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Field Notes

Application of Lidar Technology: Pipeline Mapping

Canada's mainpipeline network consists of approximately 38,000 km (24,000 miles) of pipeline that transports natural gas and oil to the faster growing-markets in Canada and the United States. Alberta-based TransCanada Pipeline Limited plays a significant role in controlling this massive network, ensuring that homes and businesses across Canada and the U.S. are supplied with heat and power. In recent years, the public has demanded that pipeline operators take more responsibility for the safety of communities and the environments that may be impacted by the routes of these pipelines. Lidar (Light Detection and Ranging) remote sensing using airborne laser scanning equipment has emerged as a chosen technology for monitoring pipeline corridors. It is an accurate, fast, and economical method of collecting valuable data and information beneficial to the pipeline industry.

On August 25 - 28, 2002 Airborne Energy Solutions of Whitecourt, Alberta, collaborated with Optech Incorporated and took part in a demonstration effort using the Optech ALTM 2050 airborne laser scanner. The survey mission demonstrated how lidar terrain information could improve the risk management efforts of pipeline operators. The lidar data and imagery delivered a viable solution to the pipeline industry to assist in its endeavors to monitor and sustain the integrity of pipelines.

Track Changes in Terrain

Areas of terrain that are unstable due to poor soil conditions and steep slopes pose a risk to the integrity of the pipeline and must be monitored. Permafrost also creates problems, as ground settling may cause significant changes in terrain stability. Accurate DTMs (Digital Terrain Models) can be generated from lidar data to allow for identification and calculation of slope changes. This valuable information will aid in detecting the sinking and uplifting of the pipeline. Surface movement can also be identified by collecting sequential data sets. Airborne laser scanning using the ALTM also penetrates the forest canopy to detect below-canopy features. The forest canopy may be removed during processing with Optech's REALM (Results of Airborne Laser Mapping) laser point classification software. A DEM (Digital Elevation Model) may be generated using third-party software to show the bare earth model.

Detect Ground Surface Erosion

Having accurate lidar-generated terrain information allows for the detection of significant soil erosion and the ability to predict future attrition for given areas of concern using flow analysis simulations. There are regulations which outline the acceptable ground coverage over a specific pipeline dependent on the contents being carried. The collection of information using the ALTM may prove invaluable to future construction considerations not only for the pipelines themselves but for other projects which may be planned nearby the corridor.

Installation of ALTM 2050 in a Piper Navajo.

Identify Vegetation Encroachment

Airborne lidar data collection is a non-intrusive method of acquiring information for a given area, in this case a pipeline corridor. Lidar offers a solution for areas that are non-accessible by ground crews. The gathered data and information can be used to identify areas of vegetation encroachment that may pose risks to the integrity of the line.

Model Spill Flow

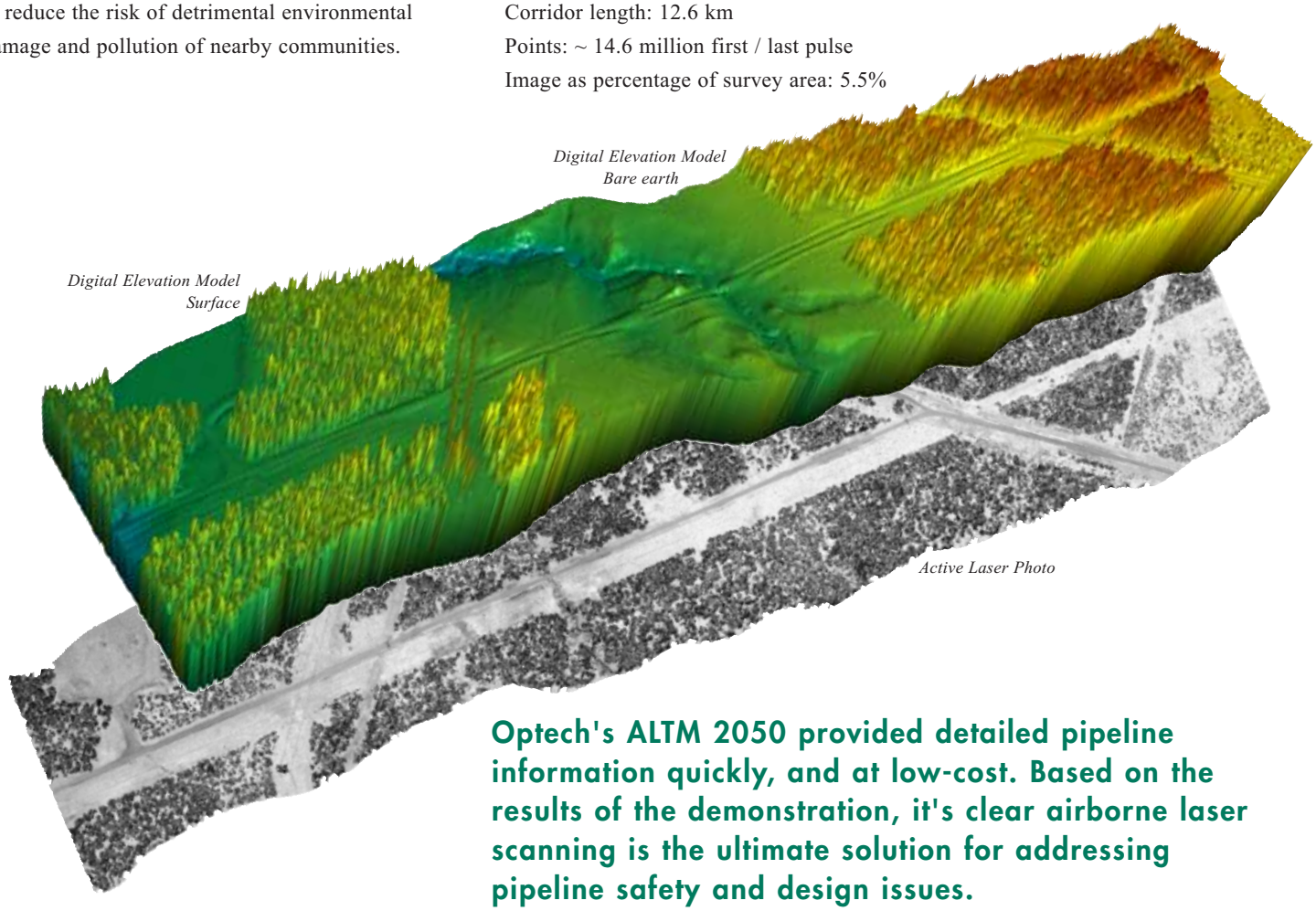
Knowing the direction that a discharged product may follow is crucial for emergency planners and pipeline operators for spill containment. Having ground terrain information collected with lidar aids in the planning efforts to ensure that spillways and shut-off valves are located in ideal positions for controlled diversion of the pipeline contents. Flow simulation analysis can be used to reduce the risk of detrimental environmental damage and pollution of nearby communities.

Define Line of Best Fit

Lidar-generated terrain information defines the profile of the ground and accurately identifies areas which may be of concern in the design and laying-down of pipeline sections. A DEM offers the advantage of being able to plan which route will mitigate safety risks without compromising the delivery expectations of the pipeline.

Pipeline Corridor Survey Parameters:

Spot Spacing: x= 0.9 m y= 0.4 m
Time to process: ~ 2 hours
Time for data collection: 13 mins.
Rep. rate: 50 kHz
Scan Frequency.: 40 Hz
Scan Angle: 10 degrees
Flight lines: 2
Height: 600 m agl
Corridor length: 12.6 km
Points: ~ 14.6 million first / last pulse
Image as percentage of survey area: 5.5%



Optech's ALTM 2050 provided detailed pipeline information quickly, and at low-cost. Based on the results of the demonstration, it's clear airborne laser scanning is the ultimate solution for addressing pipeline safety and design issues.

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