DYNAMOMETRIC MEASURING PROCEDURES FOR HORIZONTAL BAR AND UNEVEN BARS

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INTRODUCTION

Dynamometric measuring procedures for gymnastics apparatuses are applied to analyse sports technique, to determine load effects on female and male gymnasts and to optimise gymnastics apparatuses. In studies on sports technique dynamometric procedures are mostly applied in combination with kinemetric procedures, especially with photogrammetric procedures.

Dynamometers are developed for horizontal bar and uneven bars, which are integrated in measuring units (Figure 1). The dynamometers are installed to original gymnastic apparatuses. The lab-stadium (Bauer 1976) of the investigations should get over and the realistic conditions in training and competition are to consider, e.g. change of the gripping point on the bar, variable chain tension and stake position.

RESULTS

According to the principle of electric strain measurement reaction forces on horizontal bar and uneven bars are determined in vertical as well as in horizontal

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direction. Using the same measuring principles the torque caused by hand friction was monitored. These measurements do not depend on the working point of the force, because the strain gauges are applied on both ends of the bar (Figure 2). The bearing of the bar is original.

Figure 2: Arrangement of the strain gauges

In this measuring system the measurement voltage $U$ is influenced by guy strain strength $F_c$ (chain tension). Therefore the guy strain strength must be known with its initial value. It is monitored by a tractive force transducer which is part of the guy wire. The calibration of the dynamometers are realized statically with a special device in vertical and horizontal direction. The calculated calibration curves (force as a function of measuring voltage) are non-linear in the upper loading range (Figure 3 exemplary with the calibration curves in vertical direction).

Figure 3: Calibration curves in vertical directions with increasing load and different chain tension

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CONCLUSION

Based on the optimal number of strain gauges and the uneven bars the calibration graphs have been used already at FIG and UEG (Knoll). Dynamometers in con excellent for the technical fast provision of the measurement.

The measured optimizing the gymnast on the hand friction are for simulation of the movement. Compared with kinematics measurement of the dynamometer

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measuring system voltage \( U \) is influenced by hand friction working point of the horizontal bar (Figure 2). Therefore the guy must be known with its monitoring by a transducer which is realized with a special device in horizontal direction. Calibration curves are used for non-linear strain gages (Figure 3 exemplary calibration curves in combination with three gages in Figure 2).

CONCLUSIONS

Based on the principle of electric strain measurement and introducing an optimal number of strain gages accurate dynamometers for the horizontal bar and the uneven bars have been developed. Different strain forces and non-linear calibration graphs have been taken into account. 80th dynamometers have been used already at World- and European championships with confirmation of the FIG and UEG (Knoll, Krug & Wagner 1993). The measurements unit with the dynamometers in connection with synchronised video recordings are suitable for the technique training including feedback information. This is based on the fast provision of the information.

The measured reaction forces are the basic for the design engineer optimizing the gymnastic apparatuses. The reaction forces and the torques based on the hand friction are used for validation of the mathematical-physical models for simulation of the movements (Auspurg 1989, Arampatzis 1995, Knauf 1985). Compared with kinematical procedures (details of the bar of 3D-procedures) the measurement of the dynamic of the horizontal or uneven bar is much more exact.

REFERENCES


INTRODUCTION
It is generally known that movement science: studying movement behavior on the basis of (neuro)physiological models is the concern of the non-linear theories and phenomenological models. The non-linear theories and phenomenological models are:• the basis of movement adaptation in a flexible manner;• existence of general parameters independent of the components;• it is possible to describe the dynamics of these parameters;• the existence of control parameter(s) (called control parameters).The dynamical system theory is often used in other sciences: biomechanics, psychology etc. to describe the movement interactions between information. The object of this paper is to study breaststroke swimming in breaststroke swimming with results from traditional

METHODS
Corresponding to the dynamical system theory (JEKA / KELSO (1989)) the following is important. With help of the attractor the time delay τ, 0 < τ < 0.1. For this, it is necessary to know the time delay τ. For the first presentation of embedding and the attractor analysis can be used (Lies and τ from the time series...