What is Spatial Keyframing?

Spatial Keyframing is an approach to interactively control motions of a character in a 3D control space by positioning target icons in that space. The cursor specifies a changing interpolation among a set of poses. Each pose has an associated target icon; users lay these out in an abstract control space. The cursor's position in that low-dimensional space is interpreted as a weighted interpolation among poses, and cursor motion then defines a pose-to-pose style animation.

Traditional Interfaces with 3D Spatial Keyframing

A mouse or other traditional manipulation device cannot fully specify a 3D control space, as the device does not have sufficient degrees of freedom to fully specify 3D control space. Using such devices, users can only specify the interpolation by constraining cursor navigation to a constant depth relative to the control space. By contrast, our approach allows a user to specify the interpolation in 3D by freely manipulating target icons in the control space.

Interface Techniques for 3D Control of Spatial Keyframing

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Spatial Keyframing requires that motion planning be performed in a high-dimensional space; however, we can reduce this space to a lower dimensionality using algorithms that take into account the structure of the target icons.

Three groups are obtained from the clustering (one has the single rest pose), and they are respaced to isolate the groupings. Using a mouse to navigate among these target icons, the user recognizes the performance of that action. To retain this clustering in the new layout, we optionally cluster the targets using another algorithm, such as k-means. This allows us to view the targets that maximize navigability. When creating complex motions, we have found it advantageous to cluster targets into action-specific groups as we create poses. Navigating from one logical cluster to another corresponds to a change in character action, and navigation among the target poses in that group leads to the performance of that action.

We are currently investigating the use of this approach to independently control speech and expressions for facial animation.

3D Control and Visualization

The volumetric display creates a real-world 3D environment by rotating a semi-transparent 2D screen around a vertical axis through the center of a glass dome. At each of 198 orientations, the screen displays a 768 x 768 image, changing as it rotates to maintain a volumetric frame rate of 24 frames per second. An OpenGL-like file editor allows us to produce interactive motion trajectories, and we have developed an interface to create 3D spatial keys within 3ds Max for the display. For more information, visit http://www.aktuallity.com.

Ongoing Work

We are currently investigating the creation of a library of complex character motions with rich face animation; using this data for 3D animation, we plan to support for character manipulation and motion planning. The act of changing a pose in control space represents a motion, and the original motion is a curve connecting all the poses. Using such data, we can create a motion that is a weighted average of the previous pose and the new pose.

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