Enhanced Forest Inventory Activities at the Petawawa Research Forest

- Creating species tree lists for LiDAR ABA inventories - in search of the Holy Grail

- Evaluation of mobile laser systems for measurement of trees and forests - doing more faster - cheaper & adding value ????
LiDAR - Area Based Approach (ABA)

Petawawa Research Forest Inventory Surfaces

Gridded Land base

20m

20m
Informing ABA Predictions with ITC Species information

ABA Prediction of GMV

Individual Tree Crown Approach

Adding Species - DiamDist

HYBRID

Image Based

ALS Based
Potential to inform LiDAR raster grids with species information vs. Polygon

Predicting 10 Conifers x Origin (14 species)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Correct</th>
<th>Total</th>
<th>Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration</td>
<td>519</td>
<td></td>
<td>701</td>
<td>74%</td>
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<tr>
<td>Validation</td>
<td>160</td>
<td></td>
<td>212</td>
<td>75%</td>
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François Gougeon & Don Leckie (retired) - CFS Victoria
New Multispectral LiDAR Technology – Optech Titan

RGB Image

LiDAR Intensity (Single)

Multispectral LiDAR

AWARE - Jean-Francois Prieur & Benoit St-Onge, UQAM
Informing ABA Predictions with Species information - Imputation

Methods
- Most Similar Neighbour
- Random Forest

ABA Prediction of GMV

Reference & Target Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>BA</td>
<td>Basal area of all live trees</td>
</tr>
<tr>
<td>GTV</td>
<td>Gross total stem volume</td>
</tr>
<tr>
<td>GMV</td>
<td>Gross merchantable stem volume</td>
</tr>
<tr>
<td>DQ</td>
<td>Quadratic mean Dbh</td>
</tr>
<tr>
<td>LH</td>
<td>Lorey height</td>
</tr>
<tr>
<td>PBA</td>
<td>Pole BA</td>
</tr>
<tr>
<td>SsawBA</td>
<td>Small sawlog BA</td>
</tr>
<tr>
<td>MsawBA</td>
<td>Medium sawlog BA</td>
</tr>
<tr>
<td>LSawBA</td>
<td>Large sawlog BA</td>
</tr>
</tbody>
</table>

Lidar Predicted Target Rasters

Reference Plots

Finding the closest match & informing the pixel with species and Dbh, etc
Informing ABA Predictions with Species information - RF LiDAR

**Observed Forest Type Composition**

![Bar chart showing forest type composition for Stand 463 - TolHwd - Observed](chart1)

**Observed Species Composition**

![Bar chart showing species composition for Stand 463 - RF - LiDAR LeadSpec](chart2)

**Closest Match By Forest Type**

![Bar chart showing closest match by forest type](chart3)

**Closest Match By Leading Species**

![Bar chart showing closest match by leading species](chart4)
Use of GeoSLAM Mobile LiDAR Technology for forest Inventory?

ZEB-REVO

100Hz Scanner
FOV - 270-360°
Data Acquisition - 43,200 pts/Sec
Range - 15-20m (up to 30m)
**Objective**

Evaluation of Rapid Laser Scanning Techniques in the Measurement of Tree and Forest Stand Attributes for Enhanced Inventories

- Measurement of fixed-area plots - closed
- Operational Cruising - linear
- Regeneration Assessments - linear

**Questions**

- What % of trees can be detected?
- Can we recover Dbh? Taper?
- Heights/LCR/Fork Locations?
- Species ???????
- Effort to process?
PRF 161 - Hardwood Stand
PRF 161 - Hardwood Stand Cylinder Fitting

Measuring Dbh

Measuring Taper - Merchandizing

Source: AWARE - Bastien Vandendaele
PRF 209 - Conifer Plantations
PRF 209 - Conifer Plantations

Raw Vegetation Point Cloud

Vegetation Slice (50cm - 2.5m)

Filtered Stem Point Clouds

Detected and Measured DBHs

Source: Jili Li
Operational Cruising - Plantation Performance

Hardwood
OPC

Pine
Shelterwood

Direction of travel
20m
Contact: murray.woods@canada.ca
        peter.arbour@canada.ca

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