SIMULATION SYSTEM FOR DANCE GROUPS USING A GAMEPAD

Asako Soga[1] and Itsuo Yoshida[2]

[1]*Faculty of Science and Technology, Ryukoku University, 1-5 Yokotani, Oe-cho, Seta, Otsu, Japan*
[2]*Graduate School of Science and Technology, Ryukoku University, 1-5 Yokotani, Oe-cho, Seta, Otsu, Japan*

Keywords: Human Animation, Dance, Formation, Simulation, Gamepad.

Abstract: A dance group requires a formation, quite unlike a solo dance, and thus the arrangement on the stage is critical. We have developed a system to simulate the formations of dance groups. The simulation is executed by specifying the number of dancers, the formation pattern, and the dancing motion with a gamepad. Typical formations used for classical ballet pieces were analyzed, and three formation patterns were obtained. Each dancer's position is calculated by the number of dancers and the selected formations. The system arranges dancers on a virtual stage and simulates dance animations by using motion-capture data obtained from a professional dancer.

1 INTRODUCTION

Our goal is to develop useful tools in dance education and creation, such as a self-study system for students and a creation-support system for choreographers. In this paper, we describe a simulation system for dance groups.

In recent years, simulation systems for groups and crowds have been developed (Ulicny, 2004), (Lai, 2005), (Kwon, 2008), but composing complex human motions remains a challenge.

A dance group requires a formation, quite unlike a solo dancer, and thus the arrangement on the stage is critical. We have been developing simulation systems for dance groups (Soga, 2010). In this paper, we describe a simulation system for ballet using a gamepad. The subject of the simulation is the type of dance group called a *corps de ballet*. Our purpose is to develop a system that allows anyone to easily create the formation of dance groups.

2 SIMULATION SYSTEM

2.1 System Outline

The system arranges dancers for group dancing, and can simulate the flow of the dancers on stage between the dancers' entry and exit. First, the user inputs parameters such as the number of dancers and

formation patterns using a gamepad. Next, the user draws an indication line to arrange dancers corresponding to the positions on the stage. Then, the user arranges CG dancers on the stage in the virtual space. Finally, the simulation results are obtained by 3D animation.

Typical formations used for classical ballet pieces were analyzed, and three formation patterns were obtained. We implemented a function to arrange the dancers symmetrically because such arrangement is often used in classical ballet. This system can also simulate transitions of dancers when changing formations. Furthermore, users can control dancers using a gamepad, with which they can easily arrange the typical classical ballet formations.

2.2 System Structure

The system executes simulations using a personal computer running Windows OS, and is operated with a gamepad. Figure 1 shows the system being operated. We developed the system using Visual C++ 2008 and DirectX. The DX Library is used to handle DirectX.

Dance animations are edited from motion-capture data obtained from a professional dancer. The system has several motion data sets of classical ballet steps. The user can arbitrarily select dance motions of virtual dancers. Dancer models were created using Maya. The dance motions were applied to the dancer models, which were outputted

Figure 1: The operation scene of the system.

in DirectX file format.

2.3 GUI and Simulation Procedure

The system is operated by switching between two modes. The system has an operation mode for inputting parameters, and a preview mode for checking the dancers' formations and CG animation.

Figure 2 shows the GUI (Graphical User Interface) of the operation mode, which consists of the number of dancers, main menu, sub menu, a virtual stage, and the sequence area. The main menu has items such as parameter settings and commands to execute the simulation. When the user selects parameter settings from the main menu, parameters are displayed on the sub menu. Then the user enters the parameters. The input parameters are the number of dancers, formation patterns, etc. Each menu can be selected using the arrow keys on the gamepad, and certain buttons are used for setting parameters.

The user draws lines required for the simulation on the virtual stage. The camera view is fixed from the top, but users can play CG animation on the virtual stage. The inputted parameters are displayed in the sequence area.

The preview mode is for checking the dancers' formation and CG animation. The CG animation is displayed in full screen, and the user can see it from any perspective. The user can zoom in/out and change the camera view using the joy stick or the arrow keys of the gamepad.

The simulation procedure is as follows.

1) The user determines the dancers' initial position and the number of dancers.
2) The user selects the various parameters such as formations from the main menu and the sub menu.
3) The user draws an indication line to arrange dancers on the stage.

(1) Number of dancers
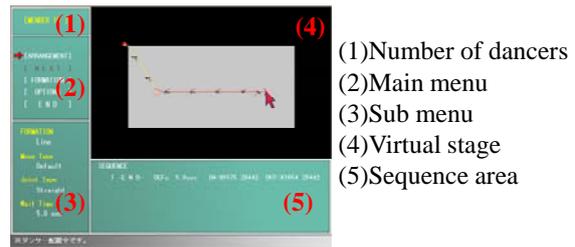(2) Main menu
(3) Sub menu
(4) Virtual stage
(5) Sequence area

Figure 2: GUI of the operation mode.

4) The user selects the command to start the simulation from the main menu, and arranges the dancers on the virtual stage.
5) When moving to another formation, the user selects the command to change the formation on the main menu, and then repeats steps 2) through 4).
6) When terminating a simulation, the user selects the command to complete it from the main menu, and determines the location of the dancers leaving the virtual stage.

If the user sets the parameters and executes the simulation, CG dancers appear and assemble in formation on stage, and then choreographic animation is played. After the dancers leave, the user can play the simulation result.

3 ARRANGING DANCERS

3.1 Formation Patterns and Drawing Methods

Three kinds of typical formation patterns are prepared; dancers are arranged in a straight line, a circle, and a curve. The user can freely arrange dancers on the virtual stage based on the formation patterns.

The user draws an indication line to arrange the dancers using a gamepad, and then the system calculates the position of each dancer and arranges dancers to create the formation. In the case of the straight line formation, the user draws a line by selecting two points. All dancers are arranged at the same distances. For the circle formation, the user inputs a center point and another point on the circle. Then a circle whose radius is the distance between the two points is drawn. All dancers are arranged at the same distances. In the case of the curve formation, the user selects two end points of the curve and then a temporary line between the points is shown. Then the user drags the temporary line to form the curve. The curve is drawn using the third
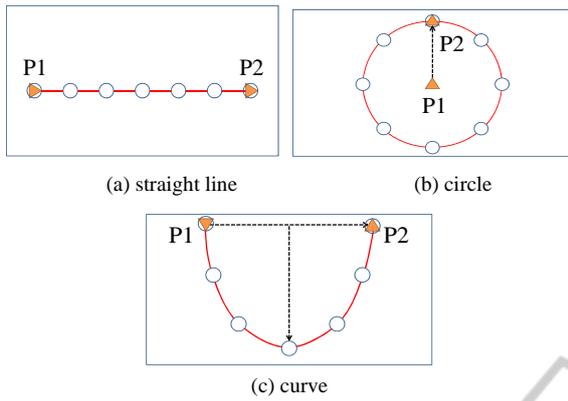
(a) straight line   (b) circle

(c) curve
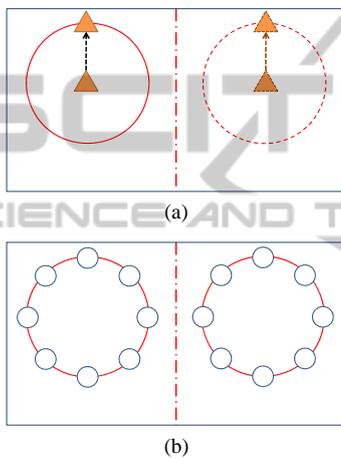
Figure 3: Formation patterns.

(a)

(b)

Figure 4: Symmetric arrangement.

Bezier method. The number of control points of a Bezier curve is 60, and all dancers are arranged with the same number of control points between dancers.

Figure 3 shows the examples of each formation. Triangles P1 and P2 in each figure are the selected points by the user. The red line is the indication line to arrange the dancers.

3.2 Symmetrical Arrangement

We implemented a function to arrange the dancers symmetrically because a symmetric arrangement is often used in classical ballet. Each formation pattern can be mirrored based on the line at stage center. When this function is enabled, the reflective indication line automatically appears according to the inputted indication line. Half of the virtual dancers are arranged on the inputted indication line, and the others are arranged on the reflective line.

Figure 4 shows an example of a symmetrical arrangement by 16 dancers in a circle formation. When the user inputs an indication line as shown in
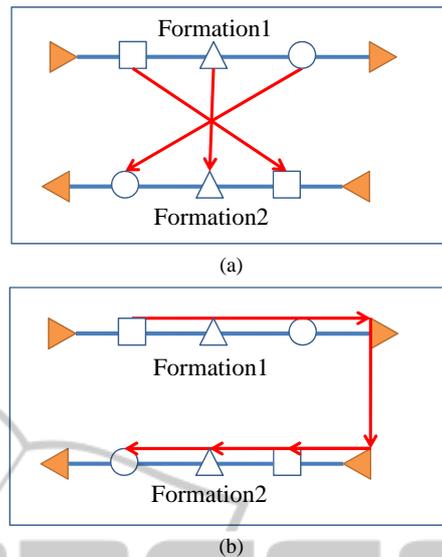

(a)

(b)

Figure 5: Transition patterns.

the left part of Figure 4(a), the corresponding line appears in the right part. After arranging the dancers, each circle can be formed by eight dancers on both sides as shown in Figure 4(b).

3.3 Transition Patterns

After arranging the dancers, they can be rearranged in another formation. This allows users to simulate the path of each dancer and the transition of formation. For rearranging dancers, the user draws the other indication line to arrange the dancers with the gamepad, and then the system calculates the path for each dancer from the current position to the next position. The dancers move along the shown path, and then enter a new formation. Two types of transition routes are predefined. The user can select the type when inputting parameters. One is the shortest route for each dancer from the current position to the next position. The other is the route along the two indication lines.

Figure 5 shows the transition patterns. Figure 5(a) shows the shortest route. In this case, each dancer moves directly from the current position of Formation 1 to the next position of Formation 2. Figure 5(b) shows the route along the indication lines. In this case, each dancer moves to the end point of the current indication line, and then to the next position via the starting point of the next indication line.

When moving from the current position to the next position, each dancer's route is displayed. Figure 6 is an example of transition from a straight line formation to a curved line formation. In this
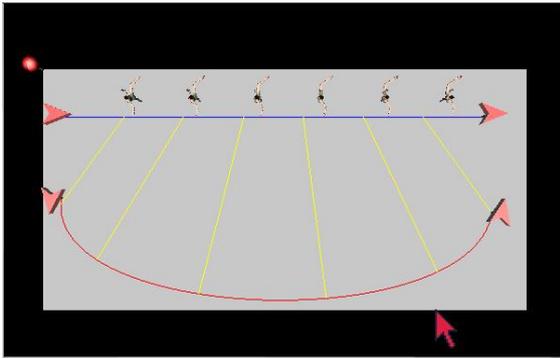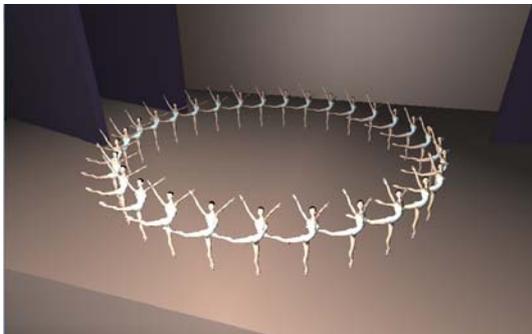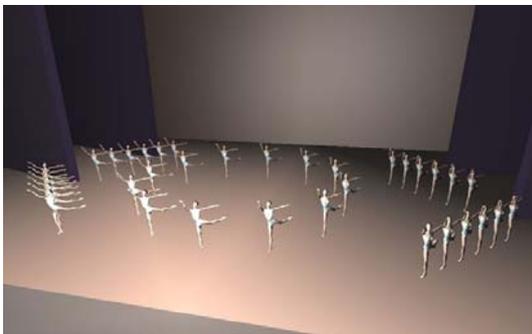
367

Figure 6: Transition path.

figure, the shortest route to the next position of each dancer is displayed. The transition path as well as indication lines are shown on the virtual stage.

4 SIMULATION RESULTS

The simulation results demonstrate the effectiveness of this system. Figure 7(a) is an example of a circle formation by 30 dancers. Figure 7(b) is a complex example of multiple arranging. One circle of 12 dancers is formed in the center, and two symmetrical lines are each formed by six dancers. In total, 36 dancers are arranged on the virtual stage.

(a)

(b)

Figure 7: Simulation results.

5 CONCLUSIONS

We have developed a system to simulate the formations of dance groups using a gamepad. From the results of an experiment, we verified that the system is easy to use once the user becomes accustomed to its operation. In future works, we aim to improve the system's usability and to reproduce more complex dancing groups.

ACKNOWLEDGEMENTS

REFERENCES

Ulicny, B., Ciechomski, P. H. and Thalmann, D., 2004. Crowdbrush: Interactive Authoring of Real-time Crowd Scenes. In *SCA '04, Proceedings of the 2004 ACM SIGGRAPH/Eurographics symposium on Computer animation*, pp. 243-252.

Lai, Y. C., Chenney, S. and Fan, S., 2005. Group Motion Graphs. In *SCA '05, Proceedings of the 2005 ACM SIGGRAPH/Eurographics symposium on Computer animation*, pp. 281-290.

Kwon, T., Lee, K. H., Lee, J. and Takahashi, S., 2008. Group Motion Editing. In *ACM Transactions on Graphics*, Vol. 27, No. 3, Article 80.

Soga, A., Boulic, R. and Thalmann, D., 2010. Motion Planning and Animation Variety using Dance Motion Clips, In *CW '10, Proceedings of the 2010 International Conference on Cyberworlds*, pp. 421-424.