Modeling Virtual Humans

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Virtual human modeling has been an important and active research field in computer graphics for many years. Realistically representing a virtual human necessitates that we address several multifaceted challenges. For example, it is vital to generate realistic locomotion for a character while at the same time animating its deformable skin. Moreover, the generation of realistic facial expressions and natural speech are important to avoiding the uncanny valley problem. In addition to these factors, external materials must believably interact with the virtual human, such as clothes and hair.

Thus, this research field is strongly coupled with computer animation research. The techniques developed in computer animation are an important part of many modern computer tools in a range of application areas, such as VR, computer games, special effects in movies and commercials, and virtual prototyping and training simulators, just to name a few. More recently, physically based simulation has become a popular topic in computer animation. Researchers have developed different simulation methods to generate realistic animations of rigid bodies, elastic rods, cloth, deformable bodies, fluids, and so forth. These methods are investigated in the field of virtual humans to realize the realistic animation of hair, clothes, and skin.

This special issue of *IEEE Computer Graphics and Applications* focuses on these and other key factors that come into play when modeling virtual humans.

In This Issue

The article "Full-Body Animation of Human Locomotion in Reduced Gravity Using Physics-Based Control" by Yun-hyeong Kim, Taesoo Kwon, Daeun Song, and Young J. Kim focuses on the full-body animation of human locomotion in a low-gravity environment. The proposed method is used for the animation of virtual humans in places with lower gravity than Earth, like on the Moon or Mars. The authors' approach takes motion-captured human motions under Earth's gravitational conditions as input. Then the desired velocity and stride frequency of a virtual human is estimated using the Froude number to estimate its gait properties in the reduced gravity environment.

Markus Huber, Bernhard Eberhardt, and Daniel Weiskopf introduce a novel method to retrieve cloth animation from collections of simulations that features the same characteristics as the input. In "Cloth Animation Retrieval Using a Motion-Shape Signature," they describe an approach based on the similarity of cloth simulations. The authors use a feature vector based on static deformation metrics. This vector is used as a motion-shape signature that captures the spatiotemporal shape characteristics of cloth and can be used as a similarity measure for physics-based cloth animations.

In their article, "A Generative Audio-Visual Prosodic Model for Virtual Actors," Adela Barbulescu, Remi Ronfard, and Gerard Bailly investigate the generation of natural speech and facial animations during a conversation with a virtual human. The authors introduce a data-driven method for automatically producing multimodal expressive behaviors from didascalia and neutral performances. Their approach takes neutral speech and animation as input and generates natural speech and facial animations in an expressive conversion.

Further Directions

Modeling a realistic virtual human is a complex task that combines many different research topics, including motion synthesis, natural speech, facial animation, and physically based skin, hair, and cloth simulation. In recent years, advances have been made in each of these research areas that will allow for more detailed models and more realistic effects. However, one of the biggest challenges when modeling a virtual human is to combine the best methods of each area and to solve the emerging problems, like handling collisions between hair and cloth models. Other big challenges involve simulating large groups of virtual humans and developing methods for interactive environments where a real human interacts with a virtual human.

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