ON - LINE BIOMECHANICAL ANALYSIS

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INTRODUCTION : Biomechanical analysis is that branch of science which involves a description of the position and movement of the body and its parts and the forces acting on them. This analysis may include the energy released or consumed by these parts.

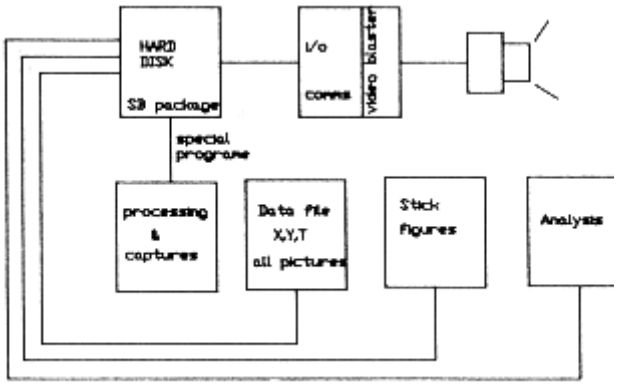
On-line analysis means the technique of collecting electronically measured date from an experiment and fed directly into a computer for immediate date processing and result sorting. The idea of an on-line computer system for recording biomechanical date was discussed for 25 years by the Biomechanical Laboratory or Pennsylvania State University [1]. This work and others showed three advantages for the on-line system; fast and accurate measurement and collection of biomechanical data, drastic reduction of processing time for a large number of parameters and finally the possible immediate feedback from the on-line system operator to the subject or the player under analysis. Recent advances in multimedia and the simplicity of handling multimedia packages permit the trainer and coach to efficiently operate on-line biomechanical analysis systems.

For many years, biomechanical analysis depended on techniques such as stroboscopic photography and cinematography, as methods of capturing temporally spaced kinematic data. From this data; position, velocity, and acceleration could be determined and forces could be derived. In the last decade video was introduced as a recording technique. Since the precision of the kinematic values observed in biomechanical analysis depends upon the recording method of the subject's motion, many studies were carried out to investigate the credibility of video as a recording technique [3,4]. Those investigations compared film as a well established and precise technique and video technique. They concluded that video recording methods are as accurate as 16 mm cine devices However, for some special situations, slight differences in accuracy between film and video analysis were noticed [2], but it is not clear that whether those differences were due to the lower resolution of the video images or to the distortion produced by the lenses.

The coupling between the video and the computer through the use of video blaster facilitates the creation of an accurate and simple multimedia used in biomechanical analysis.

A cooperation between the Arab Academy for Science and Technology and the physical Education college of Tanta University created a precise and powerful multimedia tool for an on-line biomechanical analysis of sport skills. (Figure 1).

Fig.1 On-line Multimedia configuration



The method of analysis is similar to that used by cinematography. The actual system is composed of a video camera, a video blaster, a computer, a computer program Figure (1).
A scale mark having a known length is fixed in the camera field of view. The camera is fixed in its position over all the recording time. The field of view must contain all the elements of the skill trial.
After recording the trial, a video blaster is used to store the successive frames of the trial movement. This permits one to obtain a series of frames similar to those obtained by cinematography and also by conserving the time increment between the frames.
A computer program is specially designed to analyze the performance of sport skills.
The program allows one to obtain the data of any point on a displayed image, including the vertical and horizontal displacements between two successive frames. Those displacements are the inputs to the program calculations.
In the center of gravity calculation, other data are involved, such as the joints' weight and center of gravity. Any displayed image is used to obtain the actual distance by comparing the scale mark previously fixed in the view at nearly the middle plane of the movements.
From the points data, the program performs the following calculations and the results; smoothed displacement (X and Y), velocity (X and Y), acceleration (X and Y), resultant displacement, resultant velocity and resultant acceleration.
From these data it is possible to calculate the angular displacement, angular velocity and angular acceleration.[2]

RESULTS: The above-mentioned multimedia configuration was successfully used in the biochemical analysis of such different sport skills as the skill of Oramawashi-Geri in Karate and the skill of side parry in fencing. This later skill is presented as an example of results obtained by this multimedia configuration.
The study of the side parry in fencing was directed to getting an immediate qualitative and quantitative analysis for this movement. The subject of the study was a world champion in fencing.

The multimedia configuration immediately sorted a paper copy of the successive images of the movement (Figure 2) and the corresponding stick-Figures (Figure 3).

Fig.2 Successive Images of the Skill

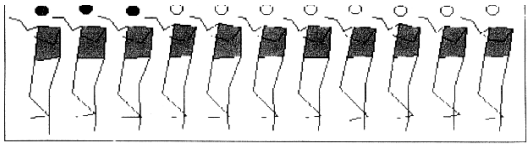


Fig. 3 Stick-Figures of the Skill

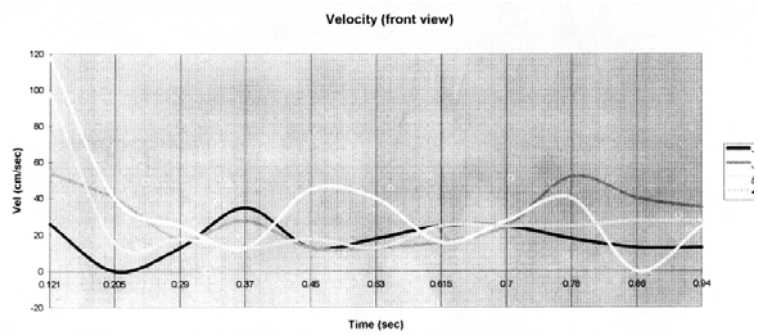


Fig. 4: Armed Arm Points; Velocity Versus Time

Also the values of the required parameters such as velocities and acceleration of the armed arm points were determined. An example is given in Figure (4), which represents the variation of the resultant velocity with time for the four points of the armed arm, shoulder, elbow, wrist and fist.

The immediate data obtained from this on-line biomechmical analysis greatly reduced the time needed to determine the causes of the drawbacks in player performance. In karate this reduction was enormous.

CONCLUSION:

1- In this study the methods of biomechanical analysis are reviewed. The cinematography was found to be very accurate but expensive and heavily time consuming.
2- This study presents a method of biomechancal analysis using a fully computerized system.
3- This method proved to be accurate and inexpensive.
4- Any mistaken trial could be corrected by the actual multimedia system.
5- Video technique offers many advantages over traditional filming methods.
6- In the on-line multimedia configuration, trainers and coaches could obtain a fast reporting of various sport skills performed by their athletes.

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