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ANALYSIS SPORTS MOVEMENT

Pia Simona FĂGĂRAŞ

Abstract: *Sports biomechanics research technique aims to elucidate the improvement of shooting technique in the game of basketball, to improve effectiveness. This work is part of a larger research that aims to study the throws in basketball game from biomechanical point of view (for better understanding at phenomenon),, the realization of a mathematical model that allows modeling the throw disposal in terms of different parameters (heights, scale, distance, etc.), and tracking by throwing motion, following to change the trajectory of the ball phenomenon through girodynamics percussion effects.*
Key words: *human movement, dynamic model, kinogram, basketball throw,*

1. INTRODUCTION

"Sports Science" is that branch of science that deals with the application of scientific principles in sport, with aspects of Exercise Physiology, Biomechanics, Sports Psychology, Kinesiology, Coaching Science and Statistical Analysis of sports performance.

2. METHODS OF MOVEMENT ANALYSIS

Analysis of human motion in sport activity involves determining in which way the athletes performances are influence when using optimization methods and specific elements for identify movement.[2]

Movement analysis has its roots in ancienttimes. Philosophers and physicians had been thinking andarguing about human movement. The beginning of dynamiccalculations of human movement, however, began withGiovanni Borelli during Renaissance.

The study technique of motion has developed and once with the development of science have occured new analysis methods.
Muybridge was analyzing human and animal movementswith photographs in 1870. Using cinematographic pictures, Braun and Fischer made their own calculations, transformingimages to numeric values, like "change of locationper second," which actually is the velocity of movement. Informatics development also led to the emergence of computerized methods for the analysis of movement.

Hundreds of laboratories around the world are now working on movement analysis.
Kinematic analysis of human movement is widely used in various areas: ergonomics, biomechanics, kinesiology and sports.

The objectif of this is to understand better the human motricity and optimization the sport performance. Analysis of motion is the process, the operation by which decomposes the motric act to determine and examine all the elements from quantitative and qualitative point of vue. The study of human motion have two major components: the capture and the analysis of human motion. For the first component – capture of human motion – we used systems which have in their composition the hardware devices like cameras, markers electrical circuits, with infrared or reflective. For analysis of human motion are using software aplication they are able to read the colected dates and process them in a structure then can be translate in significant results that define a person's movements. [3], [4]
Biomechanical research of human movement, considered the human body like a mechanical

system made from segments (called multibody system – figure 1) on which acting various forces like, muscle force, gravity force, inertia force, reaction force. [5].

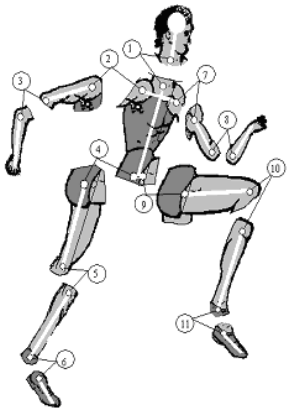


Figure 1 – Human body in mechanic and decomposition in components part

To describe the positions and movements of body segments must know the plans in which can take place these movements. These are illustrated in figure 2.

Sagittal planedevide the body in two sides: left and right (the plane passes the anterio-posterior midline of the head).

Frontal plane divides the body into two parts: the anterior and posterior (cross section in the two holes of the ears)

Transversal plane divides the body into two parts: upper (cranial) and inferior (caudal)

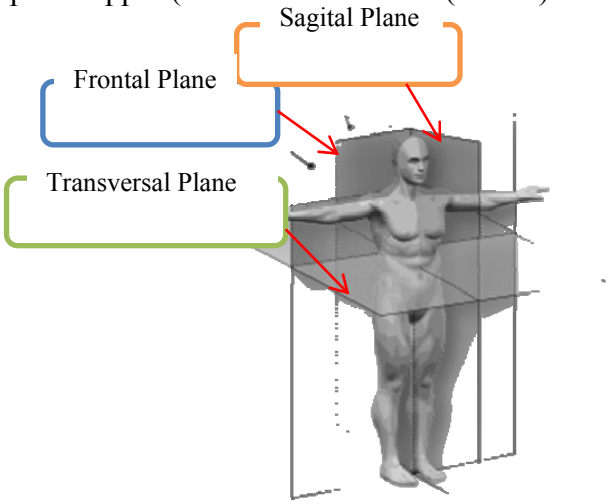


Figure 2 – Anatomic plans of human body

The base for biomechanical analysis of sports movement is the antrophometric model.To interpret computerized data for each segment of the body (head, hand, forearm, arm, trunk, pelvis, thigh, calf, foot) depending on the motion carried is the human movement research.

In this study we tried to present how to achieve a kinograme, of throwing in basketball game.This study is part of a larger research,which is to study the shooting in basketball from biomechanical point of vue, for better understanding of phenomenon, and to achieve a dynamic model of free throws in basketball.

In the book „Research methodology of body activity", M. Epuran define kinogram like a succession of moments of an motric act, their number being given during this act and frame rate per second" [1].

One of the stage to define the model was the identification of the antrophometric mesurement needed to realise the model,(it is impossible to obtain kinematic and dynamic results without properly set of centers of mass, length segments considered).

3. CONDUCTING RESEARCH

To observ the movement of body segments,and the angles between them, we made some records of throwing in the gym hall of Physical Education and Sport Faculty from „Transilvania" University Braşov, under the direction of Mrs. Prof. Dr. Eng. Mihaela Baritz and Eng. Dr. Ionel Serban.

In conducting the research, we used high-speed video camera Optiplaza laboratory of the Faculty of Mechanical Engineering of the University "Transilvania" of Brasov

The features of this camera are:

- Fastec camcorder purchase Troubleshooter maximum speed 500 frames / second and stages 30, 50, 60, 125, 250, 500 frames / second.
- Variable focus lens and focal length of 14 mm
- Natural or artificial illumination system (halogen lamp)
- Positioning the tripod with the possibility of aligning and fixing
- Camera CMOS sensor with 640 x 480
- The camera connects to a Dell Laptop.

Figure 3 - Video camera Fastec Troubleshooter

These records were made on a total of 5 subjects, 4 of which are athletes (2 boys and 2 girls) junior basketball teams making up the University Sports Club Brasov. Athletes are also components of national teams in their age group, respectively (U17 - boys) and (U 14 - girls) (Table no. 1) The fifth issue (Benea A.) is a student at Sport College, whitout specific basketball experience.

Tabel nr. 1

Nr. crt.	Name and surname	Year of birth	Sex	Basketball experience
1	**Chiriac A.**	1995	M	7 year
2	**Stochici O.**	1995	M	7 year
3	**Armanu E.**	1998	F	5 year
4	**Ferariu M.**	2000	F	4 year
5	**Benea A.**	1992	F	without–student at sport college

The recording of the gym was conducted according to the following protocol:
There were two type of throws: a) free throw (5,80m), b) Jump shot (5,80m). This throws permite a better visualization of throw tehnique. Of each throw were made 3 recording, noted with x = failure, 0 = succes of throw. The dates were records like in the table below:

Tabel nr. 2

Nr. crt.	Numele şi prenumele subiecţilor	**ARUNCAREA LA COŞ**					
		ARUNCAREA LIBERĂ (AL) (x = nereuşită, 0 = reuşită)			**ARUNCARE DIN SĂRITURĂ (AS)** (x = nereuşită, 0 = reuşită)		
		AL1	AL2	AL3	AS1	AS2	AS3
1	**C.A.**	x	x	0	x	x	0
2	**S.O**	0	0	x	x	0	x
3	**A.E**	x	0	x	0	x	0
4	**F.M**	x	x	0	x	0	x
5	**B.A**	x	x	0	x	x	x

The parameters of these throws were:

- Distance between player and basket - 580cm
- Ring height - 305 cm
- Camera distance from player - 700 cm

From each subject were attached markers at each joint to see the movement.

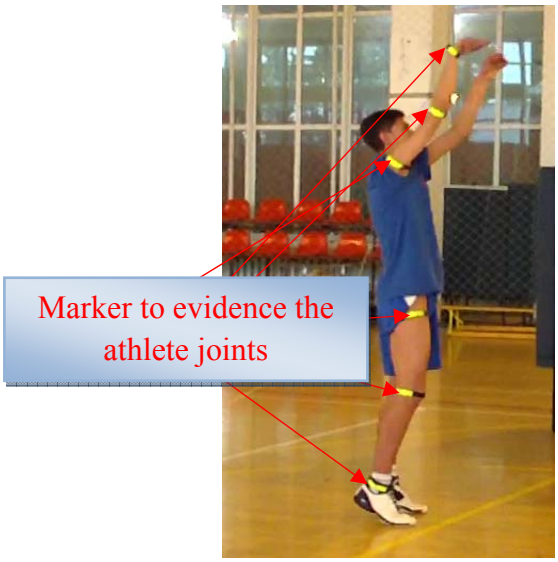


Figura 4 – athlets prepare for record

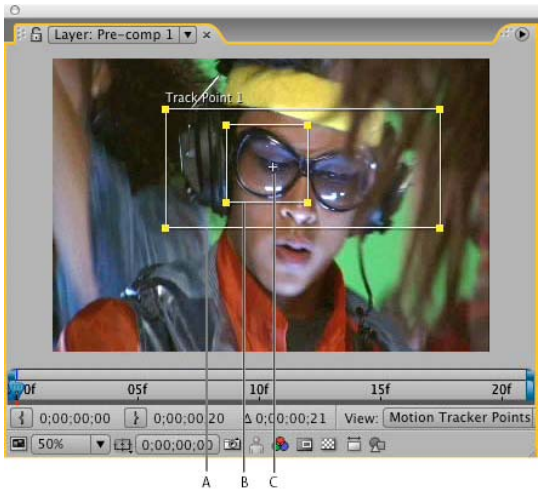
4. DATA PROCESS

To process this images were usedAdobe After Effects 7.0 program. After we open the program, the movie or the imagine is imported to be processed. Then will determine what you want to do, in our case, determining the trajectory of a point, the marker placed on the joint.

You specify areas to track by setting *track points* in the Layer panel. Each track point contains a*feature region*, a *search region*, and an *attach point*. A set of track points is a *tracker*.

1. *Feature region* - The feature region defines the element in the layer to be tracked. The feature region should surround a distinct visual element, preferably one object in the real world. After Effects must be able to clearly identify the tracked feature throughout the duration of the track, despite changes in light, background, and angle.

2. *Search region* - The search region defines the area that After Effects will search to locate the tracked feature. The tracked feature needs to be distinct only within the search region, not within the entire frame. Confining the search to a small search region saves search time and makes the search process easier, but runs the risk of the tracked feature leaving the search region entirely between frames.
3. *Attach point* - The attach point designates the place of attachment for the target —the layer or effect control point to synchronize with the moving feature in the tracked layer.



Layer panel with track point ***A.*** *Search region* ***B.*** *Feature region* ***C.*** *Attach point*

Figura 5 – Adobe After Effects / marker (figure is copied from official website of Adobe.com)

Once positioned the track point , the registration of his movement is started. So we obtain the trajectory of the marker (figure 6)

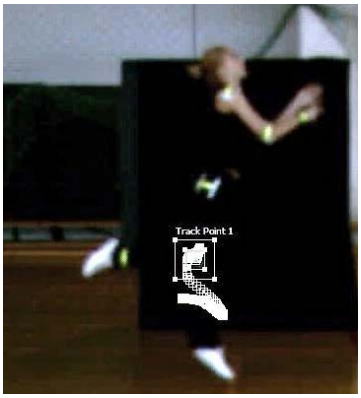


Figure 6 –marker trajectory

Each marker is made in this way, obtaining the coordinates of each point of the trajectory (2D - (x, y)), and the data obtained are exported to EXCEL

	A	B	C	D	E	F	G	H	I	J	K
1	xA	yA	450-yA	xB	yB	450-yB	xC	yC	450-yC	xD	yD
2	x glezna	y glezna		x genunchi	y genunchi		x sold	y sold		x umar	y umar
3	269	444	6	304	365	85	265	330	120	287	220
4	268,988	443,977	6,023	304,031	365,117	84,883	265,043	330,02	119,98	287,039	219,988
5	269,012	443,941	6,059	304,125	365,074	84,926	265,145	330,043	119,957	286,984	219,934
6	269,039	443,996	6,004	304,203	365,262	84,738	265,199	330,184	119,816	287,016	219,918
7	269,016	443,961	6,039	304,328	365,242	84,758	265,355	330,277	119,723	286,984	219,938
8	269,07	443,918	6,082	304,422	365,273	84,727	265,457	330,301	119,699	287	219,902
9	269,039	443,977	6,023	304,523	365,262	84,738	265,531	330,41	119,59	286,926	219,855
10	269,102	443,938	6,062	304,695	365,379	84,621	265,688	330,441	119,559	286,914	219,801
11	269,043	443,98	6,02	304,832	365,457	84,543	265,711	330,613	119,387	286,887	219,77
12	269,082	443,984	6,016	304,93	365,563	84,437	265,863	330,742	119,258	286,84	219,719
13	269,137	443,938	6,062	305,102	365,656	84,344	265,949	330,781	119,219	286,789	219,648
14	269,094	444	6	305,27	365,719	84,281	266,137	330,883	119,117	286,758	219,555
15	269,133	443,957	6,043	305,469	365,777	84,223	266,242	330,988	119,012	286,688	219,488
16	269,113	444,004	5,996	305,566	365,82	84,18	266,473	331,074	118,926	286,637	219,453
17	269,25	444,004	5,996	305,82	365,957	84,043	266,695	331,133	118,867	286,613	219,34
18	269,266	443,926	6,074	306,094	366,016	83,984	266,93	331,215	118,785	286,539	219,207
19	269,301	443,941	6,059	306,332	366,109	83,891	267,105	331,422	118,578	286,492	219,129
20	269,262	443,863	6,137	306,539	366,25	83,75	267,316	331,574	118,426	286,414	219,004
21	269,352	443,875	6,125	306,773	366,348	83,652	267,504	331,695	118,305	286,367	218,918

Figure 7 – dates from Adobe After Effects exported in Excel

Here they are processed and using some application created in Matlab Program we obtain the kinograms for each athlete throwingin the corresponding part of the dynamic model developed previously.

Figure 8 – model of athlete

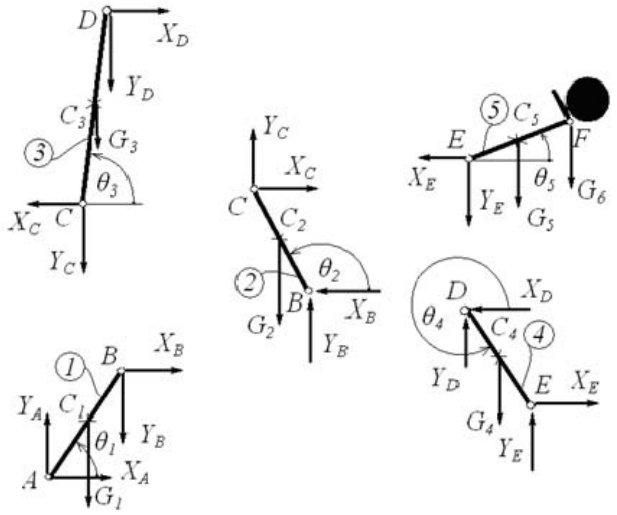


Figure 9 – coordonations of segments

In figure 9 we have the segments of the model with their coordonations:

- AB segment corresponds to calf
- BC segment corresponds to thigh
- CD segment corresponds to trunk
- DE segment corresponds to arm
- FE segment corresponds to forearm

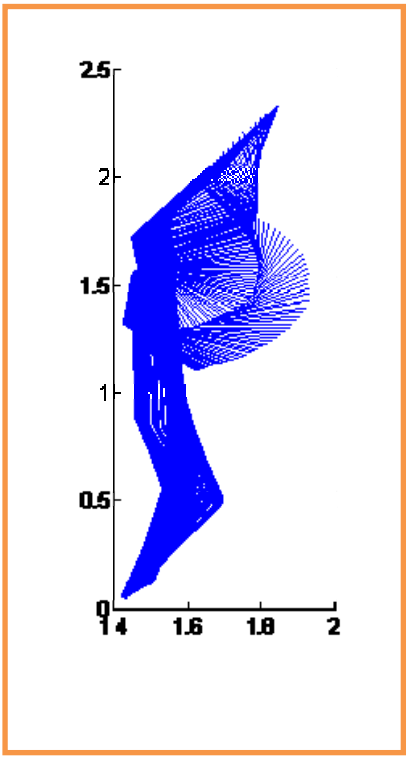


Figure 10 – Kinograme obtained in Matlab programm

5. CONCLUSION

To study an athlete's movement, in general, the proposed models representing various segments of the human body

So, there are models that are based on two segments and others more complex and reach over 12 segments, connected by cylindrical or spherical joints that truly simulates as close links between human body segments.

This study finds application in the understanding the sport tehnique, allowing further modeling of training to achieve the sport performance.

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ANALIZA MIŞCĂRILOR SPORTIVE

Abstract: *Cercetarea biomecanică a tehnicii sportive îşi propune să elucideze perfecționarea tehnicii în aruncările la coş din jocul de baschet, pentru îmbunătățirea eficacității acesteia. Această lucrare face parte dintr-o cercetare mai amplă care îşi propune studierea biomecanică a aruncărilor la coş în jocul de baschet (în vederea înțelegerii mai bune a fenomenului), realizarea unuimodel matematic, care să permită modelarea aruncării la coş sub aspectul diferiților parametri (talie, anvergură, distanță, etc), şi a mişcării imprimate de aruncare, urmărind fenomenul de schimbare a traiectoriei mingii prin percuții cu efecte girodinamice.*

Pia Simona FĂGĂRAŞ, Lector univ. drd. **,** Universitatea „Petru Maior", Tg. Mureş, Departamentul de management, monihaba@yahoo.com, telefon 0265- 219004, Str. Aleea Covasna nr. 10/1; Tg. Mureş, 0744.355644