The 40th International Conference on
Mechanics of Solids, Acoustics and Vibrations &
The 6th International Conference on
"Advanced Composite Materials Engineering"
COMAT2016 & ICMSAV2016
Brasov, ROMANIA, 24-25 November 2016

USING INEXPENSIVE MOTION ANALYSIS TOOLS TO ANALYZE THE FREE THROW IN JUVENILE BASKETBALL

Mircea Mihălcică[1], Ioan Burcă[2]
1 University „Transilvania" of Brasov, ROMANIA, Department of Mechanics, mircea.mihalcica@unitbv.ro
2 University of Medicine and Pharmacy Tg. Mures, ROMANIA

Abstract: *In this paper we will describe an inexpensive method to capture and analysis motion in juvenile sports. We will focus on juvenile basketball and mainly on the angle of the free throw and we will show how to capture and analyze this important parameter in order to improve performances for juvenile players and correctly develop them into professional players.*
Keywords*: sports, biomechanics, basketball, motion analysis*

1. INTRODUCTION

Solid ball shooting skill development since juniors is a very important factor in the formation of an athlete in basketball. Ideally, the coach should have access over the entire "ball shooting skills over time" evolution of an athlete in order to correct certain deficiencies that may arise. In this paper we present a simple method to capture and analyze one of the main parameters of the free-throw to the basket, namely throwing angle, considering junior athletes.

2. MEANS AND METHODS

The system which we propose is both not complicated and inexpensive. We will use a regular video camera to record junior athletes during free throwing to the basket – we recommend a video camera that is able to record using at least 30 frames per second, but please note that a high-speed camera will increase the precision of the measurements which we perform on these video recordings. We also need specific software to analyze the recorded data with and extract the throwing angle, and we will use Kinovea (a totally free and Open Source software dedicated to analyzing the technique of athletes and not only) and Adobe After Effects for this purpose (Figure 1). In the end, we will use MATLAB to put together the extracted data and create angle evolution graphs suited for singular analysis, comparison between athletes etc.
The Kinovea software package is ideal for a direct, live analysis of the angle: we just put the video into the software, we apply a simple angle tool and we obtain the needed angle. We store the data in Excel tables and then we use MATLAB or even Excel (if all we need is just some graphs) to analyze it. For a more thorough analysis, we recommend Adobe After Effects – we can install markers at the main upper body joints for a combined body kinematics – angle of throw, speed of the ball etc. analysis, correlations between the speed of various components of the hand and the speed of the ball being known to exist [1].

3. EXPERIMENTAL ANALYSIS

We asked a junior basketball player to perform a series of 20 throws (during two sessions of 10 free throws each) and we video recorded them as described above. We then used Kinovea to extract the angle at which the ball is launched, in order to compare the values for this only subject, as our aim was to analyze the consistency of the free throws – in other words, how often the player deviates from the technique he feels the most comfortable with.

Obviously, the angles comparison can be performed using multiple players, doing things this way makes it easier to spot the differences between the players' techniques and eventually detect which differences might positively or negatively affect the performance of players – this was not our aim here, we plan to perform such an analysis in future work.

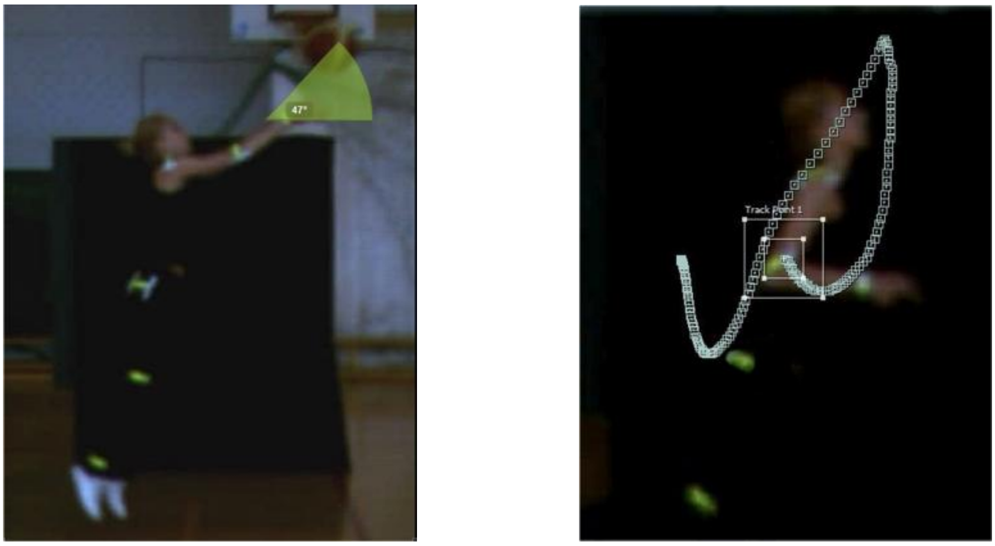

Figure 1: Capturing the shooting angle using Kinovea (left) and capturing the trajectory of the elbow during the free throw (right)

After analyzing the video recordings, we obtained 20 values for the launch angle of the ball, which we present in Table 1:

Table 1: Launch angle of the ball during 20 throws

Session 1 (10 throws)										
Throw	1	2	3	4	5	6	7	8	9	10
Angle	47	44	42	49	53	54	47	42	41	48
Session 2 (10 throws)										
Throw	11	12	13	14	15	16	17	18	19	20
Angle	48	49	43	51	55	52	45	53	47	44

Researching the previous works on this subject, we found that a good ball launching angle begins somewhere around 43 degrees to the horizontal, with the ideal ball launching angle being around 52 degrees to the horizontal, with 3 Hz of backspin, at a perfectly smooth and consistent speed [2]. As our analysis stops only at the launch angle, we can compare the results and see that 17 times out of 20, our player was able to shoot the ball with at least 43 degrees angle to the horizontal, with 5 throws between 50 and 54 degrees to the horizontal (close to 52 degrees). The most important thing is that this kind of analysis is easy to do and can be performed even on the court, by the coach, with a video camera and a laptop with Kinovea installed.

4. CONCLUSIONS AND FUTURE WORK

The competition in today's sports is extremely tough and every small edge matters. A biomechanical approach to basketball shooting brings more information than the naked eye of the coach might be able to extract. Solid ball shooting skill development will significantly aid junior players on their road to becoming professionals. The system which we propose here is very easy to use and affordable even for smaller sports clubs. For future work, we aim to expand the subject to an analysis of the combination between the biomechanics of the full body and different parameters of the throw (the launching angle, the speed of the ball etc.), hoping to find some mechanical parameters which directly influence the efficiency of the throw.

REFERENCES

[1].Covaci A, Talaba D. Correlations in Basketball Free Throw, Applied Mechanics and Materials, Vol. 332, pp. 509-514 (2013)

[2].Tran CM, Silverberg LM. Optimal release conditions for the free throw in men's basketball, J Sports Sci., 26(11):1147-55 (2008)