Work safety improvement for motormanual felling operations

General thoughts and presentation of a prototype tool
Introduction – accident statistics

Case risk
Newly registered, accepted cases per 1’000 full-time employees

Number of accidents – forestry (Suva 2018a)
Introduction – accident statistics

Risk of daily allowance cases
Cases with daily allowance per 1’000 full-time employees

- Forest accident statistics still worrying
- Many accidents in motor manual felling: insufficient or missing tree and environmental evaluation (Suva 2018b)
Project objectives

- Reduce the number of accidents in motor manual felling

- Support forest workers in the evaluation of felling and danger area with modern technologies
  - bird’s eye perspective
  - Remote sensing (drone and LiDAR) and GNSS data

- Development of a prototype
  - Programming for iFOS
  - Visualisation of potential felling and danger area based on remote sensing and GNSS data
Material and methods - Overview scheme

- Development with data from Switzerland
- Application tested with data from Germany
Material and methods - GNSS accuracy analysis

- **Geodetic survey**
- **Recording concept:**
  - Factors: degree of coverage & lateral shading
  - Sensor dependent (App / datalogger)
  - 2D position accuracy

Measuring points for the accuracy analysis with GNSS sensors (Source: Bernhardsgrütter 2018)
Material and methods - GNSS sensors

M8N sensor (Source: u-blox AG 2015)
- Single-frequency receiver
- GPS and GLONASS signals
- Patch antenna
- ca. 160 euro

10xx sensor (Source: PPM GmbH 2017)
- Dual-frequency receiver
- GPS and GLONASS signals
- Helix antenna
- Ca. 2’200 euro
Material and methods - Remote sensing data

- Drone eBee RTK: sensefly, 18.2 megapixel camera, high precision GNSS
- Used in previous research projects
Results – Accuracy single tree detection

- Accuracy for tall trees better than 2m
- Flat terrain, hard- and softwood

Deviation of stem foot coordinates according to «Kraft’s tree classes» for FINT (n=25 (0), 85 (1), 58 (2), 26 (3), 5 (4)) in marteloscope Wiliwald (Condrau 2017, modified)
Results - Accuracy analysis GNSS sensors

Degrees of coverage

Sensor deviation (M8N & 10xx) for different degrees of coverage (n = 93 for 10xx; n = 903 for M8N)

- higher coverage = lower accuracy
## Results - Accuracy analysis GNSS sensors

<table>
<thead>
<tr>
<th>Distance to tree</th>
<th>10xx sensor</th>
<th>M8N sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1m</td>
<td>2.82m</td>
<td>4.44m</td>
</tr>
<tr>
<td>3m</td>
<td>2.79m</td>
<td>4.41m</td>
</tr>
<tr>
<td>All measurements</td>
<td>2.87m</td>
<td>4.83m</td>
</tr>
</tbody>
</table>

Sensor accuracy over the first 5 minutes of all measurements at 1-3m distance to the tree (n=186 each for 10xx; n =1806 each for M8N) and accuracy over all measurements (n = 890 for 10xx; n = 8720 for M8N)

- Distance to the tree: no significant influence on the accuracy or overlapped by other factors
Results - 3D view of drone data

- Insufficient detailing
- High required computing power: image disappears when rotating

→ 3D visualization rejected
Results – Prototype: 2D visualisation in iFOS
Discussion & conclusion

- Additional information: size of potential felling and danger area
  - 2D visualisation works -> 3D visualisation?
  - GNSS position 3 to 5m -> needs verification
  - Modular system
    - GNSS sensors / GIS layer

- Possibilities of using:
  - Education and training (sensitisation)
  - Trees near infrastructure

- Further development
  - Improvement of GNSS accuracy
  - Automatisation (visualisation without clicking)
  - Display other forest workers / warning if necessary
Sources

- u-blox AG 2015. EVK-7, EVK-8, EVK-M8 u-blox GNSS evaluation kits – Product summary, 1S.
Thank you for the attention!

Questions?