White Paper

Quaternion Skinning

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Document Change History

Version	Date	Responsible	Reason for Change
	June 27, 2008	Konstantin Kolchin	Initial release

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Quaternion Skinning

Abstract

Quaternion Skinning refers to a number of skinning animation techniques that, in contrast to the standard skinning, often called *linear blend skinning*, use quaternions rather than matrices. Such methods have been developed with the purpose to eliminate well-known artifacts inherent to linear blend skinning.

This sample demonstrates only one of those techniques, *dual quaternion linear blending* [1, 2]. We chose this method among other quaternion-based skinning approaches because it seems to be the most consistent from the mathematical point of view and thereby the least prone to producing artifacts.

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How It Works

In linear blend skinning (LBS), vertex transformations are represented by 4x4 matrices and blended linearly. The matrices describe rotation and translation of a vertex. Mathematically, these rotation and translation can also be represented as a dual quaternion [1]. In the dual quaternion blending (DLB) method, dual quaternions are also blended linearly.

Ideally, dual quaternions should be produced during 3D modeling. However, it turns out that even if only 4x4 matrices for LBS are available, it is possible to transform them to dual quaternions. After that dual quaternions are blended with the same weights that were supposed to be used for matrices, and the result is visually very similar to that given by linear blend skinning with the exception that the LBS artifacts, such as "candy-wrapper" one (see the figure below), disappear.

References

1. Ladislav Kavan, Steven Collins, Jiri Zara and Carol O'Sullivan, Skinning with Dual Quaternions, *Proc. Interactive 3D Graphics and Games 2007*, p. 39-46.

2. Ladislav Kavan, Steven Collins, Jiri Zara and Carol O'Sullivan, Geometric Skinning with Dual Quaternions, to appear in *ACM Transactions on Graphics*.

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