THE SYSTEM OF KINEMATIC ANALYSIS OF SKI-JUMPING

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INTRODUCTION

The high quality of training in ski-jumping is determined by the quality of information about the proper ski-jump. The main focus of the trainer's effort is to correct the movement during jump. The kinematic analysis of ski-jumping is the starting point for gathering high quality information about an athlete's jump. The presented system of Kinematic Analyses of ski-jumping was elaborated with the aim of obtaining both fast and high quality information of completed ski-jump.

BASIC CHARACTERISTICS OF THE SYSTEM

The system is based on 2-D analysis of the ski-jumper's movement and provides for:

- the realization of analysis of ski-jumping technique in four
- main phases
- comparison of athletes
- statistical elaboration of analyzed parameters
- creation of specific database files

The system utilizes input data taken from a videoanalyzer of our own construction or can be easily adapted for the input data taken from other similar systems.

The basis of the system is the database of analyzed jumps from different events. The system enables us to compare individual jumps and analyzed parameters of selected sets of athletes. A key component of the system is modeling of the movement which enables one to extract other information according to user choice. A specific part of the system is the recording of the ski-jumping hill parameters according to the official FIS certificate. By using the appropriate technique the system can work'in any terrain.

THE STRUCTURE OF THE 'SYSTEM

Menu consists of: File , Database, Analysis, Comparison, Statistics, Jump–hill, Options.

File The menu allows basic file operations, e.g. creation, open, close, any type of connection of two files, import and export of the file in ASCII and also change the current directory. In this part we find the instruction of the end of operation of this system.

Database The menu consists of the basic elements of the system which are indispensable for the operatmg of the database file. By using the function records can be edited, deleted, selected, etc. The status line content shows the function keys which extend the possibilities of database operations.

Analysis The system renders the analysis of the jumper's movement in four phases: inrun, take-off, transition and flight.

Inrun The analysis characterizes the inrun position in graphical and numerical form. It describes the position of athlete's angle between the body segments, the distance of the center of gravity from the ground and compares the position of the ski-jumper with the model which can be changed according to user's wishes.

Take-off The analysis is measured from a distance of 8 m before and 1 m after take-off edge. It gives visual information about the take-off in the form of a simple stick figure diagram. Further information includes data about the angle values of the body

segments, the position of the center of gravity of skier-ski system, the velocity of the center of gravity' in the direction of the run and the perpendicular direction to the ground and take-off angle. The special procedure is the analysis of angle-time function. The output from this analysis consists of three information screens.

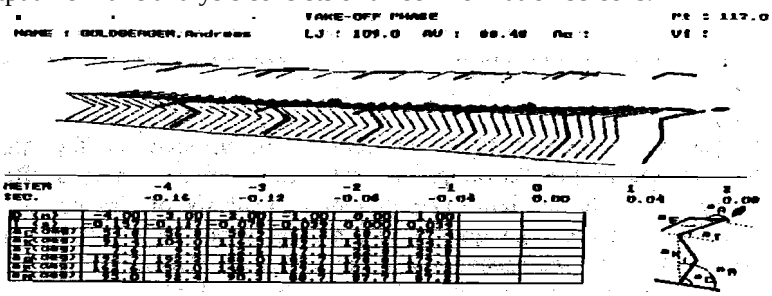

Fig. 1 An example of the take-off analysis

Transition The analysis of the transition from the take-off to the flight position can be done in the range of 1 m to 8 m from the take-off edge. The graphical and numerical information are similar to the take-off phase. Additionally, the angles expressing the position of the body segments and ski with regard to the direction of the flight, are evaluated. This output consists of four information screens.

Flight The system enables the analysis of the flight phase according to the choice of user and the terrain conditions from 2 m after the take-off to the preparation phase of the landing. It gives visual information about the angles between body segments and the slope of the flight curve, the relative height of the flight curve above the landing area. and the velocity of the center of gravity. The output can be seen on two information screens.

Modeling The system enables one to work with models of elaborated phases in interactive manner. For example. the input information of the modeling process could be the distance from the take-off edge, the timing of the athlete's movement and/or the concrete value

of some defined angle. The model gives further information relating to the input parameter.

COMPARISON

The procedure renders the comparison of two athletes in the same hase of movement. It can be used for all analyzed phases of ski-jump. The user can watch both graphical and numerical information on the screen and compare two athletes selected from the same database set. The length of step used in the modeling process can be chosen continuously according to the length or time intervals.

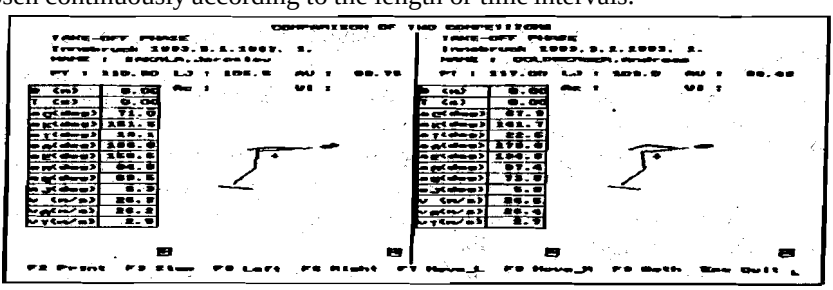

Fig. 2 An example of the comparison

STATISTICS

The system enables us to realize the statistical analysis on two levels. Descriptive statistics render the basic statistical characteristics including the graphical information about the analyzed parameters of a selected set of the athletes. This procedure can be utilized in all analyzed phases of the jump. The second possibility is the analysis of the relationship between two selected parameters, e.g. approach velocity and

length of jump, accuracy and vigour of take-off, by one or two selected sets of athletes in the measured values or so-called T-points.

JUMP HILL

A relatively separate part of the database is the jumping hill data which is based on official FIS certificate. It is possible to browse and edit technical data and graphically express the profile of a selected hill. Stored data can be utilized in conjunction with the analysis of the flight phase.

OPTIONS

The menu enables users to change the range of selected angles in inrun position and take-off phase. Also some parameters of statistical comparison can be changed. For the high quality of the output the appropriate type of printer can be chosen.

VIDEOANALYZER

The videoanalyzer elaborates the video recorded movement to digital form and using special software provides the analysis of the athlete's position in the space. These data are the most suitable input for the kinematic analysis of ski-jumping.

This system was created in cooperation with the Laboratory of Human Movement Studies and Computer Center, Palacky University, Olomouc, Czech Republic.

CONCLUSIONS

The system was developed for both the trainer's practice and the research work. In principle this system can be used in following ways:

- It enables one to provide the proper analyses in connection with a videoanalyzer and to create one's own database of analyzed jumps according to one's own selection. The system can be connected to the coidmercially produced videoanalyzers.
- The system can be stored in the trainer's computer as an information database and added to the provided analyses based on our offer.
- The system can be used as an instructional aid for the teaching of biomechanics in the form of a demonstration model with a limited number of analyzed jumps. The demonstration model can be completed with the best athletes or it is possible to choose athletes according to your own wishes.

In the period from 1992 to 1994 more than 400 inrun positions and over 900 take-off, transition and flight situations were analyzed at top ski-jumping events. Data are used by the trainers from some countries and are elaborated from the point of view of research in ski-jumping.

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