BIOMECHANICS OF CANOE SLALOM: MEASURING TECHNIQUES AND DIAGNOSTIC POSSIBILITIES.

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INTRODUCTION

Until now very few reports exist about research on biomechanics of wild water canoe slalom. Experiments have been carried out under laboratory conditions only sporadically. Experts often believe that results in wildwater races are determined more by accident than by physical regularities applied by the athlete's technique. A closer look to this type of sport shows that there are possibilities to dissolve the activities of the athlete into reproducible parts taking place under defined external conditions. So, the basis of a biomechanical investigation is given.

METHODS

Measurements have been taken about the forces transmitted to the water via the athlete's paddling actions and of the acceleration of the canoe viewing the effects generated by the measured forces. Additionally, video pictures were taken in order to get an information about the canoe position relative to the gates and during the turning manoeuvres. The force measuring equipment consisted of a strain gauge system attached to the paddle, registrating the bending movements of each side (cf. fig.1). The special construction of the force sensor allows every athlete to use his own paddle. In this way, adaptational difficulties during the measuring process can be avoided.

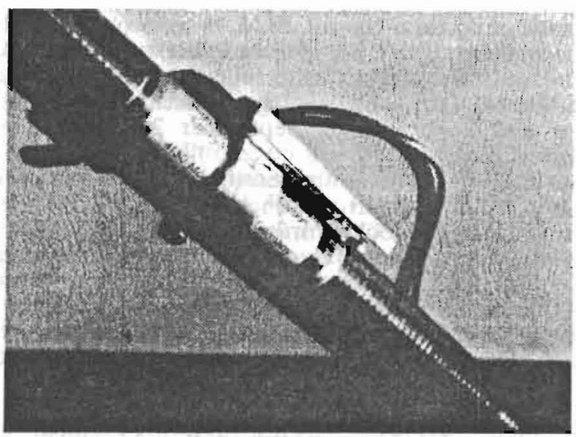

Fig.1: Strain gauge bending force sensor fixed to the paddle

Acceleration was measured using an accelerometer fixed to the canoe. Additional systems: bridge amplifier, analogue amplifier and a two-channel cassette recording system, bearing a total weight of not more than 500 grams were carried along with the canoe. So, the athlete was not influenced by the measuring equipment and could perform his technique without limitations.

RESULTS

Forces and accelerations measured during wild water canoe racing can give information about the basic movement technique, force development and endurance capabilities of the athlete as it is shown by example in fig.2.

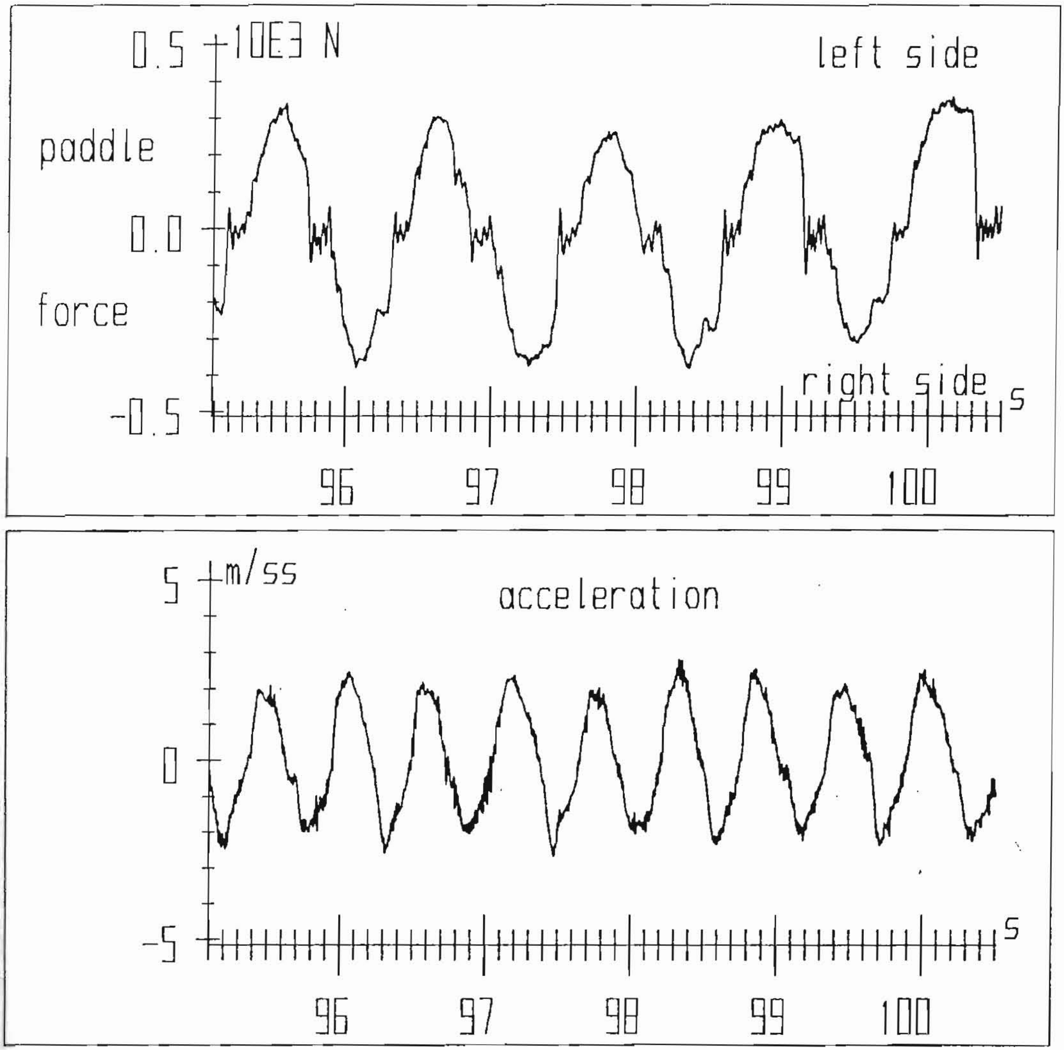

Fig.2: Paddle force and canoe acceleration in white-water canoeing

The curves show very clearly the relationship between the canoeist's action -expressed by the paddle force on each side- and the resulting effects via the acceleration of the canoe. So, each paddle stroke can be described e.g. by stroke frequency, stroke duration, force and acceleration ampltitudes, and furthermore by integrated parameters as the linear momentum. A special interest can be directed towards the negative acceleration values of the canoe during the recovery phases of the paddle, i.e. when the active side is changed by the athlete.

A very special problem in canoe slalom consists in obtaining objective data about the kinematics and dynamics of turning movements during passing the slalom gates yielding an impression of the technique used by the canoeist. For these aims, the measurement of the paddle forces in combination with video analysis can be helpful as it is shown in fig.3.

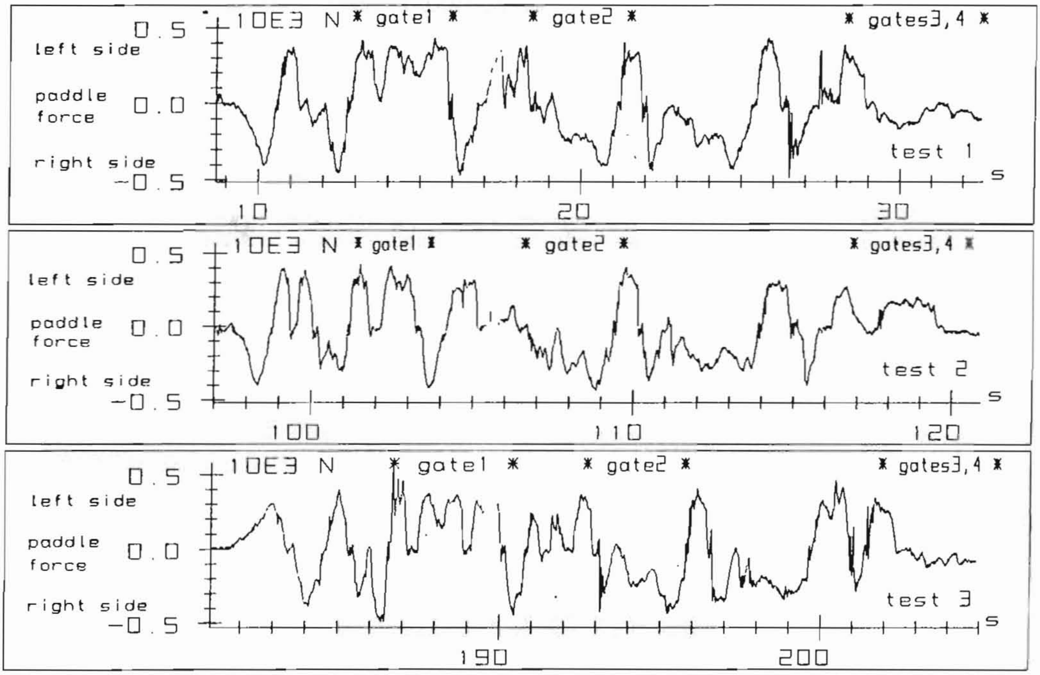

Fig.3: Paddle forces during passing the same gates - three independent trials

It can be seen from fig.3 that the force curves are reproduced very well by the athlete, announcing a good paddling technique. Besides this, the diagrams can used also to study the possibilities concerning paddle stroke order and magnitude at passing different types of gates.

CONCLUSIONS

The measuring methods and procedures as presented here seem to be powerful tools in delivering objective data about the paddling technique and the behaviour of the canoeist under special water conditions. So, the diagnostic possibilities offer better approach to a well - controlled training in canoe slalom.