20th annual ECSS Congress Malmö/Sweden, June 24-27 2015

Validation of measuring rowers' Centre of Mass acceleration in rowing direction with inertial sensors

Lintmeijer, L.L., Hofmijster, M.J., Schulte Fischedick, G.A., Zijlstra, P.J., Kruk, H.R., Faber, G.S.

Vrije Universiteit Amsterdam

Introduction
Rowing performance depends on maximization of mechanical power delivered by the rower(s) and minimization of power losses during a stroke cycle(Hofmijster et al., 2008). In many cases, a rower's mechanical power has been calculated by multiplying the moment of the oar with oar angular velocity (e.g. Baudouin&Hawkins, 2004). However, due to the boat speed being unsteady (Hofmijster et al., 2008; Baudouin&Hawkins, 2004), a secondary power term -related to the rower's centre of mass (CoM) acceleration- needs to be incorporated. In this study we evaluated whether horizontal CoM acceleration of the rower during ergometer rowing could be estimated by using a magneto-inertial suit.

Methods
Ten participants (5 male and 5 female) rowed 7 trials on an ergometer placed on two force plates. For each trial, stroke rate per minute (15, 25 ,35, ascending stroke rate) or technique (early leg extension, early back extension, stroke to recovery ratio 2:1) was manipulated. The rower's CoM acceleration in rowing direction was calculated (100 Hz) from the weighted average (Hof, 1989) of the accelerations of 17 inertial sensors of an Xsens MVN motion capture suit (Roetenberg et al, 2013), each strapped to a separate body segment. Validating the accuracy of this calculation, this CoM acceleration was compared to the rower's CoM acceleration as determined by the force plates, namely the recorded inertial force divided by the mass of the rower.

Results
For every trial, 10 strokes in the middle of the trial were selected. Statistics showed that the rower's CoM acceleration in rowing direction determined with inertial sensors (0.52 m/s2≤M≤5.53 m/s2) was strongly correlated with the rower's CoM determined with the force plates (0.49 m/s2≤M≤5.87 m/s2) for every participant in every trial (0.98≤r≤1.00, 0.09m/s2 ≤SEE≤0.95m/s2).

Discussion
This study shows that a rower's CoM acceleration in rowing direction can be calculated accurately by means of an inertial magnetic suit. This suggests that this technology could be used to measure the secondary mechanical power term related to the rower's CoM acceleration. On-water studies will be conducted to test the magnitude of this power term.

References
Baudouin, A., & Hawkins, D. (2004). J Biomech, 37 (7), 969-976.
Hof, A.L. (1989), J. Biomech, 1209-1211.
Hofmijster, M.J., Van Soest, A.J., & De Koning, J.J. (2008). Med Sci Sports Exerc, 40 (6), 1101-1110.
Roetenberg, D., Luinge, H., & Slycke, P. (2013). Xsens Technologies.

Contact
l.l.lintmeijer@vu.nl

Topic: Biomechanics

Presentation form: Oral

European Database of Sport Science (EDSS)

Supported by SporTools GmbH