Application of Motion Capture Technology in 3D Animation Creation*

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Abstract—The character movement in 3D animation creation has always been the main difficulty in creation which relies mainly on the experience of animators traditionally. In recent years, a new animation technology, motion capture, is often used in Hollywood animation and film production. By capturing the movement of the human body, the character model and the actors have the same movements, which can greatly improve the efficiency of animation creation. This paper introduces the capture process and key technologies of motion capture based on MotionAnalysis system, which is of great significance to the improvement of the quality of 3D animation production in China.

Keywords—3D animation; motion capture; character binding

I. INTRODUCTION

The animation of characters has always been the main difficulty in creation. The quality of character action performance directly affects the success or failure of the entire animation work, and the animator is crucial to the performance creator of the character action. Animators must study the laws of animals such as birds and beasts, so that the movements conform to the principles of kinematics. Therefore, the realization of perfect animation effects depends entirely on the accumulation of animators' years of experience. The excellent animators are few and far between, and it is difficult to find a lot of three-dimensional animation movements, which affects the quality of creation. In order to overcome the obstacles of manually adjusting virtual character movements, in recent years, a new animation production technology, motion capture[1], is often used in Hollywood movies and animation film and television works, and has gradually become an important technology for 3D animation production.

II. APPLICATION OF MOTION CAPTURE

Motion Capture uses sensors to detect and record the trajectory of the actor's body and face in three-dimensional space in real time, convert these records into data, and then assign the virtual character model that has been generated in the animation software to make the model and the actor has the same action and generates a sequence of motions [2].

Motion capture can greatly reduce the difficulty of creating character movements and reduce the dependence on creators' experience and skills. The most important thing is that the motion capture system records the actual motion of the object. The captured data is key frames, so the motion is accurate, smooth and realistic. "Avatar" [3], "Rise of the Orbs", "The Hobbit" and so on had used a lot of this technology. In 2007, the "Monster House", which was nominated for the best animated feature film in Oscar, is an out-and-out animation of motion capture. With the development of technology, motion capture has become an indispensable technology in 3D animation creation.

Motion capture systems can be divided into the following categories according to their working principles: acoustic, optical [4], electromagnetic, mechanical [5], and video-based motion capture systems [6]. The optical motion capture system has more mature technology, higher sampling rate and less motion limitation, and has become the most widely used capture system. MotionAnalysis [7], Vicon [8], etc. are all optical devices. During capture, some marker points are pasted on the main joint of the capture object. These marker points have the characteristics of illumination, and the camera receives the light reflected from the marker point to obtain the position of the marker point in the two-dimensional image. If a marker is seen by multiple cameras at the same time, the coordinate information of the marker in three-dimensional space can be calculated to obtain optical motion capture data.

Taking the MotionAnalysis optical motion capture system as an example, this paper introduces in detail the whole process and key technologies of the motion capture to make character movements, which is of great significance to the improvement of the quality of 3D animation production in China.

III. MOTION CAPTURE PROCESS

The MotionAnalysis system includes the following main devices:

Marker Point: A pasted marker coated with a reflective material that provides the motion capture system with location information about the motion of the object.

Signal capturing devices: usually captured by high-resolution infrared lenses.

Data transmission equipment EagleHub: The motion capture system needs to transfer a large amount of motion data from the signal capture device to the computer system for processing quickly, and the data transmission device is used to accomplish this work.

Cortex real-time operational analysis software: capture data, noise processing and 3D models combined with the completion of the role of the action, which requires the application of data processing software to do this. The high-speed computing power of the computer is used to complete the processing of the data, so that the CG character can move in a real and natural manner.

Other equipment: motion-assisted special tight-fitting clothing, L- and T-type dynamic calibration rods, horizontal check rods and other auxiliary equipment.

This article uses 8 digital capture lenses for single-action motion capture. The workflow is to use the infrared lens to collect the actors' actions in real time and transmit them to Cortex for processing, and output the collected motion data. This data is then imported into the MotionBulider software drive character, which causes the character to animate the captured action.

A. Device Initialization

1) Device startup: Turn on the server and camera power, start the server, and plug in the Cortex software's main dongle. Set the server IP to the factory default IP: 10.1.1.199, open the Cortex software, and configure the Cortex IP to the factory default IP. In order to prevent the server's IP from being modified manually, it is necessary to configure whether to restore to the default setting each time the software is opened, because the camera defaults from the IP of 10.1.1.200.

2) Cameras detection: The eight digital capture lenses in the MotionAnalysis system are evenly distributed across the four walls of the room. In order to detect whether the camera can completely cover the capture area within its angle, it is necessary to set a reflective spot in the capture zone for testing. The reflective point, also known as the Marker point, is usually a high-brightness reflective ball that is detected in real time by different motion capture lenses from different angles. In theory, for any reflection point in space, as long as it can be seen for both shots at the same time, the position of the point in space at this moment can be determined. When the lens is continuously shot at a sufficiently high rate, the motion trajectory of the point is obtained from the sequence of images.
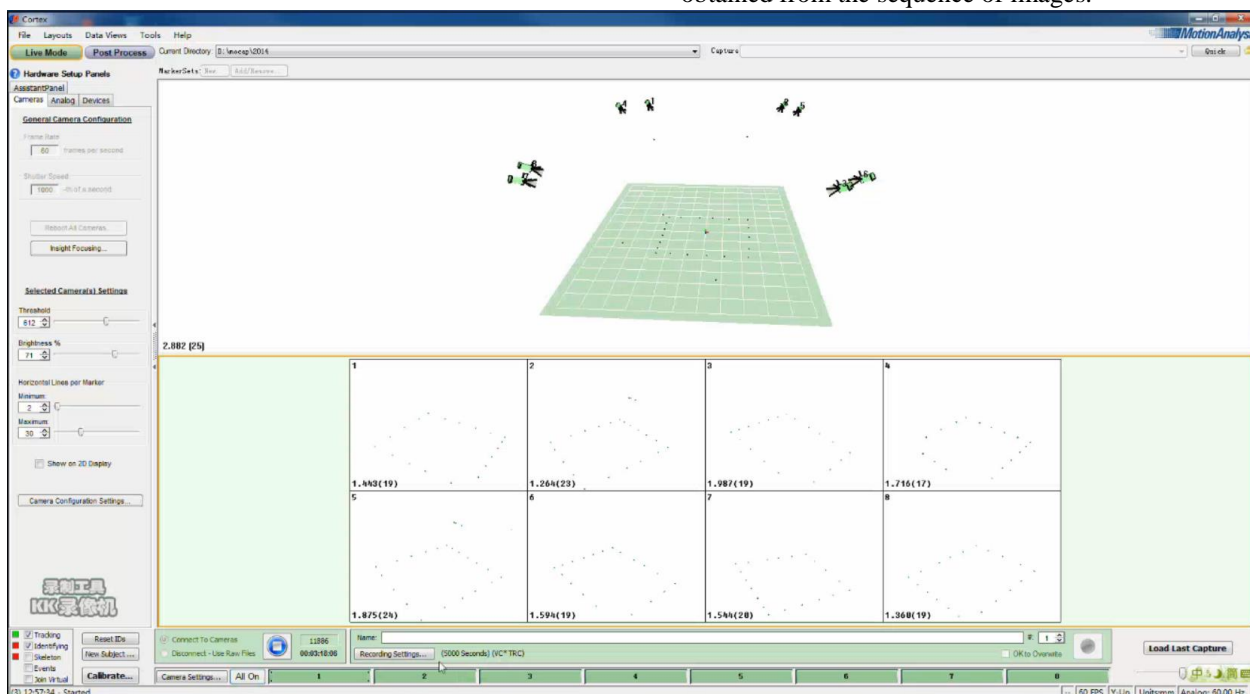

Fig. 1.   View Camera in Cortex.

Generally, the capture area is set to a rectangle. The test process is to apply a reflective point equidistantly around the center of the indoor capture area, for example, set 20 reflection points. Check in Cortex whether all the lenses can see all the reflective points. Under normal circumstances, the lens can see the number of reflective points equal to the number of reflective points, but some lenses may see more reflective points, these are not Marker's reflections call them

noise. As shown in the "Fig. 1", Camera 2 sees 3 extra noise points. At this time, these objects that generate noise are removed in the current scene. It may be an object worn by a person, or a reflective stool. In short, the number of reflective points displayed in the capture area must be equal to the number of reflective points set. In "Fig. 1", the bottom shows the number of reflective points in the capture area seen by the 8 cameras. The 2nd camera sees 23 points. In

theory, only 20 Marker points should be seen. There must be some noise points. You need to find the source of the noise generated in the capture area.

3) Calibration: The purpose of the calibration is to detect the area that the cameras can capture. Calibration is done with a T-bar. The T-bar device has several reflective points on the T-bar device. The sweeping field is continuously moved up and down, left and right, and the single lens can capture the spatial position of the reflective point, so that you can get the range that you can capture. The speed of the sweep is preferably close to the speed of the model's movement, which allows for a more accurate test of whether the camera can capture all the data. Combine the data captured by each shot to see the entire capture space.

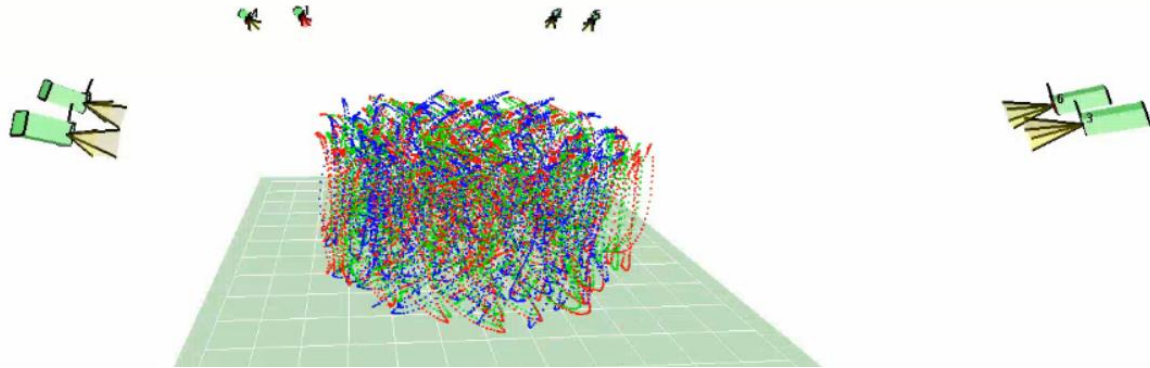As shown in the "Fig. 2", it is the capture area captured by the eight cameras.

Fig. 2.   Show Camera Field of View.

B. Capture Performance

Motion capture is possible when the device is initialized. It requires actors to perform, so picking good actors is important. For example, New Zealand Vita Studio chose the famous actor Andy Serkins when making "Rise of the Orangutan". The performances of Serkins were all captured by the orangutan Caesar, and the performance of Caesar was vivid.
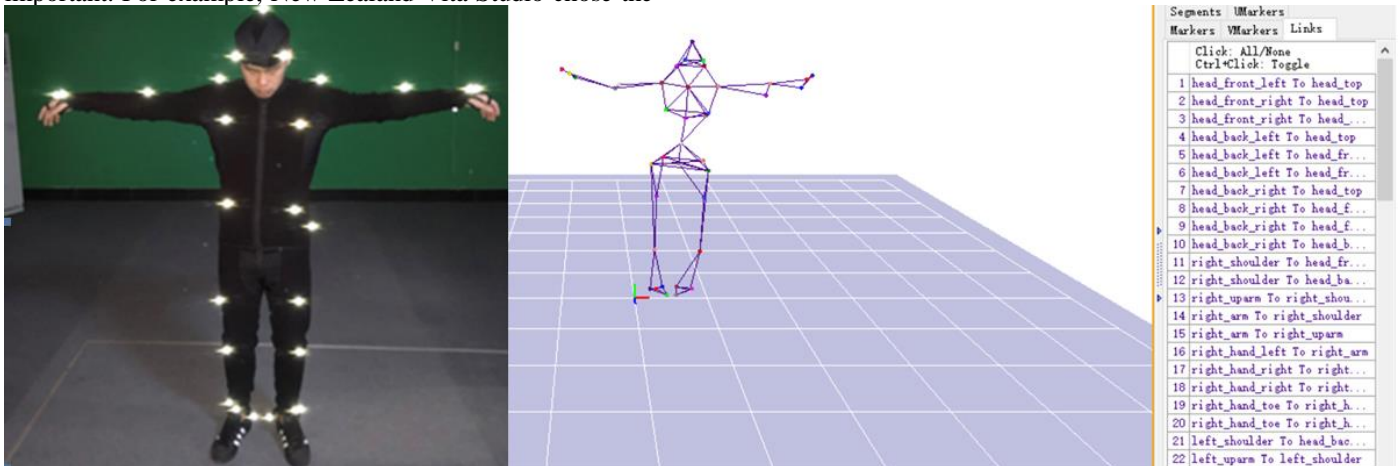

Fig. 3.   Skeleton Builder.

1) Installation of marker points: To capture the action, the actor needs to wear a special action capture suit, usually black tights. Then paste the Marker point on the capture suit. The Marker point settings need to conform to certain rules, such as using the standard BVH [9] or ASF/AMC [10] skeleton information model, or you can use a custom skeleton model. Each Marker point needs to be given a name corresponding to it, such as the Marker point pasted on the head to give its custom name is bread_top, the point on the right shoulder is called right_shoulder. All Marker information is recorded in the MarkerSet that you created.

Then create a two-two connection relationship for the Marker point in Cortex. The advantage of this is that if some points are occluded during capture, the position of the point can be calculated by other points. "Fig. 3" shows the Marker points setting on the actor's body on the left and the skeleton building on the right.

2) Noise data processing: After the Marker point is defined, you can capture the simple action of the actor to test whether these illuminating points are captured correctly. For example, the actor can do simple actions such as T-Pose, lifting the foot, and walking around. The actors' movements

begin with T-Pose, which facilitates the binding of the bones. When detecting the captured test data, it is necessary to call up the animation curve of the action to synchronize the viewing. As shown in the "Fig. 4", there are viewing tracked data in post process mode. Since the Marker point may be occluded, confused or lost during the acquisition process, the collected motion capture data is prone to errors and pseudo data to generate noise, that is, some light points cannot be captured or some light points are captured and the motion is deformed. The noise data needs to be patched. Patching is typically done by interpolation or by other cursor point information associated with it until all Marker points are captured to the correct action at the correct location. Save the test action after the entire adjustment is saved as an action template and save it to the action library for later reference to capture other actions of the actor.
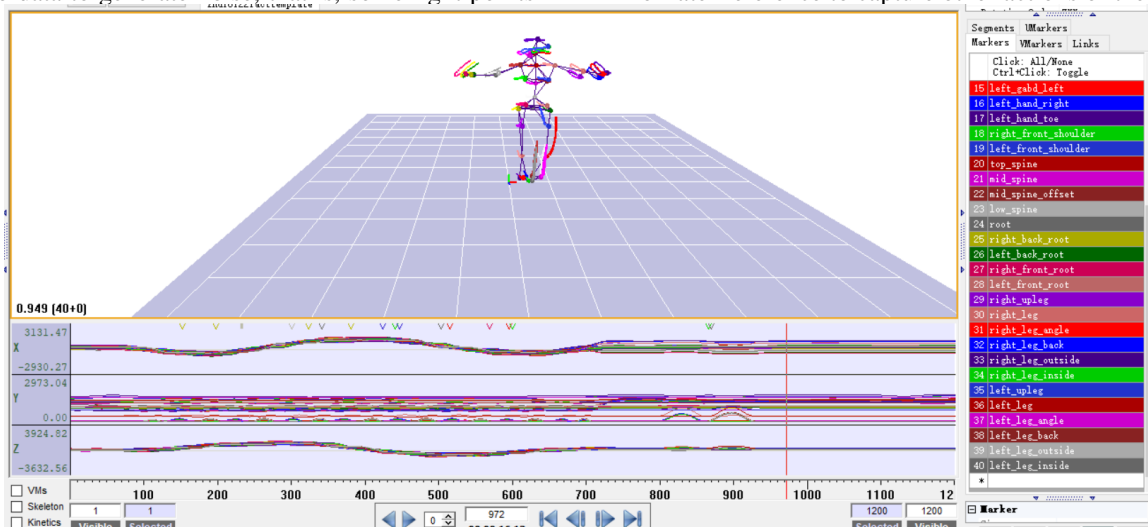

Fig. 4.   Viewing tracked data in post process mode.

When the system detects the error of Marker point, it will display the types of error on the motion curve. There are mainly the following categories:

- Marker **/**: Indicating jitter in motion data. The solution is to either delete these frames or insert them using join cubic or join virtual. Another easy way is smooth, but sometimes it can't be solved.

- Marker **|**: Indicating frame loss. Dark rectangles are formed when there are many vertical lines. In this case, join virtual is preferred. Selecting three points adjacent to this point will automatically calculate the missing frames.

No matter which method is used to repair the noise data, it should be checked with the motion law. Sometimes the repaired data may have incorrect actions, which should be noted. To be safe, you can view the trajectory point by point.

The test action after the adjustment is saved as an action template and stored in the action library so as to capture other actors' for reference.

3) Capturing formally: Now, actors can perform formally, capturing all the actions of the performance. Similarly, the noise data generated in the capture process need to be corrected. After all the noise data has been corrected, the data can be saved, generally set to TRC format, which is convenient for the recognition of animation software such as MotionBuilder and Maya.

C. Characterization

Let's take the animation software MotionBuilder as an example to explain how to drive the character after the motion capture is completed. In MotionBuilder, import the data Trc file you just captured. The captured data is the motion information of all Marker points. To change the point motion into the character's motion, you must design your own character and character bones. As shown in the "Fig. 5", this character is the role of the system's own Aragor, which has bone information. When you create a character yourself, you need to build a character model, and then design a skeleton model and brush weights for it. It is important that the character's bone naming must conform to the MotionBuilder bone naming convention so that MotionBuilder can recognize it.
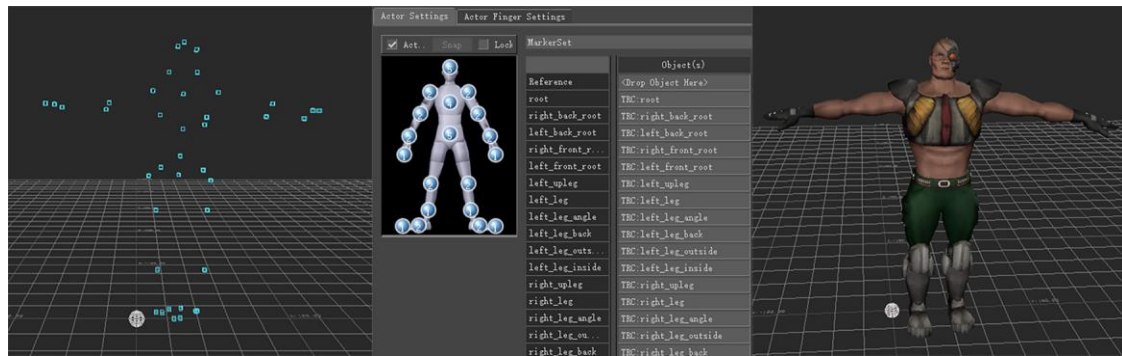
Fig. 5. Model characterization.

At this point, the entire motion capture process is complete.

IV. CONCLUSION

The MotionAnalysis system in the United States has provided a complete solution for nearly a thousand users around the world. This system is used in 80% of animation and game studios around the world. In China, there are few animations that use motion capture systems. There are two main reasons for this: First, the capture equipment is more expensive. The dynamic capture system is expensive, which is unbearable for the average enterprise and limits the large-scale application of these systems in China. Second, the lack of relevant training leads to the inability to master the core technology. The core technology of such systems is entirely from abroad, and foreign designers cannot come to China for training, resulting in most devices being idle due to lack of professionals who understand motion capture technology.

Although the international motion capture technology has a very prominent advantage in animation creation, it is difficult to develop this technology in China due to factors such as funding and talent. Therefore, the research in this paper is very important for upgrading this technology in China, and it can be well applied to the production of movies, animations and games. With the development of technology, motion capture equipment is constantly being updated, and many new types of equipment, such as inertial capture, expression capture, hand-capture equipment, etc., have emerged, and new technologies need to be constantly understood along with the development of the times.

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