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P105. Kinematic Measurement of Wheelchair Racing Using Smartphones Sensors

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INTRODUCTION

Given the increasing demand for high-performance in Paralympic sports, there is likewise a larger demand for analytical data. Recent developments in miniaturisation allows tri-axial measurement of the acceleration with very small sensors (~2.6mm^3) such as the ones embedded in smartphones. Therefore, smartphones might provide kinematic data in field testing (Hummell, Fehr & Ferger, 2013). The aim of the study was to compare linear kinematic data recorded by a smartphone and an IMU in wheelchair sprinting.

METHODS

A T52 wheelchair sprinter competing at national and regional competitions was recruited. Over a period of two weeks, and as part of the standard training program, the participant was requested to perform 60m and 120m all-out trials. Acceleration data over the 60m (12 trials) and the 120m sprints (17 trials) was recorded concurrently at 100Hz by a smartphone (Galaxy A3, Samsung, South Korea) and an IMU (OS3D, InertialLabs, US). Smartphone and IMU were fixed on the lower support bar of the seating cage and aligned in the same orientation to limit the effects of gravitational acceleration to one axis. Data was handled on RStudio (v 1.0.136). Time-series was processed with a second-order low-pass Butterworth digital filter at 8Hz and detrended with a constant filter (best-fit line subtracted from data) to remove the bias within the acceleration data. Distance and velocity were obtained by integration of the time-series. The Root Mean Squared Error (RMSE) of the velocity and the normalised RMSE to maximum velocity (NRMSE) for smartphone time-series against IMU were calculated. Comparison of mean values between 60m and 120m trials were analysed by student's T-test ($p<0.05$).

RESULTS

Typical velocity-time series is depicted in Figure 1. Comparison of data is presented in table 1. The 120m bouts elicited a faster maximum velocity in comparison to 60m trials ($p<0.001$). RMSE was smaller over the 60m than the 120m trials ($p<0.001$). However, when normalised, there was no significant differences ($p=0.14$). The mean NRMSE in the 60m and 120m trials was 16.82±7.09% and 22.42±11.96%, respectively.

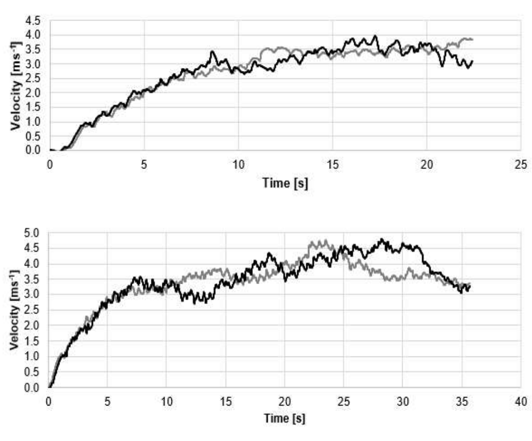

Figure 1. Comparison of the velocity-time series collected by a smartphone accelerometer (black line) and an IMU (grey line) in the 60m (top panel) and 120m (bottom panel) trials.

Table 1
Comparison of the velocity collected by a smartphone accelerometer and an IMU.

	Maximum velocity [m/s]	RMSE [m/s]	NRMSE [%]
60m trials	3.35±0.38	0.55±0.21	16.82±7.09
120m trials	4.63±0.60	1.04±0.55	22.42±11.96
p-value	<0.001	<0.001	0.14

CONCLUSIONS

On average, the smartphone accelerometer yields an error of about 16-22%. In the event of selecting this device to monitor wheelchair sprinting, one should be aware of such bias; specially comparing time-series collected by different apparatus in other time points or settings.

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References

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