Measuring Timber Piles with TRESTIMA Stack

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TRESTIMA Stack

• Founded by Finnish company Trestima Ltd.

• Mobile application for measuring volume of a timber pile from images taken by a smartphone or a tablet device.

• Machine vision recognizes the ends of logs and determines their diameters using one meter long TRESTIMA Yardsticks as a reference.

Process of using TRESTIMA Stack:

1. Name the time of measurement.
2. Attach TRESTIMA Yardsticks to pile side and make a picture.
3. Input the outer boundary of the pile to the screen.
4. Add an average length of logs (need to measure manually).
5. Add tree species (coniferous/deciduous).
Actual volume is counted based on surface area of pile, log length, and an automatically generated coefficient factor.
Our Study

• The aim was to determine the **accuracy and time consumption** of TRESTIMA Stack tool compared to the conventional measuring method of piled timber stacks.

• The usage of the TRESTIMA Stack was clarified both with smaller **roadside timber piles** and larger **wood terminal and intermediate yards**.

• The control volumes of all piles studied were measured in October 2016 – February 2017 in Stora Enso Anjala, Imatra and Varkaus mills by **weight scale sampling with immersion**.
## Data and Results of Accuracy

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Trestima Stack</th>
<th>Conventional measuring</th>
<th>Avg pile</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate/Terminal</td>
<td>28</td>
<td>0.7 %</td>
<td>-4.8 %</td>
<td>9650</td>
<td>29</td>
<td>1037</td>
</tr>
<tr>
<td>Coniferous pulpwood</td>
<td>19</td>
<td>0.8 %</td>
<td>-6.0 %</td>
<td>7621</td>
<td>89</td>
<td>1037</td>
</tr>
<tr>
<td>Deciduous pulpwood</td>
<td>9</td>
<td>0.6 %</td>
<td>-2.4 %</td>
<td>2029</td>
<td>29</td>
<td>821</td>
</tr>
</tbody>
</table>

|                | 32 | Roadside       |                         | 2307     | 72  | 15  | 298 |
| Coniferous pulpwood    | 21 | 4.3 %          | -3.6 %                  | 1706     | 15  | 298 |
| Deciduous pulpwood     | 11 | 4.9 %          | -7.5 %                  | 600      | 29  | 97  |

**Total** 60 2.7 % -4.9 % 11957
Results: Time Consumption

<table>
<thead>
<tr>
<th>Avg Effective Time Consumption</th>
<th>Trestima Stack (N=49)</th>
<th>Conventional Measuring (N=36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement method/pile</td>
<td>0:18:16</td>
<td>0:28:07</td>
</tr>
<tr>
<td>Time/m³</td>
<td>0:00:10</td>
<td>0:00:16</td>
</tr>
<tr>
<td>Measurement/pile</td>
<td>0:08:48</td>
<td>0:24:52</td>
</tr>
<tr>
<td>Time/m³</td>
<td>0:00:05</td>
<td>0:00:14</td>
</tr>
<tr>
<td>Volume counting</td>
<td>0:09:28</td>
<td>0:03:16</td>
</tr>
</tbody>
</table>

Employees of TRESTIMA verify imagines before the final result of stack volume which caused occasionally remarkable delays to measurements.

By omitting the time loss caused by the delays, the effective time consumption of TRESTIMA Stack decreased to 5 s/m³.
Correlation analysis showed that **average pile diameter** correlate statistically significantly with the accuracy of TRESTIMA Stack.

- Average diameter of timber pile differed from 27.9% (3.6 cm) with TRESTIMA Stack and
- 21.3% (2.7 cm) with conventional measurement method.

Studied attributes that might affect the accuracy:

- Average pile diameter
- Coefficient factor
- Density of timber
- Gross volume
- Number of images
- Number of piles
- Pile size
- Snow
- Shooting distance
- Tree species
- Storage
- Temperature
- Time between measurement and immersion
Gross Volume

• The most common reason for the inaccuracy by the TRESTIMA Stack was empty space in the final image framing around the pile.

• Consequently, the TRESTIMA Stack application assessed the gross volume of pile too high.
Discussion & Conclusions (1/2)

• TRESTIMA Stack:
  - Compared to conventional measurement method, it is more accurate and faster system.
  - Measurements in wood terminals and intermediate yards are more accurate than measurements at roadside landings.
  - Determination of average diameter of timber pile is inaccurate.
  - Average diameter of timber pile has statistically significant impact to accuracy.

• Conventional pile measurement method:
  - Almost equally accurate in both storage types.
  - Determination of average diameter of timber pile is inaccurate.
Discussion & Conclusions (2/2)

• Although the TRESTIMA Stack is very accurate especially when measuring large quantities in terminal and intermediate yards, the usage of the TRESTIMA Stack between narrow timber yards is not easy.
  
  − In terminals namely timber stacks are stored normally side by side because of the lack of space.
  − Those timber yards are currently measured by multiplying the first stack with the number of stacks behind it because measuring the middle stacks is impossible.
  − TRESTIMA Stack will not remove challenges of volume evaluation in that kind of timber yards.

• Therefore, the TRESTIMA Stack is recommendable for inventoring timber piles at roadside landings.
Thank you!
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