

As a girl excited about the possibility of getting a free helicopter ride for this issue's aerial inspection article, I was more than gung-ho to take on the topic when assigned. While it didn't pan out for me to take a flight myself, I did get to talk to a company full of experts who see the world from the sky nearly every day.

LiDAR Imaging Takes Flight in Canada

By Kathleen Davis, associate editor

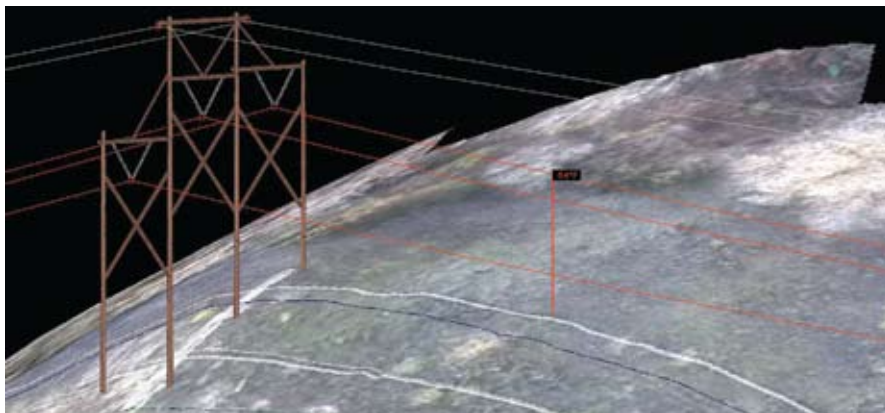
Manitoba Hydro started their aerial inspection company, W.I.R.E. Services, after a successful program to re-rate their own transmission lines. Pairing up with LiDAR Services International of Calgary gained them additional expertise in airborne imaging analysis, especially using LiDAR technology (which stands for "Light Detection and Ranging"). According to W.I.R.E. Services,



wire
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A full thermal rating analysis tells the utility the maximum operating temperature for every span on the line. Since the wire sags more in hot weather or when the electricity flow heats it up, this is very important information to make sure the line is operated safely. The results can be displayed graphically as well as output into a spreadsheet format.

they are the industry's first "combined utility and private LiDAR company relationship."

We spoke with L. J. (Luke) Chaput, the technical marketing engineer for W.I.R.E. Services about what they do, how they do it, and what can ground their helicopter. (Here's a hint: What grounds them is what the U.S. Post Office has sworn to overcome.)

UAE: What are the top reasons utilities utilize your aerial services?

L.J. Chaput: The top reasons for utilities to contract W.I.R.E. Services is the need to acquire detailed information on their current transmission line inventory or on proposed new transmission line routes that will be used as a basis for making informed cost-effective decisions. When the project is for a newly

proposed transmission line route, we provide a comprehensive digital terrain model used in developing the final alignment and tower location to produce a safe, cost-effective design.

If the project is the rating of an existing transmission line, the LiDAR and digital imagery data is used to develop dynamic three-dimensional models representing the "as-built" conditions of the line. These models are then used to thermally rate the line and locate any deficiencies. Once this is complete the line can be returned to its original design rating by fixing deficiencies or upgraded to meet the growing capacity demands.

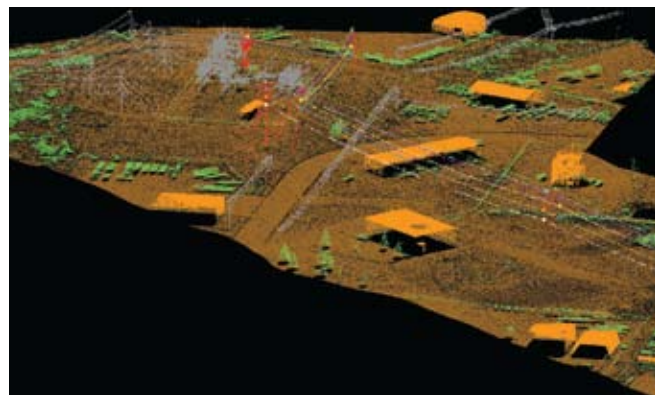
UAE: Could you give us a layman's explanation of your thermal rating analysis technique?

LJC: The LiDAR data we gather

is like taking a snapshot picture in time of the existing transmission line. By matching the cable in the model to the conductor LiDAR points, this snapshot can be used to create a model which represents the actual condition of the line during the time of survey. The LiDAR points are used to match structure locations, conductor sags, and any ground or aerial obstacles which may infringe upon required design clearances.

During the collection of the LiDAR data, we also deploy high-accuracy portable weather stations to collect weather data which is used along with the line loading at the time of survey to calculate the conductor temperature for that time period. We then assign this temperature to the cable in a computer-generated model, which in turn is used to check ground and aerial clearances at specific operating temperatures. The reason for this temperature calculation is that the cable used in transmission lines expands and contracts with the change of temperature. This change in length may cause it to sag too low to the ground.

Once the model is complete and the desired operating temperature is provided by the client, we can complete a variety of engineering analyses to determine span-by-span operating temperatures. The lowest span operating temperature dictates the overall line rating.



LiDAR data sample, point clouds. The picture at left displays the points once they have been visually classified into specific objects such as tower structures, wires and substation equipment. It has the orthographic imagery laid on top of the digital terrain model, which is a surface model derived from the collected ground points. The picture at right displays the LiDAR points at a low level of classification in which the points are coded based on elevation and object shape. No orthographic imagery is used to aid in the point classification.

UAE: What do those thermal ratings tell you about a transmission line, and how can a utility best utilize that data?

LJC: The thermal rating represents the maximum allowable temperature you can safely operate your line at based on clearance of wires over ground-based features such as trees, buildings and the ground itself. These ratings aid utilities in maintenance forecasting, export analysis and are essential if a utility is considering upgrading the capacity of the line.

Typically the thermal ratings show problem areas where the clearance between the energized cable and the ground or structures attached to the ground are insufficient. A large portion of the deficiencies take the form of vegetation encroachments, new road or line crossings, and new building or roadway lighting and signage.

UAE: What happens on a typical day for one of your aerial inspection projects?

LJC: The ground survey team will get an early start on the day following the morning safety meeting. The surveyors will leave to deploy GPS receivers and MET (meteorological) stations on selected geodetic survey control points



This shows a typical LiDAR installation on a Bell 206B helicopter. The installation can be completed in about six hours, which allows for quick access to project sites.

that will be used during the actual airborne LiDAR survey. The airborne team will arrive at the airport used for staging and meet with the pilot and air traffic control to plan out the day's activities. Following a safety meeting and communication with the ground survey team that all GPS receivers and MET Stations are in place, the helicopter will lift off, fly the previously surveyed calibration range and then start the LiDAR survey. Upon completion of the LiDAR data collection, the survey helicopter will return to the base of operation, fly the calibration site once again, and then touch down ending the data collection portion of the project.

The next thing that happens is the collected GPS data from the ground-deployed GPS receivers and the GPS

data collected in the air are processed, followed by the LiDAR processing to develop the initial set of LiDAR point clouds which are viewed to ensure all data collection aspects of the project have been met. Forward video and downward-looking imagery are also reviewed for project completeness.

UAE: What are the biggest hurdles in the aerial inspection game? Weather?

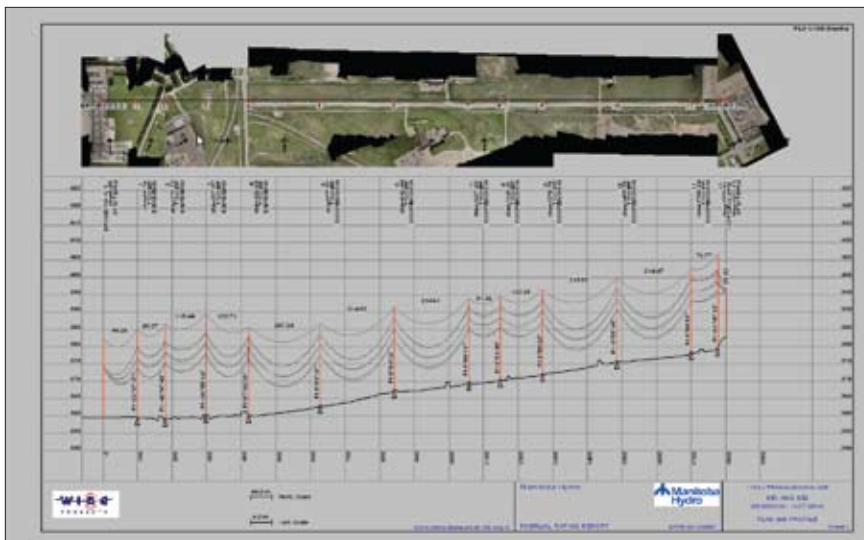
LJC: Weather is indeed the biggest hurdle. LiDAR data collection cannot be done during rain or snow, low clouds or ground fog, or during periods of high winds.

UAE: You offer thermal analysis, route surveys, ROW vegetation analysis. What different tools do each of these areas require?

LJC: The software used for filtering and classifying the data is somewhat different depending on whether it is a new or existing route. The transmission line CAD software used is generally dictated by the client, and we support all of the latest CAD software packages.

All thermal, new route and ROW vegetation surveys require the same basic LiDAR and imagery collection. The factors which can change are the flying height and forward speed at which we collect the data; typically new route surveys are flown at higher elevations.

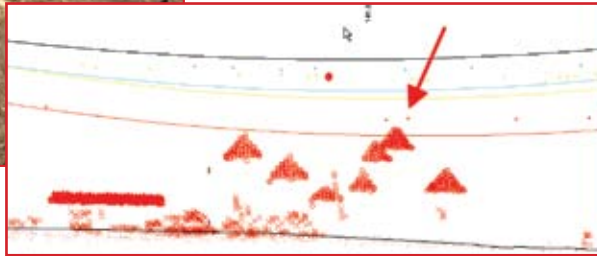
As mentioned previously, if we are providing a complete "as-built" model for the purpose of a thermal analysis, then during the LiDAR collection we also set up meteorological stations



Typical plan and profile output from PLS-CADD software using LiDAR data to accurately create a computer model of an existing transmission line. In many cases, W.I.R.E. Services delivers the utility's first "as-built" view of its transmission line. These accurate plan and profile drawings help make sure they meet current safety codes and are vital when considering upgrade options to get more capacity from the line.



Images of grain silos (storage bins) located on a farm in western Canada with a 138 KV transmission line directly overhead. The profile view, displays the LiDAR points at the time of survey; note the red colored points which are the collected LiDAR wire hits. They are approximately 1.5m above the top of the silo. The solid-colored lines represent the conductor at 100 degrees Celsius, a projected hot temperature that we can predict by using the computer model; note the red phase wire at 100 degrees Celsius combined with a slight side wind would make contact with the Silo. This situation was remedied before any accidents occurred.



which record current MET data during the survey.

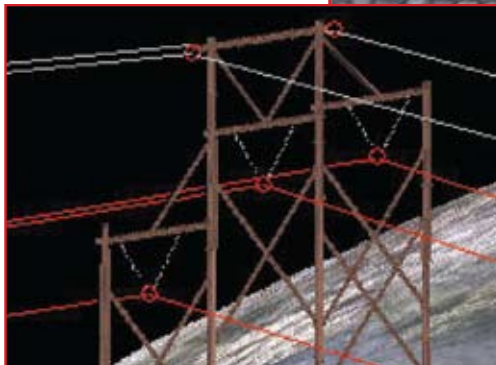
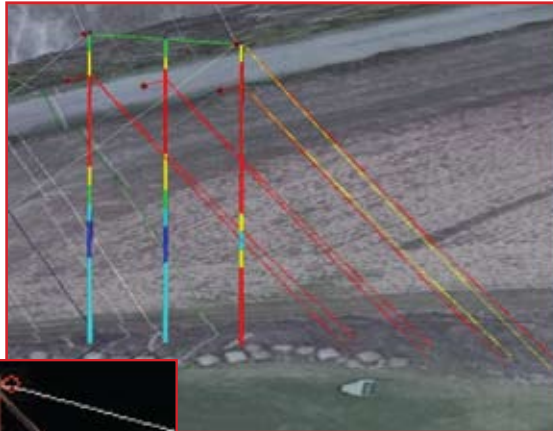
Also, the utility must provide us with the line loading (how much power is being used on the line) during the time of the LiDAR survey.

UAE: On top of the LiDAR Survey W.I.R.E. Services also offers analysis and consultation. So, let's talk a few details there. What kind of power flow increase can a utility expect by re-rating a line to a higher operating temperature?

LJC: The increase in power flow is dependent upon many variables,

i.e. conductor, voltage, ambient temperature, wind conditions and so on. Rather than provide one specific example, try out our online capacity calculator located at www.wireservices.ca. It's easy to find on the left navigation bar under "research." We developed this tool to help a utility see the huge potential that increasing a thermal rating can have on line capacity. So, that will give your readers an idea of the potential for re-rating analysis.

Overloaded structures (such as this tight running angle), can be identified easily with the proper use of LiDAR data and a good modeling software. By improving the failing components, solutions to the dangerously overloaded structure can be derived. The components shown in red represent greater than 100 percent usage of allowable design strengths. Cost effective solutions can generally be determined prior to catastrophic failures which can lead to large outages and costly repairs.



UAE: Briefly, for a novice like me, how do you determine the tension of the wire in each span along the transmission line?

LJC: Through analysis of LiDAR data, we can calculate the wire tension by mapping the catenary shape of the wire in every span.

In addition, experience has shown that there can be significant tension variances between adjacent spans even within a specific ruling span section.

UAE: Can you tell us about any projects you are currently working on for electric utilities in the U.S. and Canada?

LJC: We have completed many projects in Canada and the U.S. and have a large project in Costa Rica starting in January of 2008. At the moment we are working on a large upgrade project for a Canadian utility. They contracted W.I.R.E. Services to gather LiDAR data on five of their existing transmission lines approximately 700 kilometers in total length. We are using this data to build complete three-dimensional models of each line, rate the existing lines and then use this rating to rectify any deficiencies as well as ensuring the lines can be safely operated to a required ground clearance at a specific operating temperature. <<

Chaput graduated from the University of Manitoba in 2005 with a B.S. in Civil Engineering. He is a registered engineer in training with the Association of Professional Engineers and Geoscientist (APEGM).

Manitoba Hydro, with head office in Winnipeg, Manitoba, is the fourth largest electrical utility in Canada and a major exporter of power into the USA.

LiDAR Services International is a LiDAR data collection and data processing services company with LiDAR experience dating back to the early 1990s. LSI's team of survey engineers have collected LiDAR data on five continents. LSI uses the HELIX LiDAR system for all W.I.R.E. Services data capture requirements. The HELIX system is the fifth generation LiDAR system built by the LSI team.



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