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(54) SYSTEM AND METHOD FOR PRODUCING LOCOMOTION ANIMATION

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(57) **ABSTRACT**

Provided are a system and a method that automatically produce natural locomotion animation without an applicable discontinuity portion with respect to various moving distance and timing by using motion capture data. The system includes a motion capture data storage, a simulation calculator, and an animation calculator. The method includes defining a speed calculated in the moving motion capture data as a maximum moving speed of a simulation in order to calculate an entire moving distance, a stopped time when starting and arriving, and a stopped time before starting and after arriving regarding to respective characters; extracting a portion of the arriving motion capture data to be appropriate for the entire moving distance in order to produce the locomotion animation when the entire moving distance is less than a moving distance of the arriving motion capture data; and satisfying an entire time corresponding to an entire motion of animation.

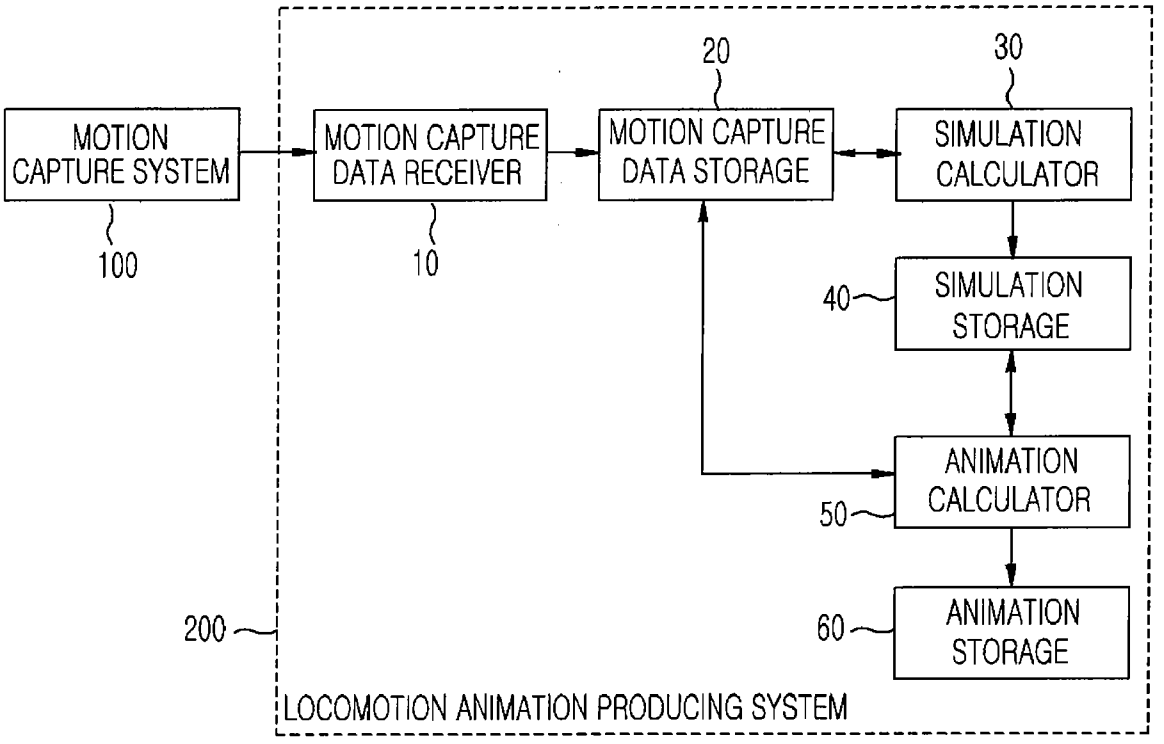


FIG. 1

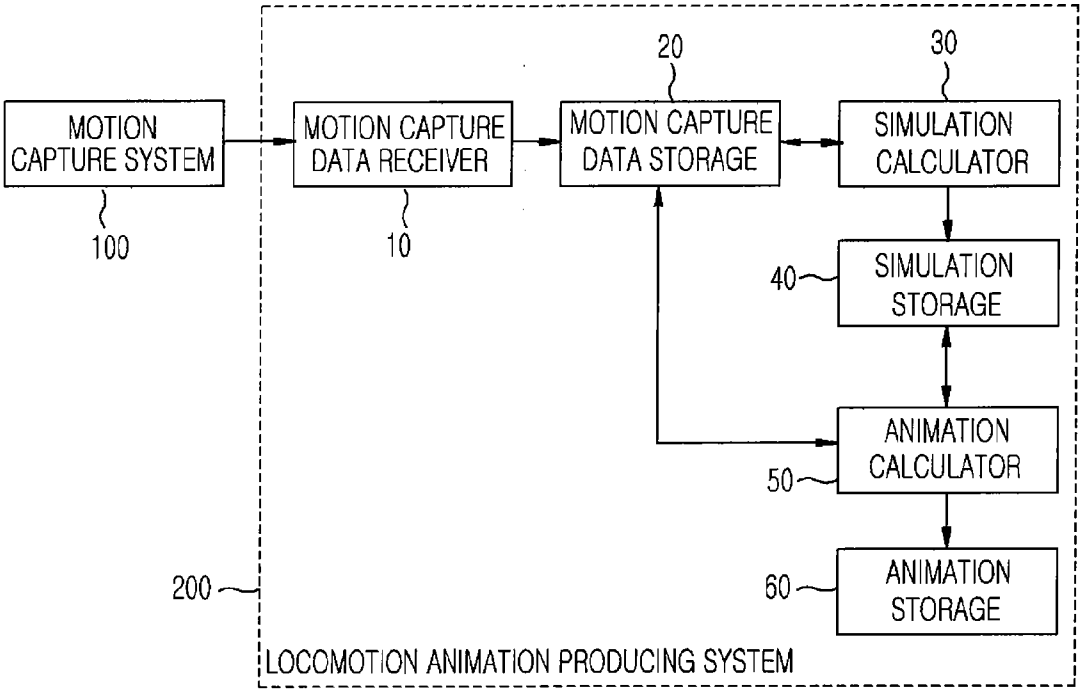

MOTION CAPTURE SYSTEM
100
MOTION CAPTURE DATA RECEIVER
10
20
MOTION CAPTURE DATA STORAGE
30
SIMULATION CALCULATOR
40
SIMULATION STORAGE
ANIMATION CALCULATOR
50
ANIMATION STORAGE
60
200
LOCOMOTION ANIMATION PRODUCING SYSTEM

FIG. 2

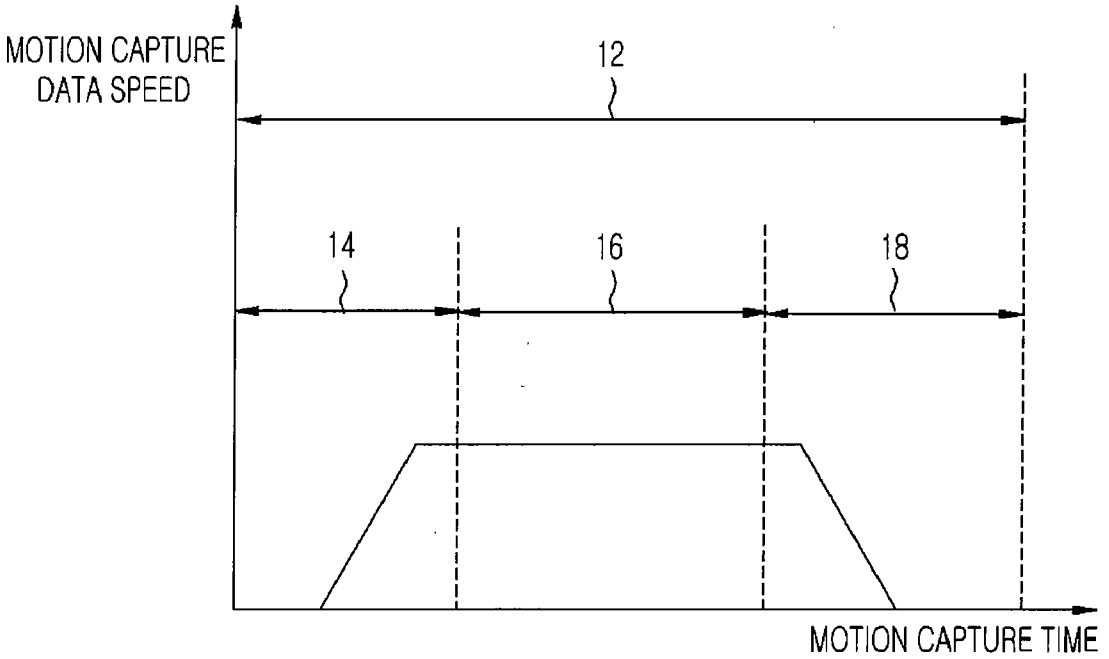
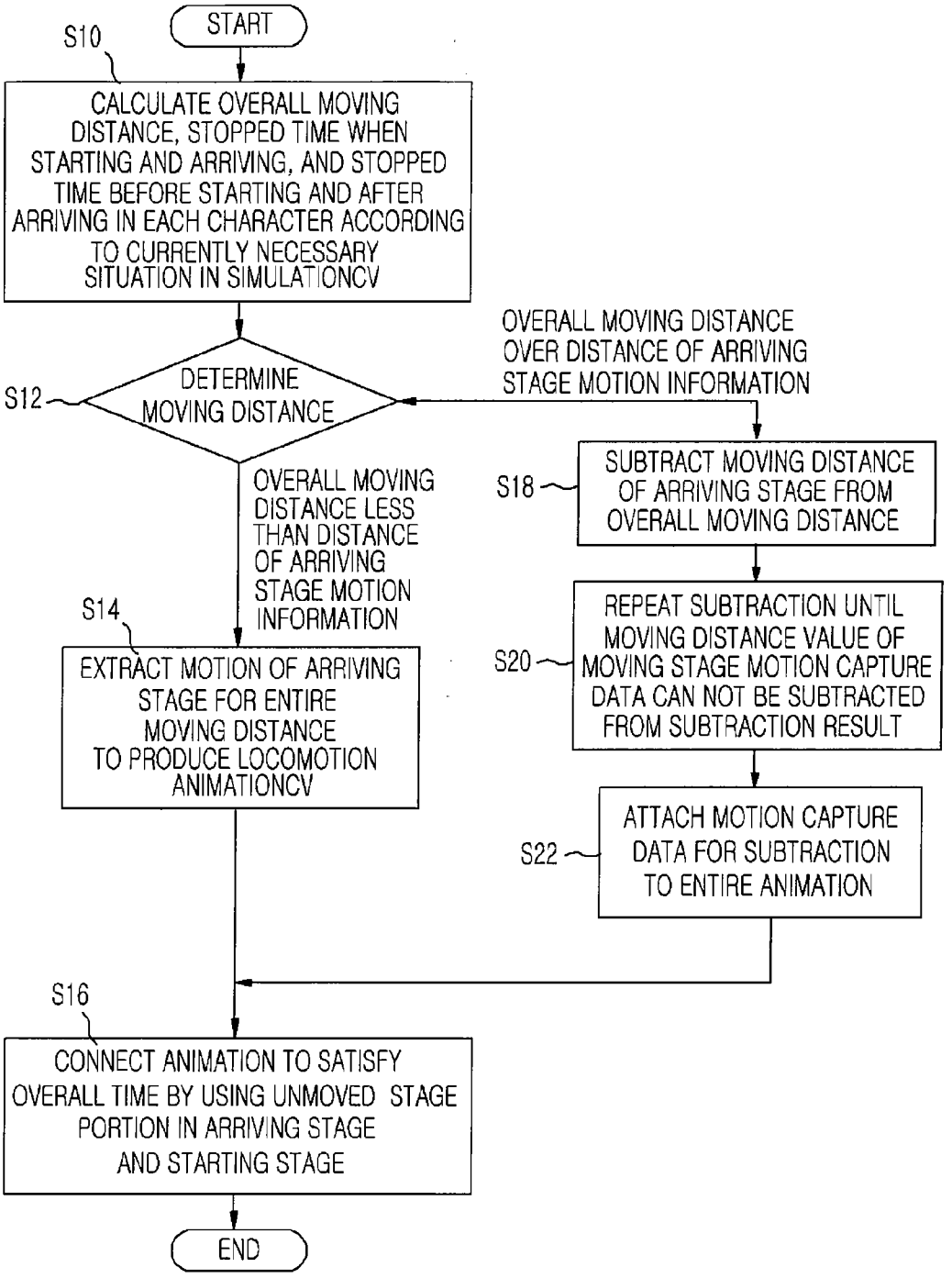


FIG. 3


START
S10
CALCULATE OVERALL MOVING DISTANCE, STOPPED TIME WHEN STARTING AND ARRIVING, AND STOPPED TIME BEFORE STARTING AND AFTER ARRIVING IN EACH CHARACTER ACCORDING TO CURRENTLY NECESSARY SITUATION IN SIMULATIONCV
S12
DETERMINE MOVING DISTANCE
OVERALL MOVING DISTANCE OVER DISTANCE OF ARRIVING STAGE MOTION INFORMATION
S18
SUBTRACT MOVING DISTANCE OF ARRIVING STAGE FROM OVERALL MOVING DISTANCE
S20
REPEAT SUBTRACTION UNTIL MOVING DISTANCE VALUE OF MOVING STAGE MOTION CAPTURE DATA CAN NOT BE SUBTRACTED FROM SUBTRACTION RESULT
S22
ATTACH MOTION CAPTURE DATA FOR SUBTRACTION TO ENTIRE ANIMATION
OVERALL MOVING DISTANCE LESS THAN DISTANCE OF ARRIVING STAGE MOTION INFORMATION
S14
EXTRACT MOTION OF ARRIVING STAGE FOR ENTIRE MOVING DISTANCE TO PRODUCE LOCOMOTION ANIMATIONCV
S16
CONNECT ANIMATION TO SATISFY OVERALL TIME BY USING UNMOVED STAGE PORTION IN ARRIVING STAGE AND STARTING STAGE
END

SYSTEM AND METHOD FOR PRODUCING LOCOMOTION ANIMATION

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a system and a method for producing locomotion animation, and more particularly, to a system and a method that automatically produce natural locomotion animation without an applicable discontinuity portion with respect to various moving distance and timing by using motion capture data.

[0003] 2. Description of the Related Art

[0004] A conventional method of producing a high-quality animation includes a method of utilizing original motion capture data as it is and a method of combining or modifying motion capture data to produce a high-quality animation.

[0005] First, the method of utilizing original motion capture data put a sensor on an actual person and extracts motion capture data by using the sensor to produce animation.

[0006] This method utilizes the motion capture data of an actual person as it is such that a high quality animation is very natural. However, since the motion capture data must be used as it is in animation, it can be very hard to be applied to locomotion animation necessary for various moving distance and timing.

[0007] Second, to resolve the above problem by combining or modifying the motion capture data according to a blending method, a blending method combines respectively different two motion data to create intermediate motion data. However, in the case of locomotion animation, unnatural motion data are produced due to the limit such as no slip between foot and ground in the locomotion animation.

[0008] Moreover, a designer may correct problematic motion capture data, respectively, but this costs a lot of money and cannot be applied to a large-scale animation such as crowd.

SUMMARY OF THE INVENTION

[0009] Accordingly, the present invention is directed to a system and a method for producing locomotion animation, which substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0010] It is an object of the present invention to provide a system and a method that automatically produce natural locomotion animation without an applicable discontinuity portion with respect to various moving distance and timing by using motion capture data.

[0011] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0012] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is provided a locomotion animation producing system using motion capture data, the system including: a motion capture data storage storing starting motion capture data in a starting stage, moving motion capture data in a moving stage, and arriving motion capture data in an arriving stage; a simulation calculator defining a speed calculated in the moving motion capture data as a maximum moving speed of a simulation in order to calculate an entire moving distance, a stopped time when starting and arriving, and a stopped time before starting and after arriving regarding to respective characters; and an animation calculator extracting a portion of the arriving motion capture data to be appropriate for the entire moving distance in order to produce the locomotion animation and to satisfy an entire time corresponding to an entire motion of animation when the entire moving distance is less than a moving distance of the arriving motion capture data.

[0013] The system further may include a motion capture data receiver dividing the motion capture data into the starting motion capture data in the starting stage, the moving motion capture data in the moving stage, and the arriving motion capture data in the arriving stage in order to store them in the motion capture data storage.

[0014] The calculating of the entire moving distance, the stopped time when starting and arriving, and the stopped time before starting and after arriving may be performed regarding to respective characters according to a currently necessary situation in the simulation.

[0015] The animation calculator may subtract the moving distance of the arriving stage from the entire moving distance when the entire moving distance is more than the moving distance of the arriving stage motion capture and may repeat the subtraction until a moving distance value of the moving motion capture data can not be subtracted from the subtraction result according to the subtraction result in order to attach a portion of the motion capture data used for the subtraction to an entire animation and to satisfy an entire time corresponding to the entire motion of the animation. The number of connecting the portion of the motion capture data used for the subtraction to the entire animation may be the same as the number of the repeating the subtraction.

[0016] A value and a ratio of the stopped time before the starting and after the arriving may be utilized and stop portion motion capture data in the starting stage and stop portion motion capture data in the arriving stage may be attached to a front and a rear of the animation, respectively, in order to satisfy the entire time corresponding to the entire motion of the animation.

[0017] The system further may include an animation storage storing the animation satisfying the entire time by using the animation calculator, the entire time corresponding to the entire motion of the animation.

[0018] The motion capture data receiver may receive the motion capture data from the motion capture system.

[0019] In another aspect of the present invention, there is provided a method of producing a locomotion animation by using a motion capture data that is divided into a starting stage, moving motion capture data in a moving stage, and arriving motion capture data in an arriving stage, the method may include: defining a speed calculated in the moving motion capture data as a maximum moving speed of a simulation in order to calculate an entire moving distance, a stopped time when starting and arriving, and a stopped time before starting and after arriving regarding to respective characters; extracting a portion of the arriving motion capture data to be appropriate for the entire moving distance in order to produce the locomotion animation when the entire moving distance is less than a moving distance of the arriving motion

capture data; and satisfying an entire time corresponding to an entire motion of animation.

[0020] The defining of the speed may calculate the entire moving distance, the stopped time when starting and arriving, and the stopped time before starting and after arriving regarding to respective characters in the simulation according to a currently necessary situation in the simulation.

[0021] The satisfying of the entire time may utilize a value and a ratio of the stopped time before the starting and after the arriving and attaching stop portion motion capture data in the starting stage and stop portion motion capture data in the arriving stage to a front and a rear of the animation, respectively, in order to satisfy the entire time corresponding to the entire motion of the animation.

[0022] The method further may include: subtracting the moving distance of the arriving motion capture data from the entire moving distance when the entire distance is more than the moving distance of the arriving motion capture data during the extracting of the portion of the arriving motion capture data; repeating the subtraction until a moving distance value of the moving motion capture data can not be subtracted from the subtraction result; and attaching a portion of the motion capture data used for the subtraction to the entire animation and satisfying the entire time corresponding to the entire motion of the animation. The number of connecting the portion of the motion capture data used for the subtraction to the entire animation may be the same as the number of the repeating the subtraction.

[0023] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The accompanying drawings, which are included to provide a further understanding of the invention, are incorporated in and constitute a part of this application, illustrate embodiments of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0025] FIG. **1** illustrates a block diagram of a locomotion animation manufacturing system according to an embodiment of the present invention;

[0026] FIG. **2** illustrates a graph of dividing entire motion capture data into starting motion capture data of a starting stage, moving capture data of a moving stage, and an arriving motion capture of an arriving state; and

[0027] FIG. **3** illustrates a flowchart of a locomotion animation manufacturing method according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0029] FIG. **1** illustrates a block diagram of a locomotion animation manufacturing system according to an embodiment of the present invention and the locomotion animation manufacturing system **200** produces locomotion animation by using motion capture data provided from a motion capture system **100**. The locomotion animation manufacturing system **200** includes a motion capture data receiver **10**, a motion capture data storage **20**, a simulation calculator **30**, a simulation storage **40**, an animation calculator **50**, and an animation storage **60**.

[0030] Referring to FIG. **1**, the motion capture data receiver **10** in the locomotion animation manufacturing system **200** divides entire motion capture data **12** supplied from the motion capture system **100** into starting motion capture data **14** in a starting stage, moving capture data **16** in a moving stage, and an arriving motion capture **18** in an arriving state, and then stores them in the motion capture data storage **20**. The starting motion capture data **14** of the starting stage are motion capture data when a corresponding character sufficiently stops and starts movement until being stabilized. The moving motion capture data **16** of the moving stage are motion capture data during a period of when the corresponding character is stabilized. The motion capture data are generally stored by using cycles to express various moving distance. Here, if necessary, a little change can be applied. This includes a first method makes cycles when diversely expressing stopped times at the starting stage and the arriving stage and a second method makes the beginning of the starting point and the end of the arriving point as cycles by connecting the beginning and the end when repeating various stills and movements.

[0031] The simulation calculator **30** accesses the motion capture data storage **20**, defines the maximum moving speed of the simulation as a speed calculated from the moving motion capture data, calculates overall moving distance, stopped time when starting and arriving, and stopped time before starting and after arriving, respectively, in each character according to a currently necessary situation in simulation, and stores them in the simulation storage **40** in operation S**10** of FIG. **3**.

[0032] The animation calculator **50** accesses the simulation storage **40** and the motion capture data storage **20** and compares overall moving distance in the simulation storage **40** with moving distance of the arriving stage motion capture data in operation S**12** of FIG. **3**.

[0033] In operation S**14** of FIG. **3**, the animation calculator **50** extracts a portion of motions in the arriving stage for the entire moving distance and constitutes locomotion animation when the overall moving distance is less than the moving distance of the arriving stage motion capture data according to the comparison result.

[0034] In operation S**18** of FIG. **3**, the animation calculator **50** subtracts the moving distance of a arriving stage from the entire moving distance when the overall moving distance is more than the moving distance of the arriving stage motion capture data according to the comparison result.

[0035] In operation S**20** of FIG. **3**, the animation calculator **50** repeats subtraction until the moving distance value of the moving stage motion capture data can not be subtracted from the subtraction result.

[0036] In operation S**22** of FIG. **3**, the animation calculator **50** attaches the motion capture data of a portion used for subtraction to the overall animation, and then performs operation S**16**.

[0037] The animation calculator **50** utilizes a value and a ratio of a stopped time before starting and after arriving in the simulation storage **40** and attaches the stopped portion motion capture data of the starting stage and the stopped portion motion capture data of the arriving stage to the front and end of the animation stored in the animation storage **60**, thereby satisfying an overall time corresponding to an overall

motion of the animation. Consequently, animation with the synchronized time and moving distance is produced, and then is stored in the animation storage **60** in operation S**16** of FIG. **3**.

[0038] Since the locomotion animation is produced by using the received motion capture data, it is naturally connected without a discontinuity portion. This can be also applied to an arbitrary moving distance and time, and thus its expandability is excellent.

[0039] The present invention explains one dimensional locomotion animation with starting and arriving, but this can be applied to a multi-dimensional locomotion animation that occasionally performs arriving after starting easily when arriving after starting constitutes one cycle.

[0040] Additionally, when the stopped motion capture data before starting and stopped motion capture data after arriving makes cycles, the location animation that can be easily applicable to the very long stopped time can be produced.

[0041] The present invention divides the motion capture data **12** into starting motion capture data **14** in a starting stage, moving capture data **16** in a moving stage, and an arriving motion capture **18** in an arriving state, and then stores them in the motion capture data storage **20**. By using this, a natural locomotion animation can be produced without a discontinuity portion and animation satisfying various moving distance and requirement of time can be automatically produced. Therefore, by using this, unnatural motion data produced due to the limit such as no slip between foot and ground can be improved in actual various animation works and thus realistic locomotion animation can be easily produced.

[0042] As described above, the method of the present invention can be programmed and can be stored in computer readable recoding medium (e.g., CD ROM, RAM, ROM, Floppy Disk, Hard Disk, Optical Disk, etc.).

[0043] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A locomotion animation producing system using motion capture data, comprising:

a motion capture data storage storing starting motion capture data in a starting stage, moving motion capture data in a moving stage, and arriving motion capture data in an arriving stage;

a simulation calculator defining a speed calculated in the moving motion capture data as a maximum moving speed of a simulation in order to calculate an entire moving distance, a stopped time when starting and arriving, and a stopped time before starting and after arriving regarding to respective characters; and

an animation calculator extracting a portion of the arriving motion capture data to be appropriate for the entire moving distance in order to produce the locomotion animation and to satisfy an entire time corresponding to an entire motion of animation when the entire moving distance is less than a moving distance of the arriving motion capture data.

2. The system of claim **1**, further comprising a motion capture data receiver dividing the motion capture data into the starting motion capture data in the starting stage, the moving motion capture data in the moving stage, and the arriving motion capture data in the arriving stage in order to store them in the motion capture data storage.

3. The system of claim **1**, wherein the calculating of the entire moving distance, the stopped time when starting and arriving, and the stopped time before starting and after arriving are performed regarding to respective characters according to a currently necessary situation in the simulation.

4. The system of claim **1**, wherein the animation calculator subtracts the moving distance of the arriving stage from the entire moving distance when the entire moving distance is more than the moving distance of the arriving stage motion capture and repeats the subtraction until a moving distance value of the moving motion capture data can not be subtracted from the subtraction result according to the subtraction result in order to attach a portion of the motion capture data used for the subtraction to an entire animation and to satisfy an entire time corresponding to the entire motion of the animation.

5. The system of claim **4**, wherein the number of connecting the portion of the motion capture data used for the subtraction to the entire animation is the same as the number of the repeating the subtraction.

6. The system of claim **1**, wherein a value and a ratio of the stopped time before the starting and after the arriving are utilized and stop portion motion capture data in the starting stage and stop portion motion capture data in the arriving stage are attached to a front and a rear of the animation, respectively, in order to satisfy the entire time corresponding to the entire motion of the animation.

7. The system of claim **1**, further comprising an animation storage storing the animation satisfying the entire time by using the animation calculator, the entire time corresponding to the entire motion of the animation.

8. The system of claim **2**, wherein the motion capture data receiver receives the motion capture data from the motion capture system.

9. A method of producing a locomotion animation by using a motion capture data that is divided into a starting stage, moving motion capture data in a moving stage, and arriving motion capture data in an arriving stage, the method comprises:

defining a speed calculated in the moving motion capture data as a maximum moving speed of a simulation in order to calculate an entire moving distance, a stopped time when starting and arriving, and a stopped time before starting and after arriving regarding to respective characters;

extracting a portion of the arriving motion capture data to be appropriate for the entire moving distance in order to produce the locomotion animation when the entire moving distance is less than a moving distance of the arriving motion capture data; and

satisfying an entire time corresponding to an entire motion of animation.

10. The method of claim **9**, wherein the defining of the speed calculates the entire moving distance, the stopped time when starting and arriving, and the stopped time before starting and after arriving regarding to respective characters in the simulation according to a currently necessary situation in the simulation.

11. The method of claim **9**, wherein the satisfying of the entire time utilizes a value and a ratio of the stopped time

before the starting and after the arriving and attaching stop portion motion capture data in the starting stage and stop portion motion capture data in the arriving stage to a front and a rear of the animation, respectively, in order to satisfy the entire time corresponding to the entire motion of the animation.

12. The method of claim **9**, further comprising:

subtracting the moving distance of the arriving motion capture data from the entire moving distance when the entire distance is more than the moving distance of the arriving motion capture data during the extracting of the portion of the arriving motion capture data;

repeating the subtraction until a moving distance value of the moving motion capture data can not be subtracted from the subtraction result; and

attaching a portion of the motion capture data used for the subtraction to the entire animation and satisfying the entire time corresponding to the entire motion of the animation.

13. The method of claim **12**, wherein the number of connecting the portion of the motion capture data used for the subtraction to the entire animation is the same as the number of the repeating the subtraction.

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