[0007] Controlling skeleton animation directly through joint parameters has certain disadvantages and complications. Manually defining joint angles requires many trial-and-error iterations which usually can be accomplished only by experienced artists. To rotate a particular bone in a skeleton bone structure, one needs to change the parameter values for associated the joints (two parameters in 2D and three parameters in 3D). The most difficult part of this process for the artist is that the result of simultaneously changing two or more parameters is hard to predict and intuitively imagine. In other words, an artist needs to keep in mind relationships of motion mechanics to place a bone to a desired position.

[0008] Another issue arises when skeleton motion must be constrained, for example, to meet some physiologically realistic behaviour. This requires specifying individual boundaries for every parameter and any changes must meet these constrains.

[0009] Furthermore, manipulating with parameters in terms of angles leads to ambiguity since different values of joint angles could correspond to the same spatial position of the corresponding bone. This could introduce additional complexity in the process of skeleton animation.

OBJECT OF INVENTION

[0010] It is an object of the invention to improve Skeletal Animation, or to at least provide the public or industry with a useful choice.

SUMMARY

[0010a] In a first aspect, the present disclosure provides an Actuation System for animating a Virtual Character or Digital Entity including: a plurality of Joints associated with a Skeleton of the Virtual Character or Digital Entity; and at least one Actuation Unit Descriptor defining a Skeletal Pose with respect to a first Skeletal Pose, the Actuation Unit Descriptors represented using Rotation Parameters and one or more of the Joints of the Skeleton are driven using corresponding Actuation Unit Descriptors multiplied by corresponding Activation Weights.

[0010b] In a second aspect, the present disclosure provides a Actuation Unit Descriptor Combiner for controlling Virtual Character or Digital Entity animation, wherein the Actuation Unit Descriptor Combiner is configured to combine a plurality of Actuation Unit Descriptors as claimed in any one of claims 1 to 6 using a linear equation.

[0010c] In a third aspect, the present disclosure provides an Actuation Unit Descriptor Mapper for estimating parameter values for the Actuation Unit Descriptor Combiner of claim 7 for a given pose parameterized in terms of joint angles which includes the steps of: a. converting given pose parameters to a set of rotation vector values associated with rotation of skeleton parts around particular joints; b. constructing a structure, P* containing the rotation parameters associated with each joint of the skeleton; and c. obtaining Actuation Unit Descriptor weights through solving a least squares problem.

[0010d] In a fourth aspect, the present disclosure provides a method for animating arm reaching in a Virtual Character or Digital Entity including the steps of: receiving a desired location of an end effector of an arm of a Virtual Character or Digital Entity in the parameter space; retrieving example poses, each associated with a coordinate of an end effector and pose Actuation Unit Descriptors; generating interpolated poses by interpolating poses using the example poses as interpolation nodes, wherein interpolation is performed in parameter space with a coordinate of an end effector as a parameter and pose Actuation Unit Descriptors as values; animating the arm reaching using the interpolated poses.

BRIEF DESCRIPTION OF DRAWINGS

FIGURE 1: Skeletal Base Pose with the example of Actuation Unit Descriptor controls set to zero;

FIGURE 2: Example pose showing full activation of the “armAbductR” Actuation Unit Descriptor;

FIGURE 3: Example pose showing partial activation of the “armAbductR” Actuation Unit Descriptor;

FIGURE 4: Two example poses, “posePeaceSign” and “poseSit01”, generated using multiple Actuation Unit Descriptor values for each pose;

CLAIMS

1. An Actuation System for animating a Virtual Character or Digital Entity including:
   a plurality of Joints associated with a Skeleton of the Virtual Character or Digital Entity; and
   at least one Actuation Unit Descriptor defining a Skeletal Pose with respect to a first Skeletal Pose, the Actuation Unit Descriptors represented using Rotation Parameters and one or more of the Joints of the Skeleton are driven using corresponding Actuation Unit Descriptors multiplied by corresponding Activation Weights.

2. The Actuation System of claim 1 wherein the first Skeletal Pose is a Skeletal Base Pose.

3. The Actuation System of claim 1 or claim 2 wherein Rotation Parameters are representations of rotation configured to combine linearly.

4. The Actuation System of any one of claims 1 to 3 wherein each Actuation Unit Descriptor is configured to drive a single Joint.

5. The Actuation System of any one of claims 1 to 3 wherein each Actuation Unit Descriptor is configured to drive multiple Joints.

6. The Actuation System of any one of claims 1 to 5 wherein applying a rotation transformation of each Actuation Unit Descriptor to the skeleton produces a motion of skeleton parts reflective of contraction or relaxing one or more muscles in a biological system having a skeletal topology similar to the skeletal topology of the Virtual Character or Digital Entity.

7. A Actuation Unit Descriptor Combiner for controlling Virtual Character or Digital Entity animation, wherein the Actuation Unit Descriptor Combiner is configured to combine a plurality of Actuation Unit Descriptors as claimed in any one of claims 1 to 6 using a linear equation.

8. An Actuation Unit Descriptor Mapper for estimating parameter values for the Actuation Unit Descriptor Combiner of claim 7 for a given pose parameterized in terms of joint angles which includes the steps of:

   a. converting given pose parameters to a set of rotation vector values associated with rotation of skeleton parts around particular joints;

   b. constructing a structure, P* containing the rotation parameters associated with each joint of the skeleton; and

   c. obtaining Actuation Unit Descriptor weights through solving a least squares problem.

~~9. A method of generating an animation of a Skeleton of a Virtual Character or Digital Entity including the steps of:~~

~~a. defining a plurality of Actuation Unit Descriptors as animation controls configured to change rotation and/or translation values of one or more Joints of the Skeleton;~~

~~b. converting the plurality of Actuation Unit Descriptors into Rotation Parameters;~~

~~c. using the Rotation Parameters to blend and convert two or more input animations to an Actuation Unit Descriptor space; and~~

~~d. composing and playing back the animations generated by (c) on a joint-driven skeleton using any rotation representation.~~

~~10.~~9. A method for animating arm reaching in a Virtual Character or Digital Entity including the steps of:

receiving a desired location of an end effector of an arm of a Virtual Character or Digital Entity in the parameter space;

retrieving example poses, each associated with a coordinate of an end effector and pose Actuation Unit Descriptors;

generating interpolated poses by interpolating poses using the example poses as interpolation nodes, wherein interpolation is performed in parameter space with a coordinate of an end effector as a parameter and pose Actuation Unit Descriptors as values;

animating the arm reaching using the interpolated poses.

~~11.~~10. The method of claim ~~10~~ 9 wherein interpolation uses a meshless or mesh base technique which represents solutions through a weighted combination of interpolation node values.