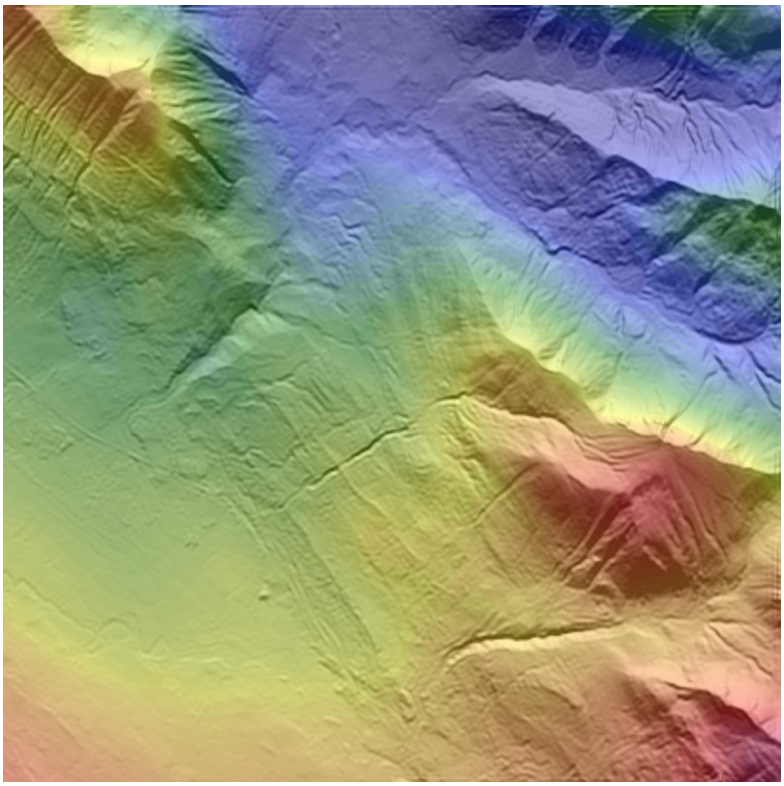
Scanning LiDAR System for Terrain Mapping

Sander Geophysics Ltd (SGL) provides terrain mapping services using a sophisticated airborne scanning LiDAR (Light Detection and Ranging) system, which collects data along a swath below the aircraft flight path, using a Riegl LMS-Q280i airborne laser scanner. The scanning LiDAR data are geometrically corrected using accurate GPS location, and pitch, roll and yaw determinations.

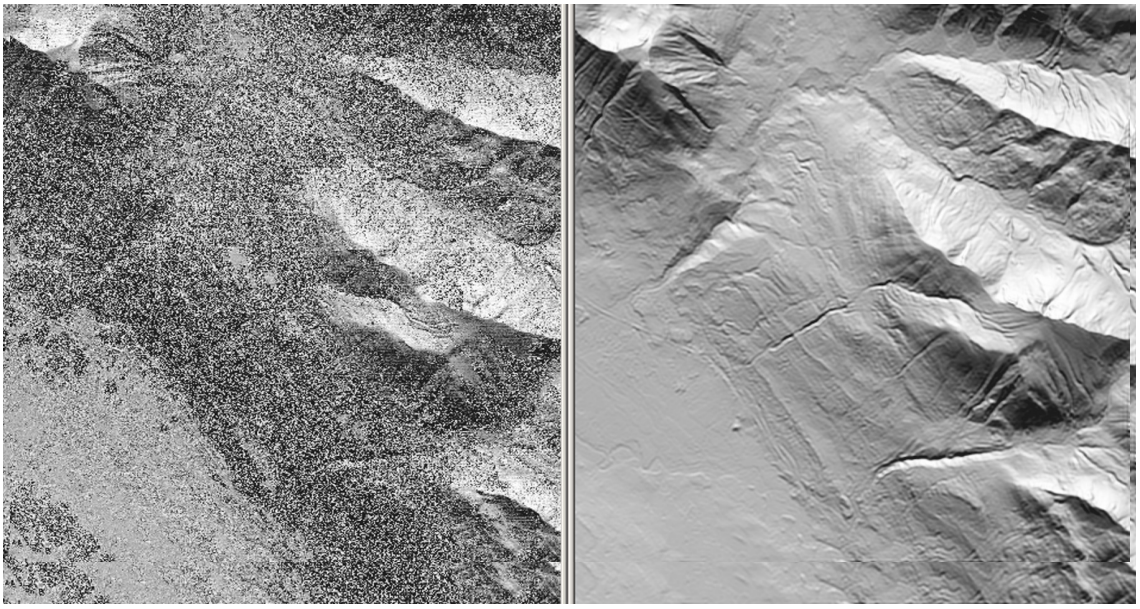
Other geophysical information, such as **AIRGrav** or aeromagnetic data, is collected simultaneously using SGL's fixed-wing and helicopter platforms. The scanning LiDAR system allows SGL to produce high resolution digital terrain models which can be used for environmental assessment, geotechnical and engineering applications as well as gravity terrain corrections.SGL has used laser scanner data since 1998 in order to provide its clients with the most accurate terrain elevation data possible.

The laser wavelength of SGL's scanning LiDAR system is near infrared and the scanning mechanism is a rotating polygon mirror which provides the laser measured distance and the 24-bit RGB colour of the target's surface. This allows SGL to provide a digital colour image of the ground surface along with the digital elevation model, and any other geophysical data collected.

The GPS position recovery uses NovAtel multi-frequency receivers in the aircraft and on the ground, processed using SGL's proprietary GPSoft navigation processing system, resulting in a horizontal position accuracy of better than 0.2 m and a vertical position accuracy of better than 0.3 m. The aircraft attitude (pitch, roll, and yaw) can be provided using SGL's **AIRGrav** system at a data rate of 128 samples per second, and an accuracy of better than 0.5 arcmin for pitch and roll measurements and 1.0 arcmin for yaw.



Scanning LiDAR digital terrain with magnetic data superimposed



Scanning LiDAR digital terrain model before tree removal *Scanning LiDAR digital terrain model after tree removal*

A "bare-earth" digital terrain model, in which the effects of vegetation are removed, can be generated through the application of an iterative process. An example is shown above.

BASIC SPECIFICATIONS OF THE SCANNING LiDAR SYSTEM

- Range measurement accuracy is typically ± 20 mm.
- A measurement rate of 16,000 shots per second with a 60° scan angle, provide 33 scans/second and 481 shots/scan.
- The number of measurements per square meter is 1.8 on average at 150 m altitude and a speed of 100 knots (185 km/h or 51 m/s).
- Laser ground point measurement accuracy is largely dictated by GPS position accuracy, and type and density of vegetation. Inaccuracies due to pointing error and range measurement error are typically 10 cm horizontal and 5 cm vertical, to bare earth, at a flying height of 150 m.

MEASUREMENT RANGE FOR NATURAL TARGETS

Reflectivity (%)	Flight Altitude Up To* (m)	Example Target
≈15	800	coniferous trees
≈20	850	dry asphalt
≈30	1,000	vegetation – green leaves
≈80	1,500	masonry and cliffs

* minimum altitude range is 30 m

LASER SAMPLE SPACING

This assumes a flying speed of 100 knots (185 km/h or 51 m/s) and along track sample spacing of 1.53 metres

Flight Altitude (m)	Swath Width ± 30° (m)	Average Cross Track Sample Spacing (m)
80	92.4	0.19
100	115.5	0.24
120	138.6	0.29
150	173.2	0.36
200	230.9	0.48
250	288.7	0.60
300	346.4	0.72