Towards the optimization of skicross training using a human motion capture algorithm based on an inertial measurement unit and GNSS

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**Introduction**

Skicross is one of the most intense and spectacular Olympic winter sports. The possibility to analyze and compare the performance of an athlete between different runs and other athletes is crucial for efficient training.

Today’s training techniques include the live feedback from the trainer, the videos from the recordings or the split-times that can either be placed over the whole run or over a specific section.

Still a lack is the ability to analyze the difference of the performance of two riders, as well as the direct influence of a technique used for a specific element on the velocity.

**Objectives:** Design and validate a new algorithm that detects different elements of the skicross course automatically based on the data collected with a single IMU/GNSS sensor. Further use these detection as instants for further split-time and velocity comparison between different athletes and runs.

**Methods**

- Four athletes compete at the same time on a course spotted with different obstacles like the jump roller and turns.
- Fastest to athletes proceed to next run until the finals.
- During training runs athletes have worn sensors to measure different kinematic and the position.
- Rider were equipped with an inertial measurement unit (IMU) and a GNSS sensor.
- Data available: Position, velocity, Acceleration, Angular velocity.
- For validation the runs were filmed.

**Results**

<table>
<thead>
<tr>
<th>Jump 1</th>
<th>Jump 2</th>
<th>Roller1</th>
<th>Roller2</th>
<th>Turn 1</th>
<th>Turn 2</th>
<th>Turn 3</th>
<th>Turn 4</th>
<th>Turn 5</th>
<th>Turn 6</th>
<th>Turn 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>8</td>
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</tr>
</tbody>
</table>

**Future Work**

- Improve stability of roller detection
- Get more measurements to improve validation
- Integrate algorithm in training software

**Conclusion**

- Detection of roller, and jump precise enough for split time usage
- Velocity comparison possible between athletes possible for all elements
- Roller detection not stable yet