# Research on error analysis and improvement of image measurement kinematic parameters

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**Abstract.** Image measurement as the main method in sport biomechanics kinematics research, the main principle is the photography technology in does not affect the athletes training and competition of a non-contact quantitative measurement. Then through the use of a variety of software on the image processing and analysis of the human body kinematics parameters, with simple, easy, convenient, and other features are widely used. However, in the process of image measurement, it is often easy to produce errors due to the operation and measurement, which seriously affects the accuracy of the results. By the reason of error in the measurement process of analysis and discussion, and puts forward the feasible method to improve, can reduce the image measurement error in order to ensure the data accuracy, for the athletes improve training, improve athletic performance to provide true and reliable data.

## Introduction

With the progress of science, the use of communication technology and mobile phone software, sports biomechanics won the rapid progress, but from the overall look at present domestic and international sports biomechanics in research methods still mainly uses the research methods of kinematics, dynamics, and biology and so on. One is the main method of kinematics of the video, camera and digital signal processing, through computer processing can quickly get motion data and help coaches timely access to information related to the player, a great help to the training and on-site guidance. With the development of modern science and technology, kinematics both in testing means or in research methods has been rapid development, especially the rapid development of digital technology, computer technology, virtual technology, and the mathematical methods of physics technology, provides advanced technical conditions for the research and application of kinematics. Three dimensional image measurement technology in the measurement of kinematic parameters is particularly prominent. But because of the technology used in the measurement process, testing methods, analysis of the software is different, which is easy to cause the error, this article will be analyzed and discussed in this paper.

## Analysis of the advantages and disadvantages of the kinematic parameters of image measurement

Image measurement kinematic parameters analysis is widely used in the field of sports technical analysis, and it plays an important role in the development of athletes' technical improvement and kinematics theory. Analysis of the image measurement as today's kinematics research method [1], through non-contact quantitative measurement, in does not affect training and competition, athletes to increased any burden, for processing and measuring motion film technology, obtain the kinematic parameters of the human body. Through the analysis of these parameters can explore the best athletic technical movements and the law of motion and found that athletes in sports technique has disadvantages to improve training, improve athletic performance provide the basis [2]. But due to the image acquisition, image analysis and data processing methods and means not standardized, many

 

kinematic parameters of the obtained there are large or small errors and differences, which not only the research result seriously affected, also hindered the image measurement technology in dynamic in the development of. In this paper, so the analysis and research of kinematic parameters of image measurement error, and put forward a feasible improvement method. The purpose is to reduce measurement error of image provides a reference value, to ensure data accuracy. It is beneficial to the application of kinematic analysis in theory and practice. Provide the basis for the athletes to improve the sports training and improve the sports performance results and analysis.

## Error analysis of kinematic parameters of image measurement

The parameters of kinematics are mainly determined by the method of photographic camera to get the original data, and then the data are processed and analyzed by the analysis software. These two processes are the direct source of the error, and also the important stage of reducing the error. So by analyzing the causes of the errors in these two processes can effectively reduce the emergence of errors, but also on the rationality of the evaluation of the data and the conclusion plays a vital role.

**Original data sampling error.** The error of the original data acquisition in the motion image mainly includes two kinds of. The first type is the equipment use error, which is usually the shooting personnel to the equipment and equipment knowledge master is not proficient in the result. Mainly includes three aspects: (1) set up the camera caused by improper the screen shot effect is not good, the definition is too bad, (2) camera equipment selection is not suitable for and need to use high-speed camera without using a high speed camera and need to use ordinary camera is used for high speed camera. (3) the selection of the shooting angle is not good so that the required research object is not in the field of vision, or the target is too large or too small. These can cause the original image sampling to a certain degree of distortion, which has a direct impact on the back of the image analysis [3]. The second category is the ratio coefficient to determine the error caused by improper scanning and shooting. Due to the movement of human body is in a certain space, the space of every point and the camera distance are different, according to the principles of geometrical optics, the camera from a moving subject farther, distance between the relative difference is small may cause error is relatively smaller. But distance farther will cause shooting target is too small, in image processing, target movement and trajectory can not clearly reflect in the image, thus invisible to the next image analysis bring difficulty and error, so the shooting process need to identify good distance and the proportion coefficient.

**Error in image conversion.** Image conversion is the main source of error in two aspects: the first is in artificial point mark in the process of operation personnel operation error, because in specific image motion in some markers for blurred images is difficult to distinguish, some because in the image is occluded need to guess, so a marker bit inaccurate [4]. The error of this kind of operation can be solved by standard and improved shooting technique and method. The second type of error is the error caused by the selection of the parameters of the inertia of the human body. Due to the image analysis software to select the inertia parameters of human body are factory set and the software are mostly foreign manufacturers, so in the choice of the human body inertia mostly follow the inertia parameters of the foreign body. There are some differences in the height and length of the human body in Asia, and the error in the calculation process is inevitable. So we should choose the inertia parameters which represent the Chinese people as the body inertia parameter model for data processing and analysis.

**Error in data processing.** Data processing is entirely essentially template and operation of computer software, the principle in the contemporary computer technology is very advanced the operation error should is very small, but human motion parameters calculation have its particularity and treatment system, there is no uniform standard, so obtained results will resulting in differences. It is mainly produced in two aspects, one is the data smoothing process itself is an approximate curve fitting process, in which the choice of smoothing frequency is the key factor that affects the curve fitting. So the size of the truncated frequency should be selected according to the needs of different motion and data. Two is the error caused by the computer to the differential numerical operation.

Differential operation to replace the computer in the differential operation in normal of smooth curve calculation, after twice differential operational error will be magnified, so usually case, using the moving image analysis system to measure the acceleration curve are not reliable.

## An improved method for the kinematic parameters of image measurement

Because sports biomechanics research object is the human body movement, it has the essential difference with the ordinary object mechanical movement experiment. Because people's subjective will control the movement state, under the influence of various factors, the subjects can not repeat to do exactly the same movement, so the human body movement test is not repeatable. Only by improving the testing method and making the standardization technology can we ensure the success rate of the measurement and the production of the error, so as to improve the accuracy of the data and provide a reliable guarantee for the research of kinematics.

**Raw data sampling standardization.** According to the analysis of the original data sampling error, the original data collection can be divided into two aspects. (1) to determine the content of the project and research should be determined to determine the speed of shooting. For example 100 meters run this type of high-speed track events; should with high-speed camera shooting frequency at least in more than 200 per second to accurately record the action of athletes, is conducive to the accuracy of the data analysis. And most of the strength and stability of events such as weightlifting and shooting can be around 50 shooting frequency of image acquisition by per second. It can not only reduce the workload of image analysis nor because of the shooting frequency is too high caused by the picture is not clear. (2) choose the way to be in line with the nature of the motion. Shooting method can be divided into two categories: the plane shooting and three dimensional shooting, the plane shooting for data acquisition and processing are simple and easy to implement. Three dimensional shooting operation is relatively complex. So usually for symmetry, periodic motion can be used to shoot the way. And for the long jump and high jump higher and more complex motion is required to use a three-dimensional shooting method, the full range of the technical action and track record of the athletes.

**Uniform image conversion parameters.** The specification of image transformation is mainly about the selection of the parameters of human inertia and the operation of joint points. First is the human body inertia parameters selection should conform to the Chinese human body structure and the actual and current in China compared with the authority of the human body inertia parameters is by Professor of Tsinghua University Zheng Xiuyuan using magnetic resonance imaging (MRI) CT method to scan the whole body and local scan image, determined by image processing of inertial parameters of human body. The inertial parameters of human body parts is mainly according to the human body model to study, so for the data processing selected inertia parameters should follow the Zheng Xiuyuan professor from the studies of human link link inertia parameters of. Thus the results obtained have a uniform reference system to carry out a reasonable evaluation [5]. Followed by the selection of the operation of the joint point to be standardized. Due to selection of the joint operation, there is no unified standard, different operation technical personnel selected joints have different habits, such income data there will be some of the differences, this difference may seriously affects the results of the analysis. In order to avoid such a situation, it is necessary to use some sensitive material to mark the desired joint points and links before shooting. In this way when the image can be clear on the required joint points and links to the center of gravity. It avoids the error caused by the inaccurate marking of some image, which is not easy to distinguish or to be blocked.

**Data processing standardization.** Data processing includes data smoothing, parameter conversion calculation, curve and graphics display, etc.. This needs to be done to regulate the use of the selected indicators and the various parameters. The smoothing technique of digital filtering, which can reduce the error of the frequency according to the motion and data need to be controlled in 5-8Hz, can reduce the error. As for the display of curves and graphics are computer digital operation, so the format and the unit basically reached the standard.

**Results analysis standardization.** The result of the analysis report is the final result of the study, which is the most concerned part of the researchers and coaches. But at present all kinds of analysis report forms are multifarious, there is no uniform format. Is not conducive to the mutual communication between the researchers and coaches around, so the results of the analysis of the report is also very important norms. This not only helps to analyze the data and the project of the regularity of the analysis. Is also conducive to the coaches, athletes understand the use of diagnostic results for the improvement and optimization of technology.

## Summary

Image measurement as the main method of data acquisition, not only provides a broad space for the research and application of kinematics. Also makes the measurement of the time characteristic of the human body's mark point movement, the space characteristic, the time and space characteristic is more convenient succinct. The error analysis of image measurement and the improvement of technology can make the data more accurate, so as to ensure the reliability of the results. Objective to provide an effective basis for the selection of athletes, technical optimization of athletes, sports equipment, research and development, improvement and prevention of sports injuries, etc.

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