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Chapter II

Virtual Character Definition and Animation within the MPEG-4 Standard

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Abstract

Besides being one of the well-known audio/video coding techniques, MPEG-4 provides additional coding tools dedicated to virtual character animation. The motivation of considering virtual character definition and animation issues within MPEG-4 is first presented. Then, it is shown how MPEG-4, Amendment 1 offers an appropriate framework for virtual human

animation and compression/transmission. It is shown how this framework is extended within the new MPEG-4 standardization process by: 1) allowing the animation of any kind of articulated model, and 2) addressing advanced modeling and animation concepts, such as "Skeleton, Muscle and Skin"-based approaches. The new syntax for node definition and animation stream is presented and discussed in terms of a generic representation and additional functionalities. The biomechanical properties, modeled by means of the character skeleton that defines the bone influence on the skin region, as well as the local spatial deformations simulating muscles, are supported by specific nodes. Animating the virtual character consists in instantiating bone transformations and muscle control curves. Interpolation techniques, inverse kinematics, discrete cosine transform and arithmetic encoding techniques make it possible to provide a highly compressed animation stream. Within a dedicated modeling approach — the so-called MeshGrid — we show how the bone and muscle-based animation mechanism is applied to deform the 3D space around a humanoid.

Context and Objectives

The first 3D virtual human model was designed and animated by means of the computer in the late 70s. Since then, virtual character models have become more and more popular, making a growing population able to impact the every day, real world. Starting from simple and easy-to-control models used in commercial games as those produced by Activision or Electronic Arts, to more complex virtual assistants for commercial[1] or informational[2] web sites, to the new stars of virtual cinema[3], television[4] and advertising[5], the 3D character model industry is currently booming.

Moreover, the steady improvements within the distributed network area and advanced communication protocols have promoted the emergence of 3D communities[6] and immersion experiences (Thalmann, 2000) in distributed 3D virtual environments.

Creating, animating and, most of all, sharing virtual characters over Internet or mobile networks requires unified data formats. If some animation industry leaders try — and sometimes succeed[7,8] — to impose their own formats in the computer world, the alternative of an open standard is the only valid solution ensuring interoperability requirements, specifically when hardware products are to be built.

A dream of any content producer can be simply formulated as "creating once and re-using forever and everywhere, in any circumstances." Nowadays, content is