SIMULCABLE: A new software to optimise the line implantation for cable yarding

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French Context

• Cable yarding is sometimes used to cross river or swamp areas, but most of the time in mountains areas, where building a road is too expensive or not compatible with nature protection goals.
• Less than 15 enterprises in France.

• Focus on the French Alps,
  ✓ 7 enterprises, and only 3 with cable crane (tower yarder).
  ✓ less than 40,000 m^3 per year are extracted by cable yarding.
  ✓ Difficulties to install new teams, while demand is increasing ⇒ foreigner contractors for logging operations.
**The cable cranes**

In the French alps, all enterprises are equipped with a trailer:

- **On a truck:**
  1100m, 3 to 6 tons

- **On a trailer:**
  800m, 3 tons

- **On a tractor:**
  400m, 3 tons
The crane on the road offer the possibility of harvesting downhill or uphill.

Whole tree are extracted and cut at road side with a harvester or processor:
- Production of wood chips
- Safety conditions for the loggers
- High productivity
Programmation of the line implantation

• Generally done by the forest manager (owner’s delegate, expert, ….)
• Necessary to establish the business plan of the harvesting operation

The needs, before cutting the corridor:
• Position of the crane and terminal support (tree)
• Number of intermediate pylons and their position for:
  ✓ Determine the time for line implantation (1 to 2 days)
  ✓ Determine the cost for logging

For memory, install 1 pylon takes 0.5 to 1 day, for a cost estimated between 1 to 3 €/ m³

⇒ How many pylons are needed?
Actually, the loggers leave some trees instinctively, in case of additional support should be needed
The objectifs of Simulcable:

• Create the line implantation with a 3D visualisation, with the localisation of the pylons and the critical places.

• The Principe: calculation of the forces in the cable
The operator needs to know where the crane and the terminal support will be installed. Then the profile can be obtained from:

- **Digital elevation models** (max 50,000 points): good precision but rarely used in France because of his high price
- **Paper maps** (generally 1/25000): quickly realised, but insufficient precision
- **Raise of ground measure**, with compass, clinometer and topofil, which have the best precision

<table>
<thead>
<tr>
<th>point</th>
<th>Distance on the map (mm)</th>
<th>Altitude (m)</th>
<th>Difference of height (m)</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1250</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>24</td>
<td>1450</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>28.5</td>
<td>1480</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>38.5</td>
<td>1560</td>
<td>180</td>
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<tr>
<td>4</td>
<td>60.5</td>
<td>1830</td>
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</table>

Creation of a profile from paper map 1/25000
Parameters: cable yarder

- Diameter (mm) of the cable for skyline and mainline
- The rupture resistance
- The carriage: weight and the maximum charge
- Safety factor: minus 1, generally 2
- Height of pylons

The software makes proposition, but the operator can save his own values.
Results 1/4: first visualisation

First visualisation (3D) after calculation without pylons
Results 2/4: final visualisation

Final visualisation (2D) after adding 2 pylons
Results 3/4: calculation

- The results of the successive calculations determine:
  - Tensions in the skyline
  - Highest and lowest point
  - Length of the line

<table>
<thead>
<tr>
<th>Results</th>
<th>Type</th>
<th>Tension max (kg)</th>
<th>Safety factor</th>
<th>Charge (kg)</th>
<th>Fleche (m/%)</th>
<th>Length in charge (m)</th>
<th>Length on ground (m)</th>
<th>Critic point (m)</th>
<th>High point (m)</th>
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<tbody>
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<td>438.53</td>
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</table>

The results provide information on how many pylons to preserve and their proper position.
Results 4/4: the anchors

• The operator has the possibility of positioning the anchors of the crane and the terminal support
• Not necessary, it can validate the positioning of the anchors in steep terrain

<table>
<thead>
<tr>
<th>Pylon</th>
<th>Anchors</th>
<th>X (m)</th>
<th>Altitude (m)</th>
<th>Y (m)</th>
<th>Tension (kg)</th>
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<tbody>
<tr>
<td>Mat n°03</td>
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</table>
Conclusion and perspectives

• Helpful for determine the number of necessary pylons and their position
• The cable operator can plan the time for the line implantation, as well as its cost

• Future development or link with research project:
  • Development of a module for running skyline
  • Optimisation of cable line position as near as possible to the intended felling, with the best “yield index” (m³/linear meter of line)
  • Adaptation to a software for the cost calculation like HEPROMO (WSL, Switzerland)
Conclusion and perspectives

Thank you for your attention