A Study on Motion Visualization System Using Motion Capture Data

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Abstract

In this paper, we describe a development of the Motion Visualization System which make us understand intuitively a series of action of an actor by coordinates information obtained from motion capture system (MC System). The MC System we use is wireless magnetic type and has 11 sensors each which give us position and angle data. To visualize the motion of limbs, we transform momentary position and/or angle data from corresponding sensor into color lines and place the line in a row every moment.

As a result, the motion of a sensor is shown as an image like a color belt on display. The idea of this method is based on principle of slit camera. Once the image is generated, we can get some characteristics of motion by image processing techniques without original sensor data. Some examples of the image and extracted features from the image will be shown.

Keywords: Motion Capture, Motion Visualization

1. Introduction

Many types of motion capture system (MC System) is used for not only entertainment fields of movies and computer graphics animations but also any fields like sports, action analysis and so on. The motion data acquired from MC System include various information and the volume of data grows very large. For showing the motion, special software is used and the transform the data sequence into animation of acting body is generally used method. And for showing some characteristics of the motion, many methods are proposed like curve graph for angle and/or speed, overlaying picture and so on. The curve graphic representation is suitable for long time motion with repetition. However, from the representation we have no way to get some characteristics of the motion except our eyes.

In this paper, we propose the motion visualization method which is able to be looked about the motion data at one view, and we can get and visualize the features of the motion by using well known image processing techniques from visualizing image. The proposed method is based on principle of slit camera, and motion information are displayed as a color belt.

2. MC System

In this research, MotionStar Wireless [1] of the Ascension Technology Corporation is used. The MotionStar Wireless is a magnetic system and can acquire six kinds of data at each time. The coordinate system of the system is the right hand system with $z$ axially of the plus downward (Figure 1, Figure 2). The 11 sensors are installed and placed of the actor in the joint part. Figure 3 show location of sensors on abstract human body.

We use a special program for getting the location and angle information on each sensor and can get those data as a text form file.

![Figure 1: Standard](image1.png)  ![Figure 2: Magnetic](image2.png)

3. Method of Motion Visualization System

The idea of the method proposed in this paper is based on principle of slit camera. The slit camera is used for judgments of horse racing and track sports, the media art [2] and so on. On another our research [3], principle of the slit camera is applied to video scene display compactly and to extract features of video scene. The best feature of the slit camera is to be able to display the local domain of the space of long time scene compactly and to extract characteristics of the scene by well known image processing techniques on displayed images without original scene. So we need no programs for extraction of some kind of characteristics other than using package software like Photoshop®.

To show and extract the characteristics of motion, we transform position and/or angle data given by sensors at a moment to a color line which correspond to one slit of the slit camera, and place the lines in a row every moment.

Now, we describe how to visualize motion of four limbs as a example of our method. Four limbs (Right arm, left arm, right leg and left leg) are corresponding to sensor number 7-9, 8-9, 3-9, and 4-9 respectively.

We explain about the left arm movement. We are drawing red line from coordinate original point to left elbow and to back (Figure 4). In this case, difference vector between No.8 and No.9 represents direction of left arm and the angle $\theta$ is computed easily. Then corresponding to the angle information $\theta$, color information on RGB is determined following way. Because range of value $\theta$ is $\theta = 2/\pi \geq 0 \geq -2/\pi$. So we set the RGB value of line as follows.

- $R = 255, G = 0$ and $B = 0$, when $\theta = 2/\pi$.
- $R = 0, G = 0$ and $B = 255$, when $\theta = -2/\pi$. 

Other than this, we can symbolize the magnitude of the movement by value of $R$. Also, we set $R = 255$ and $G = 0$ if we want to reduce the magnitude of the movement. When $\theta = 0$, the line is red, and when $\theta = 90$ or $\theta = 270$, the line is blue.

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The color of intermediate angle is shown in Figure 4. Figure 5 shows the movement of right arm, left arm, right leg, and left leg as a color belt. A horizontal axis of the color belt shows time. As shown in Figure 5, we can understand intuitively a series of action of an actor especially repetition of an action.

This is data of a certain radio gymnastics which is well known as a healthy physical exercise in Japanese. This exercise consists 13 phrases about three minutes (Figure 6). Figure 5 shows from 1 to 4 phrases.

4. Features of This Method

Once the color belt like Figure 5 is generated from motion data and save it as a image file, we can apply image processing technique to the image file.

More compact representation:

when we apply scaling on horizontal direction, we get more compact representation of motion with respect to time domain.

Motion emphasize:

when we apply filter of edge-emphasis which is basic function of most image processing software, we can get specific movement of each arms as a color belt. Example is shown in Figure 7. In addition, motion is emphasized by image processing, applying color conversion from the value red of RGB color map to value Hue of HSV color map. In this case, we convert red to the angle of Hue. So, the portion is colored by nearer red, when the arm position is down. The portion is colored by nearer blue (or purple), when the arm position is up.

Extract motion speed:

applying Prewitt filter (Hue threshold value = 0) to shown image in Figure 8, we can get the image that shows speed information of moving arms like Figure 9. Figure 9, the color corresponding to strength of the hue change is extracted. The portion is colored by nearer red, when the motion speed is low. The portion is colored by nearer blue (or purple), when the motion speed is high.

5. Conclusion and Future Work

Using the visualizing method proposed in this paper, it is possible to display to be compressing time and space by color belt image and to extract of characteristics of motion by applying image processing method. For the future, we will look for a way to feature extraction and representation for a more comprehensible way.

References