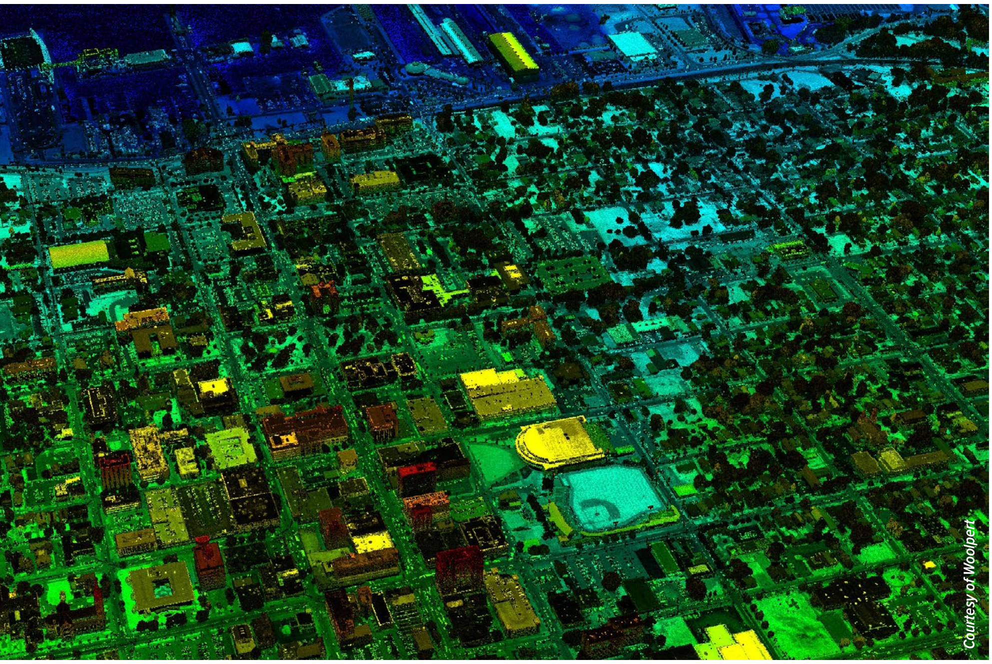
Lidar, which can generate up to 10 million pulses per second or more, creates a dense terrain model of unmatched accuracy when compared to manual photogrammetric collection. As a result, it is the most efficient three-dimensional modeling and surveying method available.

There are multiple lidar sensor technologies available and others in development, with varying data collection factors for multiple data applications.

Linear mode lidar has been the most conventionally used aerial lidar approach for several years. Recently, the advent of single photon and Geiger-mode lidar sensors have brought new methods and applications of lidar collection to light.

These advancing technologies have raised the question—especially for those currently making long-term, large-scale investments in these services—as to whether one aerial lidar methodology will emerge and eclipse the others or whether the industry will support multiple lidar methodologies.

Given the breadth of projects utilizing this technology and the varying applications of the data, I believe not only will a variety of aerial lidar methodologies continue to coexist, but that the data delivered to clients will be more affordable and specific to a growing array of client needs.



This image of Erie County, Pa., was captured by Woolpert via linear mode lidar.

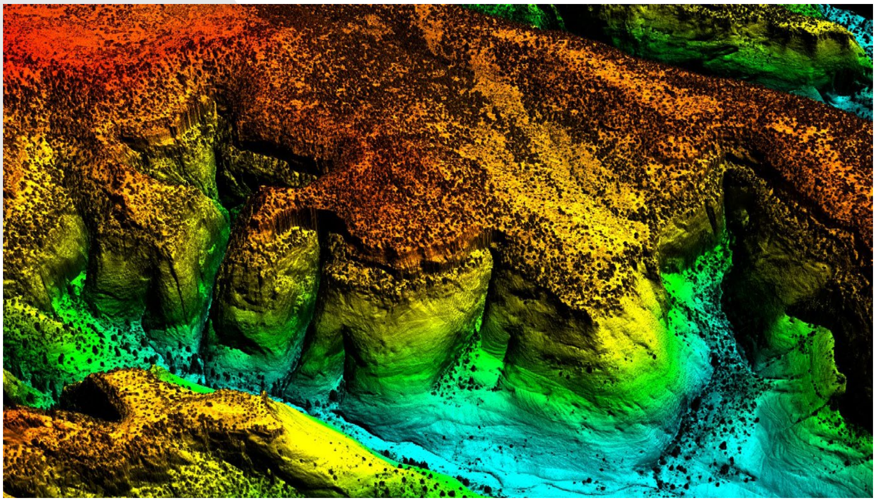
Key Differences Between Aerial Lidar Approaches

There are technical differences between single photon and Geiger-mode lidar, but together they represent a denser and higher-altitude option when compared to conventional, linear mode lidar systems.

Linear mode lidar can be described as one-to-one, in that a single laser pulse transmits a single spot image received at the single anode. Single photon and Geiger-mode lidar sensors both collect as one-to-many, starting as a laser pulse, and projecting as an array of outlet beams onto the target and detecting measurements at the receiver.

Linear mode lidar is collected utilizing a scanning pattern, continuously collecting points at altitudes of up to 5,000 meters but typically closer to 3,000 meters. The result is highly accurate data, with density commonly in the range of 1-8 points per square meter.

Single photon and Geiger-mode lidar data can be collected faster by operating at higher range of altitudes, between 3,000 and 10,000 meters. Unlike the patterned flights of the linear collections, single photon and Geiger-mode sensors operate like that of a laser-based digital camera. The laser beam is diffracted through an optical element to hit the target as a spot array, using a lower laser



Linear mode lidar was used to collect this image of Zion National Park.

energy requirement and providing a surface model with a density of approximately 25 points per square meter.

Linear mode lidar can incur more time for data collection and typically produces much less density than what is common with the single photon and Geiger-mode systems.

Woolpert is familiar with the current range of sensor platforms, having worked with nine different lidar sensors from three manufacturers in the last year alone, spanning projects across various regions, terrain, and near-shore environments across the U.S. and overseas.

The linear collections have included the Leica ALS 80, which has been employed for the majority of the firm's recent U.S. Geological Survey (USGS) 3D Elevation Program (3DEP) projects; the Optech Galaxy, which was used to collect data in the San Juan Mountains in Colorado; and the Riegl Q780i, which was used to map the Kuskokwim Delta in western Alaska. Woolpert also used the Leica SPL100 Single Photon Lidar System to collect data over 3,700 square miles in South Dakota.

Our exposure to a variety of lidar sensors used for multiple projects has provided us a firsthand perspective as to which sensors are the most appropriate per the project needs.

Testing, Building Toward the Future

The USGS is in the process of evaluating single photon and Geiger-mode lidar for use on 3DEP projects. The 3DEP initiative aims to systematically collect enhanced elevation data via lidar over the conterminous U.S., Hawaii and U.S. territories, along with a mix of lidar as well as interferometric synthetic aperture radar (Ifsar) in Alaska.

As part of that evaluation, the USGS has collected data with both single photon and Geiger-mode sensors, and tasked Woolpert and Dewberry with collecting, processing, and analyzing that data to help gauge how useful this data could be to meet 3DEP requirements.

The USGS and the National Oceanic and Atmospheric Administration (NOAA) recently awarded Woolpert a project for collecting the Big Island of Hawaii that will expand the use of single photon lidar data in support of 3DEP.

The firm intends to collect this data with the Leica SPL 100 Single Photon Lidar System, leveraging this technology's faster collection capabilities to maximize the available windows of clear skies.

This project will further test the capability of the single photon lidar technology.

Looking Ahead 3-5 Years

As lidar technology advances, the industry appears to be moving more toward increasing functionality via multiple lidar approaches instead of eliminating methods of acquisition.

In the next three to five years, I believe not only will we see the maturation and implementation of single photon and Geiger-mode lidar technology for large-scale projects in support of 3DEP, but we also should see more specialized sensors develop as the demand for data increases.

We also should expect the continued advancement of high-altitude, wide-area linear mode sensors with improved as well as unique capabilities, buoyed by the continued development by sensor manufacturers.

In addition to these high-altitude aerial lidar sensors, the need also will remain for low-altitude sensors for energy and transportation corridor mapping projects.

Moving forward with multiple types of sensor technology, firms will increasingly be able to provide the best sensor technology, appropriate to each project, and deliver data to meet the specific needs and budget of each client.

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