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Procedia Engineering 2 (2010) 3429

Procedia Engineering

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8th Conference of the International Sports Engineering Association (ISEA)

Poster Session I, July 14th 2010 – Abstracts

Design Of An Ergometer to Train And Evaluate Elite Cross-Country Skiiers

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Sport ergometers offer a reasonable alternative for semi-specific training conditions as it provides a sheltered environment to practice. Their additional values from in situ performances are mainly due to real time feedback of mechanical variables as the external power generated by athlete at one (or more) contact with the ergometer (e.g. handle power while rowing an ergometer). These variables are mainly recorded using force and displacement sensors. As a result, in many sport (e;g. rowing, cycling, running), these machine are also used for performance assessment and both physiological and biomedical research program. However, the design of a specific ergometer has to reproduce the dynamics of the in situ movement for an accurate mechanical analysis. A first step in such a way is to analyse the three-dimensional kinematics in order that the ergometer design simulate accurately the kinematic performed in situ. In cross-country skiing, the kinematics observed while skiing the actually available ergometers is far from the one performed during in situ conditions. Thus, the mechanical parameters measured while skiing these ergometers are not pertinent to analyze and discriminate the performance produce by elite athletes. This work presents an approach based on a 3D kinematics analysis to design an innovative ergometer fully instrumented to acutely train and evaluate elite cross-country skiers.

3D kinematics analysis of in situ skating, performed using three video cameras showed characteristic 3D trajectories of the stick during the contact period with the snow. The ergometer was design to reproduce this specific kinematics (two specific phases) by adding one *dof* in translation of the contact point between the rope with the ergometer. This rope connects skier's hand to an air-braked flywheel to reproduced the resistance. A selfrecoiling system allows to perform the following skating cycle. An instrumentation coupled with a specific interface allows real time feedback of the power generated by skier at each hand. During the last two years, this ergometer was skiing by the french national teams to prepare Vancouver 2010. Further investigations must be undertaken to support the accuracy of this ergometer with in situ conditions and to still improve his design.

Keywords : Cross Country Ski, Ergometer , semi-specific trainning

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doi:10.1016/j.proeng.2010.04.171