IMPROVED FOREST INVENTORY:

WHEN REALITY IS BETTER THAN FICTION

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A revolution is taking place in the forest inventory world: technology has arrived that makes it possible to collect data in a completely different way and with greater precision than ever before. Laser technologies such as aerial LiDAR or terrestrial LiDAR as well as other instruments that can measure the internal attributes of a tree are currently being tested by FPInnovations and Natural Resources Canada's own Canadian Wood Fibre Centre.

Very Promising Advances

In addition to being costly, traditional forest inventories are difficult to update. In terms of stands, they produce a lack of volume precision in the area of 20 to 40%, often making it necessary to get additional data in order to make informed decisions. One of the major challenges of the improved forest inventory is to provide foresters with precise and detailed information, both on a large scale such as a vast land area and on an operational scale for each block to be processed. Well, that challenge has been met! The quality of the information has exceeded expectations and an entire forest can now be inventoried tree by tree. Furthermore, major steps forward have been taken in posting the internal attributes of the wood's fibre on forest maps using the EvaluTree[1] program.

Aerial LiDAR

Data collected using aerial LiDAR *(light detection and ranging system)* on the forest canopy (stand structure, tree crown dimensions, height, volume canopy density and biomass), on the waterways and on the topography make it possible to produce forest maps covering ***100% of the territory*** (figure 1). Field sampling is no longer required for this type of data.

These maps provide valuable information for road construction and the location of logging trails and generate a stand table that is a great deal more precise by listing the trees by diameter class. The block contours are also better defined, which has an impact on the precision of performance calculations (m^3/stem/ha). Furthermore, a more detailed knowledge of forest structure makes silvicultural prescriptions easier. It goes without saying that such information will allow for a better calculation of forestry possibilities. This kind of cartographic and georeferenced data, combined with the FPInterface software[2] , makes it possible to predict operational costs for harvesting, transportation, road construction and silviculture.

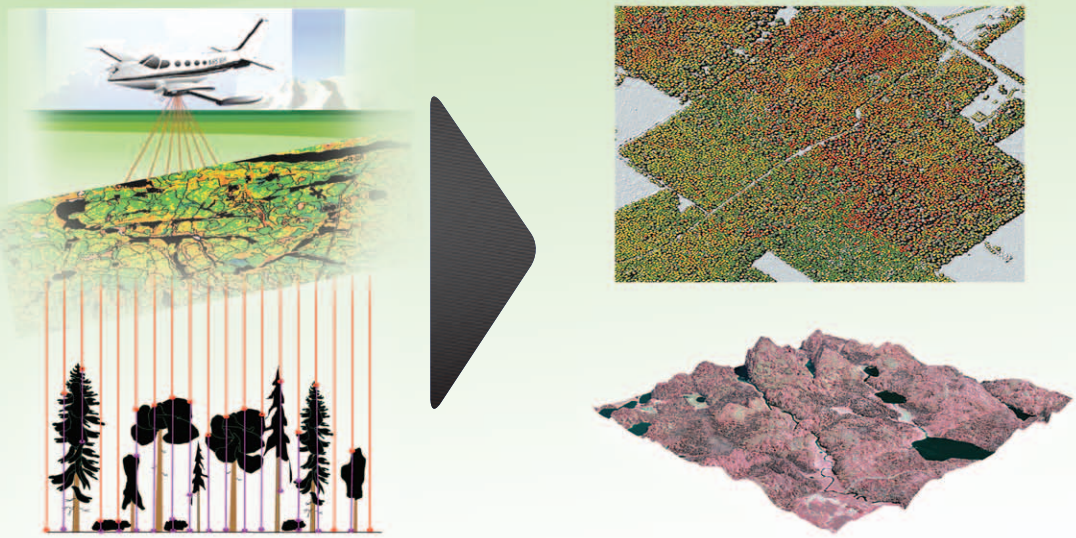

Figure 1 :
Maps Produced Using Aerial LiDAR

[1] *EvaluTree: A joint collaboration by FPInnovations, the University of Northern British Columbia and the University of Victoria, this program allows researchers to use advanced technologies (such as SilviScan) to analyze the internal attributes of wood fibre.*

[2] *Forest planning software developed by FPInnovations; www.partenariat.qc.ca/pdf2/0T-141.pdf*

Terrestrial LiDAR

Photo : Thomas Hilker, UBC, Forestry

In addition to taking diameter and land surface measurements, terrestrial LiDAR makes it possible to obtain a three-dimensional image of the tree with its tapering, branching and crown characteristics. This data is then processed using FPOptitek to estimate the wood products contained in each tree and establish the revenues expectations for based on the markets (figure 2). Knowing the value of the products and transformation costs using FPOptitek[3] as well as the supply costs using FPInterface, it is possible to determine the net worth of the block, to find out the array of products per block before cutting as well as to optimize the value, sorting and destination based on the needs of the processing plants. It will therefore become easier to select the most profitable sectors based on the destinations.

The data provided by land LiDAR also makes it possible to evaluate the stumpage in order to meet market needs for primary processing and secondary processing, both for appearance wood and structural lumber. For example, the branching data provides information on knots, which in turn provides indications on the wood grain for appearance wood or on mechanical weakness zones for structural lumber.

Figure 2: Measurements and optimization based on terrestrial LiDAR and FPOptitek

Precision Means Savings

There are many benefits to the improved forest inventory. A detailed knowledge of the land (topography, drainage) associated to the available volumes makes harvest planning more reliable and the construction of road networks easier. Control over operations is made easier through enhanced knowledge of the variability in harvesting conditions within each cutting block. A more precise estimation of the quantity of crowns, bark, stumps, branches and leaves provides indications on the actual availability of biomass in the stand, in the cutting area and on the edge of roads.

To summarize, the improved forest inventory makes it possible to better plan and control forestry operations and increases the value of the wood harvested through both the reduction of costs and better use of the wood's value. It generates a savings of $3/m^3 over the traditional forest inventory by avoiding, among other things, revenue losses associated with low-value areas, losses in productivity in the forest-plant production chain and the non-productive movement of machinery. Furthermore, it will no longer be required to constantly review the operational planning.

Going Even Further

Although there is still a lot of work to be done in meshing the data from various sources – the two types of LiDAR, the traditional forest inventory and the instruments measuring the internal attributes of trees – a lot of very promising results are already available. All this data, pooled together and correlated, will make it possible to obtain more detailed information and predict the quality of the wood and the attributes of the fibre based on the morphological characteristics of the tree, visible both in the field and from high above. The concept of quality will be added to that of quantity on forest maps… quite a revolution!

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[3] *Software for optimizing the cross-cutting and breakdown of logs developed by FPInnovations; www.partenariat.qc.ca/pdf2/0T-101.pdf*

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