An Introduction to Lidar Data

Light detection and ranging, or lidar, is a remote-sensing technology that uses pulsed laser energy (light) to measure ranges (distance). Engineers and earth scientists use lidar to accurately and precisely map and measure natural and constructed features on the earth's surface, within buildings, underground, and in shallow water. It has broad applications in many industries such as engineering and public safety.

Often deployed in down-looking systems in the air or oblique geometries in ground systems, a lidar system includes a laser source, a scanner, and a GPS receiver. During a lidar survey, an active optical sensor transmits laser beams toward a target while moving along or rotating across defined survey routes or fixed objects.

The laser energy is reflected by the target and is detected and analyzed by receivers in the lidar sensor. The receiver records the precise time from when the laser pulse left the system to when it is returned to the sensor. Using precise pulse time, the range distance between the sensor and the target may be calculated.

When combined with the positional information from GPS or an inertial navigation system (INS), these distance measurements are transformed into measurements of three-dimensional points that define the reflective target in 3D space. Lidar point data—including laser time range, laser scan angle, GPS position, and INS information—is postprocessed. It is then compiled into highly accurate georeferenced x,y,z coordinates by analyzing the laser time range, laser scan angle, GPS position, and INS information.

Laser pulses return to the sensor from different reflective surfaces located above and on the ground. A single emitted pulse may return as one or more reflections. The first returned pulse is very important, as it marks the highest or tallest reflective surface. First returns can include treetops, building roofs, and vehicle tops. If no other reflective surfaces are encountered, a single first return may represent the earth's surface.

A cloud of multiple intermediate returns allows modeling of forest canopy, ground cover, and some constructed features. The lowest elevation return may reflect from earth materials and support modeling of a single bare earth surface.

For additional information about lidar and its application in ArcGIS Pro, read the ArcGIS Pro topic, "What is lidar data?"

in the river, and maybe even a cow or two. Save once more.

Exporting and Reviewing a Lidar Map

To export the map, click the Everson_4_Layout tab and inspect your layout. Open the Catalog pane and expand Layouts. Right-click Drone_4_Everson and select Export to File. Save the export file as a PDF with a resolution of 300 dpi. Place it in \CAUSE_V_Drone\Graphics and name it Drone_4_Everson_1.pdf. Because the map has a lot of detail, it may take some time to generate the PDF.

Open a file manager such as Windows Explorer and browse to \CAUSE_V_Drone\Graphics. Open Drone_4_Everson_1.pdf. Click the Layers icon and use the visibility selection (eye symbol) to turn individual layers off and on. Investigate how the ArcGIS Pro PDF export function manages labels, images, analytical rasters, and transparency. Compare the lidar height contours to Everson structures and the georeferenced images. They should match pretty closely thanks to the 1-meter resolution of the rasters. Continue to explore the PDF export, and consider how you might use the workflow presented in this article.

If you were wondering why the cars in the lidar rasters aren't in the drone imagery, remember that the lidar was acquired in 2013, while the drone imagery was flown in 2017. Any cars or cows shown in the 2013 lidar rasters were long gone when the drone imagery was captured.

Summary

This is certainly one of my favorite *ArcUser* exercises. I took traditional ArcMap workflow tasks and updated them directly in ArcGIS Pro. I am especially thankful for the robust online help included with ArcGIS Pro. I encourage you to use it whenever you need extra assistance.

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