LiDAR as a Resource Tool

By Paul Schuetz

In recent years, timber harvesting in much of British Columbia has become significantly more complex. During the past two decades, as tenure-holders have focused increasingly on dealing with the mountain pine beetle (MPB) epidemic in the north, harvesting has transitioned to operating on pine plateaus and river flats in an effort to salvage the more easily accessible pine before log quality deteriorated too far.

While harvesting dead pine trees comes with its own set of safety risks, harvesting operations have been relatively easy. The terrain was typically flat to gently rolling, the soil was well-drained and dry, and skidding to roadside locations became the norm. Over the past three to four years, logging companies began making the switch back to steeper, more difficult terrain, targeting spruce and balsam stands located on the sides of remote mountain valleys.

With this tougher terrain has come the need to consider a change in recent traditional harvesting methods, and greater effort spent in the planning and layout phase. In the Coast region, steep-slope harvesting has always been the case.

In terms of harvest planning in more difficult terrain, technological advancements have developed to assist in ensuring logging practices are completed safely, within machinery specifications and as cost-effectively as possible. One such technical advancement that has greatly helped forestry workers in harvest block planning has been the evolution of LiDAR—light detection and ranging technology.

This technology is one of the recommendations made by George Abbott of Circle Square Solutions in the Contractor Sustainability Review. Abbott advised government to "acquire the most advanced version of LiDAR (2.0) and make province-wide topographical and inventory data freely available to all partners on the Crown land base."

LiDAR is an optical remote-sensing technique that uses light in the form of a pulsed laser to densely sample the surface of the earth. The resulting data can be used to produce a high-resolution 3D image of the landscape—or Digital Elevation Model (DEM)—that is highly accurate in the vertical and horizontal axes. The DEM can produce reflective images of vegetation canopies that are useful for forest inventory work, or can be filtered out to provide a profile of the ground that would otherwise be concealed by trees and other foliage.

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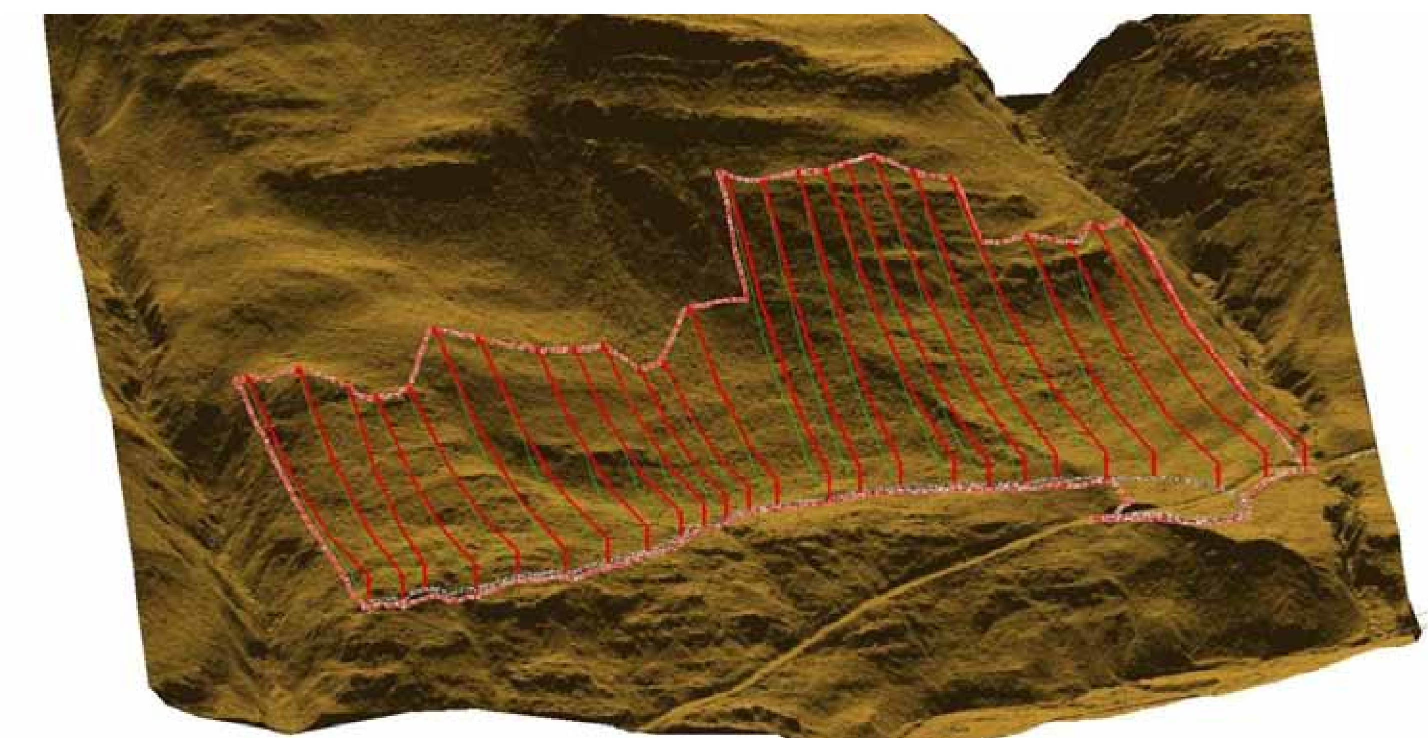
There is an enormous array of applications for LiDAR technology, ranging from map production to astrophysics. However, in BC, resource professionals use airborne LiDAR, an innovation that involves placing LiDAR sensors and highly accurate GPS receivers on fixed-wing or rotary aircraft in order to scan a predetermined area.

The data obtained through LiDAR technology have been utilized in the forest industry for over 20 years, albeit



Courtesy Colin Hines

This figure shows a high-quality LIDAR DEM with deflection lines, boundary and roads for a proposed cable harvest block near Chetwynd, BC.

to a lesser extent. The largest previous impediment to extensive utilization has been cost, but improvements in technology have made LiDAR more cost-effective of late. Today, forestry companies are using high-resolution data and accurate terrain profiles to update forest inventory and fibre supply, produce log-pile volume estimates, and facilitate harvest block planning in difficult terrain.

In steep, difficult terrain, foresters are using very accurate DEMs enhanced with the acquisition of LiDAR to map deflection lines for cable harvesting systems. While fieldwork is still required, the information can significantly reduce the exhaustive and time-consuming field reconnaissance. The DEM data can also be used to plan optimal road locations, identify areas in which alternate harvesting systems would be required and, most importantly identify steep and dangerous terrain that is unsafe for machine operators.

LiDAR availability in much of BC is patchy at best; this is especially true when compared to other Canadian provinces such as New Brunswick, which has recently acquired full LiDAR coverage of the province. The obvious difference is the comparatively larger size of the BC land mass, a factor that greatly influences the overall cost of such an undertaking as province-wide LiDAR mapping.

Consequently, many resource users in BC have created or purchased their own LiDAR mapping systems, e.g., oil and gas companies operating in the Peace Region of northeastern BC, and forestry companies such as Canfor and West Fraser, have attained LiDAR data for particular operating areas.

Not all LiDAR is equal. The quality of the information will vary based on the density and spacing of the ground data, and the intensity of the imagery (i.e., pixel size). Consequently, there is a wide range in the quality being utilized across the industry. In March 2017, the BC government published a paper on LiDAR specifications, but much of the data developed prior to this are of questionable quality.

While operating in steep and challenging terrain, TLA member Steve Willick of Newland Enterprises in Fort St. James, BC is experienced in working with LiDAR-produced maps, although he finds the quality inferior to that of the maps he used in the past. “Harvest plan mapping these days shows less ridges and slopes compared to when we had strip line data [provided by timber cruises]," Willick notes. Meanwhile, other loggers in the province have reported using LiDAR-produced maps that have been very accurate.

The range in LiDAR quality is typically a result of the type of equipment used to collect the data. Equipment that can send high-density (i.e., nominal point density of >8 points/m^2) light pulses toward the ground can result in the production of a much more accurate DEM. Additionally, the precision and reliability of other LiDAR components, such as the GPS receiver, the inertial measurement unit, and the type of aircraft, all contribute to the accuracy of the data and the overall detail of the maps. Unless the accuracy of the contour information can be identified beforehand, quality control measures in the form of field checks are required to ensure that harvest boundaries and roads are in the optimal locations.

Nonetheless, LiDAR is widely seen as a technological advancement in operational planning that will benefit licensees through more cost-effective development of their block and road locations. It is hoped that contractors will see the advantage too, with improved deflection in yarding and more strategic road locations.

There is a precedent in government in terms of making this kind of investment: in 1996, the Government of BC provided resource users with Terrain Resource Inventory Management (TRIM) base map data that covered the entire province. These maps were produced through the late 1980s and 1990s using high-level aerial photographs and photogrammetric plotters.

For the first time, detailed terrain information was made available to resource users and became a valuable tool in harvest block and road planning. Like TRIM mapping, the BC government is on its way to producing a standardized and accurate LiDAR inventory for the province, with areas of Vancouver Island and the Lower Mainland already being mapped. However, the process is slow and costly.

As harvest development in BC steers into steeper, tougher ground, and during a time during which labour shortages are becoming an increasing reality in the forestry sector, good-quality, reliable and efficient province-wide LiDAR will inevitably become a major asset in ensuring proper resource management and industry cost-effectiveness.

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