THE MICROCOMPUTER SYSTEM OF MEASUREMENT OF THE LENGTH OF JUMP AND ADDITIONAL PARAMETERS IN SKI-JUMPING

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INTRODUCTION

The quality of ski-jump management and control is dependent on both the speed and objectivity of the jump performance. The jump length, along with in-run and landing velocity and flying phase time (period) are factors which play quite a significant part in the technique evaluation. The automatization of these data measurements and computer-made evaluation presents a new dimension in ski-jumping management and control.

PROBLEM

In the present paper measuring principles are described and the results of verification of the accuracy of jump length measurements are given. The measuring system is intended for bridges covered with plastics or ceramics. The efforts to bring about objectivization of ski-jumps length measurements (HEINICKE, HOLZ, 1969, BENEDIK, BOL¬O, 1973. KREISELMAYER. 1987. HOCHMUTH, WOITAS, 1979, GEODYNAMIC AB, 1983) failed to bring a satisfactory application owing to high financial and personal requirements and technological problems. Contemporaneously, the only official ski-jumps length measuring system elaborated by HOCHMUTH is being used at World-Cup events as well as at official FIS competitions. This system requires, however, quite a specialized service and relatively complicated measuring preparations.

MEASURING PRINCIPLE

In the system an induction principle is used in which a ski-located magnet generates, in a specially positioned conductor, fixed on both the in-run and landing parts of the bridge, electrical signals treated by microcomputer of the type PC AT after necessary adaptation.

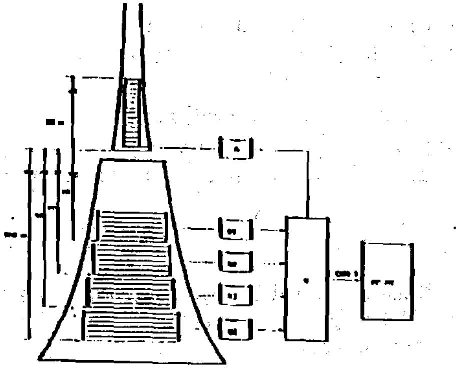

Figure 1 A schematic view of the principles of measurement

The recording conductors are divided (Fig. 1) into five sections, section A of which provides for in-run velocity measurement, and sections **B1 -** B4 for jump length and landing velocity. The signals coming from these sections are amplified and formed with evaluation unit V linked to the microcomputer by mediation of the standard port **COM1**. Its basic-software equipment makes it possible to solve the following operations:

- automatic searching of the active section,
- artefacts disturbance filtration **(e.g. elimination** of disturbances and completion of **lacking** impulses,
- measurement and calculation of in-run velocity (NR), jump length **(DS),** landing velocity (DR) and flight phase time (DL) resp.

This software equipment may be completed by a special model appropriate for training or race analysis **e.g. viz** the T-method, as well as for a more detailed analysis of the parameters NR, DS, DR and DL resp. and the correlation of the latter.

EVALUATION OF MEASUREMENT RESULTS

The accuracy of the parameters referred to was checked at the GRAND **PRIX** 1993 competition held in Frenstat **p.R.** (Czech Republic), where the innovated system was installed. Altogether 250 jumps were subject to evaluation, the time parameters being checked by the etaloned comparative method. In the parameter DS, partly the kinematographical examination method was used, partly the comparison of measuring results obtained by the DSS-system to those obtained by the referee (DSR) of the official competition made.- In Hg. 2 are to be seen photographically treated video record materials (11150 s), where the full line shows the value measured by the system. The differences exceeding 0.5 m were found in 2.5 percent of jumps and mostly caused by non-standard landings. Moreover, there was a statistical evaluation of jump length obtained by DSS and DSR methods. The results of the trial, first and second

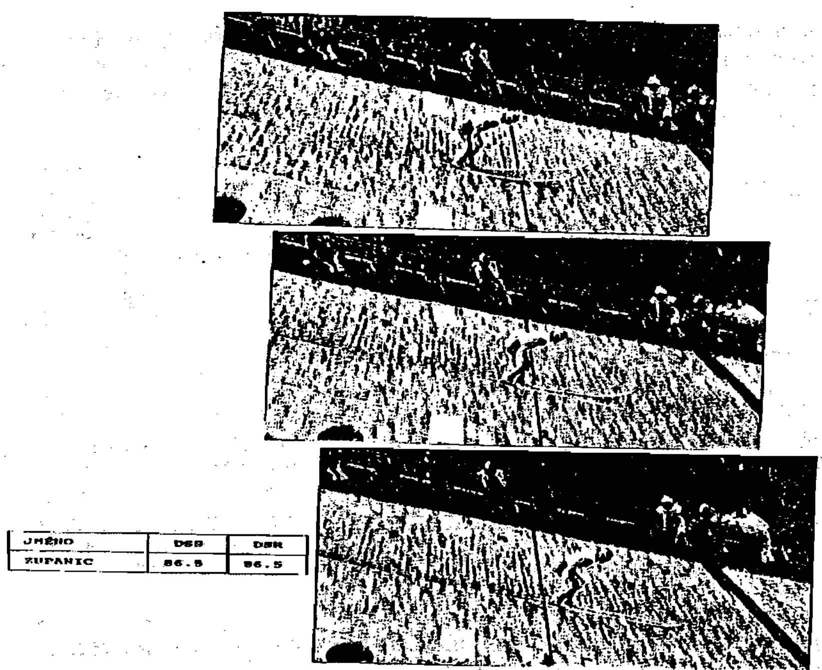

Figure 2 Verification of the jump lengths using **kinematic** analysis based on videorecording

		NR	DR	DL	DSS	DSR	Δ= DSS–DSR	t-test
trial round n=56	MEAN	84.35	104.69	3.12	79.24	79.15	0.09	1.12
	S.D.	0.40	2.58	0.16	4.41	4.34	0.60	
	MAX	85.20	11.40	3.58	89.50	90.00	-0.50	
	MIN	83.60	100.30	2.75	68.50	70.00	-1.50	
	C. of var.	0.47	2.46	5.11	5.56	5.48		
I. round n=53	MEAN	83.75	103.99	2.99	75.59	75.57	0.02	0.18
	S.D.	0.36	2.87	0.17	4.75	4.45	0.75	
	MAX	84.70	110.30	3.41	86.00	86.00	0.00	
	MIN	83.10	96.80	2.61	65.50	65.50	0.00	
	C. of var.	0.43	2.76	5.82	6.28	5.90		
II. round n=34	MEAN	83.60	103.83	3.23	81.25	81.13	0.12	1.13
	S.D.	0.38	2.87	0.17	4.92	5.08	0.61	
	MAX	84.40	110.10	3.64	92.00	92.00	0.00	
	MIN	82.70	97.60	2.97	74.50	75.00	-0.50	
	C. of var.	0.46	2.77	5.44	6.05	6.27		

Table 1 The measured system parameters and comparison of jump lengths with referees

Statistical **characteristicsrounds** are presented in Table 1. The values of the pair t-test are not statistically significant over 5 % of the significant level. The relation between the measured jump length by the methods DSS and DSR is expressed by the correlation coefficient r (see Fig. 3).

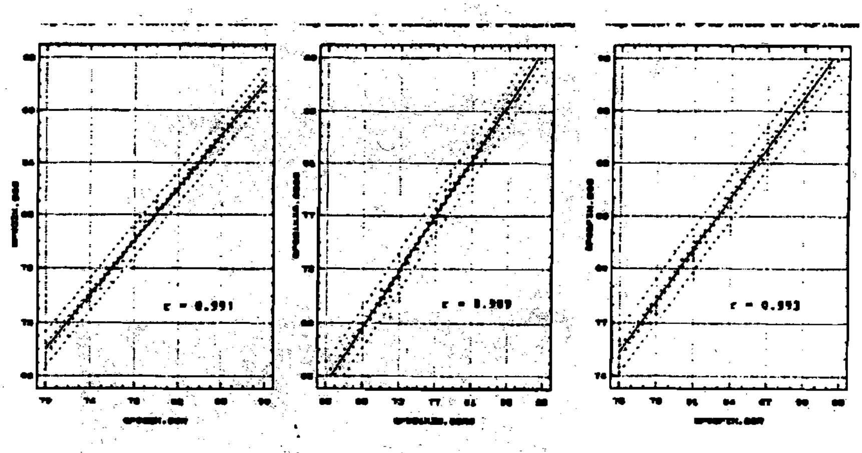

Figure 3 Dependency between jump lengths measured by the system and referees

Linear regression, correlation coefficient also presented the fundamental statistical characteristics of the other parameters measured by the system NR, DR and **DL.indicated** the basic statistical characteristics of additional parameters to be measured by the system, that is to say NR, DR and DL resp.

CONCLUSIONS

The results of the analysis of jump length measurements **precision** proved the applicability of the measuring system in both training and race conditions. The measuring process is a fully automated one, **thus** satisfying the requirement of minimum complication as regards service and maintenance of the device. The amount of the parameters measured together with the special programming equipment prove to be the starting point of good control and management of the **ski-jumping** training process.

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