CLAIMS

1. A method for controlling a motion of a virtual character, the method comprising:

acquiring original motion data, wherein the original motion data is position data of a plurality of skeletal joint points of an original model in a case that the original model performs a target motion;

determining initial motion data of the virtual character based on the original motion data, wherein the initial motion data is initial position data of a plurality of skeletal joint points of the virtual character;

constructing a target function using the initial motion data and the original motion data, wherein the target function is configured for calculating a similarity between the initial motion data and the original motion data;

acquiring at least one profile joint point on an outer contour of the virtual character, wherein the profile joint point is a virtual point set on the outer contour of the virtual character according to an outer shape feature of the virtual character, and is configured to prevent clipping when the virtual character performs a motion;

generating a collision constraint between the plurality of skeletal joint points of the virtual character and at least one profile joint point, and generating a length constraint between adjacent skeletal joint points in the plurality of skeletal joint points of the virtual character with an unchanged distance between the adjacent skeletal joint points;

acquiring target motion data of the virtual character by solving a minimum distance value of the target function under the length constraint and the collision constraint, wherein the target motion data is target position data of the plurality of skeletal joint points of the virtual character; and

driving the virtual character to perform the target motion by controlling the plurality of skeletal joint points of the virtual character to move to positions indicated by the target position data.

2. The method according to claim 1, wherein prior to acquiring the original motion data, the method further comprises:

setting joint points, wherein the joint points comprise the plurality of skeletal joint points of the original model, and the profile joint point and the plurality of skeletal joint points of the virtual character.

3. The method according to claim 1, wherein acquiring the original motion data comprises:

collecting an image of the original model; and

acquiring, by performing joint point identification on the image, the position data of the plurality of skeletal joint points of the original model as the original motion data.

4. The method according to claim 1, wherein determining the initial motion data of the virtual character based on the original motion data comprises:

calculating rotation data of a bone between every two adjacent skeletal joint points based on position data of the every two adjacent skeletal joint points in the plurality of skeletal joint points of the original model in the original motion data; and

acquiring the initial motion data of the virtual character by transplanting rotation data of each bone in the original model to a bone, corresponding to the each bone, of the virtual character as rotation data of the bone of the virtual character.

5. The method according to any one of claims 1 to 4, wherein constructing the target function using the initial motion data and the original motion data comprises:

calculating an original vector of the plurality of skeletal joint points of the original model using the original motion data, and calculating an initial vector of the plurality of skeletal joint points of the virtual character using the initial motion data;

generating a motion semantic matrix of the target motion based on a skeleton structure of the original model and a predetermined motion semantic adjacency relationship;

acquiring a first product by calculating a product of the motion semantic matrix and the original vector, and acquiring a second product by calculating a product of the motion semantic matrix and the initial vector; and

calculating a distance between the first product and the second product as the target function.

6. The method according to claim 5, wherein generating the motion semantic matrix of the target motion based on the skeleton structure of the original model and the predetermined semantic motion adjacency relationship comprises:

acquiring a joint point adjacency matrix of the original model, wherein each element value in a row where each skeletal joint point is located in the joint point adjacency matrix represents a joint adjacency relationship of the each skeletal joint point with other skeletal joint points;

determining a motion semantic adjacent joint point of each target skeletal joint point of the original model based on a predetermined motion semantic adjacency relationship of the each target skeletal joint point, wherein the predetermined motion semantic adjacency relationship of the each target skeletal joint point comprises a predefined adjacency relationship of the target skeletal joint point with other skeletal joint points; and

acquiring the motion semantic matrix of the target motion by updating an element value of the motion semantic adjacent joint point in a row where the each target skeletal joint point is located in the joint point adjacency matrix.

7. The method according to claim 6, wherein a number of the motion semantic adjacent joint points of each target skeletal joint point is greater than one; and

acquiring the motion semantic matrix of the target motion by updating the element value of the motion semantic adjacent joint point in the row where the each target skeletal joint point is located in the joint point adjacency matrix comprises:

setting an element value of each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located in the joint point adjacency matrix as a predetermined value;

calculating a distance between the each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located and the each target skeletal joint point;

calculating a weight of the each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located using the distance;

acquiring a weighted value by calculating a product of the weight of the each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located and the predetermined value; and

updating the element value of the each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located in the joint point adjacency matrix as the weighted value.

8. The method according to claim 7, wherein calculating the weight of the each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located using the distance comprises:

calculating a reciprocal of the distance between the each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located and the each target skeletal joint point;

calculating a sum of all reciprocals corresponding to all of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located; and

calculating a ratio of the reciprocal corresponding to the each of the motion semantic adjacent joint points in the row where the each target skeletal joint point is located to the sum as the weight of the each of the motion semantic adjacent joint points.

9. The method according to claim 5, wherein the distance between the first product and the second product is calculated as the target function by the following formula:

$$\min 0.5 \times \|L \times tarPos3d - L \times srcPos3d\|^2,$$

wherein *L* represents the motion semantic matrix, *tarPos3d* represents the initial vector of the plurality of skeletal joint points of the virtual character, *srcPos3d* represents the original vector of

the plurality of skeletal joint points of the original model, and ||. ||2 represents a two-norm distance.

10. The method according to claim 5, wherein generating the length constraint between the adjacent skeletal joint points in the plurality of skeletal joint points of the virtual character with the unchanged distance between the adjacent skeletal joint points comprises:

calculating a distance between two skeletal joint points of each bone of the virtual character as an original length of the each bone;

calculating a distance of vectors of the two skeletal joint points of the each bone; and

constructing the length constraint as follows:

$$\|tarPos3d[i] - tarPos3d[j]\| - resetLength = 0,$$

wherein *resetLength* represents an original length of a bone between two adjacent skeletal joint points *i* and *j* of the virtual character, *tarPos3d*[*i*] and *tarPos3d*[*j*] respectively represent vectors of the skeletal joint point *i* and the skeletal joint point *j*, and both *i* and *j* are integers greater than or equal to 0.

11. The method according to claim 5, wherein the profile joint point comprises a predetermined collision point, the skeletal joint points comprise a joint point subjected to the collision constraint, and the collision constraint between the plurality of skeletal joint points of the virtual character and the profile joint point of the virtual character is generated as follows:

$$(tarPos3d[i] - collPos).dot(colldepth) \leq 0,$$

wherein *collPos* represents a vector of the predetermined collision point, *tarPos3d*[*i*] represents a vector of a joint point *i* subjected to the collision constraint, *tarPos3d*[*i*]-*collPos* represents a vector from the joint point *i* subjected to the collision constraint to the predetermined collision point, dot product *.dot(colldepth)* represents a projection, in a direction perpendicular to an outer contour of the virtual character, of the vector from the joint point *i* subjected to the collision constraint to the predetermined collision point, and *i* is an integer greater than or equal to 0.

12. The method according to any one of claims 1 to 4, wherein acquiring the target motion data of the virtual character by solving the minimum distance value of the target function under the length constraint and the collision constraint comprises:

acquiring the target motion data of the virtual character by solving the minimum distance value of the target function under the length constraint and the collision constraint using a sequential quadratic programming method or a lagrangian method.

13. An apparatus for controlling a motion of a virtual character, the apparatus comprising:

an original motion data acquiring module, configured to acquire original motion data, wherein the original motion data is position data of a plurality of skeletal joint points of an original model in a case that the original model performs a target motion;

an initial motion data determining module, configured to determine initial motion data of the virtual character based on the original motion data, wherein the initial motion data is initial position data of a plurality of skeletal joint points of the virtual character;

a target function generating module, configured to construct a target function using the initial motion data and the original motion data, wherein the target function is configured for calculating a similarity between the initial motion data and the original motion data;

a constraint constructing module, configured to acquire at least one profile joint point on an outer contour of the virtual character, wherein the profile joint point is a virtual point set on the outer contour of the virtual character according to an outer shape feature of the virtual character, and is configured to prevent clipping when the virtual character performs a motion; and generate a collision constraint between the plurality of skeletal joint points of the virtual character and at least one profile joint point, and generate a length constraint between adjacent skeletal joint points in the plurality of skeletal joint points of the virtual character with an unchanged distance between the adjacent skeletal joint points;

a target function solving module, configured to acquire target motion data of the virtual character by solving a minimum distance value of the target function under the length constraint and the collision constraint, wherein the target motion data is target position data of the plurality of skeletal joint points of the virtual character; and

a virtual character controlling module, configured to drive the virtual character to perform the target motion by controlling the plurality of skeletal joint points of the virtual character to move to positions indicated by the target position data.

14. A device for controlling a motion of a virtual character, the device comprising:

at least one processor; and

a storage apparatus, configured to store at least one computer program,

wherein the at least one computer program, when executed by the at least one processor, causes the at least one processor to perform the method for controlling the motion of the virtual character as defined in any one of claims 1 to 12.

15. A computer-readable storage medium storing a computer program, wherein the computer program, when executed by a processor, causes the processor to perform the method for controlling the motion of the virtual character as defined in any one of claims 1 to 12.

16. A computer program product comprising one or more instructions, wherein the one or more instructions, when loaded and executed by a processor, cause the processor to perform the method for controlling the motion of the virtual character as defined in any one of claims 1 to 12.