Towards the prediction of wood resource in tropical forests from TLS and ALS

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TOWARDS THE PREDICTION OF WOOD RESOURCE IN TROPICAL FORESTS FROM TLS AND ALS

Marilyne Laurans, Grégoire Vincent, Chantal Geniez, Jean-Louis Smock, Vincent Bézard, Florence Heuschmidt, Melaine Aubry-Kientz, Alice Penanhoat

STEM VOLUME ESTIMATION: COPING WITH WIND AND OCCLUSION

- **Dicorynia guianensis** emergent trees were scanned at Paracou Research station in French Guiana with a Faro Focus 3D.
- Two cases of TLS points distortion by wind:
  - TLS points are segmented and shown at two stem heights; they are colored by separate scans.
  - Wind may introduce inaccuracies to the estimation of stem volume performed from TLS multi-scan point clouds. We compare here four methods for 3 trees with noticeable wind problems.

<table>
<thead>
<tr>
<th>Method</th>
<th>Multiple scans</th>
<th>Single scan</th>
<th>Standard deviation between singles scans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic</td>
<td>0.13</td>
<td>0.34</td>
<td>0.42</td>
</tr>
<tr>
<td>Manual</td>
<td>0.12</td>
<td>0.14</td>
<td>0.26</td>
</tr>
</tbody>
</table>

- Result: When confronted to windy conditions, a manual correction seems necessary to prevent underestimation of the volume. The low error we get with manual estimation on single scans may be an hint to improve efficiency on the field and take only fewer scans when confronted to non favorable conditions.

PERSPECTIVES: IMPROVING GEOMETRICAL FITTING

- Processing chain of (Pitkanen et al. 2019): tree stems are first modelled as cylinders which are used for further circle fitting procedures using co-registered data or single scans.
- STEP method (Ravaglia et al. 2017): combining a Hough transform and a new form of growing active contour model ("snakes") to detect and reconstruct complex tubular shapes in dense, noisy and occluded point clouds.


CALIBRATING ALLOMETRIC MODEL WITH TLS

- Terrestrial lidar acquisitions (TLS) will provide a reference database for calibrating species-specific allometric models.
- Prediction of stem volume (V) from tree height (H) and crown width (CW):
  - Preliminary dataset: 13 *Dicorynia* g. trees
  - V is estimated from field measures of stem diameter
  - H and CW are extracted from TLS point clouds
  - Log-linear model: \( \log(V) = a + b \log(H) + b' \log(CW) + \varepsilon \)
  - Predicted vs. measured stem volume: \( R^2 = 0.84 \)

PREDICTING WOOD RESOURCE FROM ALS AND THR PHOTO

Segmentation algorithms are used to delineate individual tree crowns in ALS point cloud.

Classification algorithms are computed on hyperspectral image to discrimination of tree species with high accuracy (Laybros 2019)


Metrics like height and crown dimensions are extracted for each tree => prediction of timber stem volume

Segmented ALS point cloud

UMR AMAP, Montpellier, France
ONF, Cayenne, Guyane Française

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