Journal of Physical Education and Sport ® (JPES), 18 Supplement issue 5, Art 294, pp. 1986 - 1990, 2018
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Preliminary work on the testing of power glove applied to volleyball

FEDERICA FERRARA[1], PIO ALFREDO DI TORE[2]
[1,2]University of Salerno, ITALY

Published online: November 30, 2018
(Accepted for publication November 20, 2018)
DOI:10.7752/jpes.2018.s5294

Abstract:
Spreading, in sport, of technologies able to detect and organize in real time a wide range of data relative to the athlete and the context (tracker, gps, gyroscopes, accelerometers, bio-sensors incorporated in smartphones or available as wearable devices) offers a great opportunity to collect performance data, allowing objective, accurate and non-invasive physical activity monitoring. A review in the literature revealed that, in volleyball, despite it being a sport heavily affected by the presence of technologies during performance and training (think of the spread of software for video analysis or for coaching), there is no significant presence of wearable measuring instruments. this work presents a training program designed to evaluate the effectiveness of an instrument designed to measure the pressure exerted by the palm of the hand on the ball during the execution of the serve. The goal is to investigate the difference in performance and precision that the instrument can produce, relative to the fundamental object of investigation, allowing the athletes to confront an objective data different from the simple perception of the coach or his own.
Key words: Serve and spike, training method, Arduino Nano Controller, match analysis

Introduction

Spreading, in sport (Altavilla et al., 2018ab, Di Tore, Raiola 2012ab) and in volleyball (D'Isanto et al., 2017, 2018, Parisi, Raiola, 2014a, Raiola, 2014), of technologies able to detect and organize in real time a wide range of data relative to the athlete and the context (tracker, gps, gyroscopes, accelerometers, bio-sensors incorporated in smartphones or available as wearable devices) offers a great opportunity to collect performance data, allowing objective, accurate and non-invasive physical activity monitoring (Di Tore, 2015, Di Tore, et al 2014). In particular, this type of detection allows to avoid all the interferences connected to the laboratory settings: «An athlete studied within laboratory conditions might perform quite differently from on the field» (Armstrong, 2007). In this sense, wearable technologies allow surveys that do not alter the "natural" scenario of the performance:: "Wearable sensors can be used to monitor the body's physiological response to exercise and also the kinematic aspects of performance. To monitor this in a natural way there is a need for integrated sensors that are comfortable, wearable and straightforward to use" (Helmer et al., 2010).Helmer et al. explicitly connect the ability to capture performance data with the development of interactive models for coaching:« wearable devices extend the body in a real and virtual manner. The flow of information and stimuli from real - to - virtual, and virtual -to - real enable experiences to be shared across time and space. Wearable devices using textiles with embedded physiological sensors are used in various applications involving monitoring, control and learning» (Helmer et al., 2010).

Furthermore, it needs to frame the testing in large aspect of scientific identity (Raiola et al., 2018, Raiola 2017, Raiola, Di tore, 2017, Raiola, 2013) of sports methods and at the related education (D'elia et al., 2018, D'Isanto, 2016) about interpretative keys on body and movement including the reality by technologies (Di Tore, 2018, Aiello et al., 2012, Di Tore, Raiola, 2012ab)

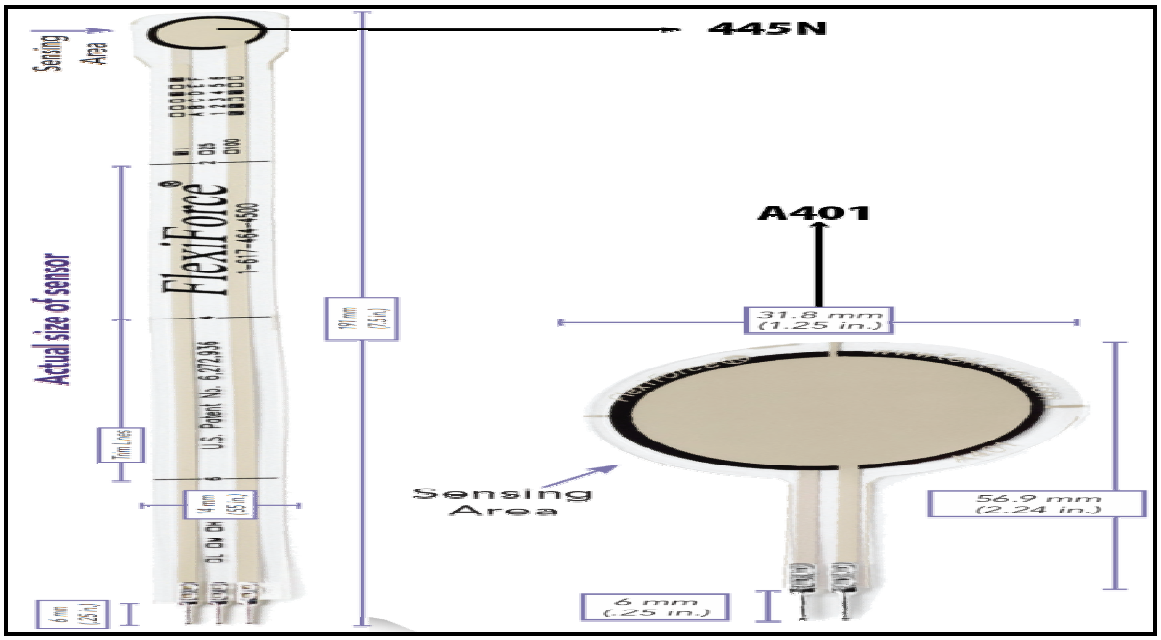
A review in the literature revealed that, in volleyball, despite it being a sport heavily affected by the presence of technologies during performance and training (think of the spread of software for video analysis or for coaching), there is no significant presence of wearable measuring instruments. The present work concerns the evaluation of the effectiveness, in terms of training, of the use of an instrument (PowerGlove) able to measure the pressure exerted by the palm of the hand on the ball during the execution of the serve.

The tool collects information on: a) force, b) surface, c) impact time d) direction. The tool can be used for research and coaching purposes.

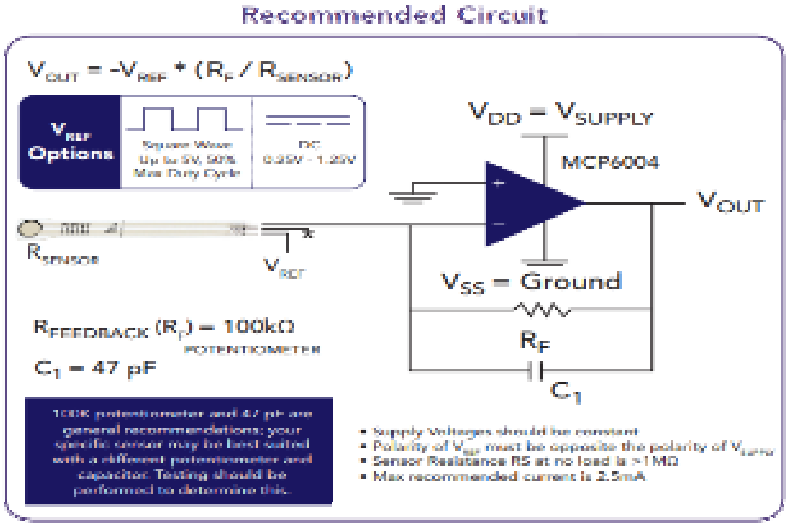
The device consists of a glove, which can be worn by the spiker, equipped with various ultra-thin sensors (such as not to affect performance). The sensors are managed by an Arduino Nano microcontroller (fig. 1), worn at arm level by arm band. The basic sensor is a flexible and ultra-thin TekScan pressure sensor (<0.1 mm), able to detect the pressure exerted by the hand on the ball in a range between 0 and 100 kg with an accuracy of 100g and a sampling frequency of 100 Hz. The system is equipped with a Bluetooth module able to communicate data in real time to a border station with a recommended circuit (fig. 2) and a mass memory to

Corresponding Author: RAIOLA GAETANO, E-mail: raiolagaetano@libero.it

store data locally for post-match analysis. The double mode of data management allows double use (in real time and postponed for post-match analysis). The collected data are processed by a support software developed ad hoc that provides the basic statistics



Graph 1. Arduino Nano microcontroller



	Typical Performance	Evaluation Conditions
Linearity (Error)	< ±3% of full scale	Line drawn from 0 to 50% load
Repeatability	< ±2.5%	Conditioned sensor, 80% of full force applied
Hysteresis	< 4.5% of full scale	Conditioned sensor, 80% of full force applied
Drift	< 5% per logarithmic time scale	Constant load of 111 N (25 lb)
Response Time	< 5µsec	Impact load, output recorded on oscilloscope
Operating Temperature	-40°C - 60°C (-40°F - 140°F)	Convection and conduction heat sources
Acceptance Criteria	±40% sensor-to-sensor variation	

Graph 2. Recommended circuit

The aim of performance analysis is to improve knowledge of parameters that affect performance. In team sports, this information allows us to become more familiar with the dynamic system involved in team sports. In addition, it provides reference values and criteria to coaches that can be used to guide the training process and prepare teams for the demands of their sports and their opponents. The design and development of a

data collection tool must follow a strict protocol to ensure that the information obtained is objective, reliable, accurate and valid.

The tool collects information about players in their natural context without interfering in their behavior. To avoid problems in the reliability of the instrument and of the observers, the tool collects data only of the actions of the players that can be observed. This allows to establish relationships between the execution mode and the temporal and spatial aspects of the execution with the effect of the actions in the game. In particular, this work presents a training program designed to evaluate the effectiveness of an instrument (PowerGlove) designed to measure the pressure exerted by the palm of the hand on the ball during the execution of the serve. The goal is to investigate the difference in performance and precision that the instrument can produce, relative to the fundamental object of investigation, allowing the athletes to confront an objective data different from the simple perception of the coach or his own.

Methods

The research will be carried out by referring to volleyball athletes aged 12 to 16, constituting a first group, and from 18 to 25 years, forming a second group. The study will cover the test of the instrument to verify its effectiveness. Both groups will be subjected to the same training program. For the final data we will proceed to an average estimate of the 2 groups.The transmission of data coming from the sensor in real time means that the training methodologies can be modified and evolved on the basis of the analysis of the athlete's performance.Before the start of the training cycle, the athletes have to be tested to get some basic data from which to start and then be able to make a longitudinal comparison.

The athletes will be subjected to quarterly training cycles at the end of which the tests will be redone to compare the improvement and validate the use of the tool itself. The types of exercises will be different according to the technical gesture to which the athletes will be submitted. Training planning is carried out on an annual basis and then passed to a more detailed periodization in view of the tests for the comparison of the improvement of technical gestures. A fundamental component of the work is the identification of objectives such as, in this case, the improvement of the technical gesture of the serve (Raiola et al., 2016, Parisi, Raiola, 2016) and spike including the execution of movement model (Gaetano, 2012ab, Raiola, Di Tore, 2012abc).

The annual plan will be divided into quarters to check the improvement of the athletes from time to time.

1. The first one that goes from the teaching of the movement to the technique, then from basic movement to spike or serve;

The determining aspects are:

I. The synthesis of the technical gesture performed in individual form;
II. Global execution of the technical gesture in a specific situational case;

2. The second, which goes from technical training to game dynamics.

The determining aspects are:

I. The synthesis of the situational sequence;
II. Training through play and global work allow the management of the difficulties of the situational task;

Each training session will include training of fundamentals and team play from an analytical, synthetic and global point of view.

With reference to smash technique we have:

- Analytical procedure: Ball hitting development work:
- Synthesis procedure: Drop-jump Work; hitting the ball on the coach's throw (or with the use of teaching aids);
- Global exercise: smash on setter pass (context of the game action);

With reference to the serve technique we have:

- Analytical procedure: Ball hitting development work:
- Synthesis procedure: Work of consecutive wall-serve;
- Global exercise: Serve in predefined zones on objectives;

For the validation of the instrument, specific training cycles will be performed:

In the first cycle we will perform exercises aimed at improving the serve, such as:

1. Serve against the wall.

The athletes have a ball each and are in front of the wall. They must perform a serve so that the ball rebounds against the wall and returns to hand, constantly varying the distance from the wall, either approaching or moving away.

2. Paired in front, with the net in the middle.

The athlete A, in front of the net, must perform the serve from above, taking care of the extension of the arm. The ball must reach the athlete B in the back row.

3. Top serve on target ns (floor mats)

Series of serves with the goal of centering the mats.. From zone 1 to zone 5, from zone 5 to zone 5, from zone 1 to zone 1

In the second cycle we will perform exercises aimed at the ability of the precision of the attack hit as for example:

1. Training of the attack shot from kneeling:

The athlete kneels and hits the ball on the wall without stopping. The progression tends to lead the player to have more freedom of movement and more muscular districts available, but starting from the main ones and up to here without the kinetic chain of the lower limbs, which often lead to the rotation of the pelvis, one of the main problems of attack shot.

2. Attack on the player who defends in compression.

Athlete A throws the ball to Athlete B, who charges the arm with high hand movement above the head and attacks on predominantly wrist. Athlete A performs a defensive compression on the attack hit and defends the ball over the head. This exercise allows to fix some important contents both of the attacking gesture and of the defense in compression.

Expected data and discussion

The initial data of the first training cycle and the final ones are compared, recording the percentage of improvement. The result should have a degree of direct proportionality between the work done and the percentage of improvement estimated by the individual athlete and the coach. If the data is proportional directly for each individual athlete, the average of the 2 groups is estimated. If, on the other hand, it is considered not proportional directly, any changes are shared jointly between all athletes and the coach. Work proceeds for the second cycle of training.

Conclusion

The definitive test of the instrument can take place only after the calibration of the instrument that must be provided and remodeled with the help of the results of the present study.

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