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CASE STUDY

Turning Over a New Leaf

By Mary Jo Wagner

"Go big or go home" seems to be an unwritten motto at North West Geomatics, a digital aerial photography and remote sensing provider in Calgary, Alberta. Though it is a fairly small outfit, it has a penchant for taking on massive projects. In 2007 the company successfully acquired a nearly 800,000-square-kilometer LiDAR survey of northwest Alberta and northeast British Columbia - the largest-ever, privately funded LiDAR survey project in North America. That same year, NWG embarked on what is considered to be the largest digital airborne survey of its kind for forested land: 600,000 square kilometers of dense forest in Ontario.

"In terms of project size, imagery resolution and the depth of products being delivered, this is the biggest airborne survey in North America," says John Welter, NWG's vice president of technology.

Initiated by the Ontario Ministry of Natural Resources (OMNR), the survey has also presented one of the biggest logistics-challenges to NWG as well. Apart from coordinating flight crews and survey field teams 2,000 miles away, NWG has had to devise strategies to triumph over complex operational issues such as limited aircraft fuel availability, prohibited vehicle access to provincial and national parks and protected areas, scant lodging facilities and very remote, challenging terrain.

However, the one aspect of the project that has not posed a challenge has been the technology, says Welter. In fact, he says, NWG's Leica Geosystems' airborne sensors in conjunction with its specialized data-processing workflow have been the core enablers of the project's success to date.

"The Leica ADS40 not only provides excellent image quality but it also offers stereo imagery so we can create 3D views of trees - a crucial visual for foresters in creating forest inventories," explains Welter. "Given the forest management objectives of the project and the data products required by the OMNR, the Leica ADS40 was really the only sensor that could have delivered."

Harvesting digital traditions

Ontario is characterized by vast and diverse forests that comprise nearly two thirds of the province. Ranging from deciduous, mixed and boreal species, Ontario's total forested land equals the combined land masses of Germany, Italy, Switzerland and the Netherlands - almost 700,000 square kilometers. Ninety percent of this 70-million-acre area is owned by the province and is managed by the OMNR in conjunction with forest products companies and communities.

A significant part of that management involves the on-going Provincial Forest Resource Inventory Program designed to catalog and to map the province's forest assets down to the individual tree species, their health and their growth rates. Historically, the OMNR has produced inventories every 20 years. Each inventory began with acquiring a patchwork of hard copy black and white aerial photographs. Then photo interpreters would use stereoscopes to study each photo and manually delineate each forest stand and its attributes on the print. Another colleague would then digitize the information into a GIS and three years later, the OMNR would have a complete forest inventory for 1/20th of the area.

With the advancements in both aerial imaging and computing technology, it became clear that the OMNR could adopt a more efficient forest-inventory process.

In late 2006 the OMNR awarded the new imagery acquisition campaign to NWG and in early summer 2007, they flew the first flight campaign. A little over one year into the four-year project, NWG has now acquired 50 percent of the project's coverage to date.

"Leafy" ambitions

Unique to the new survey is that the OMNR is capturing digital imagery when the trees are in full leaf as opposed to many other projects that required digital imagery at leaf-off conditions. To take advantage of the leaf-out conditions and to capture the foliage's unique spectral signature, NWG has needed to cover as many forest management units (FMUs) - a tract of forested land licensed to a forest company - as possible from June to September.

Prior to June, OMNR personnel provide NWG teams with a prioritized list and GIS map layers of FMUs to acquire. NWG staff imports those map Shapefiles into their Leica Flight Planning and Evaluation Software (FPES) to create the most efficient flight plan and then uploads the plan directly into their Leica ADS40 sensors.

Weather permitting, up to eight aircraft equipped with Leica ADS40 sensors would collect nearly 4 terabytes of stereo imagery in a six-hour day - the sensor captures a 4.8-km-wide swath of imagery at 20- to 40-cm resolution. Within 24 hours of each flight, NWG image processing teams would archive the data, inspect its quality and create base-level orthophotos to pinpoint the needed ground control points.

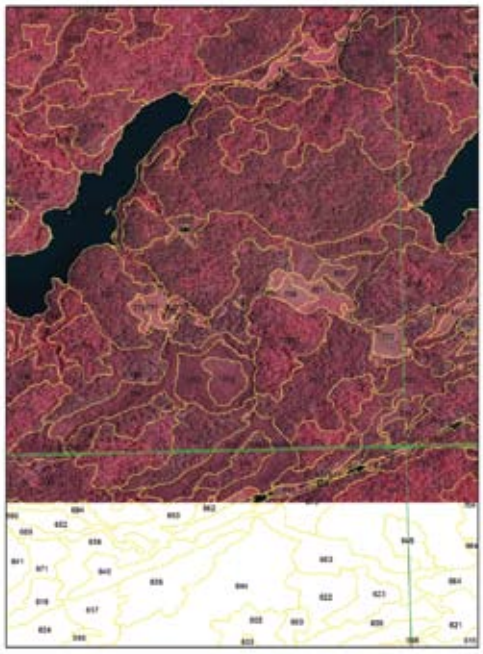
Using a unique ground-control "photo ID" approach, NWG personnel analyze the imagery to locate distinct features such as road intersections, rocks, or outcrops that offer the best control points for a given area. They then create a Shapefile showing those exact measurement points along with the actual image capture of those points, email the files and post them to an FTP site for the team of 12 surveyors to download and import into their Leica GPS base stations. After every flight, NWG teams would send a new set of ground measurements in near real-

time to the field teams, enabling them to maintain a continuous field operation and complete the ground component in four weeks.

Welter says the crispness of the imagery and the iterative communication environment have been key to meeting the stringent project parameters and keeping them on schedule.

"The photo ID method is far more proactive, efficient and environmentally friendly," explains Welter. "With the level of image detail we have from the ADS, we can pinpoint exactly where we need to have control and limit it to only what we need. Choosing control points with the ADS imagery also mitigates safety risks and measurement errors because we identify the exact features to measure in the image so we know they're visible, measurable and the surveyors can reach them safely. And because we're all working directly from the imagery and communicate in real-time, we can quickly refer to the imagery and revise control point locations on the fly if any unexpected access issues arise."

The production process has been rather fluid as well. A continuous stream of image and map products have been flowing into the OMNR including panchromatic and four-band orthophotos both as raw image strips and radiometrically corrected mosaics as well as 1-m and 5-m digital surface models. In total, Welter estimates NWG will deliver 1.2 petabytes of imagery to the OMNR.



Wayne Day, a forest resources inventory specialist with the OMNR says false-color orthophoto mosaics such as this one benefit interpreters because they allow them to manipulate the data and include additional layers to increase assessment accuracies. The yellow lines on the imagery represent stand boundaries including tree species composition, age, height and density.

A tree of a different color

Joseph Kapron, acting director of OMNR's geographic information branch, says the breadth and depth of the new imagery has been a very welcome addition and has already spurred personnel to think about future applications of the data.

"This project has gone extremely well and our staff are very enthusiastic about the imagery," he says. "The quality of the imagery is very good and its digital nature is so much more dynamic than hard prints. We have the flexibility to zoom into specific areas, annotate directly on-screen and the different color bands and infrared band enable us to differentiate different species, which eases the interpretation process and enhances the quality of our assessments. We have not only been able to increase our efficiency by 33 percent but we are already seeing the potential for the imagery to be used in other forest-related applications."

And that's good news for Welter and his staff at NWG as they prepare to return to survey more OMNR forestry assets in June. It not only validates the viability of the Leica ADS40 as a cost effective and reliable visual aid for producing forest inventories, it strengthens the sensor's potential to become the de facto digital airborne resource for forest-management intelligence.

"The ADS40 has features that are particularly well suited for forestry applications," says Welter. "Many competing vendors use pan-sharpening techniques to create high-resolution multispectral products but that decreases its usefulness for remote sensing because it dampens the spectral resolution, which is what foresters need to identify individual trees. The ADS40 delivers both the spectral resolution from the four-color bands for tree-species analysis and the high spatial resolution to allow foresters to zoom in for more detail. We think the sensor offers us a real chance to open up the forestry market."

CORPORATE PROFILE

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