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Improvements In The Design Of A Kayak-Ergometer Using A Sliding Footrest-Seat Complex

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As observed previously in rowing, kayaking an ergometer becomes more and more popular. Nowadays, indoor kayak championships are organized performed on ergometer designed with a fixed footrest-seat complex. The main goal when one designs ergometers is to reproduce as closest as possible the on-water conditions. The reliability with on-water condition is usually assessed using both physiological and kinematics parameters. The previous studies of our research group have shown that the dynamics of the in situ movement has also to be reproduced. In other words, major muscular groups (who generated the joint torque and by the way the contact forces) involved in kayaking should be recruit with the same timing during on-water and ergometer kayaking. At the 7th ISEA conference, our research group presented a method based on numerical optimization to design a kayak ergometer equipped with a sliding footrest-seat complex that reproduces the acceleration generated in flatwater kayak. Based on these preliminary results, we have constructed a new ergometer. Then, the purpose of this study was to present the last developments performed on this ergometer and preliminary 3D kinematics analysis from elite kayakers.

The characteristics (stiffness and damping) of the bungee cord linking the back of the frame with the trolley were determined using our previous results. An air brake, composed of a flywheel with a heavy wheel and two freewheel-pulleys on a shaft, simulated the water drag on the blades. However, a magnetic brake was added for specific training sessions. The paddle was linked to the pulleys by two ropes. Each side of the frame is equipped with one slide (1 *dof* in translation) in order to always keep the directions of the ropes parallel to the long axis of the ergometer whatever the instant of the cycle. First trials performed with elite athlete showed the robustness of all the mechanisms developed. 3D kinematic analysis showed the relevance of the adding slides when compared with on-water paddle trajectories observed during the propulsion phase. An instrumentation (3D force sensors at each contact) coupled with a specific interface that allows real time feedback is under development. This innovative ergometer will be used to collect dynamic and kinematic parameters. They will serve as input data of our simulator in order to carry out intra-athlete comparisons and to still improve the design of kayak ergometers.

Keywords: Type your keywords here, separated by semicolons ; Human, Kayak; Equipement; Innovation; Design; 3D Kinematics

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