THE APPLICATION OF COMPUTER TECHNOLOGIES TO THE MANAGEMENT OF SPORT SPECIFIC TRAINING IN RHYTHMIC SPORTS

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INTRODUCTION

It is well known that results in sports such as rowing and most other rhythmic sports are determined by the quality of the athlete’s sport-specific training. There are two main parts of this special training that have a close interrelationship with each other, but are also to some extent independent of each other: the athlete’s sport-specific fitness or work capacity and technique development routines. The application of computer technologies could increase the efficiency of the management of this special training in cyclic sports by allowing simultaneous testing and training of both the special work capacity and the exercise technique. The purpose of this study was to develop a computer-aided testing and training system for cyclic sports and then to demonstrate its use in rowing.

This study was designed to address the following questions:

• to find a way of computer-aided analysis of rowing technique and assessment of the work capacity of rowers
• to determine the main biomechanical features of rowing using computer-aided methods of data processing;
• to define interrelations between a rower’s technique and his work capacity.

There are a number of studies devoted to the analysis of rowing technique using racing boats and improved means of filming (Martin and Bernfield, 1980; Nelson and Widule, 1983; Zatsiorsky and Yakunin, 1991). A common disadvantage of these methods is that they take no account of the forces applied by rowers to the oar and to the footrest and therefore can not evaluate precisely the rower’s power output and work capacity. Some direct measurements of force have been made during real boat rowing (Dal-Monte et al, 1985; Fukunaga et al, 1986), but due to difficulties in the standardisation of exercise
conditions and the evaluation of a sufficient number of subjects, these studies have generally failed to produce clear results.

The main principles of an effective rowing technique were reported by Nolte (1991) who determined the four most important principles:

1. the greatest possible transfer of physiological capacity into boat propulsion
2. a long stroke to maximise power output
3. the movement of rower must be as horizontal as possible
4. the horizontal velocity of the rower relative to the boat should be as small as possible.

It is clearly necessary that more information on the relevance of these principles to rowers should be obtained.

Some researchers have used rowing ergometers with the aim of measuring mechanical parameters of rowing and the work capacity of rowers of different skill levels (Kleshnev, 1992, Hartmann et al, 1993). At the present time, a variety of off-water devices (including the “Concept II “and others) are widely used by rowers in training and also for testing purposes. More than 100 different competitions are held each year on rowing ergometers, including World and continental championships. Martindale and Robertson (1984) and Lamb (1989) have shown that the biomechanics of ergometer rowing are different from those in a real boat. Ergometer rowing can not therefore be used for the analysis of rowing technique.

METHODS and SUBJECTS

The problem of combined investigation of a rower’s technique and work capacity were solved by the design of a special-purpose rowing ergometer “IGL-1” with a moveable seat, which simulates real boat rowing in off-water conditions. This new development became possible because the rower performs exercise in a moving unit. External forces applied to the unit are similar to the real boat external forces. Six mechanical parameters were recorded by the attachment of appropriate recording apparatus to the rowing simulator. Handle force and the force applied to the horizontal part of the foot rest force were measured by tensiometer gauges. Movements of the handle, the seat and the athlete’s back were measured by electrical resistance gauges. Horizontal acceleration of the moveable unit was measured by an electric resistance accelerometer.

An analogue-to-digital converter (12 bit, 16 channels, 50 Hz) with amplifiers provided data transformation from the recording apparatus to a personal computer, which performed the data processing, visualisation and storage of the results.

The total work power of the rower was estimated by calculation of the energy dissipated by rotation of the ergometer flywheel. A performance monitor taken from the Concept 2 rowing ergometer was used for this purpose.

A software program was designed to provide an original algorithm for information handling and evaluate patterns of each of the mechanical parameters during the stroke cycle. The main advantage of this approach consists in resolving the problem of selection from a lot of cycles a typical one that can be used for evaluation of the quality and stability of the athlete’s rowing action. The algorithm also removes any electrical or movement artifacts. Testing of the algorithm validity showed that it removes random variability without compromising the integrity of the data.