Verification of Expressiveness of Procedural Parameters for Generating Emotional Motions

Yueh-Hung Lin[§], Chia-Yang Liu[*], Hung-Wei Lee[†], Shwu-Lih Huang[*], Tsai-Yen Li[§]

[§] Department of Computer Science, National Chengchi University, Taiwan
{g9339,li}@nccu.edu.tw
[*]Department of Psychology, Research Center for Mind, Brain, and Learning, National Chengchi University, Taiwan
{95752003,slh}@nccu.edu.tw
[†]Department of Applied Psychology, Hsuan Chuang University, Taiwan
spoon@hcu.edu.tw

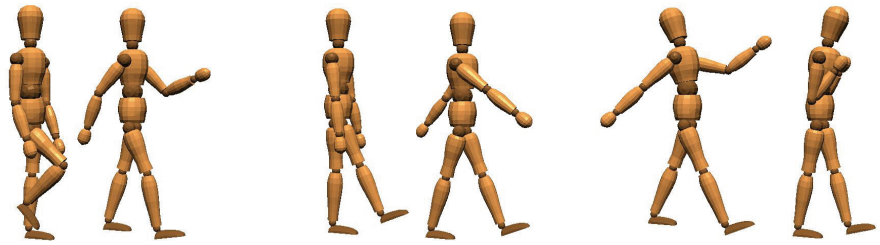
1 Motivation and System Overview

Body movements are crucial for emotion expression of a virtual agent. However, the perception of expressiveness of an animation has always been a subjective matter. Research in psychology has asked professional actors to perform emotional motions to study how body gestures deliver emotions [2]. In this work, we aim to design an animation system that can generate human body motions in a more systematic manner and then study the expressiveness of the generated animation as a preceding step for the study of the relation between motion and emotion.

We propose to stratify the variables relevant to describing motion and emotion into four layers (from upper to lower): *emotional*, *style*, *motion*, and *procedural* layers with their own respective sets of parameters. In the emotional layer, emotions can be modeled with either the basic emotions approach [1] or the dimensional approach. The style layer serves as an intermediate layer for describing expressiveness of an animation. In the motion layer, the parameters specific to a target type of motion are defined. In the procedural layer, generic animation procedures are used to generate parameterized motions. In this paper, we focus on designing generic animation procedures for the generation of human body motions and studying how the parameters in these procedures are mapped onto the parameters in the upper layers through the example of walking motion.

In procedural animation, a motion is specified by defining appropriate keyframes and interpolations. The interpolations are performed on the procedural parameters such as joint angles or points in the 3D space. If the points in the Cartesian space are specified as a curve, the curve is re-parameterized by arc length. Given these procedural parameters, the motion parameters for interpolation are defined as the locations of the control points that are used to specify a spline curve (such as a Bezier curve) in the parameter-time space. By designing appropriate mapping between the motion parameters and the style parameters, we hope to produce expressive walking motions.

We have adapted the style attributes defined in [2] for our style parameters which include *smooth-jerky*, *stiff-loose*, *slow-fast*, *soft-hard*, and *expanded-contracted*. For example, in our implementation, we assume that each joint is equipped with a virtual



(a) (b) (c) (d)

Fig. 1. Examples of (a) loose (b) stiff (c) expanded (d) contracted walking motions

spring of constant stiffness that determines how displacement affects spring force. Typical snapshots for the stiff-loose parameter at extreme values are shown in Fig. 1(a) and (b). The parameter of expanded-contracted is realized by changing the expansiveness of keyframe definitions as illustrated in Fig. 1(c) and (d).

2 Preliminary Experimental Results

We have conducted two psychological experiments to verify the expressiveness of the generated animations. In both experiments, thirty participants were invited to compare two side-by-side videos with a target and a standard stimulus, respectively, and then rate the target stimulus for the five style parameters. The standard stimulus is set to mid-point values on all of the five style parameters while the target stimulus is one of the 32 combinations of the five dimensions with either a high or a low value. We use the point-biserial correlation to reveal the correspondence between the manipulation of animations and the participants' subjective experiences. The correlation coefficients are as follows: smooth-jerky (0.65), stiff-loose (0.56), slow-fast (0.92), soft-hard (-0.04, not significant) and expanded-contracted (0.95). In order to investigate why the manipulation of the soft-hard parameter is not effective, we conducted another experiment in which only one style parameter is changed at a time but with finer granularity. The F-values of the linear trend analysis on the result are as follows: smooth-jerky (79.59), stiff-loose (67.07), slow-fast (573.54), soft-hard (0.31, not significant) and expanded-contracted (952.70). From these results, we learn that four out of the five parameters have been implemented with satisfactory expressiveness. The only one exception (soft-hard) probably is due to the fact that it is not easy for a human to discern second-order changes (i.e. the acceleration of object motion) given that the lower order changes remain fixed.

References

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