Big Data in Sport and Movement Science – Challenges and Opportunities

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Performance related data acquisition

Movement (phase) duration: ms to minutes

Data acquisition rates depending on device and movement duration:
100 to 2000 samples/s

IMU sensors (segment and body acceleration)

Muscle activities (sEMG)

3D GRF and pressure distribution

3D kinematics (segment positions & joint angles, e.g.)

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Muscle activity synergies during running at different speed and slope (Jaitner et al. 2010)

378 trials (≈ 8 subjects x 5 conditions x 10 steps)

Muscle x wavelets
Dimension reduction Multidimensional scaling (Cox & Cox, 1994; Kruskal, 1964)
Wavelet transformation (van Tscharner, 2000)

Support Vector Machine

<table>
<thead>
<tr>
<th>Condition</th>
<th>Individuals</th>
<th>Speed/Decline</th>
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</thead>
<tbody>
<tr>
<td>Level running at 4, 5 and 6m/s</td>
<td>100%</td>
<td>78,6%</td>
</tr>
<tr>
<td>Running at 5m/s [+5°/±0°/-2°]</td>
<td>97,7%</td>
<td>88,2%</td>
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<tr>
<td>Slope running [+5°/-2°]</td>
<td>99,3%</td>
<td>82,1%</td>
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<tr>
<td>All trials</td>
<td>92,9%</td>
<td></td>
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</tbody>
</table>
Injury prediction and prevention in teamsports (e.g. football)

Biomechanical Screening

- 65 Youth Elite Soccer Players
- 25 Youth Elite Handball Players
- 12 month injury documentation (FIFA consensus)

Movement patterns (e.g. GRF in running)

Interaction of risk factors

Prediction

Injury specific risk factors

Interaction of risk factors

Approx. 100 parameters

Injury incidences/status

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Performance analysis of jumping and sprinting
Further research questions

- movement pattern adaption following motor learning or training
- gait pattern variability and adaption following short time interventions (e.g. balancing, wobbling)
- identification of pathologic gait/running pattern (that result from injuries or may cause overuse injuries)
- motor control strategies and muscle activation variability in gross motor movement

Big Data in Sport and Movement Science: Interdisciplinary Opportunity and Challenge

Schmidt, Nolte & Jaitner, Institute for Sports and Sports Science