



CHAPTER NUMBER

Automatic analysis of football games using GPS on real time

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1.1 INTRODUCTION

Global Positioning System (GPS) is a localization system designed by the United States Department of Defence in 1978 that allows knowing latitude, longitude and altitude. GPS system has proofed itself to be an accurate way of calculating the position of an individual in biological and biomechanical studies (Schutz and Chambaz, 1997; Schutz and Herren, 2000; Perrin et al 2000; Terrier et al 2000; Terrier et al 2001 and Witte et al, 2005), animals monitoring (Von Hünerbein et al 2000) as well as for determining the velocity of peoples' movements (Witte and Wilson 2005).

The potential of GPS and dGPS (differential GPS, another system that offers higher levels of accuracy according to (Terrier, et al 2001) has been tested recently (Terrier, et al 2001; Terrier and Schutz, 2003), but cost and apparatus size issues make both of them unsuitable for many studies.

A few works have been undertaken in the realm of the physical activity for describing human locomotion generally speaking (Schutz and Herren, 2000; Terrier et al 2001; Terrier et al 2005;), cross skiing using dGPS (Larsson and Henriksson-Larsen, 2005) or Australian rules football (Elgethun et al 2006). As far as soccer is concerned, Petersen et al (2004) analyzed physiological and kinematical activities made by the referees, and Hennig and Sterzing (1999) 70 players' activity.

To a certain extent, soccer action implies using space in an intelligent way that can be tracked by describing players' positions on the pitch. Even though, today's technology allows to collect other data than spatial position which can be an outstanding monitoring tool for coaches and researchers.

1.2 OBJECTIVES

The main objective of this investigation was to test and ad hoc designed and developed application for real time recording of cinematic and physiological variables of team sports named RealTrack Futbol (www.realtrackfutbol.com).

1.3 MATERIALS AND METHODS

1.3.1 Participants

Four professional football players of a Spanish 2nd division team took part in this study after being informed according to international protocols. Both club and participants were selected for reasons of accessibility and experience. The four players' profile was (mean and SD): 22.5±1.8 year old, 172.0±5.7 cm tall and 70.5±2.8 kg weight.

Each participant played in a different position on the defending line: Left defender (LD), Mid left defender (MLD), Mid right defender (MRD) and Right defender (RD).

1.3.2 Data collection

On the 22nd of August of 2006 a two 30' half practice game was played in El Ejido (Almeria, Spain). Each of the participants wore a FRWD F 500 GPS set consisting of a recording unit, a tape and a heart rate (HR) transmitter band (figure 1). All data produced during play action (velocity, distance, HR and position) were taken every second and stored constantly on the recording unit.



Figure 1.3 FRWD F 500 GPS unit at play.

In addition, all data registered by the GPS unit were received on a laptop by means of the software designed and written on C++. This application let us to synchronize every piece of hardware with the computer in order to receive in to the system all the data on real time. Every second the following data were recorded for every players tracked: position, velocity and heart rate. In the end, 4,127 records were accumulated for 68 min and 47 seconds.

1.4 RESULTS AND DISCUSSION

During competition, distance travelled by the players can vary depending on playing position (Bangsbo et al 1991, Castagna and Octavio 1999; Reilly and Thomas, 1976, Reilly et al 1999, Sampaio 2000 and Tumilty 1993), on the palying style of the team (Bangsbo and Lindquist,1992; Reilly et al 1999; Shephard ,1999), competition level (Bangsbo, 1993), type of the competition (Reilly, 1996; Reilly, 1997 and Reilly et al 1999), physical conditions of the players (Di Salvo, 2001) or spatial ones (Shephard, 1999).

Table 1.1 Distance run (D) in metres and Time played (T) in seconds at different velocities by the four players in 68 minutes.

V intervals	LD		MRD		RD		MLD	
	D	T	D	T	D	T	D	T
>3 km/h	538	1297	398	1553	527	1644	511	1642
3,1-6 km/h	2039	2070	1367	1717	1752	1991	1439	1754
6,1-9 km/h	1356	859	1428	949	1138	692	1294	853
9,1-15 km/h	766	280	792	282	734	277	756	269
>15 km/h	20	6	77	17	0	0	77	14

Table 1.2 Distance run (D) in metres and Time played (T) in seconds at different velocities by the four

	RD			MRD			LD		
	HR	V	D	HR	V	D	HR	V	D
MRD	,000	,074	,000						
LD	,000	,000	,000	,000	,000	,248			
MLD	,000	,001	,000	,000	,024	,147	,000	,717	,004

Tables 1 and 2 show gross values and differences between the four players. As travelled distances and spent times can be recorded secondary variables such as velocity are available as well as HR. This value, for instance, shows differences (Mann-Whitney test, $p < 0.005$) between all players whereas distance and velocity only show differences between some of them. This indicates that a general scope must be applied to fully understand the meaning of both presence and absence of differences.

1.4 CONCLUSION

In conclusion, this small study allows us to prove that GPS technology has a tremendous potential as an easy to use technology in relation to its heuristic potential. Besides, our software allows the coaching staff to have a real time control of the players' activity in terms of internal load, tactical use of space, interaction with partners and opponents and so on.

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