Motion Filter for Making Emphasized Human Motion

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Abstract

This paper describes algorithms for the method to generate motions automatically. There are many efforts to generate motions with assistance from computers. But almost of these are methods for generating motions from scratch using computers – generally called "Computer Generated Animation". We propose a method called "Computer Aided Animation" which is a tool to help in animator generating motions. Many motions in cartoonized animation are included with impossible motions for human. Animator makes these motions based on knowledge of experiental techniques. The method in this paper works like a filter in the field of image processing. We call this method "Motion Filter". Motion Filter accepts captured motions from motion capture system and translate these motions to emphasized – cartoonized – motions.

1 Introduction

Computer animation has been in great demand in the field of TV processing. However, almost all the animations have been created by experts who have worked for pictures on celluloid in cartoon animations.

Kaneko[1] proposes a method of generating animation by using computerized system. This method makes inbetweens between two successive pictures which are drawn by animator. But, the animation created by this method cannnot express effective motions especially in cartoon films. There are also many studies on motion problems based on physical laws[2][3]. However, there are some techniques in animation to express motions which are not based on physical laws. Animator makes effective motions using techniques based on experiences.

This paper proposes a "Motion Filter" which is a computerized tool to design the motion of characters for animation. The author asked experts about their techniques and analyzed them in order to implement these techniques on a computer[4][5]. Motion Filter accepts captured motions using motion capture system and transforms them into emphasized motions. It works interactively and is very friendly to a common user who is willing to design good animation.

2 Problems of motion captured motions

Motion capture system has been available to capture real motion. Though, many animator are concerned with the difficulty in expressing wealthy motion which was included in old style animations by using overly real motion. And then, because the system can only capture motion realistically, it is unable to make a motion which is over the limitation for human.

According to the problem, post production process is very important to make motions using motion capture system.

3 Emphasized Expressions

To express many informations such as speed, counting, etc., animator uses emphasized motions. Especially, emphasized motions are some of the effective techniques used in celluloid animation.

Emphasized expressions are classified as follows:

- "expansion" and "stretch"
- "reaction" and "previous action"
- "follow through"

Fig1 shows an illustration of these motion effects.

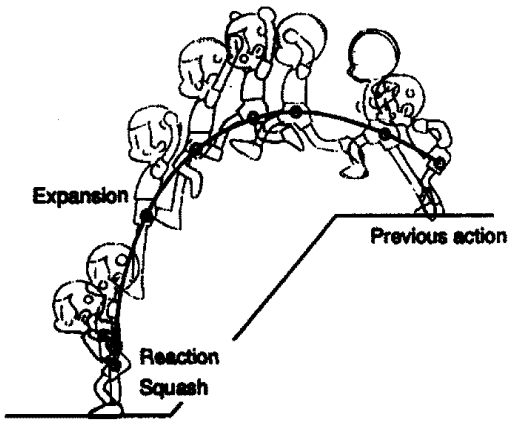

Figure 1: Emphasized expressions

Animation contains two elements, "path" and "timing". When the character in animation moves from one position to another, we call the trajectory "path" and the changes of shapes of the character "timing". In this paper, we used the timing to control movement in animation.

4 Motion Filter

Emphasized expression is an effective way of making motion in moving pictures. But it is very difficult to learn and use the expression because it depends on experienced hand. So We propose "Motion Filter" which is a computerized tool to design the characteristic motion in animation.

The way of generating emphasized motions using Motion Filter is shown as follows.

- The moving path of a character is obtained from keyframes.
- Motion Filter gets informations what kind of movement is expressed.
- Motion Filter applies the most adaptable emphasized effect to the movement.

The motion after Motion Filter is emphasized at the point of speed, counting, and so on.

4.1 Skeleton model

We have used skeleton model to input and treat human motions. The skeleton model is made from 24 segments as shown in Fig2.

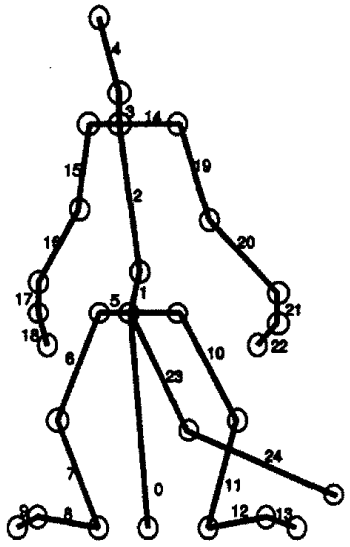

Figure 2: Skeleton model

Each segment has a parent and a few children, and has values of angle and length. As shown in Fig.3, the angle and length are lead from own parent.

4.2 Method for making emphasized angle

Using that skeleton model, "previous action" and "reaction" are defined as shown in Fig.4, and Fig.5.

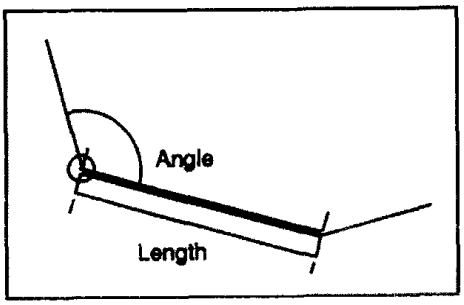

Figure 3: Segment's datas

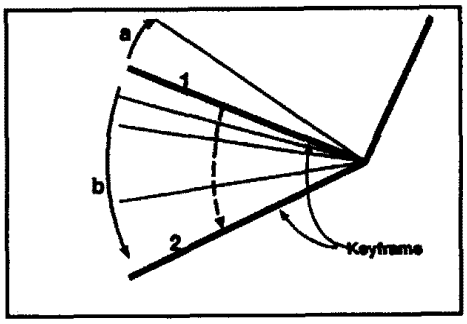

Figure 4: Previous action

When the change of velocity starts at 0 with acceleration, the effect of "previous action" occurred. This effect is defined as to pull back the angle against the expected direction before the actual motion. In Fig.4, when a expected motion is defind as lenear motion from 1 to 2, at first the segment moves for the direction a. Then the segment moves along with the expected path b.

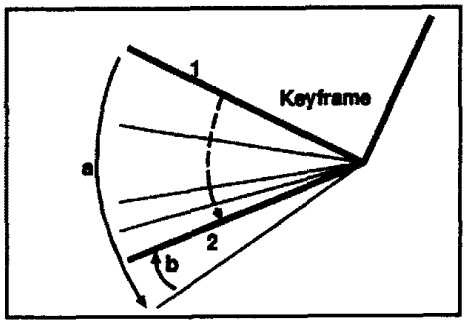

Figure 5: Reaction

When the change of velocity stops suddenly, the effect of "reaction" is occurred. This effect is defined as to over run the angle along the expected direction, and then to pull back at the expected point. In Fig.5, when a expected motion is defind as lenear motion from 1 to 2, the segment does not stop at the point 2, then it moves along the path a through the point 2. After that, the segment pull back at the point 2 along the path b.

Based on the velocity curve in each segments of the skeleton, Motion Filter makes emphasized motion to which attach effects "previous action" and "reaction". Fig.6 is the graph which show changes each of knee angles belonged in jumping human. When "Original" is the input motion, and "Velocity" is the velocity of the "Original".

To make emphasized motion, Motion Filter change the peak on "Original". In this case, the emphasized motion is to calculate difference between valuses of "Original" and "Velocity". "Destination" in Fig.6 shows emphasized motion using these process.

Let t be a number of frames. When the input motion at t is defined as $I(t)$, velocity v at t is given by

$$v(t) = \frac{I(t) - I(t - \Delta t)}{\Delta t} \quad (1)$$

Then the emphsized motion g at t is given by

$$g(t) = I(t) - v(t) \quad (2)$$

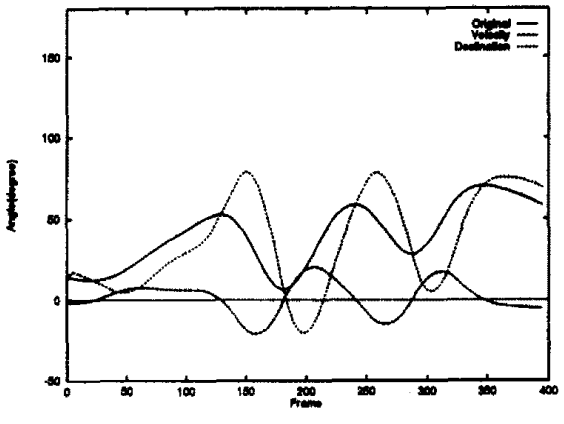

Figure 6: Previous action & reaction

You can find the difference between "Original" and "Destiny" around each peak of curves. The

effect of "previous action" and "reaction" occurs around there. After changing these angle curves, the filter must translate the character's foot position to the correct position because sometimes changing angles cause the foot position to place at unexpected position.

5 Experimental results

Fig.7 shows results used Motion Filter for jumping human motion. Fig.7(a) shows motions as input, and Fig.7(b) shows motions which are through Motion Filter.

You can find the effect of "previous action" at frame 5 and 10. In Fig.7(a), the character's hand is moved greater than Fig.7(b). The effect of "reaction" can be found at frame 40 and 45. The charcter's leg bended more than normal motions.

In frame 30, the character's leg is bended beyond limitation for human motions. But, in animation, this works effectively to express speedy or strongly motions.

6 Conclusion

In this paper we propose a method called "Motion Filter", to use this method we can generate effective motions in animation products easilly. "Motion Filter" in this paper is able to treat only two effects of "previous action" and "reaction" which is defined as change of angle. However, we can treat many other effects such as "expansion" or "stretch" to extend this method to be able to treat segment's length.

I have succeeded to make emphasized motions automatically, using filter operation as in image processing.

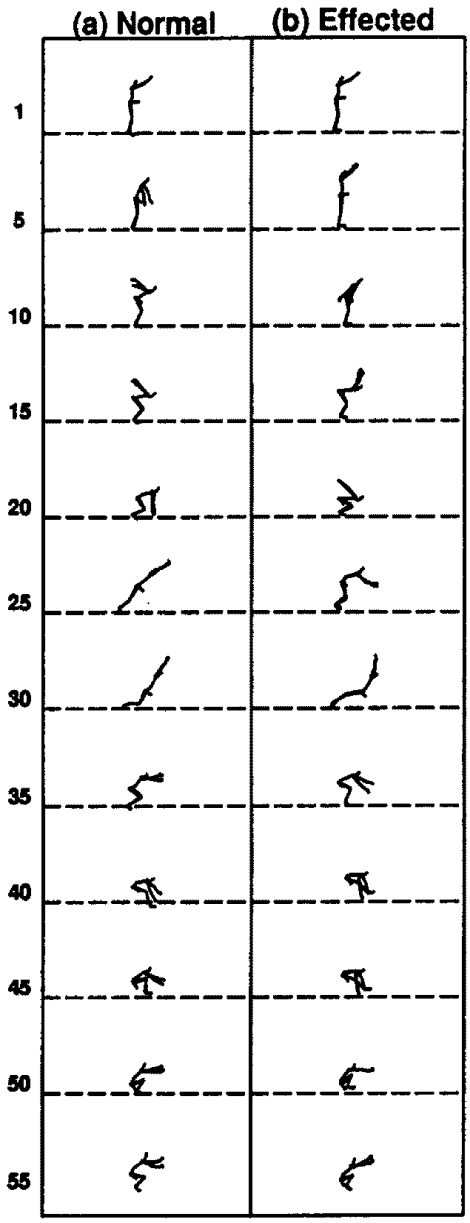

Figure 7: Emphasized motions through Motion Filter

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