Animation of a volumetric skeleton

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Abstract

This project is a part of a larger effort to animate the Visible Human Dataset, which is available from the National Library of Medicine, National Institutes of Health, and consists of cryogenic slices of a human male. Each slice is 1024x1024 pixels, and there are 1024 slices. By using a commercial animation package, we have created complex movements for the Visible Human Dataset. The figure to left is an image of the Visible Human created by using volume rendering algorithms.

Goal

Standard computer graphics animation tools operate with polygonal models. These tools allow artists to simulate motion and provide stories for movies, television and video games. However, polygonal models represent only the boundary "shells" of objects,so most of the models are hollow. A 3D dataset, such as the Visible Human Dataset, consists of the boundary and the interior. In our lab, we have developed a set of algorithms and a methodology which will allow the integration of volume models within standard computer graphics animation tools. To demonstrate our results, we have animated the largest and most complex volume model, the Visible Human Dataset. The algorithms developed also have potential use in medical visualization. The figure to left is an image of the Visible Human created by using volume rendering algorithms.

Challenges

Standard computer graphics animation tools use "skeletons" to define animations.

Generally, a polygonal model is created and a skeleton defined. The skeleton is a line-like representation of the model with joints and limbs. The polygonal model is then "attached" to the skeleton, so that when motion is defined about a joint, the corresponding polygonal model moves as well (see below). The challenge is to create a "volumetric" skeleton which can be attached to all of the pixels (voxels) in a 3D dataset. This skeleton must then be imported into traditional tools to facilitate animation.The figure to the left shows the skeleton that served as the basis for animation.

Solutions

We have defined a *volume thinning procedure* which creates a volumetric-skeleton. The skeleton has the special property of *reconstructability*, i.e. given this set of skeleton-nodes, the volume can be regenerated because it references the entire 3D data set. The figure on the right is a representation of the Visible Human Dataset using voxels. Voxels are tiny, discreet volumes used to represent three-dimensional space; voxels are three-dimensional analogues of the two-dimensional pixels seen on this screen.

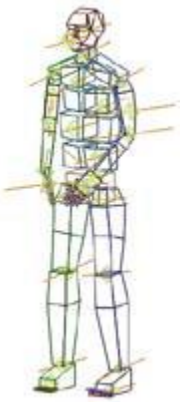
Once the volumetric skeleton is computed, "joints" are chosen for animation.

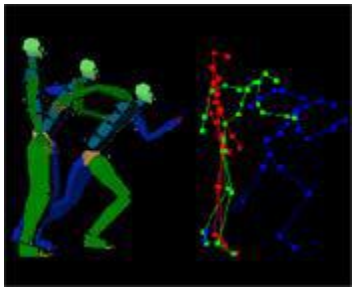
← Skeleton representation in the volume package

Skeleton representation in the animation package →

The skeleton is mapped on *Biped Man*, third-party

software written especially to run in *Character Studio. Chacracter Studio* is a plug-in for the professional animation package *3ds max* from Discreet.





Motion capture is the recording of human body movement (or other movement) for immediate or delayed analysis and playback. This technique is applied to the biped which animates the skeletal structure.

The skeleton is then exported and the volume is reconstructed and rendered by our Vizlab programs. Below is the finished Visible Human Dataset with an animated jumping rope sequence. Examples of animation based in part on the work done here can be downloaded from the web site. (Quicktime 4, compressed)

Acknowledgment

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