21st annual ECSS Congress Vienna/Austria, July 6-9 2016

Rowers' on-water power output is commonly underestimated

Lintmeijer, L.L., Hofmijster, M.J., Beek, P.J., Schulte Fischedick, G.A., Zijlstra, P.J., Soest, A.J.

Vrije Universiteit Amsterdam

Introduction
In rowing, mechanical power output is a key parameter for biophysical analyses and monitoring of performance and should therefore be measured accurately [1,2]. It is common practice to estimate a rower's on-water power output as the time average of the dot product of the moment of the handle force relative to the oar pin (MFh,r) and the oar angular velocity (ωo) [3,4]. In a theoretical analysis we have shown that this measure differs from the true power output (Prower) by an amount that equals the mean of the rower's mass (Mr) multiplied by the rower's center of mass acceleration (Arcom) and the velocity of the boat (Vb) (Presidual). The purpose of this study was to quantify Presidual for different rowers under different rowing conditions.

Methods
Nine rowers participated in an on-water experiment consisting of 7 trials in a single scull. Stroke rate, technique and forces applied to the oar were varied between trials. Inertial sensors (Xsens MVN motion capture suit; 60Hz), a GPS (LOCOSYS, Taiwan; 10Hz) and a pre-calibrated conventional digital scale obtain Arcom, Vb and Mr. Forces applied to the oar and oar angle were determined using instrumented oarlocks (Peach Innovations, UK; 100Hz). The average ratio of Presidual to Prower per trial was calculated as a measure of the difference between true power output and power output estimated while using the common proxy.

Results
On average, the ratio of Presidual to true power output was 0.123 with only small variations between rowers and rowing conditions (SD = 0.011). A multilevel analysis revealed an effect of stroke rate: an increase in stroke rate from 18 to 32 strokes per minute resulted in an increase of the ratio of Presidual to true power output from 0.120 to 0.133 ($p<.001$).

Discussion
The results of this study indicate that a rower's mechanical power output is underestimated by 12.3% on average when calculated according to the common proxy. In order to accurately analyze and monitor rowing performance, a correction of the determination of rowers' on-water power output is, therefore, required.

References
[1] Hofmijster, M. J. (2010). Mechanics and Energetics of Rowing. Faculty of Human Movement Sciences. VU University Amsterdam, Amsterdam.
[2] Smith, T. B., & Hopkins, W. G. (2012). Measures of Rowing Performance. Sports Medicine, 42, 16.
[3] Baudouin, A., & Hawkins, D. (2004). Investigation of biomechanical factors affecting rowing performance. J Biomech, 37(7), 969–976.
[4] Zatsiorsky, V. M., & Yakunin, N. (1991). Mechanics and Biomechanics of Rowing : A Review. International Journal of Sport Biomechanics, 7, 229–281.

Topic: Biomechanics

Presentation form: Oral

European Database of Sport Science (EDSS)

Supported by SporTools GmbH