Spline Animator: Smooth Camera Motion for AVS Animations

Instructions for Version 2.0

Introduction

The latest version of the Spline Animator simply attaches a Motif interface on top of version 1.0. Eventually version 2.0 will be hooked up to AVS making the actual Spline Animator module. The purpose of the Motif version is to smooth out the creation and editing process which is somewhat awkward for the text version. Version 2.0 also contains a few new features the text version didn't have like moving keyframes and scaling time.

Version 2.0 functions under the same principles as version 1.0. That is, the Spline Animator works by splining each component of camera position, view plane normal, and view up vectors. The resultant splines are then sampled at times equidistant from one another (dependent on frame rate), and the resulting spline positions are used to build the CLI script controlling camera motion. Whereas version 1.0 required editing and compiling a text file, version 2.0 provides a graphical user interface for editing and saving scripts. Another minor difference is in the specification of keytimes. While version 1.0 required absolute time in seconds, version 2.0 requires the format *mm:ss:ff* where *mm* is minutes, *ss* is seconds, and *ff* is frames.

The sections below describe in detail each function Spline Animator 2.0 provides.

Keyframe Animation Concepts

There are three terms the user should be familiar with in order to use the Spline Animator:

Framerate Framerate is expressed in frames/second and is used to determine the sampling rate of the splines created from the keyframes. In particular, splines are sampled in time steps of $\frac{1}{\text{Framerate}}$ starting from the time of the first keyframe. Framerate must always be an integer.

Keyframe Keyframes determine the actual positioning and motion of the camera. There are three types of keyframes distinguished by the type of behavior desired for the orientation of the view plane normal. An at-type keyframe specifies the view plane normal by specifying a location in space which the camera should be "looking" at. A vpn-type keyframe specifies the view plane normal explicitly as a 3-vector of values (see below). A dof-type keyframe uses the first derivatives of the x-,y-, and z-position splines to determine the view plane normal. The result is a vector oriented in the "direction of flight" of the camera. All keyframes require a *keytime* which is used to position the keyframe relative to the others. A keytime is simply a time in the form *mm:ss:ff* as described above. All keyframes also require position and view up vector specification, both of which are 3-vectors.

3-vector	3-vectors are generally used to specify positions in space and adhere to the traditional x, y, and z ordering of coordinates. e.g. (1,2,4)

The Spline Animator defines an animation using the *keyframe paradigm*. The basic objective is to define each frame of the animation in terms of a relatively small set of *keyframes* which indicate the position of the camera at critical portions of the animation. Each keyframe includes a *keytime* which orders the set of keyframes. An animation frame at a particular time t is then defined as some combination of the keyframe before time t and the keyframe after time t. For the Spline Animator, this combination is created by fitting a cubic spline through the camera parameters of each keyframe and evaluating the resulting spline for animation frames falling between keyframes.

Creating A Script

Figure 1 shows the main portion of the Spline Animator interface.

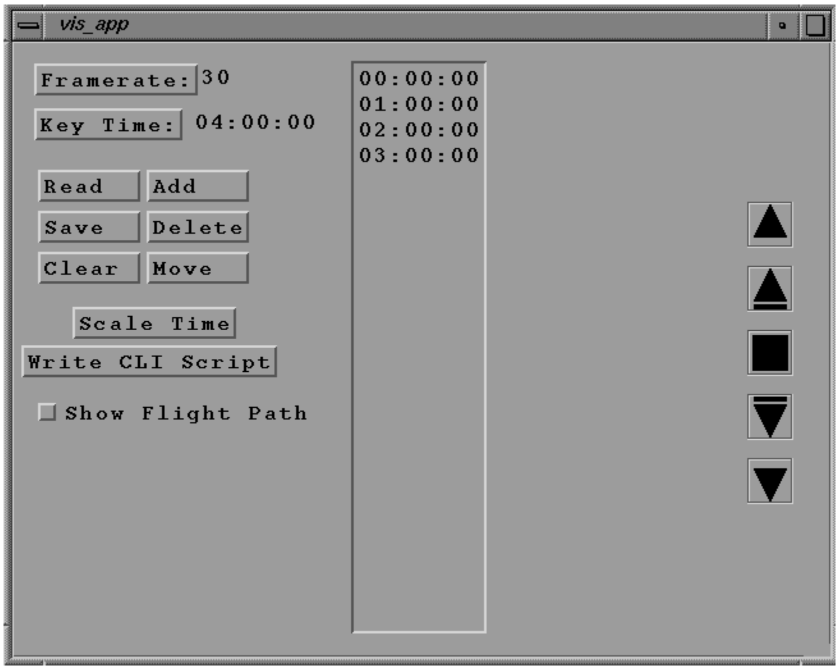

Figure 1

The buttons on the left are used to manipulate the current script. The keytime for each keyframe is displayed in the list in the center. In general, each button has an associated pop-up dialog. Each dialog allows the option of making the specified change, cancelling the operation, or obtaining a brief help file. In all cases, **CHANGES ARE IRREVERSIBLE**, so use care when employing drastic measures.

The Framerate, Key Time, Clear, Add, Delete and Move buttons are all relevant to script creation. Scale Time is also an important script creation feature but is described elsewhere. Each button is explained in detail below:

Framerate

Pressing this button pops up a dialog for changing the framerate of the current animation. The current framerate is always displayed just to the right of the framerate button. Note that framerate must be an integer greater than 0. Note also that changing framerate may change the keytime for some or all of the keyframes in the current animation. For example, if the current framerate is 30 and the keytime for some keyframe is xx:xx:15. Then changing the framerate to 60 would change this keytime to xx:xx:30.

Key Time

Pressing this button pops up a dialog for changing the current keytime. Keytime determines the keytime for the next keyframe added (see below). Note that the *mm:ss:ff* format must be adhered to when entering a keytime. Also, the frames portion of a keytime must be less than the current framerate.

Also, the Key Time parameter determines where the script will start playing from when you press one of the play buttons. Thus it is important to be sure to set this value first before attempting to playback a script using the controls on the interface.

Clear

This button simply clears the current script. Note that this is an irreversible process **use with caution**.

Add

This button allows the addition of new keyframes to the curent script. The current Key Time always indicates the keytime of the next keyframe to be added. Adding a keyframe consists of specifying up to three 3-vectors: position, up and view-plane normal. Position determines where the camera is located; up determines the up direction (i.e. orientation) for the camera; and view-plane normal specifies the direction in which the camera is "looking".

Figure 2 shows the layout of the add keyframe popup.

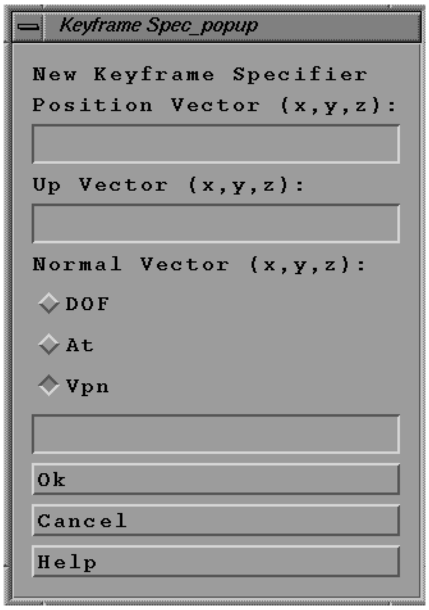

Figure 2

Position and up are easily specified as 3-vectors and should be in the format *(x,y,z)* as indicated in the figure. As mentioned previously, there are three methods of defining a view-plane normal. The DOF, At and Vpn toggles specify Direction-of-Flight, Look-At and standard View-Plane Normal vectors respectively. If a DOF view-plane normal is specified it is not necessary to enter a 3-vector. Clicking the OK button creates the keyframe and inserts it in the appropriate position in the list.

Note that it is possible to overwrite existing keyframes by setting the current keytime to that of an existing keyframe. In this case, user verification is required to add the new keyframe.

Delete

This button deletes one or more keyframes from the current animation. Keyframes are selected for deletion by highliting the relevant keytimes in the list of keytimes and clicking the Delete button.

Move

This buttons moves a keyframe to some new keytime as specified by the user. The keyframe to be moved is selected by highliting the appropriate keytime in the list of keytimes and clicking the Move button. Only one keyframe may be moved at a time. After selecting a keyframe the user is queried for a new keytime and the keyframe is moved to the specified time.

Note that it is possible to overwrite an existing keyframe my moving another keyframe to the same keytime. In this case, user verification is required to move the keyframe to the new keytime.

Script File Management

The following buttons provide file management for scripts. Each button pops up a file selector similar to that in Figure 3. The function of each button is described below.

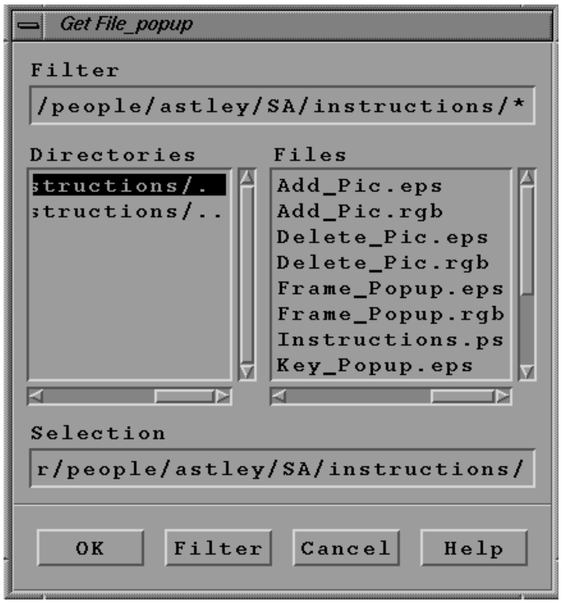

Figure 3

Read

This button reads a version 2.0 animation script.

Save

This button saves a version 2.0 animation script.

Write CLI Script

This button writes a CLI format script using the currently specified framerate. The CLI script generated is suitable for immediate use in AVS. Note that large framerates couple with long animations can produce rather large CLI scripts (usually several thousand lines).

Scaling Time: A Useful Editing Tool

Our final topic is a somewhat useful tool which allows the scaling of a particular section of an animation so that it spans more or less time. For example, suppose you have a particular segment starting at keytime 01:00:00 and ending at keytime 05:00:00. Suppose further that you wish the motion to appear slower in this segment. One possible solution is generating more frames by increasing framerate. However, this has the side-effect of increasing framerate for the rest of the animation. What is really required is the ability to *stretch* this segment in a linear fashion so that it requires ten minutes of time rather than five. The Scale Time button provides this functionality.

Scale Time works on two or more keyframes in sequence in the keyframe list. Keyframes are selected by highliting them in the keyframe list and clicking the Scale Time button. The user is then queried for a new end keytime and the selected keyframes are scaled to the interval defined by the starting keytime and the new ending keytime. Note that the new end time must be greater than the start keytime of the selected interval.

The mapping from old keytimes to new keytimes is defined as follows. If s is the start keytime, e the end keytime, and e' the new end keytime, then for each keytime m with $s \leq m \leq e$, m is mapped to the keytime $t \times e' + s \times s(1-t)$ where $t = (e-m)/(e-s)$. Each keyframe n with keytime greater than e is mapped to keytime $n + (e' - e)$. Keyframes before keytime s are unaltered.

Comments, complaints, questions:
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