Real-Time Character Control for Wrestling Games

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Abstract. This paper proposes a method to simulate the real-time interactions of tangling motions by two virtual wrestlers in 3D computer games. The characters are controlled individually by two different players - one player controls the attacker and the other controls the defender. We make use of the topology coordinates which are effective to synthesize tangling movements. The attacker's movements are simulated by changing the topology coordinates at every frame, and the defender is controlled to escape from such an attack by inverse kinematics. The experimental results show the methodology can simulate realistic competitive interactions of wrestling in real-time, which is difficult by previous methods.

Keywords: character animation, motion capture.

1 Introduction

Wrestling is a major field in 3D computer games. The motions in wrestling involve close contacts between the characters such as squeezing and locking. Simulating such motions is not easy as they require a great amount of close contacts and collision avoidance. In fact, in most of the wrestling games, such motions are designed carefully in advance by the animators and the game players have little control over the characters once complex tangling motions are started. This is completely different from real wrestling - wrestlers have lots of degrees of freedom to escape from the attackers, and attackers need to carefully select their motion to lock the defender. Such complex interactions of the wrestlers are rarely simulated in the existing wrestling games.

In this paper, we make use of the topology coordinates [5] in order to simulate such complex interactions in real-time. The attacker is controlled so that its topology coordinates approach to those of the target configuration. The player can switch the attacks according to the configuration of the attacker and the defender. On the other hand, the defender can escape from such attacks by kinematically controlling the body.

Our interface provides large degrees of freedom to the game players while minimizing the complexity of control, which can increase the attractiveness of wrestling games.

2 Related Work

We first briefly review the recent wrestling games and their interfaces. Next, we review researches of two topics that are related to character control in wrestling games - real-time character control and close interactions of multiple characters.

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Wrestling games have been attracting millions of game players around the world and has become one of the major categories in computer games. In the old games, the attacks were limited to hits such as punches, kicks or chops. Therefore, the users could only repeatedly press the buttons to give large damage to the opponent character.

The recent advanced games allow the characters to conduct complex tangling attacks such as back drops, rear-choke hold and full nelson attacks. In order to launch such motions, the user is supposed to press the button at the correct pose and timing, or select the part to attack by the pointing device [1]. Motions that involve tangling are usually just replayed during run-time as real-time editing of such motions can easily result in collision and penetration of the body segments. The attractiveness of the games will be greatly enhanced if the game players have access to the details of the tangling motions during the game play.

Real-time character control: Here we review a number of techniques which are useful for real-time control of the virtual wrestlers. We first review techniques of inverse kinematics (IK) which is a basic technique to edit character motions, and then their extensions to handle dynamics and tangling motions.

Inverse kinematics (IK) [20,13,14,23,21] is a basic technique that is often used for real-time control of characters. Methods to control characters of arbitrary morphology [7,3] have also been proposed. IK methods can be divided into (1) CCD-based approaches [9], (2) analytical approaches [11], (3) particle-based approaches [7,3] and (4) quadratic programming based approaches [20,13,21].

Among these approaches, the quadratic programming based approach has an advantage to simulate wrestling motions as it can enclose constraints based on dynamics [22,8,16] and topological relationships [5] into the solver. Our approach is built on top of Ho and Komura [5], which propose to handle tangling motions by adding constraints into an optimization-based IK solver.

Multiple Character Interactions: The simulation of interactions between multiple characters has many applications such as computer games, virtual environments and films. Liu et al.[12] simulate the close dense interactions of two characters by repetitively updating the motion of each character by spacetime constraints. Lee and Lee [10] simulate the boxing match by using reinforcement learning. Treuille et al [19] also use reinforcement learning to simulate the pedestrians avoiding each other. Shum et al [17] use min-max search to find the optimal action in a competitive environment. They also propose a real-time approach based on an automatically produced finite state machine [18]. These researches do not handle very close interactions such as holding or wrestling. Ho and Komura [4] generate wrestling motions by finding the topological relationship of characters from the template postures and use PD control to simulate movements where the topological relationship is kept the same. If we want to simulate a scene where the topological relationship of characters changes in time, we cannot apply such a method. A method to dynamically update the postures and the topological relationships is required. [6] propose to evaluate the similarity of character postures based on the topological relationships. When equivalent postures are found, the postures are linearly interpolated at the level of generalized coordinates. However, no method has enabled game players to interactively change the topological relationship of virtual characters in real-time. We propose such an approach in this paper.