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Original article

DIGITAL ANALYSIS OF PLAYER'S POSITIONING AND MOVEMENT DURING A BASKETBALL OFFICIAL GAME

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Abstract[*]

Problem statement. Basketball game nowadays is not anymore just about two teams competing against each other. The information used for preparing one single game is coming from different sources, one of the most important being the analysis of the opponent team.

The big challenge for analytics is designing a better accuracy on spatial tracking coordinates, to adopt more and different statistic information and to use all these new type of information for helping the coaching staff to use their own team's advantages better by exploiting the opponent's general mistakes.

Aim. By using the technology of *assisted GPS* we could be able to obtain information about players position during a basketball game. Using this information, the program "DIGITAL ANALYSIS OF PLAYER'S POSITIONING AND MOVEMENT DURING A BASKETBALL OFFICIAL GAME" will generate, during the game and at the end of the game, pdf. files of each player and average digits for teams and the results and compare these results, offering us a clear analysis between the teams and the players.

At the same time, the program will make an unprejudiced analysis of the tactical decisions made by the coaches during the season.

In order to offer adequate parameters the program imply generating over 2000 different indexes on players positioning, speed movement and direction during a basketball game, all these by using the assisted GPS device connected to a laptop with wireless internet connection.

*Conclusions.*The research will offer, at the end, valuable information with practical usage that will help improving coaching methods in practices and game preparation. The assisted GPS device together with the software can be used by coaches from national teams and club teams also and will help increasing their team's performance.

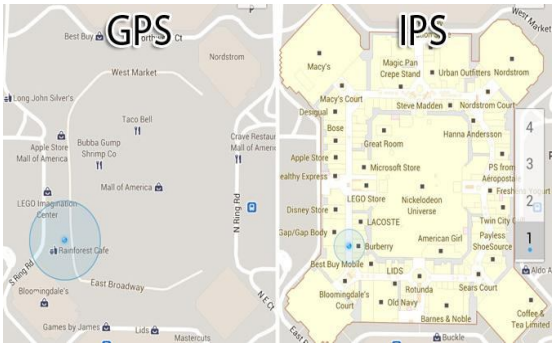
*Key words:*assisted GPS, analysis, tracking, tactics.

Introduction

One of the most popular sports games in the world, basketball is characterized by finesse, precision and fantasy of the technical and tactical exercises, by the height and the outstanding physical quality of athletes, all these involved in a sport combat that involves more factors, such as teamwork and sacrifice, intelligence under conditions of high stress.

The high pace of the game dictated by the rapid succession of phases with numerous successes in the offensive game makes the sports game of basketball be one of the most watched in the world. One of the reasons that basketball has become one of the most popular sports in the world is represented by its accessibility in terms of necessary infrastructure and equipment.

In Romania, relating to the number of legitimated athletes, seniors and juniors, basketball ranks second position, according to data provided by the Romanian Basketball Federation. As a result of these considerations, and due to the increasing interest regarding this sport, all aspects of organizing the basketball game at high performance, as to managerial, technical and tactical plan, are thoroughly analysed and it is attempted the use of as many resources as possible to allow the improvement of performance of those practicing this sport.



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The aim of the research

This project aims to streamline the tasks of basketball coaches, facilitating real-time viewing and analysing the movement of players on the court during a basketball game. This is possible thanks to *assisted* GPS technology which generates continuously data regarding the position of all the players on the court in real time. The overall comparison of data collected regarding players or teams will develop the performance capability of sportsmen, respectively their tactical skills, but also of the coaches.

On the one hand, the study of the movement of sportsmen in various branches of sports, in general, is of major interest today. On the other hand, the use of *assisted* GPS systems is based on a new technology which is being developed. Even in these circumstances, the use of *assisted* GPS for analysis of the movement in professional sports is still an unexplored field.

In the context of the evolution of the basketball game today, one of the main attributes of coaches is visual memory. They have to memorize very often isolated situations of the game for analysis in order to adapt the tactical plan during an official game.

This paper aims at facilitating the analysis of the movement of basketball players during training, preparation game or in an official match, aspect that would substantially simplify the work of the coach. Any coach uses this type of analysis, we could even say it is one of the most common methods used in high performance sport, but equipment aids is limited to video recording and interpretation of those recordings by the technical staff. The procedure takes a long time (a game is reviewed in full, several times until drawing final conclusions), and the data obtained does not have a system of standardized reference but is based on the visual interpretation of man, which generates a low degree of objectivity.

It also identifies the relevant aspects of the basketball game, important for the coach in relation to the analysis of the team efficiency, based on each player's individual performance.

In other sports, there are programs that analyse the movement of sportsmen on the field during the game, such as football or rugby. Those programs use classic GPS tracking system. Due to the sheer size of the playing fields of specific sport branches mentioned above, and to the fact that the phases of the game do not have very quick succession, the error data obtained (2-5 meters) is not relevant. In a basketball game, the small size of court, the attack time limited to 24 seconds and the high density of players on the court in isolated game phases (in most moments, all 10 players are in one half of the court) cause frequent changes of their movement direction on very short distances. Thus, the error recorded by the above-mentioned program is crucial and it cannot provide us with relevant information to develop similar software which has a real utility in the basketball game.

Every coach operates in the spirit of his thinking about training and playing, the so-called philosophy of game built as a follow-up of the answers to "why will I do it?" and "how will I do it?" as Merglsberg (2012) believes.

Regarding the activity of the basketball coach, Predescu and Ghiţescu Gabriel (2001) list the following aspects:

- The first problem is to establish their offensive system that he and the players want; to analyse and be convinced that the envisaged offensive and defensive systems can help the team win against its opponents.
- The coach must think about the arrangement of players on their post in the game system so that each player is as effective.

The same authors believe that the main task which the coach has in terms of game management is studying the opponent they are going to meet in the next stage and this is reflected in the so-called observation report. This report is drawn up on the basis of objective (preferably) and subjective information, as complete as possible, regarding the offensive and defensive game of the opponent. The basketball game is very complex that is why even its observation through a specialist eye is very different.

The responsibility of the coaches regarding the analysis in terms of the tactics of the game, in order to allow objective prediction of the team potential and creating a system suitable to the characteristics of players that are available, is a topical issue and the complexity of the basketball game which is practiced today makes it increasingly more difficult to fulfil these tasks. Whether we refer to the analysis corresponding to the game of the own team or the opponent team, whether it comes to play offensive or defensive, individual or collective tactics (relations between 2, 3, 4 or 5 players), the game model is demanding and hides many variables, difficult to control without the help of advanced systems that provide real and accurate information regarding the position and movement of players on the field during a basketball game.

The complexity of dynamic, tactical or theoretical aspects emerges from the features of

competitive basketball game mentioned by Ghițescu and Moanță (2013):

- Dynamism and swiftness – specific to all sports games; dynamism, this feature is more obvious in basketball due to the abundance of actions inevitably diversified, with unique aspects from one game phase to another. But this richness of actions is conducted in a very fast pace, with simultaneous participation of nearly all players, which leads to their satisfaction, while giving a high performance note.
- Technical acyclicity, tactical and technical complexity – the feature of acyclicity, stress to independent but coordinated movements, is embodied in technical and tactical procedure structures from the simplest to the most complex. It can be said that basketball is a sports game with the richest collection of technical and tactical processes, which stimulates continuous development of the game and sports mastery, including that of the best players. However, this rich ongoing tactical and technical background offers wide possibilities to adapt the techniques and tactics to the individual characteristics of each player
- Technical and tactical trend of universalism - participation, theoretically equal and at all times of all the team players, both in the phases of attack and defence boosts versatility in the preparation of each player and mastery by default. Specialization on jobs comes with an additional fund of technical and tactical skills and abilities engrafted based on multilateral training required by the specifics of the game that compels each component of a team to act more or less frequently on all posts and in all areas of attack and defence
- Developed theory – by its content, always capable of organizing and (individual and collective) training within subtlety, basketball lends itself to study, while theoretical preparation has become a necessity not only for coaches, but for players, too. In this framework, the creative initiative of coaches and players materialized and materializes in the permanent study, including its own performance (not only the performance of the opponents) and original solutions (amid extensive experience contained in textbooks and other works) expressed in tactical plans which are distinct from game to game, in training methods, as well as articles and specialty papers.

Due to a permanent process of selection, training and preparation, conducted on scientific bases increasingly more rigorous, we are witnessing today a continuous level growth, individually of the players and especially, collectively of teams, in the practice of the game. This causes changes in the orientation of competitive basketball game, which ranks fourth in the hierarchy of sports in terms of physical strain and first in the same ranking of sports games.

In these circumstances, the responsibility of the coaches regarding the analysis in terms of the tactics of the game, in order to allow objective prediction of the team potential and creating a system suitable to the characteristics of players that are available, is a topical issue and the complexity of the basketball game which is practiced today makes it increasingly more difficult to fulfil these tasks (Jug, Pers, Dezman, Kovacic, 2005). Whether we refer to the analysis corresponding to the game of the own team or the opponent team, whether it comes to play offensive or defensive, individual or collective tactics (relations between 2, 3, 4 or 5 players), the game model is demanding and hides many variables, difficult to control without the help of advanced systems that provide real and accurate information regarding the position and movement of players on the field during a basketball game.

After each game, the technical and tactical analysis of the game is done following the comparison, on the one hand, between the expected tactical plan and the adjustments made as a result of indications received by players during the match or the break, and, on the other hand, between the individual or collective achievements or failures sustained by as objective data as possible.

It is necessary that as many objective data as possible are provided with regard to the performance of the players during the game so that basketball coaches can better control all duties and responsibilities they have concerning the team they lead, related to the rigors of modern basketball. The means currently used (video analysis, statistics recording, observation sheets) prove insufficient to keep up with the tactical-technical rigors of modern basketball practiced and emerging from the players' mastery, from the capacity to decide in a very short time, from the developed speed of the game, the motric qualities of players who develop very high game speed and numerous theoretical resources

The issue of predictability in the game of basketball was raised early, even in the specialty literature in Romania, by Teodorescu (1979) who mentioned, among the main duties of the coach: building the team and preparing it for competitions, knowing the players (personal data sheets, technical and biomotric profile, improving professional

training and strict records of players during matches) and with respect to the training of the players, the coach must know and apply the most advanced means and methods that science offers. At the same time, he highlights the trends of basketball game at the time as follows:

– Fight for setting the rhythm and tempo of play, rhythm variations depending on the evolution of sport.

– Increasing use of air play in the fight for retrieving the ball, determined by the increase of players' size and expansion.

– The appearance of stable couples.

– Simplifying the building of the collective attack, determined by the completion of actions "direct combat" with the opponent in relation 1-1 and doubling the attack, accelerating the speed of performing the techniques, increasing the interception share and closing penetrations, as well as special created tactics for decisive players in the team context.

– In the relationship attacker – defender, it is aimed to achieve numerical and positional superiority.

– Increase in the average height of the team by generalizing the structure of team on the court with at least three players over two meters, whose biometric qualities of skill, mobility and speed are developed at the level of medium-sized players.

– The increasing complex tasks of the game will be realized as a result of the harmonious combination of technical, tactical, mental and temperamental features of each player as an individual, with those of general and specific training

– Due to strong development of individual and collective tactical actions of attack, defence borrowed an active-aggressive character.

– The individual potential of each player is recovered to the highest level by team collective tactics, given its interaction with the closest teammate: Mobility of adaptability of preparing each team to these trends, in relation to own possibilities, remains a factor of great importance in guiding the preparation, starting even with the initiation stage of the children.

– The manifestation of an attitude becoming more aware to training, often up to some sacrifices to raise the level of sports mastery.

One of the decisive factors regarding the direction in which basketball game evolved, is represented by the regulation changes implemented by the International Basketball Federation

Moanță (1998) finds that changes in the Regulation have permanently directed the development of the basketball game, the change of rules occurring every 4 years takes into account the stage of the game and its trends.

Thus, this has led to the current game practiced at full speed with spectacular counterattack conclusions, unexpected combinations of 2-3 players, concluded with underhand throws or remote throws, elaborated positional attacks, aggressive defence held on half or the whole court, tactical schemes for special situations, efficiency in shots.

Practicing competitive game implies a good physical, technical and tactical training of the whole team.

It is well known that basketball evolution has a certain cyclicality, namely the development of the attack at the expense of defence, so that after a while, under the influence of changes of regulation and orientation of the training, to reverse roles.

Tong (2013) finds that the trends of the basketball game are directed to a completely tacticalised game, but draws attention to the need to devise game strategies and tactical plans as close as possible to the actual requirements of the game itself. In the process of training, tactical training is designed to reduce vulnerability of the game system, both in the offensive and in the defensive phase, and the solution is to study the variables that occur during the game.

Trninic (2010) considers that the concept of knowledge in the basketball game can be presented as a binary tree hierarchically structured, with the following substructures: game strategy; game tactics; game tasks; as well as individual technique and tactics that are found in all the game details. Also Trninic, claims the need for modern tools that can process data regarding the general variation at the level of technical and tactical skills of the players in order to facilitate, on the one hand, establishing their roles within the team, and on the other hand, anticipating performance capacity, referring to the player, individually or to team potential, in general. Without this data, there can be no objective analysis in professional sports, since it is not possible to assess correctly the actual quality of players and teams.

The main objective of the research is to optimize the tactical behaviour of the female basketball players participating in the National League by exploiting the information provided by the program Analysis of position and movement of players during the basketball game, while the

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program provides average indices analysed comparatively between the two teams and average indices comparing players of the same team, at the end of the game, creating automatically individual and collective pdf files that will be stored in the program memory.

The program also provides objective information regarding the tactical choices made by the coach during a season (tactics design, game systems, and tactical plans).

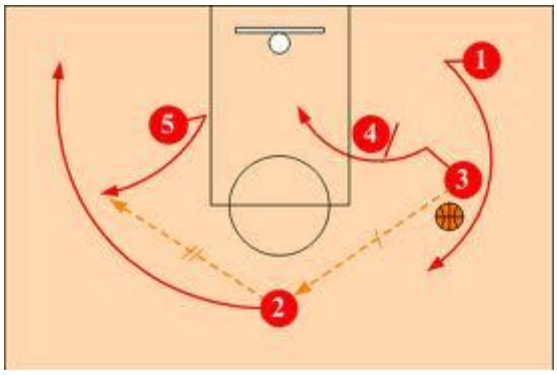

Fig. 2 Model of tactical interpretation of an offensive game situation

Conlcusions

In order to achieve the objectives, the program involves that the created device generates a large number of data required for the analysis itself, more exactly, up to 2000 indices regarding the position, speed, movement direction of the 10 players on the court during an official game can be collected every second.

The data obtained using assisted GPS, transmitted over a wireless Internet connection will be stored and sorted in the memory of a laptop.

Interpreting the data obtained is virtually impossible without creating a software program to analyse by offering intuitive images presented at choice, either as a video file type or as "step by step" analysis (frames played sequentially). The images themselves will be the basketball court, the location of the players and of the ball in the basketball court and will use, at least in step by step mode, the symbols accepted in the language specific to the sports branch regarding the movement in the court, with or without the ball, shooting, passing, players in defensive / offensive positions, etc.

The data obtained can provide valuable information on the physical efficiency of the players. Any coach records in the training plan the indices measured at training regarding the physical capacity of each player. Often, this data cannot be found exactly during the evolution of the player in the game. For example: Player A, at the tests during training, for the distance of 10 meters manages to get the time "t". During the game, for the same distance, under similar conditions, the time usually obtained will be higher because of several factors. The differences between "t1" (time during the game) and "t" can provide relevant information about the ability of each player to use in the game the skills acquired during training. Another important indicator will be the distance travelled throughout the game, compared to the time spent in the court. These data, compared with the variation of heart rate and successes or mistakes (data obtained with the means specific to statistical analysis) can give us valuable information with respect to the player and team efficiency. All these things can be possible by synchronizing the program with the statistical recording systems.

Fig. 3 Dynamic analysis of playing surface

Fig. 4 Dynamic analysis of distances

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