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188	O61. Evaluation of physical activity levels in FPF eSports e-athletes Ana M. Pereira, Pedro Figueiredo, André Seabra, João Brito
189	O62. Effect of zumba virtual reality intervention on depression symptoms in women with fibromyalgia: The possible role of creative arts therapies. Álvaro Murillo-García, Santos Villafaina, Daniel Collado-Mateo, Juan L. León-Llamas, Narcís Gusi
191	O63. The use of wearable technology in a sample of Portuguese population Carla Sá, Vítor Pires Lopes
192	O64. The magnitude of intra-rater difference using the iPhone camera for estimation of jump height: A case study Renato Maia, Filipa Silva, Gustavo Silva, Paulo Roriz
194	O65. Novel in-vivo assessment of muscular viscoelastic characteristics and the association with physical function in patients with non-dialysis dependent chronic kidney disease Thomas J. Wilkinson, Eleanor F. Gore, Alice C. Smith
196	O66. The use of activity trackers devices and physical activity levels in adolescents and adults Carla Sá, Vítor Pires Lopes

Posters Presentations

197	P104. Effects of two awareness strategies in sedentary behaviour during workplace: A pilot study Alexandre D. A. Aleixo, Isabel M. L. Machado, Tânia C.C. Ribeiro, Catarina I. N. G. Abrantes
199	P105. Kinematic Measurement of Wheelchair Racing Using Smartphones Sensors Chow Kin Ming, Tiago M. Barbosa
200	P106. Using iPhone camera for temporal gait analysis: A case study Filipa Silva, Renato Maia, Gustavo Silva, Paulo Roriz

MULTIDISCIPLINARY

Oral Presentations

202	O67. Is it quality more important than quantity? Developmental pathway and training environment of highly skilled and less skilled volleyball players Patrícia Coutinho, António M. Fonseca, Isabel Mesquita
203	O68. Exploring patient experiences of healthcare providers' advice about exercise after renal transplant: a qualitative study Roseanne E. Billany, Alice C. Smith, Clare Stevinson, Nicolette C. Bishop
204	O69. Students' self-determined motivation toward Physical Education does matter on the effectiveness of a physical fitness teaching unit Daniel Mayorga-Vega, Santiago Guijarro-Romero, Carolina Casado-Robles, Emilio J. Campos-Meirinhos, Jesús Viciano
206	O70. A retrospective analysis of career termination of football players in Portugal António Carapinha, Miquel Torregrossa, Pedro Mendes, Pedro Guedes Carvalho, Bruno Travassos
207	O71. Motor Development in Children from 11 to 46 months: influence of the variable "type of childbirth" Miguel Rebelo, Rui Paulo, Daniel A. Marinho, Pedro Duarte-Mendes, João Serrano
209	O72. From directive to constructive practices in developing a supervisory identity: The cases of an experienced and a novice physical education cooperating teacher. Mariana Amaral-da-Cunha, Paula Batista, Amândio Graça, Ann MacPhail

Posters Presentations

210	P107. Bullying in School Sports vs Federated Sports: Exploratory Study in the Interior Northern Region of Portugal Philippe Marracho, Antonino Pereira, Miguel Nery, Eduarda Coelho
211	P108. Capoeira Gymnic Workout: Emotions and Gender Ana Rosa Jaqueira, Pere Lavega, Artur Pereira, Pedro Gaspar, Paulo Araújo
212	P109. Comparison of the effect between a traditional and intermittent physical fitness-based teaching unit on students' motivation toward Physical Education and autotelic experience Santiago Guijarro-Romero, Daniel Mayorga-Vega, Carolina Casado-Robles, Emilio J. Campos-Meirinhos, Jesús Viciano

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 ($\sim 2.6\text{mm}^3$) such as the ones embedded in smartphones. Therefore, smartphones might provide kinematic data in field testing (Hummel, 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 $16.82 \pm 7.09\%$ and $22.42 \pm 11.96\%$, respectively.

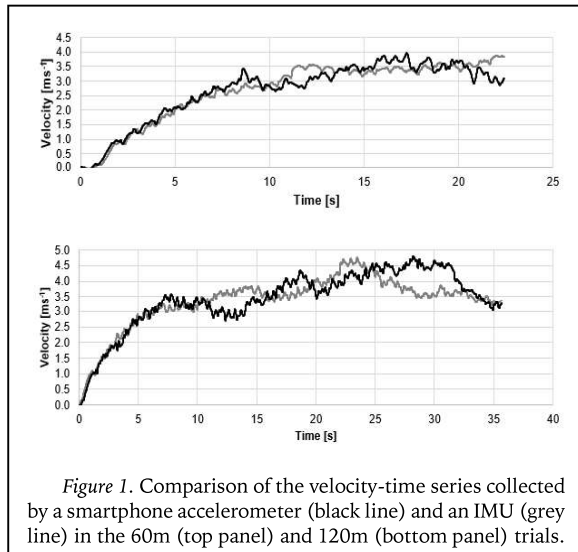


Figure 1. Comparison of the velocity-time series collected by a smartphone accelerometer (black line) and an IMU (grey line) in the 60m (top panel) and 120m (bottom panel) trials.

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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