Developing Efficient Pipeline Tools for Animation Production

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ABSTRACT

This work demonstrates a generally applicable working production pipeline technique that can be used in various character animation projects.

Categories and Subject Descriptors

I.3.7 [**Three-Dimensional Graphics**]: Computer Animation

General Terms

Documentation, Performance, Design, Standardization.

Keywords

Computer Animation, Graphics, Production Pipeline.

1. INTRODUCTION

Building and animating virtual humans and creatures has become an important part of a production pipeline for the visual effects industry. Every production has different challenges in the development of these characters, and each production strives to create a character setup pipeline that is efficient and flexible.

A character setup pipeline is a series of steps, or stages, that occur in the development of a character for an animation production. There are parts of a pipeline that slow the progress of the production if they are not managed in an efficient way. The purpose of this paper is to design character pipeline tools that address the problems of an unmanaged pipeline, create a consistent character setup across multiple characters, and speed up efficiency of a character-based production.

2. RELATED WORK

A character setup pipeline is very important to each production company that implements it. Visual effects production companies are competitive businesses, so they are very hesitant to publish their procedures and methods used for character setup. However, several examples of a basic character setup pipeline and the principles behind them can be found in course notes and books.

Schleifer defines a pipeline as the "basic path that a shot, or portion of a shot can take from start to finish" [1]. In professional production facilities animation can come from hand key-framed animation, motion capture, and procedural animation. The major question that is asked is, "How am I going to get this motion to that skinned creature?" Schleifer examines solutions to this question by providing methods for transferring animation data into a character that is ready for rendering.

Thuriot and Miller discuss the value of creating tools that advance the workflow of a character setup pipeline [2]. These tools are defined as tools to help users create data, for users to modify data, and tools to manage the version dependencies and sharing of data. Many of these tools can be created through the use of scripting.

3. TECHNIQUES

In order to allow the character pipeline to become more efficient, the linear pipeline must be broken into as many parallel workflows as possible. This allows the members of the production team to work simultaneously instead of sequentially and to specialize in specific tasks in which they excel. Breaking the character setup pipeline into multiple parallel workflows primarily requires separating the controls used for animation and the deformable geometry used for the final rendered shots. In order to accomplish the parallelization of these tasks, two tools need to be built using Maya's built-in MEL scripting language: A Character Setup Tool and an Animation Transfer Tool.

3.1 Character Setup using MEL

The Character Setup Tool (CST) is broken into several MEL scripts that are responsible for the setup of various sections of the body. The first step for using the character setup tools is to create the joint hierarchy for the character and to create the required curves to be used for control handles. Character creation methods are covered in the literature (see [1], [2] and [3] for examples).

The first MEL script that is sourced is `upperBodySetup.mel`, which creates IK (Inverse Kinematics) handles for the left and right clavicle and scapula. Next, groups are set up in the back joints to allow the top of the spine to connect to the neck and the clavicle/scapula joints. The root of the spine is then parented to "Upperbody" control handle. An expression is created to allow the control handle for the back to control the rotation of all the back joints. The `lowerBodySetup.mel` script parents the hip and leg root joints to the "Hips" control handle. It sets up the IK handle for the leg, and creates a poleVectorConstraint for the knee. An inverse foot setup is used to create the foot controls with

ACM SE'06, March, 10-12, 2006, Melbourne, Florida, USA

set-driven keys created for the foot roll, foot pivot, and toe movement [4]. The `armSetup.mel` script begins by creating the IK handles for the left and right arm. In order to get the forearm to twist accurately, an extra joint is added between the elbow and the wrist joint, labeled “`LtArmTurn (or RtArmTurn).`” The wrist is controlled through control handles. The next MEL script is `handSetup.mel`, which creates all the set driven key controls for finger movement. Basic controls are created for making a fist, spreading the fingers, and bending each finger individually. The `headSetup.mel` script sets the constraints and parents that allow for neck and head movement as well as connecting the neck and head to the spine. Lastly, the `finalParenting.mel` script sets up final connections and controls that require the previous scripts to be run. Once the scripts are run the character is ready for animation.

3.2 Animation Transfer using MEL

Once a control rig is completed and animation has begun, an alternate version of the character that has all of the deformation setup and final renderable geometry can be developed. This process requires that three separate and distinct skeleton hierarchies, the control, base and bound rigs, be developed.

The control rig is the rig that is created with the CST as described in the previous section. The base rig is a copy of only the skeleton hierarchy that was used in the control rig. The base rig provides a “clean” bridge between the control rig and the bound rig where there is no chance of controls of the base rig interfering with the method used to bind the geometry to the bound rig skeleton. The bound rig is a copy of the skeleton hierarchy used in the base rig, and is used to deform the final geometry. These three rigs are connected through the use of point and orient constraints.

The process of constraining the three joint chains together is done through the use of the `animTransfer.mel` script. For each joint in the list the script point and orient constrains the current base rig joint in the list to its equivalent joint in the control rig. It then point and orient constrains the current joint in the bound rig to the current joint in the base rig, creating a relationship where the control joints drive the movement of the base joints, which in turn drive the movement of the bound joints.

4. IMPLEMENTING PIPELINE TOOLS

For the 2005 Clemson Digital Production Arts animation, *First Impressions*, it was clear that a pipeline should be created to speed up the character setup process and allow animation to begin early. The CST and ATT scripts made this possible.

First Impressions had one female character named Jill, and four versions of a male character named Jack, who required different models due to his changes of clothing. This necessitated only two control rigs, one control rig for Jack and one for Jill.

The CST was used to create a control rig for Jill and Jack. Because the control rig is separate from the bound rig and because the four versions of Jack had identical proportions, only one control rig was required for Jack’s four variations. Figure 1 shows the control rigs for Jack and Jill. The base rigs were created by using the joint hierarchy from each character’s control rig prior to running the CST scripts and before adding the controls and proxy geometry. As character animation was in progress, the bound rigs were created. Jill required only one version of her bound rig while four different Jack bound rigs had to be created, one for each costume. Jill’s bound rig was created by using Maya’s soft binding tools and influence objects to skin the geometry to the “bound” versions of Jill’s joint skeleton. Meanwhile, Jack’s character, who imagines himself in different roles as he ponders ways of impressing Jill, required a new model and deformation setup for each imagined character.

Once the bound rigs were completed for the characters, the `animTransfer.mel` script was sourced in each scene for which animation had been completed, transferring animation data from the control to bound rigs.

The end result was character animation that was much more refined than previous Clemson University animated productions. Figure 2 shows a final rendered image from *First Impressions* that includes two Jack characters and the Jill character.

5. CONCLUSION

The major goals of the character pipeline tools were to design methods and procedures for increased efficiency in a character pipeline setup, design a standard procedure for character setup that is consistent from character to character, design a procedure for character setup that allows animation to begin early in production, and to design a procedure for separating high resolution deformable geometry and deformation systems from the animation workflow. The character setup pipeline at Clemson University has been greatly improved because of the CST and ATT. These tools and procedures will help ensure that future production pipelines function with a powerful and efficient character setup pipeline.

6. REFERENCES

[1] Schleifer, J. *Maya Techniques | The Jason Schleifer Rigging Bundle* [DVD]. Alias Systems, Toronto, 2001.

[2] Thuriot, P., Miller, E. *Maya Techniques | Custom Character Toolkit* [DVD]. Alias Systems, Toronto, 2003.

[3] Maraffi, C. *Maya Character Creation: Modeling and Animation Controls*. New Riders Press, New York, 2003.

[4] Kundert-Gibbs, J., and Lee, P. *Maya Savvy 4.5*. Sybex, Inc., San Francisco, 2003.

[5] Osipa, J. *Stop Staring: Facial Animation Done Right*. Sybex, Inc., San Francisco, 2003.

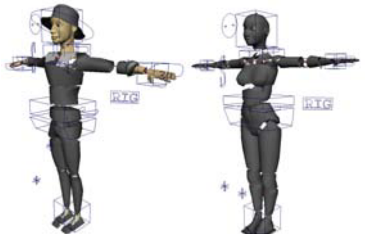

Figure 1. Control Rigs for Jack and Jill Characters

Figure 2. A Final Scene from *First Impressions*