The Development and Evaluation of a Novel IMU system for Barbell Velocity Measurement

M. O’Reilly, R. Dolan, P. Hanratty, J. Pawlak, J. Eberle, D. Whelan
School of Public Health, Physiotherapy and Sports Science
Insight Centre for Data Analytics
University College Dublin, Ireland

hello@outputsports.com
What would your ideal S&C tech measure?
What is the most important factor to you when choosing to work with technology?

- Ease of use: 32%
- Reliability: 45%
- Validity: 9%
- Cost: 9%
- Software: 5%

Their answer:

VBT

Strength
Technique
Mobility
Reactive Strength
Balance
Speed
Agility
<table>
<thead>
<tr>
<th>Device</th>
<th>Mean-Velocity r-value</th>
<th>Mean Velocity - RMSE (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GymAware</td>
<td>0.96+</td>
<td>0.06</td>
</tr>
<tr>
<td>Speed4Lift</td>
<td>0.98+</td>
<td>0.02</td>
</tr>
<tr>
<td>T-Force</td>
<td>0.97+</td>
<td>0.07</td>
</tr>
<tr>
<td>Tendo-unit</td>
<td>0.96+</td>
<td>0.04</td>
</tr>
</tbody>
</table>

## LITERATURE - IMUs

<table>
<thead>
<tr>
<th>Device</th>
<th>Mean-Velocity $r$-value</th>
<th>Mean Velocity - RMSE (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sensei</td>
<td>~0.92</td>
<td>0.10</td>
</tr>
<tr>
<td>PUSH 1.0</td>
<td>~0.86</td>
<td>0.09</td>
</tr>
<tr>
<td>PUSH 2.0</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Beast</td>
<td>~0.77</td>
<td>0.21</td>
</tr>
<tr>
<td>Myotest</td>
<td>~0.61</td>
<td>.23</td>
</tr>
</tbody>
</table>

DATA-CAPTURE

Push 2.0

CODA

CODA LED 1

CODA LED 2

CODA
DATA-CAPTURE

28 Participants

Bench-Press and Back-Squat

4 x 10 reps w/ pause
4 x 10 reps w/ no pause

Set 1 - “slowest-possible”
Set 2 – “33% of max-possible”
Set 3 – “66% of max-possible”
Set 4 – “fastest-possible”
Motion Capture
Output Sports
PUSH 2.0 (not included due to missing reps)

Mean & Peak Velocity:
RMSE
Pearson’s Correlation
Bland-Altman Analysis
Coefficient of Variation (CV)
ALGORITHM DEVELOPMENT

Raw accelerometer and gyroscope data → Motion capture’s velocity signal
MORE SAMPLE DATA
RESULTS //

MEAN VELOCITY

RMSE = 0.05 m/s
\( r = 0.989 \)
CV = 4.5
RESULTS //

PEAK VELOCITY

Last rep - peak velocity

1.13 m/s

Weight 100 kg
Power 113 W

Recording...

RMSE = 0.09 m/s
r = 0.985
CV = 2.5
Algorithm-refinement
Usability
Functionality
UX
30+ co-development partners UK/IRE
Seeking international co-dev partners
RESEARCH TO THE FIELD
LAUNCHING WINTER 2019

EXCELLENT CONCURRENT VALIDITY WITH
BIOMECHANICAL RESEARCH EQUIPMENT

Output

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