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AN INSTRUMENTED SPECIFIC ERGOMETER FOR SKATING TESTS

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SUMMARY
The purpose of this work was to develop a specific system to evaluate aerobic and anaerobic fitness of in-line skating. This system is consisted of a slide board ergometer instrumented with lateral touch sensors coupled to specific software developed to control the effort tests parameters, such as stage durations, cadence and intervals between stages. This system detects the exact end of the test when the athlete can no longer maintain the stipulated cadence. To verify the accuracy of the system, four subjects performed an incremental cadence skate ergometer test. It was verified that no touch in lateral sensors of slide board was missing in the exported data. The skater's cadence was considered lost when he is below the established threshold. Due to proximity to in-line skate movements this system seems to be more adequate to analyze the skating performance.

INTRODUCTION
The aerobic and anaerobic fitness tests are largely used to controlling and monitoring sports training performance. Many tests have been proposed to evaluate aerobic and anaerobic metabolism, as treadmill test and Wingate Test, respectively. Despite of its widespread use, the tests does not take into account specific demands of some sports, such as those using in-line skates, e.g. hockey players, speed and ice skating and skiing.

Moreover, the derivation of exercise prescriptions from a stepwise cycling or running treadmill test does not seem appropriate, and skating-specific tests should be used to evaluate performance [1,2].

Based on these statements, the purpose of this work was to develop a low cost system, composed by a skating specific ergometer and a software to control it, to evaluate skaters' performance.

METHODS
System Development
The system was registered on the National Institute of Industrial Property (INPI) named BSBT- Brazilian Slide Board Test®. The ergometer of BSBT® was made with non-slip material (Ethylene Vinyl Acetate-EVA), wood, and a plastic laminate (Formica) surface, with dimensions of 2.70 x 60 x 2.5 cm (long x wide x thick) and an adjustable area of 60 cm (figure 1). The ergometer allows a quasi-perfect skating movement pattern, where the athlete applies a sideward force (right angle to the direction of travel) [3], moving side-by-side.

Figure 1: Slide board ergometer structure.

Two touch sensors were crafted and placed at the ergometer lateral stops (figure 2). The sensors structure is similar to the

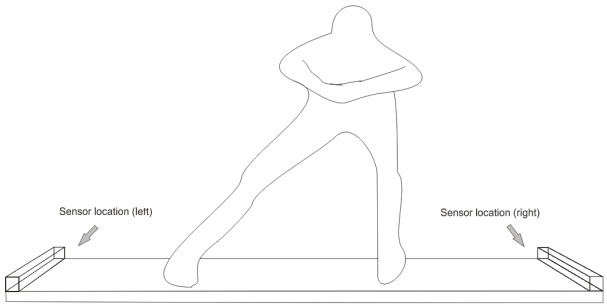

Figure 2: Slide board ergometer and sensors location.

one developed by Júnior et al. [4] (figure 3) and it's connected to the computer USB port by an electronic system (hardware). The BSBT® software system was developed using Object Pascal language. It can be used to control and monitor effort test in real time and record the information in a data file (figure 4). Different protocols' parameters can be selected in the software, such as subjects' characteristics, stages durations, initial cadence, cadence increment per stage, intervals between stages and the instant the athlete loses its pace. Also, the athlete maintains its pace by following in real time a virtual skater that appears in the main screen of the software. This helps him keep the pace

Figure 3: Structure of sensors: a) anti-slip rubber film; b) flexible wire mesh and c) leaked rubber film. (Adapted from Júnior et al. [4]).

during the test even when the athlete cannot hear well the beat emitted by the software due to the fatigue appearance.

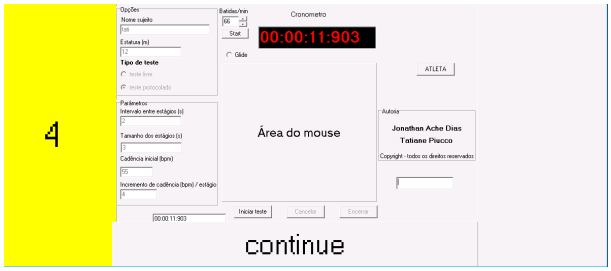

Figure 4: BSBT® software (under development).

Procedures

In order to verify that BSBT System® correctly records and detects the pace loss, four subjects performed an incremental skate ergometer test. The subject wore a pair of fleece socks to skate on slide board during the test. When the subject touch the sensors one third times delayed then he supposes perform, the software emitted an advice. When the athlete is below the established threshold, he receives a warning from the software, so that he can try to recover the pace. In case he receives three warnings, the test ends. Also, if at any time the subject is at half the expected pace, the test ends.

RESULTS AND DISCUSSION

From all the four subjects, it was verified that no touch in lateral sensors of slide board was missing. Two subjects received one software warning for delaying the pace. After that, they recovered the expected pace, ending voluntarily the test. The other two subjects kept the expected pace and received no warnings, also ending voluntarily the test. Some improvements of software are still necessary, for example visualizing the data, generate reports and retrieve the protocol. Also, a function can be added to the software to calculate an index of athlete rhythm, according to the athlete performance on keep the expected pace. The rhythm and coordination is an important ability in cyclical endurance sports such as running, cycling, rowing and skating [3].

CONCLUSIONS

We can conclude that the BSBT System® can be used to perform physiological and biomechanical analysis of skaters due to the transference of movement pattern. It is a low cost and precise system for training and evaluating physiological and technical variables. Even thought, adjustments can be done and tools can be added to improve the whole system. Moreover, performance tests should be developed using this system to explore his potential as an evaluation tool.

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