

How can it be that we're only scratching the surface of LiDAR's potential?

—by Matt Ball

The concept of Light Detection and Ranging (LiDAR) is really quite simple—it involves tuning into the wavelength, pulse width, and frequency of laser light, bouncing that light off objects, and capturing returning light over time to measure X,Y, and Z dimensions as well as the returning light's intensity. The technology has proved to be quite useful for capturing 3D terrain and features; and it is being used extensively to map infrastructure and natural resources.

Since the technology's inception in the late 1960s, LiDAR has been applied to atmospheric studies of air quality, marine and hydrographic studies, for bathymetric studies and water quality issues, in surveying and mapping, and for positioning and guidance. The technology has been tweaked and fine tuned for each subsequent application area, funneling improvements back to technology development. Yet, we're still just scratching the surface with the capabilities of this technology.

INTENSITY RETURNS

Because of its ability to measure and classify different intensity values of the light ray returns, LiDAR can be fine tuned to capture and record a variety of different phenomenon, both visible and invisible. The intensity

can be customised for atmospheric research aimed at determining which elements are present in the air using different signatures from molecules. Something similar can be done with water. The signatures of the elements can then be monitored to understand changes in the atmosphere and the make-up and changes in the composition of our water bodies.

Seeing what can't be seen by the naked eye is a key application of this technology. LiDAR is used to sense, from a distance of as much as one kilometer, such phenomena as variations in soil compaction, which can signal soil pollution, or the health of forests and their susceptibility to fires.

The potential of LiDAR in monitoring change in the physical world is truly limitless. But to take advantage of this potential we will need sophisticated LiDAR sensors capable of measuring not only distance but also motion and composition and classifying that information.

MULTI-SENSOR CONFIGURATIONS

High-resolution color images produced by aerial and terrestrial applications of LiDAR capture reality which can then be represented by models as virtual reality. Engineering and design projects, as well as the entertainment and game industries have successfully incorporated virtual LiDAR in their work flows.

Adding other sensors to the aerial platform such as hyperspectral or thermal imaging provides further sensing capabilities. Hyperspectral imaging adds to the topographic information of a 3D scan, high-resolution measurements extracted from different color bands of an image.

Thermal remote sensors do what their name says; they sense heat. And one of their application is in combating fires, providing information about fire behavior under different weather conditions and providing information about the mitigation approaches chosen.

Multi-sensor configurations are proving to be very desirable for scientific and surveillance applications. Emerging technologies such as LiDAR boost interest in understanding change on our planet, even among the general public.

LIDAR APPS

Just as video cameras were once too expensive to purchase, so too are LiDAR sensors, but they will eventually come down in price and become ubiquitous in areas which are in need of constant measurement.

One such area is surveillance where a LiDAR system could be used to create a virtual fence and alert a central system when encroaching objects pass a certain distance threshold, or, if their profile composition comprises metals or explosives.

With LiDAR sensors deployed on satellites, we have constant measurement from space, on a global scale. With increasing speed of data classification and analysis, we'll gain a much greater understanding of change. And, with increasing overlap of sensors at various scales, we'll be able to aggregate these different measurements for a much greater understanding of the whole, be it at a regional or a country scale, and all the way down to millimetres of accuracy on the ground.

OVERCOMING DATA LIMITATIONS

The biggest technological hurdles for greater LiDAR utility have been the large digital storage space required to house the measurements and the computing power needed to visualize and analyse the data. The rapidly dropping prices in computer storage and capacity are easing some of these burdens, and cloud computing is providing new ways of dealing with the data and visualization limitations.

By harnessing large numbers of computers, analysts can dive into the details of the data faster and much easier. The ability to store large

amounts of data on shared machines also eases some of the burden of storage management and makes the data much more readily accessible.

With easier data storage, analysis and integration capabilities in the cloud, more sensors can be employed for data collection and new applications.

The future of LIDAR is bright precisely because of the uniqueness of its sensing capability. In a time when we need more and better means to measure and analyse our world, LIDAR technology is the way to proceed in the coming decades.

LITERATURE

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