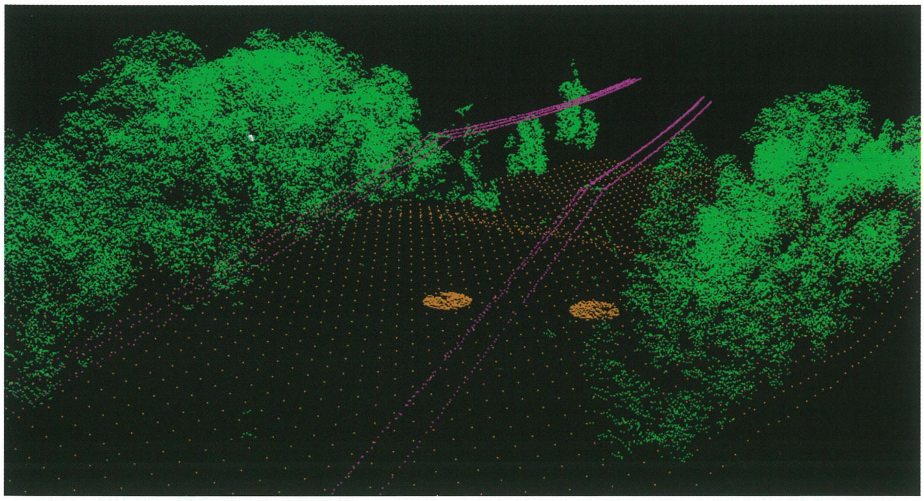
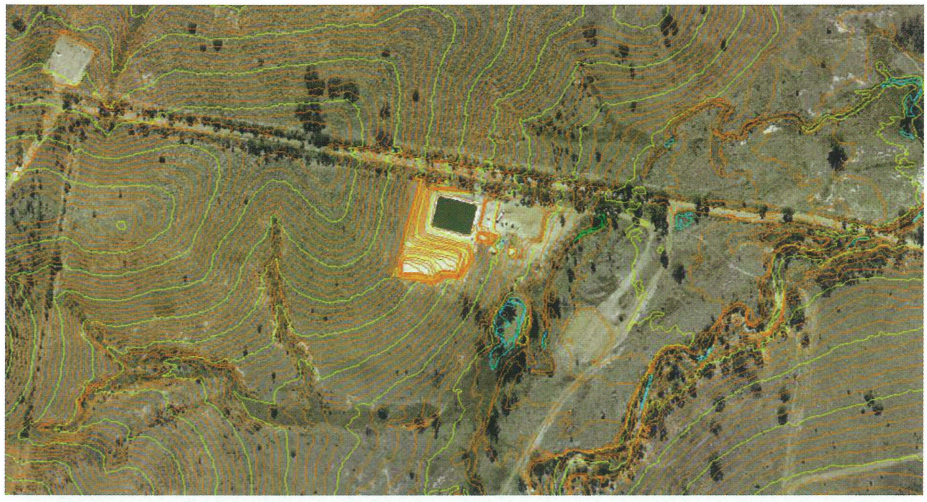
New Technologies And Techniques In Land Seismic Acquisition

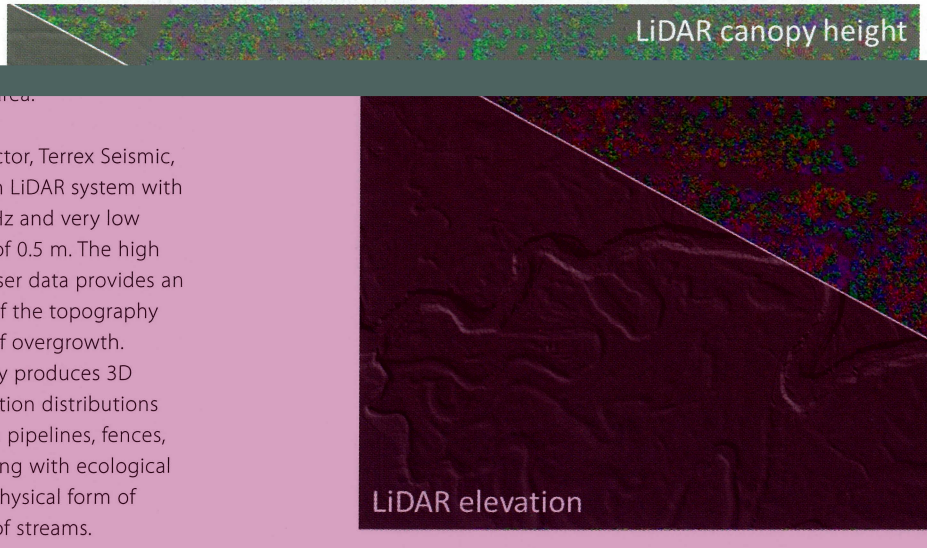
By Richard Barnwell, Terrex Seismic



3D LiDAR image.



LiDAR composite.



LiDAR elevation canopy.

In recent years, there has been a drive to increase the spatial resolution of seismic surveys in the hope of improving sub-surface imaging and additional information on subtle geological features. This has placed an added impetus on improving acquisition techniques to maintain acceptable production rates and survey costs, while minimising the environmental footprint.

This has resulted in the introduction of new technologies and techniques in land seismic acquisition, specifically aerial surveillance and souce-driven acquisition using multiple vibrator fleets.

Light Detection and Ranging (LiDAR)

Laser-based remote sensing was originally developed in the 1970s. The past decade has seen considerable improvements in data processing speeds, along with developments in Geographical Information System (GIS) and Global Positioning System (GPS) technologies. This has resulted in Light Detection and Ranging (LiDAR) becoming a cost-effective addition to land seismic data acquisition programs.

LiDAR uses narrow pulses of laser light over a range of frequencies to determine distances to objects and insight into their physical properties. By combining this information with an accurate GPS system, physical surface features can be mapped with very high resolution. Generally, LiDAR surveys are conducted using small aircraft in conjunction with coincidental aerial photography. This provides a fast and cost-effective method to attain both high resolution imagery and topography over a large area.

contractor, Terrex Seismic,
full form LiDAR system with
200 kHz and very low
tances of 0.5 m. The high
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tation of the topography
nsest of overgrowth.
herently produces 3D
vegetation distributions
such as pipelines, fences,
nes, along with ecological
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Australian seismi
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There are many benefits to land seismic acquisition through the use of LiDAR information. These include:

1. The survey design and planning can be conducted using a full suite of current high-resolution environmental and topographical information, resulting in an improved survey design with less adjustment required during acquisition.

2. The availability of an accurate representation of elevation reduces the requirement for on-ground survey accuracy and/or provides an additional independent source to confirm the acquisition elevations.

3. In addition, LiDAR data has many other uses to the local operator including the ability to quickly obtain a further dataset for the future; allow an improved understanding; and quantifiable measurement of environmental changes over time.

Source Driven Acquisition

A second technique used to reduce the surface surveying requirements is source driven acquisition. Recent improvements in information technology now allow for reliable, hi-speed digital radio networks to be established between each vibrator and the recording unit. These networks allow the establishment of hi-precision differential GPS systems and the real-time control of the vibrators by the recording system. The seismic program allows vibrator operators to be quickly guided to pre-programed source locations and all vibrator locations are known in real-time. As a result, the recorder can ensure all vibrator positions are within survey tolerances, highly repeatable and the final shot co-ordinates can be refined to reflect the true vibrator positions. This technique has been shown to increase shot positioning accuracy and reduce vibrator move-up times. The automation of vibrator control also simplifies the operation of multi-fleet shooting. The use of multiple fleets allows the positioning of one-fleet of vibrators to occur while another is shooting, further increasing acquisition rates by reducing or eliminating move-up wait times.

During 2010, Terrex Seismic established that the use of source-driven acquisition techniques using multiple fleets of vibrators resulted in increased production rates and a more efficient utilisation of seismic spread.

Wireless Acquisition Systems

Finally, the versatility, reliability and availability of wireless acquisition systems is always increasing. These systems remove some of the constraints imposed by fixed-spaced cable systems, allowing additional versatility in receiver placement, increasing the survey geometry design options and improving access to congested or obstructed areas where the running of cable is troublesome or prohibited. The removal of the cable component generally reduces the system weight and the deployment/retrieval effort, providing an added advantage of reducing health and safety exposure of line crews. The autonomous nature of the receiver units also reduces the downtime associated with factors such as weather and static causing line losses. As with the source-driven GPS, where GPS receivers are installed in receiver boxes the need for an accurately surveyed location is reduced. In the case of these static locations, the required GPS accuracy can be derived from several hours of monitoring.

The incorporation of high-resolution aerial surveillance data, along with the inclusion of accurate GPS, automation of multiple vibrator fleets, and use of wireless systems, has brought about several improvements to land seismic acquisition programs. These include:

- increased production rates and associated reduction in costs;
- accuracy of source and receiver co-ordinates;
- a reduction in ground survey requirements and equipment deployment efforts;
- reduction in the overall environmental footprint of the operations; and
- reduced risk of lost recording time due to surveying and equipment deployment delays. ■

Envirovibe acquiring for QGC, November 2010.