DEVELOPMENT OF A SPEED MEASUREMENT SYSTEM WITH GLOBLE POSITIONING SYSTEM IN ROWING AND CANOEING

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INTRODUCTION: Speedometers, such as SPEED BOSS and PaceCoach, have been widely used in the daily practice of rowing and canoeing, but there are major disadvantages with this practice. For example, only relative speed is measured with speedometers and data errors could not be eliminated due to the specific "water touch" speed sensors are used. The purpose of this study was to develop a new speed measuring system with Global Positioning System (GPS) technology, which has the potential to overcome the disadvantages mentioned above.

METHODS: The system consists of three modules: (a) GPS module, which is used to receive the signal from the GPS satellites, to process the signal and to output the data. (b) A handheld computer, which calculates, displays and stores the data; it has an RS-232 series port to transfer the data to a PC for further analysis. (c) Batteries, which supply power for the GPS module. The GPS module outputs the data flow with 1Hz, including positions, velocity, time, and etc. With development of the software, the information on velocities can be gathered and processed. The level of accuracy can reach 0.1m/s without Selective Availability (SA) (US Defence Department, US). The GPS module has the differential GPS (DGPS) function and in addition, the system can be upgraded to DGPS Speedometer for greater accuracy. Thus DGPS techniques can overcome the effects of SA and eliminate the other sources of GPS errors.

RESULTS: The GPS speedometer can display the kinematic parameters in real time, such as the speed of the boat, distance covered, direction of movement and relapsed time. This data can be stored in the handheld computer. The accuracy of measured speed is dependent on SA and the satellite ranges in space. With a single GPS unit, the accuracy is about 0.3m/s under the SA effect (Liu, 1993). The mean velocities of 2000m race course for competitors, who took the first places at 1999' World Rowing Championship, ranged from 3.91 to 5.98m/s. This indicates that the relative errors of the speed measured by GPS speedometer are 5.0-7.6%. If more accuracy is required, the differential GPS technique can be used, but the cost of hardware will rise. The recording time was depended on the memory of the handheld computer. For example, data collected in 4 hours can be stored in 300K byte memory.

DISCUSSION: The GPS speedometer is easy to use by attaching on the boat. This technique has been applied on national rowing teams in China. Comparing with other speed sensors, such as impeller and out-trigger or fin, the advantages of this new system was that absolute speed was measured, not the velocity relative to the water. For this method, calibration is not needed. If the data-link is integrated with a GPS speedometer, the data, such as the speed, heart and stroke rate can be transferred on line to the coaches, regardless of where they are, providing they are within radio signal range. The GPS speedometer can be applied in the following aspects: 1) to evaluate the stroke effect if the stroke rate is constant, 2) to determine the optimal stroke rate according to the boat speed, 3) to control the intensity of training, and 4) to help the coach to make the training plan.

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