Analysis of Plantar Pressure Based on Injury Recovery of Football Players

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ABSTRACT: *This article provides a detailed introduction to the specific implementation process of this analysis method. A comprehensive analysis of the plantar pressure distribution has been achieved by preprocessing, feature extraction, and pattern classification of the collected plantar pressure data. Specifically, precise descriptions of athlete gait are achieved by extracting the temporal and spatial features of pressure data. The evaluation and diagnosis of athlete gait were achieved by classifying the plantar pressure patterns under different gait patterns. The feasibility and effectiveness of this analysis method were verified through experiments. The experiment selected 20 football players as the research subjects and collected foot pressure data at different speeds. By comparing and analyzing the distribution characteristics of plantar pressure at different speeds, the adaptability of this analysis method was verified at different speeds. At the same time, the effectiveness of this analysis method in evaluating and diagnosing the gait of football players was demonstrated through statistical analysis of the experimental results.*

Keywords: Footballers, Plantar Pressure Distribution, Predication of Injury Degree

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1. Introduction

Football is among the most popular but high-risk sports globally [1]. In football athletes' training, they must make appropriate preparations for such a challenging sport; the athletes are easily hurt. With the support of current computer technology, the foot pressui9re distribution can be analyzed during footballers' walking [2]. Through the plantar pressure distribution of athletes walking, it is possible to protect footballs of football players ahead of time according to different data of each athlete. To protect football players and make their sports career longer. This way guarantees athletes a safe and efficient training method [3].

The analysis of plantar pressure distribution of football players during walking can prevent injury before exercise and make a clinical time estimate for the recovery time and recovery time after the injury [4]. The footballers' foot stress distribution data will

be put into the motion model to carry out corresponding data acquisition [5], and combined with a scientific and reasonable method of analysis; professional advice can be given to overtrained footballers. Applying this would increase the injury treatment process, greatly promoting football development in China.

2. State of the Art

Footballers' plantar structures and functions can be analyzed by analysing plantar pressure distribution during walking [6]. The physiological and pathological aspects of athletes can also be analyzed. Their physical condition can be evaluated very well by using different data analyses. The proportion of support will be changed for football players during the long period of physical training [7]. That is to say, the rate of time for the foot in contact with the ground time and the time for departure can be beneficial for football players to protect the front part of their feet. Presently, the analysis of foot pressure in our country is relatively weak, lacking corresponding large data samples in the foot pressure analysis of football players [8]. Changes in planta pressure are different for different races. Therefore, the pressure analysis during the walk must be based on large data collection [9]. Therefore, enough data needs to be collected to analyse the comprehensive and gradual pressure data to better analyse football players. The relationship between football players' training process and foot pressure analysis was constructed, and the most basic correlation was established based on this relationship [10]. The model established in this way has good adaptability, but the data may be cumbersome in the process of calculation.

3. Methodology

3.1. Analysis of Plantar Pressure Distribution of Football Players During Walk

Before the footballers' foot pressure distribution is analyzed, the basic data of the Asian foot analysis needs to be filled in, requiring data from the pressure acquisition devices. First, it is necessary to compare the data of the footballers and students who have no training history at school. The way of data acquisition is as follows:

State Sequence:

$$FS = \{RS, LS, DS, \phi, \mathrm{Err}\} \tag{1}$$

In this formula, *RS, LS* indicates that only the right (left) foot touches the ground, and *DS* indicates that both feet touch the ground, indicating jumping (without foot contact), and *Err* for non-synchronous motion. *Si* (*k*) represents the *K* element of this sequence. Algebraic relations describe the two modes of motion mixing. The way of foot stress analysis is shown in Figure 1 below:

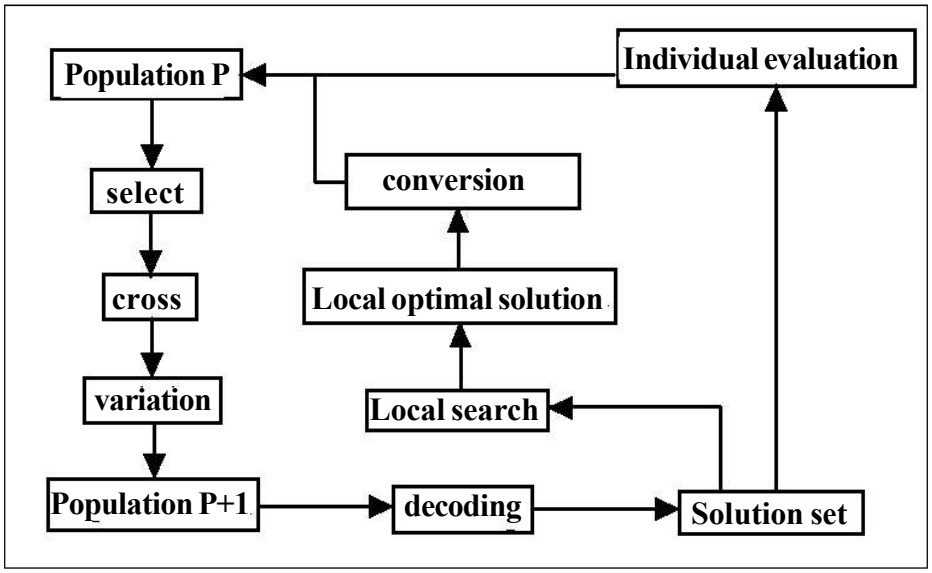

Figure 1. Based on the analysis and research method of plantar pressure distribution of football players during walking

Moreover, after the occurrence of the sports injury, the time of recovery and recovery of the damage was estimated in clinical time. By putting the foot stress distribution data often used by footballers into the motion model, this algebraic relationship follows the following principles: *DS* is a neutral element, it has the lowest priority and can be covered by any motion; in contrast to *DS*, no matter what other movements are, it presents jump; it can include all the movements, all forms of activities of athletes, and then Err is mainly used for a subset.

$$\{RS, LS, DS\} \tag{2}$$

$$\forall \mathrm{k}, \quad S_1(\mathrm{k}) \oplus S_2(\mathrm{k}) \neq E\mathrm{rr} \tag{3}$$

Error is presented when the motions are out of sync; *LS* and *RS* are completely contradictory and cannot exist simultaneously. According to the commutativity of algebraic relations, the necessary and sufficient condition for the synchronization of A1 and A2 is that two different computers, Alpha and Beta, are needed to build the model so the two computers can share the file in an interconnected way. They use the data synchronization algorithm based on the *DeDupe* technology. In the design of the process, the *Rsync* model system is opened. According to the combination of algebraic relations, *nA* sequences can be expressed as the necessary and sufficient conditions for synchronising *nA* actions based on the two equations above. LS and RS are completely contradictory and cannot exist simultaneously. According to the commutativity of algebraic relations, the necessary and sufficient condition for the synchronization of A1 and A2 is that two different computers, Alpha and Beta, are needed to build the model so the two computers can share the file in an interconnected way. They use the data synchronization algorithm based on the *DeDupe* technology. In the design of the process, the *Rsync* model system is opened. According to the combination of algebraic relations, *nA* sequences can be expressed as the necessary and sufficient conditions for synchronising *nA* actions based on the two equations above. LS and RS are completely contradictory and cannot exist simultaneously. According to the commutativity of algebraic relations, the necessary and sufficient condition for the synchronization of A1 and A2 is that two different computers, Alpha and Beta, are needed to build the model so the two computers can share the file in an interconnected way. They use the data synchronization algorithm based on the *DeDupe* technology. In the design of the process, the *Rsync* model system is opened. According to the combination of algebraic relations, *nA* sequences can be expressed based on the above two equations, the necessary and sufficient conditions for the synchronization of *nA*:

$$\forall \mathrm{k}, \bigoplus_{\varepsilon\{1,\ \mathrm{n}\}} S_{\mathrm{i}}(\ \mathrm{k}\ ) \neq E\mathrm{rr} \tag{4}$$

Only during collecting does the data satisfy the formula. In the analysis of plantar pressure, the injury of footballers can be identified for the study of the foot. It is assumed that Delta (*X*) represents the variance vector of the motion vector set *X* of the footballers' foot stress analysis. The following formula can be drawn:

$$\delta\ (X) = \frac{1}{2}\sum_{\mathrm{n\text{-}1}}^{N}\left[X_{\mathrm{n}}(\mathrm{i})\ - X\ (i)\right]^2 \tag{5}$$

The proportion of support will be changed for football players during the long period of physical training. That is to say, the rate of time for the foot in contact with the ground time and the time for departure can be very helpful for football players to protect the front part of their feet. The body condition can be predicted well through the gait cycle under normal walking conditions. After the upper calculation is completed, *X* is the weight value of each index table. The consistency check of the data is carried out, and the reliability formula is analyzed as follows:

$$CR = C_{in} / R_{IN} \tag{6}$$

The upper form CIN is the evaluation index of the judgement matrix of *n* order; R_{IN} is the consistency index derived from the matrix of *N* countdown reciprocal. It can be considered that the evaluation is consistent with the actual situation, and the accuracy of the results can be found through the analysis of the results; on the contrary, the degree of evaluation is not high enough, and the model needs to be revised again. The soccer foot's stress analysis model uses the best vector related to data selection and research content. The cost function of the influencing factors is used in the following equation:

$$H\ （V_{sf}）=\sum_{p-1}^{d/2}\delta_{sf}(X)(P) \tag{7}$$

In conclusion, the relationship among factors affecting foot injury is optimized in foot response analysis of foot stress distribution in football players. Therefore, based on the foot stress analysis of football players, the athlete's body condition is comprehensively analyzed. In conclusion, the factors affecting the foot injury of athletes need to be calculated in a complicated way. The group method selects the best vector wavelet kernels to influence the foot damage factor of football players. It carries out the corresponding data collection on the pressure of different parts. Combined with scientific and reasonable analysis methods, professional advice will be given to football players, significantly promoting football development in China.

3.2. Influence of Plantar Pressure Distribution of Football Players on Walking

The gait analysis system was tested by the application of RSCAN of Belgian Forster company. The runway is distributed on both sides of the force plate during the test. The subjects were taken out of shoes and socks, and the whole gait support period was obtained by walking normally. Each person tests three times and takes the average. According to the relevant literature, the complete gait support period is divided into four stages, namely, the beginning stage (time stage 1), the front foot contact phase (time stage 2), the foot contact phase (time phase 3) and the ground phase (4). Combined with the experimental design, four gait supports during normal walking were selected as the research objectives. Select the specific time value of each stage and the percentage of the support period as the analysis index. Single-factor analysis of variance was performed among the groups, and data processing was completed by SPSS20.0 statistical software. In the whole gait cycle, the largest proportion of the footballers' support period is the starting stage (time 4), the second stage is the full contact phase (time 3), the two is 88% of the whole gait support cycle, and the maximum proportion of the whole support cycle. The gait cycle is the contact stage of college students (3). The second stage is the ground-to-ground stage (4), and the two account for about 92% of the whole supporting period. The length of the complete contact phase and the ground departure stage are shown before. As a result, the longer the football players are exposed to the ground, and the longer they are on the ground, the longer the force is. The longer the pressure is, the greater the pressure on the front foot. The study of gait features on the ground and the distribution of foot pressure on the ground shows that there is a potential danger in the forelimb area, a longer contact time, and the protection of the forefoot should be strengthened. A phased study is shown in Figure 2 below:

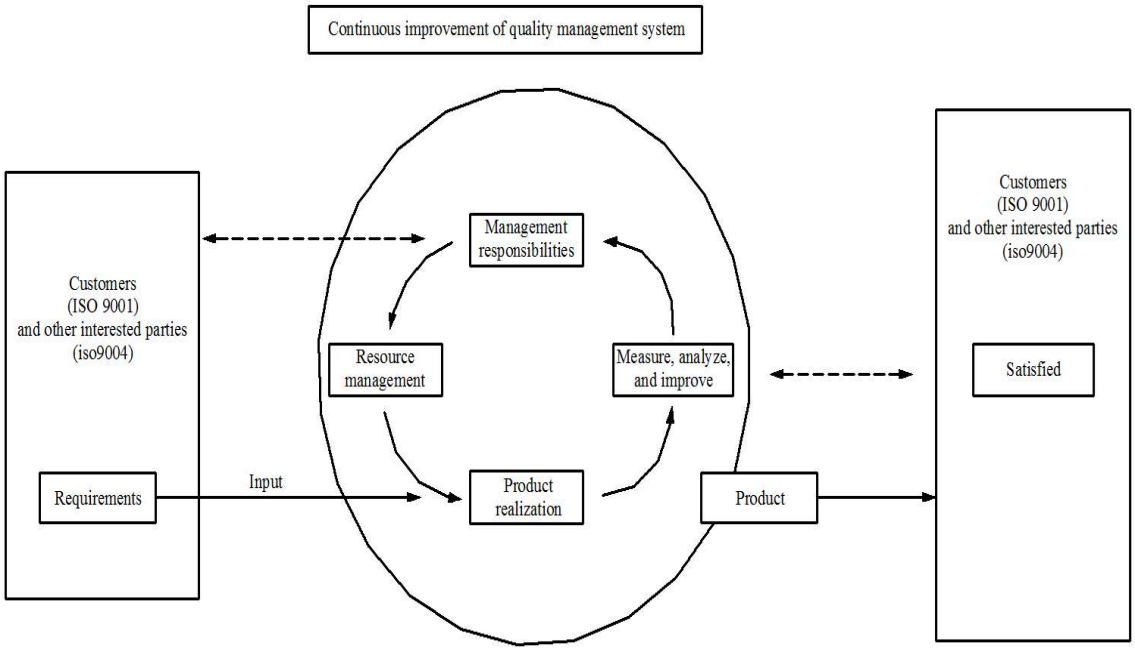

Figure 2. Based on the analysis of plantar pressure distribution of football players during walking

Therefore, during normal walking, the contact time of the forefoot is less. The ability of self-protecting is quite good. In the study of foot stress analysis of young footballers who were repeatedly injured in the ankle, Zhou Junjie found that footballers whose ankle and ankle joints were repeatedly injured were extended on the front feet and the ankle bracing time shortened, indicating the protection of the F by the footballers. EET gradually weakened after repeated ankle injuries. Conclusion it is of particular clinical value to prevent ankle injury of football players. The time value of each stage was compared when comparing football players and college students in the gait support period. It is found that only the time value of the foot contact phase (time phase 3) has a significant difference. When the time value of each time phase was compared with the percentage of the percentage of the support period, the order of foot contact was found. There is a significant difference between the phase (third stage) and the departure stage (time 4). By comparing the application proportion and value of the two methods, it was found that the application time is different. The value ratio to the gait support period can eliminate the errors caused by individual differences and accurately reflect the time indicators change.

The relationship among factors affecting foot injury was optimized in foot response analysis of foot stress distribution in football players. Therefore, based on the foot stress analysis of football players, the athlete's body condition is comprehensively analyzed. In conclusion, the factors affecting the foot injury of athletes need to be calculated in a complicated way. The group method selects the best group of vector wavelet kernels to influence the foot damage factor of football players. It carries out the corresponding data collection on the strength of the foot parts.

4. Result Analysis and Discussion

After designing the foot pressure distribution analysis model based on the footballers' walking, it is necessary to test the model of the foot pressure distribution analysis because each design model may have some problems more or less in the early stage. The test is convenient to modify the model and make further improvements so that it can be widely used in football training. First, it is necessary to test the algorithm's performance and the data processing speed, so the study was set up as a study collection process, and 300 football players in different regions were checked. The data collector was bound to the stressed area of the foot, and the real-time dynamic data of the foot was recorded from the beginning of the dribble to the shooting. These data were then analyzed and recorded; the results are shown in Table 1 below.

Data Collection	The data acquisition time	The data on cutting time	The real-time data generation time	The virtual model generation time
2	0.01s	0.001s	0.002s	1s
4	0.02s	0.002s	0.004s	2s
6	0..03s	0.003s	0.005s	3s
8	0.05s	0.005s	0.006s	4s
10	0.06s	0.007s	0.008s	5.5s

Table 1. The Real-time Data Generation Time

It can be seen from the table that the footballers' foot pressure distribution analysis based on the footballer's walking is compressed into the 2S during the data collection process. Even increasing the foot stress data of the collector it will also be an increase in the minimum time to complete the total stress number from the training process to the whole foot according to the acquisition time. In this way, the research achievements have taken a qualitative leap compared with the calculation methods previously studied by some researchers. By testing, it could be analogous that when getting more than 80% of the sportsman's motion data acquisition points, the algorithm designed could also make calculations and model generation in a short time. It would not cause a lot of lengthening time due to the accuracy of the data collected. Although this time is short enough, the

algorithm would still be improved in future research to compress the whole time to less than *1s*, so that the seamless effect of real-time synchronization would be achieved. In the testing process, each node's performance diagram is shown in Figure 3 below.

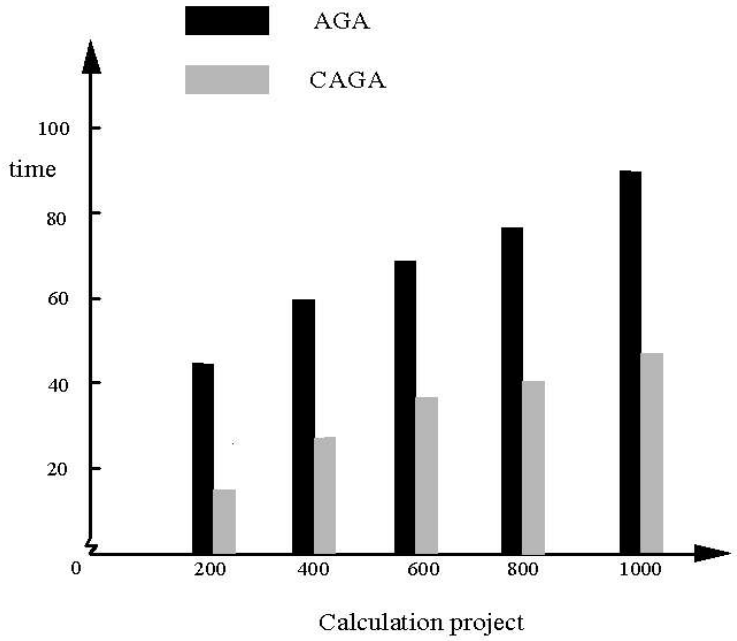

Figure 3. Based on the analysis of plantar pressure distribution of football players during walking

After the data processing and testing of the designed model, it is necessary to compare the data that the model only inputs to the actual motion mode. Then, the accuracy of the model should be analyzed. Then, the model data of 5 kinds of motion were input into the algorithm model, and the whole interconnected structure of 5 nodes was selected. The cube structure of the eight nodes had the structure of a two-forked tree, and then the experiment results were counted. The results are shown in Figure 4.

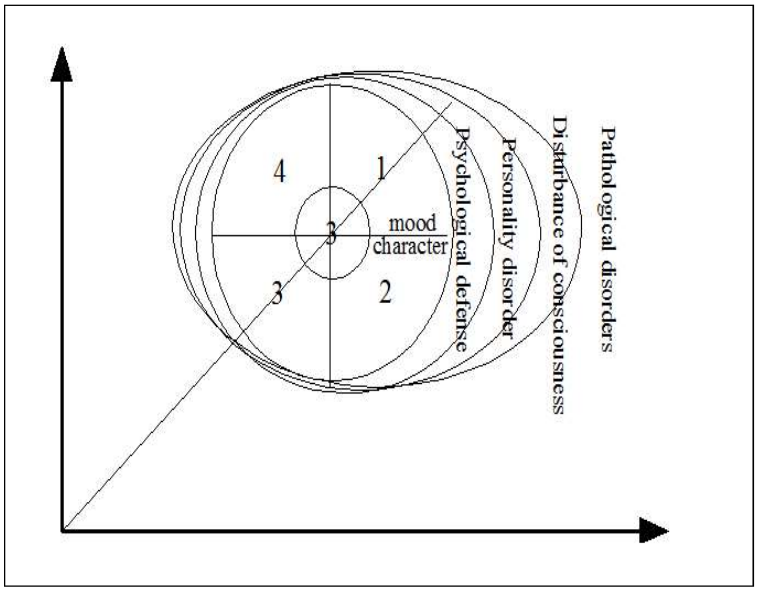

Figure 4. Based on the analysis of the plantar pressure distribution of football players during walking

It can be seen from the above figure that the model simulated by the algorithm is between the upper and lower bounds, which, to a certain extent, shows that the algorithm is also very reliable in the accuracy of the simulated motion model because there is a certain saturation value, which depends on the interconnected structure of the algorithm model. Suppose the value is greater than a certain value. In that case, the data's accuracy increases with the amount of information, so the algorithm model we designed this time is the potential value of the deep mining system that has not been used by previous technology. After a series of tests mentioned above, the design of the research system is very reliable in providing strong help in the daily training of football players.

5. Conclusion

With the continuous development of football, the current physical training of football players has been universalised. Plantar pressure needs to be analyzed in the process. Footballers' plantar structures and functions can be analyzed by analysing plantar pressure distribution during walking. The physiological and pathological aspects of athletes can also be analyzed. Their physical condition can be evaluated very well by using different data analyses. The proportion of support will be changed for football players during the long period of physical training. Therefore, analysing plantar pressure distribution based on footballers' walking is urgent. The foot pressure analysis of football players when walking was carried out. The pressure acquisition device was set at the plantar, and the pressure model related to the research was analyzed after the data processing by the computer system, providing an accurate stress analysis for the recovery of football players' injuries. The test results showed that this study can predict the injury degree of athletes accurately.

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