APPLIED SESSION: A KINEMATIC MODEL TO PERSONALIZE BOAT SETTING IN ORDER TO ROW ON A GIVEN RANGE OF MOTION

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INTRODUCTION: The boat settings is a complex matter in rowing and is mainly based on rowers' and coaches' experiences (Nolte, 2011). Most of the time, all crew members have the same settings, while they can display various anthropometries and flexibilities. Therefore, this study aimed to implement and validate a kinematic model to individualize boat settings in order that scullers can reach given catch and finish angles. The inputs of the model should be measured using simple testing that can be performed on field by coaches and athletes. In addition, the oar range of motion was the only interest of the present study, and the resistance (i.e., ratio between outboard and inboard length) was not considered.

METHOD: In order to adjust the catch and finish oar angles, it is possible to change the inboard and spread lengths.
The anteroposterior linear range of motion of the hand was measured on a rowing ergometer (Concept 2, Model E, Morrisville, VT, USA) using a rubber band. The upper limb length (i.e., from the acromion to the head of third metacarpal) was also measured.
The acromion is supposed to move in the horizontal plane, in the longitudinal direction of the boat. Hand trajectory was considered circular and only in the horizontal plane. At the catch, arm is supposed to be fully extended. The model was 2D in the horizontal plane, and adjustments were performed to take into account arm angle in respect to the horizontal plane. A cost function was calculated as the summed squared differences between the hand and the handle locations at the catch and finish. The cost function was minimized by adjusting the inboard and spread lengths.
In order to assess the accuracy of our model, data collection was performed with 3D Motion analysis (Optitrack, NaturalPoint Inc, Corvallis, Oregon, USA) of sculling on an ergometer that reproduces sculling kinematics (Fohanno, Sinclair, Smith & Colloud, 2014). Markers were placed on ergometer (for the reference frame), the acromion, head of the third metacarpal and the oar (to measure oar angle). Subjects performed 10 strokes at a comfortable pace with various settings (inboard lengths: 83, 88 and 91 cm; spread lengths: 155, 159 and 163, that being 9 configurations) tested in a randomized order. Oar angles at catch and finish estimated with the model were compared with those measured during the experiments.

RESULTS: Preliminary results were obtained for two subjects, but experiments are currently on-going in order to confirm these results. First, it was possible to find a minimum to the cost function, and thus to estimate the appropriate settings to reach the desired catch and finish oar angles. Second, a good agreement between modeled and experimental range of motion was found.

DISCUSSION: Using simple measurements, the proposed approach takes into account both rower flexibility and anthropometry, to individualize the inboard and spread lengths in order to set desired catch and finish oar angles. This method can be very useful, particularly for team

crews with various anthropometries which is often the case especially for young athletes. Depending on the rowers and coaches feed-backs, a smartphone application would be proposed in order to share the model with the rowing community.

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