A Dynamic Motion Control Middleware for Computer Games

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1 Introduction

In this sketch, we present a middleware for computer games that has the ability to realize dynamic motion control of characters. The specific novelty of the middleware is to produce dynamically changing motions in response to physical interaction between the character and environments such as collision impulses and external forces as shown in Figure 1.

In many three-dimensional computer games, it is required to produce continuous and realistic character motions on the fly. Currently most games generate such motions by combining short motion clips that are created and stored in advance. Although this approach basically works well, in this framework, characters can do nothing but just repeat prepared motion data. This limitation leaves players with a monotonous impression. The most serious problem is dynamic reactions caused by physical interaction with other characters and environments. These kinds of reactive motions should change in response to the timing, direction, and amount of the physical interaction. However, because current computer games just play a fixed motion in this kind of situation, unnatural results are sometimes generated. For example, characters fall down in the same way however it received the impact. To handle this kind of motions, the resulting motions should be generated dynamically considering the physics of the characters.

2 Proposed Middleware

The proposed middleware is linked and cooperates with game application. The system structure is shown in Figure 2. The application program gives an appropriate action data that is selected from the stored action data collection based on player control in context. The middleware controls the angular accelerations of the character joints based on the input action. The input action is normally executed as it is given and only when unexpected physical interaction happens, dynamically changed motions are produced. Because of this approach, the middleware makes use of existing motion clips and it is easy for the developers to use our system.

The controller in the middleware consists of three components; motion synthesizer, dynamic controller, and reaction generator. The motion synthesizer realizes smooth transition from one action to the following action considering the constraints of the end-effectors even when the character posture is slightly changed by external interaction. The dynamic controller then computes output angular accelerations for all joints based on the synthesized motion. It realizes human-like dynamic control in response to its balance and joint stresses of the character. For example, it moves the pelvis to keep its balance or swings the arms to reduce the stresses on the back or legs. Our dynamic control method is specified to human-like articulated figures and it controls each body part through a minimum number of degrees-of-freedom. The reaction generator produces dynamic reactions such as protective step for balancing, falling down and recovery motion. The reaction generator works when the dynamic controller cannot handle too large external influence. More details about the dynamic control techniques are found in [Oshita and Makinouchi 2001].

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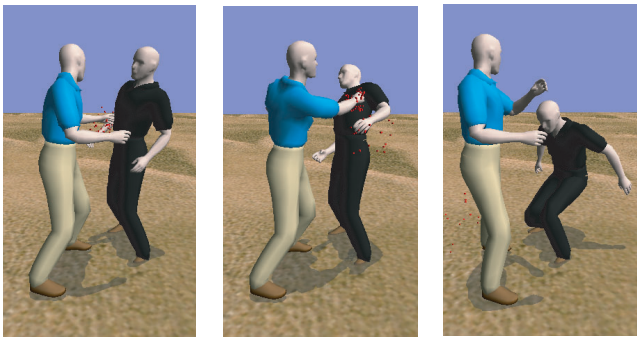

Figure 1: The middleware provides dynamic motion control in response to physical interaction between the character and environments.

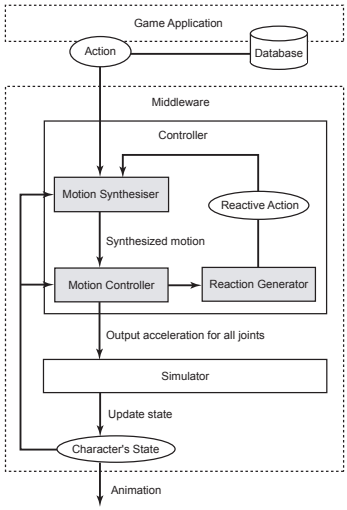

Figure 2: System structure of the middleware and application.

3 Application

We have developed a prototype of the proposed middleware and we are also developing a demo application which works on the prototype. The demo application is a kind of action game in which a character controlled by the user fights with other characters. Compared with existing games of similar type, it generates more appropriate dynamic motions. For example, when a character hits another, dynamic motions are generated in response to the position and power of the collisions. The developed demo application is going to be available soon on our web site: www.e-motion.ne.jp.

References

OSHITA, M., AND MAKINOUCHI, A. 2001. A dynamic motion control technique for human-like articulated figures. *Computer Graphics Forum (EUROGRAPHICS 2001) 20*, 3, 192–202.