

Comparing Results of Biomechanical Analyses of Raw Data Determined using AutoCAD Software with Those Determined by an AutoMatlab Software For the Annexation Movement Jump On a Pony and Hands Jump Forward in Gymnastics

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ABSTRACT

The study aims at devising a program that uses the Matlab package and also compatible with the AutoCAD software in order to automatically determine the biomechanical variables of athletic moves after feeding the program with minimum information within the movement and Comparing the results of biomechanical analyses of raw data determined using AutoCAD software with those determined by an AutoMatlab software For a number of Athletic performance moves. As the researcher recognized the fact that the number of researcher that are capable of kinematic analysis are limited , and they spend hours to determine the biomechanical variables in their researches, the researcher set fourth the problem of the study in questioning if it is possible to write a program capable of determining the largest number of biomechanical variables with highest precision and shortest time. Thus the researcher set out to devise computer program to perform the task and optimize the time of the analyzer in determining his research's variables . The study hypothesized that the results can be precise and identical to the values of variables determined using the traditional analysis programs and methods. The sample of the study was the Iraqi male and female champions in Gymnastic in the amateur category. The researcher adopted the descriptive method which is appropriate with the nature of the study. The results of the study's variables were presented first using the traditional methods from and then the results using the devised program and comparing them . The researcher concluded that Matalab and AutoCAD packages can be tuned with the aim of determining the kinematic variables including the joints of the human body during the athletic movement. The work was a result of collaboration between researcher in the fields of biomechanics and computer science to developed such programs . The study shows that there are no differences in the results of biomechanical analyses of raw data determined using AutoCAD software with those determined by an AutoMatlab software.

Keywords: *AutoMatlab, Biomechanical Analyses, Annexation Movement*

INTRODUCTION

Biomechanics analysis is considered the first step in expounding the details in any study that attempts to investigate the dynamic actions either in sports or any other field of interest. The researcher observed the positive current trend that converges to creativity in biomechanical kinetic analysis using powerful computerized analysis software that are capable of processing the variables of any dynamic movement in sports with both speed and precision. The research recognizes the contributions to this subject while proposing a program written in Matlab language that can be added to relevant kinetic analysis programs including (AutoCAD, Photoshop, and video stream players) and used to decrease the time required to determine biomechanical variables when compared to the traditional manual methods. The importance of the study stems from its designed program that is capable of extracting the biomechanics variables automatically and precisely without the need to extract the variables manually through biomechanics law.

The study's problem

The researcher recognizes the fact that the numbers of researcher that are capable of kinematic analysis using the computer are limited, and those who do, spend hours to determine the biomechanical variables in their researches. Thus the researcher states the problem of the study through questioning if it is possible to write a program capable of determining the largest number of biomechanical variables with highest precision and shortest time?

The problem of the study in a nutshell is "to speed up the process of analysis using set after set of inputs after displaying the results of each speed". Thus the researcher proposes a computer program to perform this task while optimizing the time of the analyzer in determining his research's variables. The program is easy to use by any researcher and this overcomes the bottleneck that encounters researcher when they have valid scientific ideas to investigate but lack the time for analysis.

The study's objective

Designing a program that works in the Matlab environment to automatically extract some biomechanics variables of an athletic performance in a relatively short time when compared to time spent working on AutoCAD.

The Scope of the Study

The methodology of the study was performed with the aid of one male and one female gymnastic champion in individual events on gymnastic apparatus. The tests were performed in the indoor gymnastic playgrounds in the Futowa sports club and Qarakush club both located in Nineveh /Iraq during the period between 11/12/2010 – 19/1/2010.

Key terms

Biomechanics: The science concerned with the internal and external forces acting on the human body and the effects produced by these forces through the laws that govern the movements of the human being, his systems and their interaction with the environment (Alsumaidai, 1987).

AutoCAD 2000i: Wide application engineering software that is mainly used in architectural engineering and construction plans. The program is used in sports science in extracting kinematic and kinetic values.

Matlab language: A two-word term meaning (matrix laboratory) referring to a numerical computing environment and programming language that allows high mathematical and logic computation on matrices with efficiency and precision (Brian D.Hahn, (1997), Gerard Blanchet (2006)).

Automatlab : A term consisting of two parts .The first part is taken from the first part of Autocad and the second is taken from the matlab. The term is used to denote the program that is designed by the researcher.

Digital images:The researcher defines the digital image as a number of picture element (pixels) that are spatially separated or organized. Each pixel is a scalar proportional to the brightness. Color image measures the intensity and chrominance of light. Each color pixel is a vector of color components The digital images are processed by the computer through Matlab by dividing the image into thousands of colored pixels in order to process each pixel separately. The pixels are represented by a two-dimensional matrix and the row and column index defines the location of the pixel in the digital image. A digital image is a discrete two-dimensional function of (x,y) which has been quantized over its domain and range . Without loss of generality, it will be assumed that the image is rectangular, consisting of rows X and Y columns. The resolution of such an image is written as (X x Y) (Torsten Seemann 2002).There are various input methods to feed the image into the computer including digital cameras . As the image consists of pixels, the quality of

the image increases with the number of obtained pixels and the size of the image is determined by the number of pixels. The images used in the study were colored images.

The nature and importance of biomechanics analysis

The main purpose behind biomechanics analysis is to determine the level of performance of athletic movements and skills in various sport events including gymnastic. The analysis aids specialists, researcher and trainers to recognize the points of strength and weakness in the level of performance of the athlete and to evaluate the performance objectively and scientifically. However, the analysis is incomplete if it overlooks the biological interaction between the human body and forces acting with it because the movements of the human body parts are linked to physical forces based on the neurological system as well as various other body parts and system (Mahjoob, 1990). Thus Biomechanics analysis of the motor performance is an objective method to evaluate and develop the performance. It aids in selecting the best possible moves and positions that can be utilized by the athlete in a certain performance (Hussam Aldeen 1993).

Matlab in the field of Computation

Determining, sampling and analyzing data and parameters.

Arithmetic and logic computation.

Developing algorithms

Sampling, simulating and designing primary project plans.

Engineering and scientific drawing (www.mathworks.com).

METHODOLOGY

The method adopted is descriptive based on the nature of the study. The study sample included two gymnastic champions (one male and one female) gymnastic champions that were deliberately selected and were equal in age, training experience and their mass which was 25 kg.

The biomechanic variables used in the study:

Total horizontal displacement , Total motion time , Horizontal speed ,Horizontal inertia, Horizontal force, Horizontal work ,Horizontal energy ,Kinetic energy ,Potential energy and Total energy

The algorithm

Forming an image in AutoCAD that represents the dynamic analysis of the athlete.

Reading the colored image that contains the analysis.

Input the mass of player and number of images.

Determining the dimensions of the image (rows, columns and color).

Determine the pixels that represent the beginning and the end of the motion through image processing.

If the pixels that represent the beginning and the end of the motion are not identified GOTO END.

Determine the horizontal scale of the image through two pixels by recognizing the color value.

If the horizontal scale is not identified GOTO END.

Determine the biomechanical variables.

Display the calculated biomechanical variables' values.

Determine the pixels that define the height the athlete from a certain point from the horizontal and vertical distance of the pixels.

If the height pixels were not identified GOTO END .

Determine the vertical scale of the image through two pixels by recognizing the color value.

If the vertical scale is not identified GOTO END.

Calculate the values of potential and total energy.

Display the values of potential energy and kinetic energy

End

RESULTS

The Biomechanics Results for the Tuck jump on the pommel horse as shown in the image in appendix .

Table (1) The Biomechanics results for the jump move on the Pommel horse using the traditional software and the designed program

AutoCAD		Auto Matlab	
Biomechanics variables	Value	Biomechanics variables	Value
Total horizontal distance	1.921 m	Total horizontal distance	1.921 m
Total motion time	0.960 s	Total motion time	0.960 s
Horizontal speed	2.001 m/s	Horizontal speed	2.001 m/s
horizontal inertia	50.025 J	horizontal inertia	50.025 J
horizontal force	52.100 N	horizontal force	52.100 N
horizontal work	100.084 J	horizontal work	100.084 J
horizontal power	104.254 W	horizontal power	104.254 W
Kinetic energy	50.050 J	kinetic energy	50.050J
Potential energy	160 J	potential energy	160 J
total energy	210 J	total energy	210 J

The biomechanics results for the forward arm jump move on the floor mat using the traditional software and the designed program as shown in the diagram in appendix 2.

Table 2 The biomechanics results of the jump move on the floor mat

AutoCAD		Auto Matlab	
Biomechanics variables	Value	Biomechanics variables	Value
Total horizontal distance	2.132 m	Total horizontal distance	2.132 m
Total motion time	0.840 s	Total motion time	0.840 s
Horizontal speed	2.538 m/s	Horizontal speed	2.538 m/s
horizontal inertia	63.450 J	horizontal inertia	63.450 J
horizontal force	75.525 N	horizontal force	75.525 N
horizontal work	161.019 J	horizontal work	161.019 J
horizontal power	191.689 W	horizontal power	191.689 W
Kinetic energy	80.518 J	Kinetic energy	80.518 J
Potential energy	236.312 J	Potential energy	236.312 J
total energy	316.830 J	total energy	316.830 J

CONCLUSIONS

Matlab and AutoCAD features can be combined to produce a high precision program.

The biomechanics variables of the investigated moves were determined automatically after feeding the designed program with the minimum of values.

RECOMMENDATIONS

The designed program can be used in analyzing all types of sport motion and moves.

Devising a program to determine kinematics variables of body joints during the sport movements .

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