UGP01 : B Sc in Media Graphics and Animation

MGAE101 Animation Basics

The draft instructional material is being made available “as received” from authors. The editing and various other quality checks are under progress. The uses are advised to consult Study Centers for any missing content, updates and instructions according to syllabi of course.

B Sc in Media Graphics and Animation

Animation Basics

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UNIT 01 ANIMATION BASICS

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1.0 INTRODUCTION

This unit will help you to understand the basics of animation. The basic concept of computer animation is based on the change in the position, rotation and scaling of the object at defined points in an order on a time slider. These defined points are called as keyframes. The frames between these keys consists of the information of the actions performed on a particular keyframe. When these frames are played in quick succession the objects seems to be moving.

In 3Ds Max, the average frames per second is 30 i.e. 1800 frames per minute. Hence, the frames required for the animation should be calculated as per the time limit of the animation.

Lets us see in brief some of the techniques of animation for a web page.

Animated GIFs: One of the simplest way of creating animation is animated GIFs. Several GIFs files are placed in a sequential order to obtain a satisfactory animation. You can place such animated GIF on the web page in the same way as the regular GIF file.

Javascript-based animations: Javascript is a simple programming script language that works with HTML and creates animation similar to that of animated GIF. It is different from java, and is more interactive. For e.g. the text can change its color when the cursor is placed on it.

Plug-in animations: A plug-in is a type of software which allows the user to view animation created by other software programs on a web page. You can make interactive CDs and view specially encoded videos clips with the help of plug-ins such as Shockwave and RealPlayer.

1.1 UNIT OBJECTIVES

In this unit, you will learn about:

- Keyframe animation
- Concept of in-between and interpolation
- Concept of setting keys
- The animation controls menu and its use
- The process of playback controls
- Basic Principles of Animation

1.2 KEYFRAME ANIMATION

This unit will give you a basic introduction to keyframe animation in Bryce. For those who are familiar with Bryce, can directly refer to the fast track section, 1.2.3.

1.2.1 Keyframe Animation

Keyframe animation is a technique based on a series of images illustrating a sequence of events, just like story-boarding or a comic strip. In keyframe animation, minute snapshots are taken at key moments during a sequence of movements or change. Such key moments are known as keyframes. The Bryce application calculates the animation between these keyframes. Refer figure below:

In the above figure, all the images shows the same scene, except that the ball is shown in different place in each scene. You can make an animation of the above images if a keyframe is made at every instant the call changes its position with a time gap of 1 sec between each keyframe.

Though only 3 keyframes are used, the whole animation is generated. This is possible because of the Bryce application which has a specific technique to calculate the position of the ball in all of the intermediate frames. It also calculates the splinted trajectory.

Bryce also calculates a smooth curved trajectory. The position of the ball is shown by the arrow and the curved trajectory is drawn taking these points as the reference. You can also control the trajectories with the help of the trajectory handles and thus fine tune the movement.

You can create complex animation with ease with the help of keyframe animation. In keyframe animation, you can not only change the geometry of the object but also the color as well as the movement of the object.

In this unit you will learn to create keyframe animation using Bryce. Since the basic concept of animation is the same in all the 3D applications understanding Bryce makes it easier to learn other complex applications like Maya and Max.

1.2.2 Sequencing of Events

Before you start learning the process of animation it is important to understand why you want to create the animation and how to plan it.

The reason for creating an animation may be either you are a part of a animated movie or you are animation designer. As a designer you can use animation to communicate your design ideas in a clear and concise way. However, there may be other simpler methods of

communicating your ideas. Hence it is for you to decide whether you want to use animation as the way to express your idea.

Once you have decided to use animation for expressing your ideas, you can follow the below given seven processes to complete your project.

1. Inspiration and visualization: You must first create a picture of what you want in your mind.

2. Storyboarding: You can draw a stepwise comic strip like storyboard describing what will happen in the animation. This is very helpful for the animator and can be used as a reference.

3. Constructing the scene: It is important to create all the objects that will be required during the animation and place them at the initial position of the scene.

4. Animating the scene: Once the objects are placed in their initial position, they are animated by setting time, modifying their shape, color or position and adding keyframes.

5. Previewing and modifying the animation: Once the animation is complete it is necessary to preview it so that you can modify or change it as per you requirement.

6. Rendering the animation: After finalizing the animation, it has to be rendered in a viewable movie file format.

7. Post production: The final touches can be given in post production like adding titles and sound to the movie, changing the file size or file format using software like Adobe Premiere.

Before you start your animation, you should plan your steps properly, along with the time required and a detailed storyboard.

1.2.3 Fast Track to Keyframe Animation

After you have created a storyboard and constructed the scene, you can create an animation in Bryce using keyframes in 12 simple steps.

1. Go to file option>Animation setup and set values for the duration and FPS (frames per second)

2. Scale the timeline to easily see the whole duration of the process. (Time Working Area)
3. The Auto-key should be turned off, else every change, even those which is not part of your storyboard, will be recorded in the keyframe without your knowledge.
4. At the start time, add a keyframe of the animation for all the objects that will be animated.
5. Move the time scrubber to the next keyframe position.
6. Modify the required object or objects.
7. For each modified object a keyframe should be added.
8. Repeat steps 5,6 and 7 until all the keyframes are defined.
9. Preview the animation.
10. Modify the animation as per the trajectory and set the time.
11. Go to File option>Document setup and specify render resolution (output size).
12. Go to File option>Render Animation and render your animation.

1.2.4 Keyframe Animation in Twelve Steps

In this section you will animate a single sphere using three keyframes over a period of 2 seconds. After creating this simple animation you will be able to create, research and experiment more complex animations.

Getting started

Open a new document in Bryce and change to Camera view using the Perspective Toggle button. Change the director's chair icon to camera by clicking on it.

The time palette in at the bottom of the screen with a small key icon with plus sign to the left and a minus sign to the right side. If it is not there, that means you are looking at the selection palette. If it is selection palette then click on the toggle button in the bottom right hand corner to change it to time palette.

Creating the Scene

Create a sphere and move it using the reposition tool on the edit toolbar so that the sphere is to the left of the field of view. You can add a material to the sphere from the simple & fast library to make it more interesting. You can also change the size of the sphere using the resize toolbar.

1.2.4.1 Step 1: Animation Setup

Animation setup is the most important part of animation. Select file from the menu option and go to animation setup. If you don't find it, hover your cursor for some time to the top of the screen until the menu appears. In this process you will set values for the number of frames per second and the duration of animation.

1. FPS: Frames per second or FPS is the first type of setting which tells Bryce how many frames will be used for each second of animation. By default the value is 15. For high quality animation you can use an FPS of value 30, which is also the value if it is played on video tape. However, if you increase the FPS value the file size also increases. Hence, to reduce the file size you can also decrease the FPS value to 10. Generally the FPS value of 15 is used for smooth animation.

2. Duration of Animation: The second setting is the calculation of the time required for animation. You should take into consideration all the changes that will take place in your animation and calculate the time accordingly. To start with you can set the time to 2 seconds for a simple animation. The animation times are expressed in Hours, Minutes, Seconds and Frames by default. This scheme is called SMPTE and is pronounced as 'simptee'. So, for a 2 second animation the time in SMPTE will be expressed as '00:00:02.00'. Once the FPS value and duration is setup in the animation setup dialogue box, the frame# box displays the FPS value of 30 which is the total number of frames in the animation. i.e. 15 frames per second, so for 2 seconds it is 30 frames. On clicking ok, you will complete step 1.

1.2.4.2 Step 2: Scale the Timeline

The time duration is shown at the bottom of the screen and is known as Time Working Area. You can see the entire duration of the animation at a glance. However, since some of the duration are short, you may not be able to see them properly. Hence, the timeline needs to be scaled so that all the frames are clearly visible. This can be done with the help of the Scale timeline tool which is located in the lower right corner of the screen. Dragging it to the left and right increases and decreases the size of each frame on the timeline, respectively.

1.2.4.3 Step 3: Turning off the Auto-Key

The main function of the auto-key is to automatically record keyframes as the objects are moved. However, if you don't have exact knowledge of the working of auto-key, you can be in real mess as it will create keyframes all over the timeline. So, it is advisable to turn it off in the beginning till you gain confidence. Till then, you can create keyframes manually. Click on the small down arrow just below the scale timeline tool. A pop-up menu will appear which will have the auto-key option. If there is a tick visible, that means the auto-key option is on. Just click on it again and the tick will disappear indicating that the auto-key option is now off.

1.2.4.4 Step 4: Adding a Start Keyframe

The next step is to add a keyframe for the sphere at the initial position. It is at this position that the animation begins. Make sure that the time=zero at the first keyframe by dragging the scrubber to the left until the time displayed is '00:00:00.00'.

Adding a Keyframe

You can add a keyframe by clicking the add keyframe button. The pop menu shows three parts of the Bryce world, namely, the camera, the sky and the sun. you can also a list of all the objects in the current scene. Since we only have the sphere right now, you will see a menu item called 'Sphere1'. When u click on the menu item 'Sphere1', it will display a pop-up menu which is used to set keyframes for various parameters of movement and geometry. Click the 'All Timelines' option to set a keyframe that represents all the changes to our sphere. Thus, the first keyframe is set.

1.2.4.5 Step 5: Move Time Scrubber to next Keyframe position

We are making a simple animation of 2 seconds, and as we have already added our first keyframe, you now have to add 2 more keyframes. Since we have added our first keyframe at zero second, you can add the second keyframe at 1 second mark (which is the middle part of our animation), and the third keyframe at the 2 second mark. The time line should look like the one shown below.

1.2.4.6 Step 6: Modify the object

For animating the object you need to move it from its initial position. You can do that with the help of the reposition tool on the edit toolbar. Move the sphere to the position it should

reach in 1 second. To make it fly on the curved trajectory, move the sphere off the ground in the Y direction and away from the camera in the Z direction. A grey line will appear which is the trajectory. You will see a small blue square at each end of the line. These blue squares are the trajectory handles.

1.2.4.7 Step 7: Set a Keyframe to Record the changes

Once you have done all the movements and changes in the sphere it is time to add a keyframe. Repeat step 4 to add a keyframe so that all the changes are recorded. Make sure the timeline is at the 1 second mark.

1.2.4.8 Step 8: Move Time Scrubber, Modify object and Set Keyframe

In step 8 you will repeat steps 5,6 and 7. However, this time move the sphere down to the ground by simply clicking the land Objects Down tool, located next to the selected object, and further away from the camera. You should also move the timeline to the 2 second mark before adding the keyframe and your time should read as '00:00:02.00'. After completing the keyframing part of the animation process, the Bryce should look something like the one shown in the figure below.

You will be able to see the trajectory curve along with the three trajectory handles. Each trajectory handle indicates the position of the centre of the sphere when the keyframe was set.

1.2.4.9 Step 9: Previewing the Animation

Once you are done with the animation part you can preview it by simply clicking on the Play button on the Time palette. You can see the sphere travelling in a smooth curve along the trajectory. Refer figure below. However, it is in wireframe as we are mostly concerned with the movement and speed at this stage. If everything is as per your requirement, you can skip to step 11. But, if you want to make any changes then you will have to go through step 10. It is also helpful for future use.

1.2.4.10 Step 10: Editing of Keyframes

This step is useful if you need to edit your animation after previewing it. You would like to change the position of the sphere or the speed or make some changes to the trajectory.

You can make the changes in the trajectory by tweaking the trajectory handles. If the cursor is moved over the trajectory handle, it turns into a 4-headed arrow. Just click on it and by dragging it you can change the shape of the curve as per your requirement. You can have a

sharper or fuller curve if you press 'T' on the key board and drag the cursor. The cursor will turn into a 2-headed arrow and if you drag it to the left, the curve will be fuller and it will be sharper if you drag it to the right.

Similarly you can modify the continuity and the bias of the curve by clicking the 'C' and 'B' keys respectively. Whether a curve is continuous or broken is controlled by continuity. Whereas, the emphasis is controlled by the Bias of the curve. You can understand this better by experimenting it yourself.

In the above figure, the trajectory has been changed by moving the second trajectory handle and then modifying the tension of the curve to increase the radius and result in a fuller curve.

Thus, if you want to change the speed of the sphere, you can scale up the time in Bryce. This can be done through the Animation setup dialogue box. Select File Animation setup. In this you will find two button namely, 'scale' and 'extend or clip'.

If you use the extend button, it will simply extend the time on your timeline leaving your original animation untouched. You will now have more time to continue the animation further. However, if you select the scale button, for e.g. to 4 seconds, you animation will be extended for a duration of 4 seconds. As a result your key on the 1 second mark will move to the 2 second mark and your key on the 2 second mark, will move to the 4 second mark. In other words, this will slow down the speed of your sphere by half. Similarly, if you scale the time to just 1 second, your sphere will move at twice the speed.

1.2.4.11 Step 11: Specify Render Output Frame Size

Before you render the animation, it is very important that you decide the animation frame size, as it directly affects the finished movie file size. Generally, larger frame size is required for complex scenes. But you should always remember the general thumb rule that it does not need to be as big as you think it does.

You can set the render file size from the File document setup. Render frame size is referred as ‘Render resolution’ in Bryce. In these animation all the dimensions are expressed in pixels. However, your render resolution or size should match with your work area or document resolution. Hence, you should first change the document resolution and then the render resolution.

1.2.4.12 Step 12: Render the Animation to a File

Once you have completed all the above steps, you can now render the animation to a file. Before you render your animation, you must check the following three things:

i. What are you rendering: You should always ensure that your entire animation is being rendered by checking that the entire duration radio button is highlighted.

ii. The format in which your animation will be written: There are three formats to choose an output file format, namely, AVI Movie (default), QuickTime Movie and BMP Sequence. While AVI Movies run on most of the computers, QuickTime Movie requires the QuickTime Movie Player to be installed on the computer. The BMP Sequence renders each frame to a separate BMP file. You can select the required format from the pop up menu in the output module section.

iii. Location of the file: You can save the file to the specified location using the Save As dialogue box by clicking the Set button.

Finally, you can start rendering by just clicking the tick mark. The render time will depend upon the speed of your computer. You can review your animation once it is rendered. You can always make modifications and changes and render your animation again.

Conclusion

Keyframe animation is usually a complex process. However, the end result is always worth the effort. As they say that a picture is worth a thousand words, imagine what a moving picture will be worth. Animation makes communication of ideas a lot easier, but you need to keep it simple. Always use all the techniques you know to make the project simpler, but make sure your efforts are appreciated.

1.3 IN-BETWEEN AND INTERPOLATION

In-between is one of the methods of adjusting the animation timing by adding or removing one frame or time unit. You can preserve the tangent characteristics of the animation curve by making minimal changes.

You can shift one whole time unit forward from the current time using the Add In-between function. Similarly you can shift one whole time unit backward by using the Remove In-

between function. This will cause the animation keys to move forward or backward respectively.

Set In-betweens

Tip: Adding or removing In-between buttons can be done by using the marking menu (press 'shift' + s-Left Mouse Click)

To add an In-between, follow the below mentioned steps:

1. Select the channel or animation attribute.
2. Do either of the following:
    - Right Click in the Time Slider and select Keys>Add In-between form the menu that appears to insert an In-between at the current time.
    - Go the Graph Editor, select Keys>Add In-between to insert an In-between at the current time.

To remove an In-between, follow the below mentioned steps:

1. Select the channel or animation attribute.
2. Do either of the following:
    - Right Click in the Time Slider and select Keys>Remove In-between form the menu that appears to delete the In-between at the current time.
    - Go the Graph Editor, select Keys>Remove In-between to delete the In-between at the current time.

Keys might conflict and act unpredictably as using remove In-between decreases the space between the keys.

1.4 SETTING KEYS

Once you start working on longer animations with more keyframes, it becomes difficult to keep a track of all the keyframes. Bryce, however, makes it easier to track all the keyframes with the help of few simple tools. Look for the Key icon on the time palette and you will see

that it is highlighted if the time scrubber is positioned over a keyframe. It is displayed in its normal grey color if the time scrubber is not on a keyframe. So if you want to track a keyframe, simply move the time scrubber and look for the key icon's display mode.

1.4.1 Animation Controls

Animation control in Bryce are just like those of Maya, which includes, Time Slider, Range Slider and Playback Controls. From the animation control area, you can have a quick access to the animation and you can also edit the animation preferences from here.

The Auto Key button and the current character control features are located in between the Range Slider and the Animation Preferences.

Time Slider

The time slider controls the playback range, keys and breakdowns within the playback range.

The Current Time is indicated by a grey block on the time slider. It can be dragged in the forward or backward direction.

However, by default, only the current view is updated if you drag the time slider. If you want to update all the view then, go to Window>Settings>Preferences and select Time Slider in the categories window and then select Update all Views.

Key Ticks

By, default, the red marks in the Time Slider area represents the keys you have set for the selected object and are known as Key Ticks. Whereas, the breakdown keys are displayed in green.

You can change the size and color of the Key Ticks, as well as their visibility from the Preference Window.

Time Units

Time is displayed by the ruler markings and associated numbers on the Time Slider. Select the desired Time from the Settings Category of the Preferences window to define the playback rate. The standard rate for film is 24 frames per second as per Maya's default value.

Note: It is always better to specify the time setting before you begin your animation, as expressions that use frame variable might not work correctly if you change the time settings later on.

Current Time Field

The entry field to the right side of the Time Slider, displays the current time. You can change the current time by entering a new value, thereby, moving the scene to that location in time. The current time indicator will update the new time accordingly.

Range Slider

The Range Slider controls the playback range reflected in the Time Slider.

Animation Start Time

The start time of the animation is set in the Animation Start Time field.

Animation End Time

The end time of the animation is set in the Animation End Time field.

Playback Start Time

This field shows the current start time for the playback range. You can change the start time by entering a new start time, including a negative value. If the value entered is greater than the Playback end time, then, the playback end time is adjusted to one time unit greater than the playback start time.

Playback End Time

This field shows the current end time for the playback range. You can change the end time by entering a new end time. If the value entered is lesser than the Playback start time, then, the playback start time is adjusted to one time unit lesser than the playback end time.

Other settings that follow can be edited from the animation preferences window.

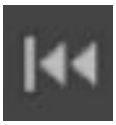
CHECK YOUR PROGRESS

1. Explain the concept of Animation.
2. Name the different types of animation.
3. Define keyframe animation.
4. Explain the function of a keyframe animator.

1.5 PLAYBACK CONTROLS

You can play and stop your animation with the help of the Playback Control Button. The playback range is displayed in the Time Slider.

Playback Controls



Go to start button

To go to the start of the playback range, click on this button.



Step Back Frame button

To step back one time, click on this button. Hotkey: Alt+, (comma) key for Linux and Windows or Option+, (comma) key for Mac OS X.



Step Back Key button

To step back one key, click on this button. Hotkey: , (comma) key.



Play Backwards button

To play backwards, click on this button. To stop the playback, press Esc key.



Play Forwards button

To play forwards, click on this button. Hotkey: Alt+v for Linux and Windows or Option+v for Mac OS X. To stop playback, press Esc key.



Step Forward Frame button

To step forward one time, click on this button. Hotkey: Alt+. (period) for Linux and Windows or Option+. (period) for Mac OS X.



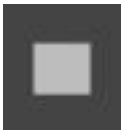
Step Forward Key button

To step forward one key, click on this button. Hotkey: . (period) key.



Go to End button

To go to the end of the playback range, click on this button.



Stop button

To stop playback, click on this button. This button is displayed only when the animation is playing. Hotkey: Esc key.

Animation Preferences Button

Animation preferences button launches the Preferences window from which you can set the Time Slider, Playback, Animation and Sound preferences for Maya session.

You can refer the following topics in the Preferences and Customization unit of the basic guides for more information.

- Interface preferences
- Help preferences
- UI Element preferences
- Kinematics preferences
- Display preferences
- Manipulators preferences
- Animation (Display) preferences

- Polygons preferences
- NURBS preferences
- Subdivs preferences
- Animation (Settings) preferences
- Settings preferences
- Camera preferences
- File/project preferences
- Dynamics preferences
- Modeling preferences
- Selection preferences
- Rendering preferences
- Snapping preferences
- Modules preferences
- Time Slider preferences
- Sound preferences
- Undo preferences

1.6 ANIMATION CONTROLS MENU

You can see the animation control operations by right clicking anywhere in the Time Slider. These operations work on keys of the currently selected objects.

Copy, Cut, Paste and Delete

The above keys affect the keys that are at the current time or in the selected range. When you select the keys and use the Cut or Copy function, it places the selected keys in the internal clipboard for pasting. The delete key will simply delete the selected key. The Cut, Copy and Delete keys operates on the current time as well as the in between range, not including the key on the next time. For e.eg. if the current time is 3, these keys will operate on 3 as well as on the integer range between 3 and 4. But it will not include the key at time 4.

The paste key puts the copied or cut keys form the internal clipboard at the current time. The paste>paste connect option is the same as edit>keys>paste with the connect option turned on.

There are two ways of pasting the keys into the time slider.

1. Click on the time you want the copied/cut keys to start and paste them. This will shift the existing keys beyond the time range of the pasted keys.

2. You can select a time range by pressing shift and clicking into the time slider and then pasting the keys in that time range. This will fit the keys in that particular time range and will delete any other existing keys in that time range.

Deleting FBIK Keys

The Time Slider context sensitive menu can be accessed by right clicking in the Time Slider.

Delete All FBIK Keys

All the keys at the Current Time Indicator gets deleted from its FBIK effectors and FK joints from the current character.

Delete Body Part Keys

All the keys at the Current Time Indicator gets deleted from its FBIK effectors and FK joints from the current body part.

Delete Selected FBIK Keys

The selected FBIK effectors delete all their keys at the current time indicator as well as those on their FK joints.

Snap

A Snap is used to force the selected keys to snap in time to the nearest whole time unit.

Keys

- Selected Breakdowns will convert keys to normal keys
- Normal keys will be converted into Breakdowns.
- Add In-between will add a single In-between.
- Remove In-between will remove a single In-between.

Tangents

The function of the tangent item is to set the tangent of the keys at the current time, or all the keys in a selected time range.

Playback Speed

The playback speed or frame rate of your current scene is set here.

Real-Time

The playback speed of your current scene is set to 24 frames per second.

Play every frame, free

The playback speed of your current scene is set to play every frame and not clamped to a specific maximum frame rate.

Play every frame, max real-time

The playback speed of your current scene is set to play every frame and clamped to a maximum frame rate of 24 frames per second.

Playback looping

These options are more or less the same as those in the Preferences window. To select playback looping options, right click in the time slider and select the playback looping>once, oscillate or continuous.

Set range to

- Start/End sets the playback range to the start/end values set in the playback range numeric input field.
- Min/max sets the playback range to the first and the last keys of the scene.
- Selected sets the playback range to the range defined by the current selection on the time slider.
- Enabled clips set the playback range to include the range of all the enabled clips.
- Sound length sets the playback range to the duration of a sound currently loaded into the time slider.
- Preferences set the playback range to the values in the preferences window.

Sound

In this menu, you can select an imported sound to be displayed on the time slider.

Time slider key edit menu

Select>Sound>filename

Sound File

A sound file is the file which is referenced by this audio node. The time slider displays this sound for the sound track to play in this file. If you move or rename the file, you can update the file here.

Start Time

The soundtrack starts to play in this current time units; for e.g., if the selected time units is Film (24 fps), a start time of 48 will start the soundtrack after 2 seconds of animation.

Playblast

The playblast window will open if you click on this and if you click on the option box[], it will open the playblast options window.

Previous/Next keyframe

By clicking on this you can jump to the previous or the next keyframe on the timeline.

Removing keyframes

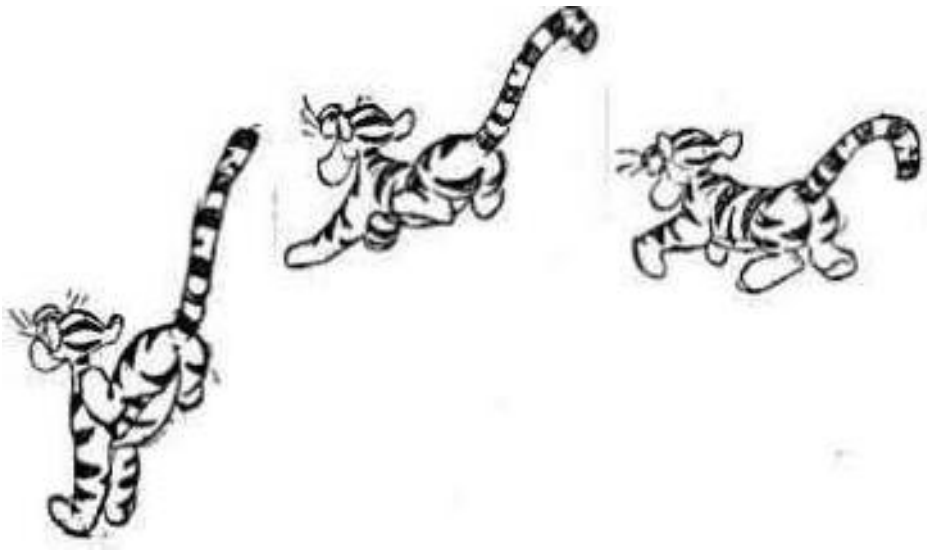
Sometimes, when you work with the auto-key on, you may add or record keyframes that you don't need. To remove such unwanted keyframes, simply click on the minus sign to the right of the key icon and select an option from the pop-up menu.

1.7 BASIC ANIMATION PRINCIPLES

The principles of animation, when consciously used in any scene, are very helpful for both animation as well as animation clean-up. Even if a character is doing nothing in a scene, some of these principles are still used. Let us take a simple scene to illustrate these principles.

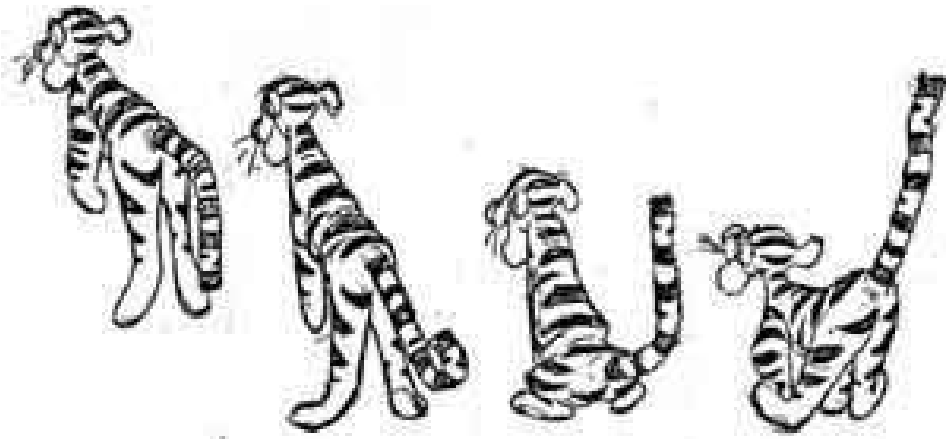


You should always study and analyze a scene to understand which of the principles of animation can be applied to it. There are 28 principles of animation. There may be few more as well. It may be difficult to remember all these principles initially, however, with practice, these will become secondary in nature. Knowing these principles will enable you to animate your scene intellectually, logically and artistically as well as emotionally.

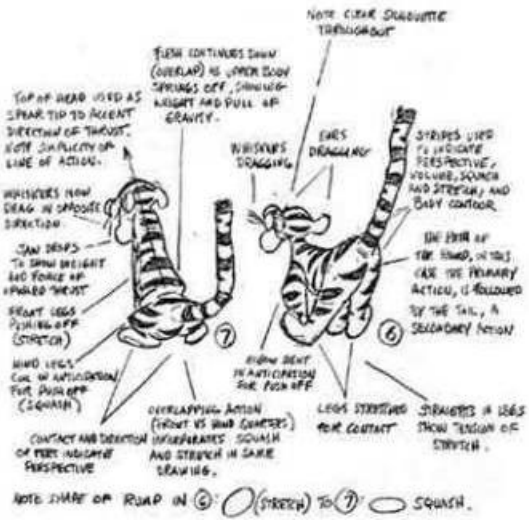


The following are the principles that you can observe in these drawings, most of which should also appear in all scenes, as they are the basis for full animation.

1. Pose and Mood 2. Anatomy 3. Weight 4. Shape and form 5. Model or character 6. Line and Silhouette 7. Perspective 8. Tension 9. Planes 10. Action and reaction 11. Direction 12. Solidity 13. Beat and rhythm 14. Arcs 15. Depth and volume 16. Squash and stretch 17. Working from extreme to extreme 18. Overlap and follow through 19. Timing		20. Straights and curves 21. Primary and Secondary action 22. Staging and compositing 23. Anticipation 24. Caricature 25. Details 26. Texture 27. Simplification 28. Positive and negative shapes



Observe the two drawings given below. You will be able to note the following by flipping and studying these drawings. When you move your eyes from one drawing to another, you will see these things happening. Also watch the negative shapes as well.



The first drawing is called the 'push off', where you can note that every line and shape is hinting towards upward thrust. Even the tail is helping in follow through. When you see the second drawing, you will note that, each shape changes to enhance the overall shape and action for instance, the neck, the chest, the legs, the back etc.

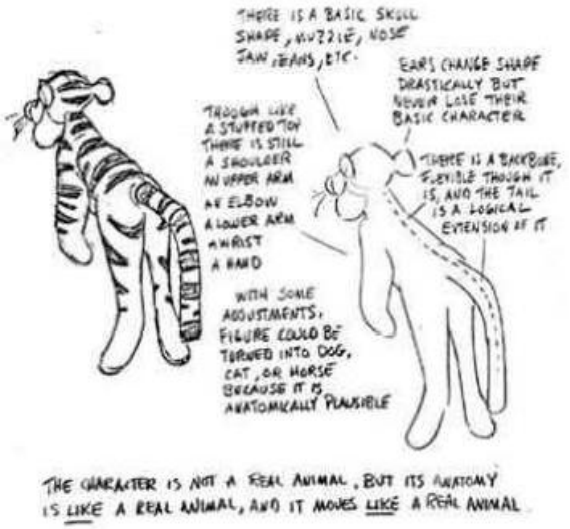
In the below drawing, even though it is just one drawing, there is no doubt about the action that is taking place in this part of the scene. This should be true of any drawing in the scene.



Consider anatomy alone

Whatever the purpose of the scene, it can analyzed for the different aspects of the drawing. Though, the shape is that of an animated animal, all the parts that belong to a real animal are

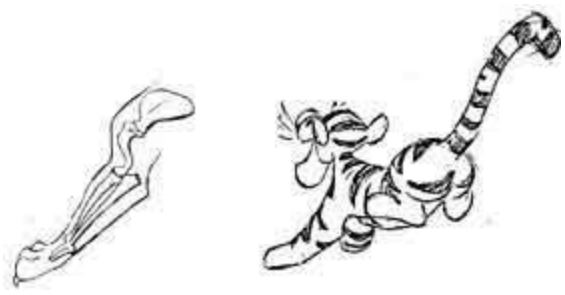
present in it, namely, head, neck, back, tail, legs etc. and when animated, they move just like a real animal.



Anatomy continued

Anatomy plays an important role in drawing, irrespective of whether it is a reference of nature or completely imaginary. Though in some characters, it may be exaggerated, but anatomy in a sense remains fairly constant. For e.g. if you take an elbow, it bends only in a certain way. You may take some liberty in its movement, but you have to maintain the reality, even in a cartoon. Converting the structural anatomy knowledge to the cartoon medium is not an easy task.

For e.g. when you draw an arm, you have to keep the elbow where it generally is, to give your drawing a realistic look. Compare the tiger's arm to that of the real tiger in the figure below.

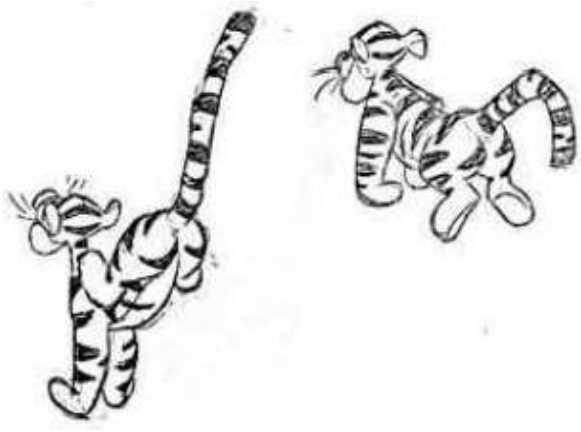


Consider Weight

Gravity plays an important part in animation as it determines the weight of the objects and how they will act and react accordingly. You can easily lose the attention of the audiences if

you are not careful. For e.g. lighter objects like feather falling like bricks, which is a heavier object and vice-versa.

Humour is a good thing, but should be added only when required. However, in cartoons, defying the laws of gravity, like weight, speed, squash and stretch, is the rule of the thumb.



1.7.1 Squash and Stretch

The best way to deform an object is through Stretch and Squash. It shows the rigidity of an object. Even if the object deforms, it should still appear to retain its volume.

The squash and stretch of an object can be referred to as its springiness. According to Hooke's law, an object should retain its volume or its density despite a constant force applied and the degree of its deformity. F=-kx, where F is the springiness or rigidity of the object; k is the constant force and x is the amount the object is deformed.

Similarly, squash and stretch of an object should be followed in animation. So, if you deform the object in one direction, say, you reduce the size of an object in Y direction, then it should increase in the X direction, thus maintaining its volume or density. Otherwise the object would appear to shrink or grow in one direction only.

For e.g. if a ball is flattened two times in one direction, then it should become two times as wide in the other direction.

Even things made of flesh will follow the same principle. If you bend an arm, the biceps will swell.

Similarly, when you chew something or smile or talk, or show different expressions the face will also react with changes in cheeks, lips and the eyes. The stretch and squash is the result of either some external pressure or when it is constricted by its own power.

Thus, the most important rule of squash and stretch is that despite its deformity, an object should always retain its volume or density.

To teach the squash and stretch principle to the beginners, they are generally told to make an animation of a bouncing ball. They are told to move the ball along a circle, drop and hit it on the ground and then bounce it back in air. This simple test not only teaches them the basics of animation, but also about the squash and stretch technique. The ball is flattened, when it hits the ground and elongated before and after the bounce giving it a sense of speed and the bouncing effect.

Rigidity

The rigidity of an object can also be defined by the squash and stretch technique. The lesser it squashes and stretches, the more rigid is the object and vice-versa. Hence the flexible parts of an object will squash more and the rigid parts less.

Thus, we can say that the rigidity of an object is indicated when an object moves. There are many objects like wooden furniture or metal things which have little or no flexibility. However, most organic objects have some level of flexibility in their shape.

An object changes its shape when some force is applied to it. How much it changes shape depends on how rigid the object is. For rigid objects, you can ignore the squash and stretch principle. For e.g. a hard league ball or a concrete bench. Even when you throw the ball or sit on the bench it will not change its shape. On the other hand, a bouncing rubber ball will bounce higher and will squash more upon impact.

Volume

- The characters will not be believable if volume is not maintained with squash and stretch.
- Use of muscles in character animation is very obvious and when a muscle is contracted it will squash and when it stretches it will extend.

No matter what expression the face makes, or how the muscles move when a person smiles or frowns, the volume will always remain constant. The matter is simply displaced into the stretched shape.

You cannot make a person or animal look real, if you do not deform them when some force is applied to them.

Squash and stretch is also very important for facial animation. It not only shows the flexibility of the flesh and muscles, but also shows the relationship between the parts of the face. For e.g., when we smile broadly, the corners of the mouth will push the cheeks, the cheeks will squash and push the eyes making them squint, which in turn will bring the eyebrows down and stretches the forehead. Similarly, a surprised facial expression will open the mouth and stretch the cheeks, squashing and wrinkling the forehead and the wide open eyes will push the eyebrows up.

In order to make a moving thing look smoother, you can stretch the object. For e.g. while animating a baseball that has been thrown fast, the ball will be stretched for a smooth motion. The drawings will have overlapping stretched images of the ball. However, such things won't happen in real life; this is just one of the freedom granted to the animators to help create the illusion of movement. Motion blur can also be used to create this illusion.

Strobing

Strobing occurs when the action is fast and the distance between the positions of the object increases and the object does not overlap from frame to frame. As a result, the eye begins to see separate images. When the action is slow, the objects overlap and the eye smoothes the motion out.

The most realistic solution to the problem of strobing is the accurate motion blur. However, when the motion blur is not available, squash and stretch is an alternative. The object should be stretched such that the positions do overlap from frame to frame and the eye will smooth the action again. Refer figure below:

The scale transformation can be used for squash and stretch in 3D keyframe animation. When scaling up in Z axis, the object should be scaled down in X and Y axis to keep the volume the same. A rotational transformation may be required to align the object along an appropriate axis, since the direction of the stretch should be along the path of action.

1.7.2 Anticipation, Follow through, Secondary Action

There are two types of secondary actions:

i. Actions that are happening apart from the Primary action

ii. Actions that happen as a result of another action

As Newton's third law of motion states, 'for every action there is an equal and opposite reaction', it is important to show secondary action in animation. If you hit something it will move. Secondary action adds realism to the scene and makes it more authentic.

Secondary action apart from the primary action can be many things. It can be anything in the background like waves of the ocean behind the character. However, you have to take care that while adding secondary action, it should not draw the audiences eyes away from the primary action. Because the slightest of the movement in the background can be very distracting.

Case Study

Few things that you have to remember is that,

- An object will always maintain its volume, no matter how it is squashed or stretched.
- The amount of squash and stretch depends upon the flexibility of the object.

However, the squash and stretch is exaggerated in traditional form of animation. A good example is that of bouncing ball which squashes when it hits the ground and stretches when it bounces back. You can make your actions look more realistic with the help of motion tweening and frame by frame animation in Macromedia Flash authoring tool.

Squashing and stretching a bouncing ball

Lets learn to give the bouncing ball some squash and stretch.

First take a look at what the animation would look like without this effect.

It looks very dull, boring, lifeless with absolutely no personality or character. You can fix this by adding some weight to the animation.

1. On Layer 1, draw a ball and convert it to a symbol. Start the ball with its highest point in the bounce. Set the frame rate of the Flash file to 24 fps. However, you can use different frame rates as well. 24 fps is fast enough for relatively smooth animation without pushing the limits of today's computer.
2. Create a second keyframe somewhere on the timeline. It actually does not matter exactly which frame you choose, you can adjust this later.

3. Create a second layer and add a simple horizontal line as your 'landing' area for the ball.

4. Select the ball symbol on the stage, hold down the shift key, and use the arrow keys to push the ball down to the bottom of the stage. Place the ball slightly above its landing area.

5. Right click anywhere over the frames between two keyframes containing the ball and select Create Motion Tween.

6. What goes up must come down; however, not at a consistent rate of speed. This is due to the fact of the gravitational pull of Earth. When you throw a ball up in the air, its speed will decrease as its altitude increases. When it starts to fall down on the ground, it starts off slowly and gradually increases its speed. You can use the Flash Ease In/Out feature in order to simulate.

   Select frame 1 in the property inspector and adjust the Ease value to -100, which enables the ball to move with ease. This creates smaller increments between the frames initially and gradually increases towards the second keyframe, resulting in the ball to start off slowly and then gradually gain speed.

7. Create a new keyframe after the second keyframe in you tween and squash something so that you can use the function to give more creative imagination to your animation.

8. Select the ball on the stage and select the Free Transform tool. Use the handles on the left and right side of the ball to stretch it wider and then squash it from the top and bottom.

9. The first step in deforming the object is done by using the arrow keys to push the call down so its bottom edges touches the landing surface.

10. The same procedure should be repeated by continuing to the right in the timeline frame by frame, creating keyframes on each frame and increasing the amount of squash and stretch.

11. Start creating the upward motion of the ball after creating three keyframes of squash. You can exaggerate the first frame after the tightest squash frame a little more than

the normal by making it very tall and thin. This results in exaggerating the 'spring' effect of the ball and launching back up from the ground.

12. Now you can make the animation loop. Select frame 1 and then select Edit>Copy Frames. Then a few frames after, select a frame at the last keyframe and select Edit>Paste Frames. This gives the ball the exact shape and position in the last frame as it has in Frame 1, giving you a seamless, looping animation.

13. At last the job is left out to apply motion tween between the final two keyframes. Select the next to last keyframe in the property inspector and apply an ease out, setting the ease value to 100.

    This will result in the ball to start off quickly and gradually decrease speed as it reaches the top (opposite the behavior of your first tween).

    Now you are done with your bouncing ball animation. You note that a the previous static image is now full of life and weight, adding more personality and character to it.

CHECK YOUR PROGRESS

1. Explain the reasons for creating animation.
2. Explain the process of animation setup.
3. What is the duration of animation?
4. How can you scale an animation?

1.8 SUMMARY

- The basic concept of computer animation is based on the change in the position, rotation and scaling of the object at defined points in an order on a time slider.
- Keyframe animation is a technique based on a series of images illustrating a sequence of events, just like story-boarding or a comic strip.

- In keyframe animation, minute snapshots are taken at key moments during a sequence of movements or change. Such key moments are known as keyframes.
- The Bryce application calculates the animation between these keyframes. It also calculates the splinted trajectory as well as a smooth curved trajectory.
- You can create complex animation with ease with the help of keyframe animation. In keyframe animation, you can not only change the geometry of the object but also the color as well as the movement of the object.
- The basic concept of animation is the same in all the 3D applications.
- The reason for creating an animation may be either you are a part of a animated movie or you are animation designer.

1.9 KEY TERMS

- **Animated GIFs**: One of the simplest way of creating animation is animated GIFs. Several GIFs files are placed in a sequential order to obtain a satisfactory animation. You can place such animated GIF on the web page in the same way as the regular GIF file.
- **Javascript-based animations**: Javascript is a simple programming script language that works with HTML and creates animation similar to that of animated GIF. It is different from java, and is more interactive. For e.g. the text can change its color when the cursor is placed on it.
- **Plug-in animations**: A plug-in is a type of software which allows the user to view animation created by other software programs on a web page. You can make interactive CDs and view specially encoded videos clips with the help of plug-ins such as Shockwave and RealPlayer.
- **Rigidity**: The rigidity of an object can also be defined by the squash and stretch technique. The lesser it squashes and stretches, the more rigid is the object and vice-versa. Hence the flexible parts of an object will squash more and the rigid parts less.

- **Storyboarding**: You can draw a stepwise comic strip like storyboard describing what will happen in the animation. This is very helpful for the animator and can be used as a reference.
- **Strobing:** Strobing occurs when the action is fast and the distance between the positions of the object increases and the object does not overlap from frame to frame. As a result, the eye begins to see separate images. When the action is slow, the objects overlap and the eye smoothes the motion out.

1.10 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Define keyframe animation.
2. Explain the seven process of animation.
3. Explain In-betweens.
4. What are the setting keys?
5. Explain the squash and stretch technique.

Long-Answer Questions

1. Briefly explain keyframe animation.
2. What is the process of setting In-betweens?
3. Explain animation controls.
4. What are playback controls? Explain them.
5. What are the basic principles of animation. Explain briefly.

1.11 FURTHER READING

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UNIT 02 MECHANICS OF WALKING

Structure

2.0 Introduction

2.1 Unit Objectives

2.2 pictures in walking

- 2.2.1 understanding the mechanics of walking
- 2.2.2 animating a walk
- 2.2.3 keeping character 's feet on the ground
- 2.2.4 cyclical motion
- 2.2.5 walking tips
- 2.2.6 walking in pictures

2.3 walking exercise

2.4 pushing a box

2.5 Summary

2.6 Key Terms

2.7 Question & Exercises

2.8 Further Reading

2.0 INTRODUCTION

In this unit, you will learn about the mechanics of walking. If you want to move the feet of 3d characters, you have to understand the mechanics behind walking. We all learn to walk as infants, it is a complex task to translate this experience into an animation, even though it may seem simple at the first glance. The process of walking is a bit complex. Along with your feet the other body parts, such as hips, arms, spine, shoulder and head all move as one system to maintain body balance. The complex mechanics of walking becomes a lot clearer if observed joint by joint rather than analysing the whole system at once.

You will also learn that there are advance tools and technology to create animations. In addition, you will also learn about walking a character.

2.1 UNIT OBJECTIVES

After going through this unit, you will be able to :

- Understand the concept of walking
- Explain the mechanics of walking
- Describe how to animate a walk
- Provide a walking exercise
- Push a box

2.2 PICTURES IN WALKING

Much balance and coordination is required while walking, yet without even thinking much about it, you can walk. Your walking style conveys a lot about your personality.

If you are in a crowded place like a market or an airport, try to observe the various ways in which people walk. Some people tend to drag their feet; others waddle and may be some saunter. It is amazing that people have their own particular style of walking. You may have probably observed the dissimilar ways in which charlie chaplin, raj kapoor, mahatma gandhi or jawaharlal nehru used to walk. So, if you want to design a character first make out they walk.

A number of tools are available for animating walks. Also some new and unique tools are available in the market for automating almost all or some of the walking process. It seems as software vendors have dedicated considerable amount of time and efforts on technology requires for animating walks. These advanced tools are both beneficial as well as hindrance. However, its important for animators to understand the way characters walk and the way they want their characters to perform it. It is fascinating to work on software that completesnit in half the time.

2.2.1 Understanding The Mechanics Of Walking

Walking is defined as controlled falling. With each step you take, you tend to lean forward, fall slightly and then balance again by your outstretched foot. You will fall flat on your face, if you fail to put your foot forward at the right time. As soon as your foot comes in contact with the ground, your body's weight is shifted to it and the shock is absorbed by bending of the knee. In a cyclic movement, your front leg lifts the body and moves it forward as the rear leg sways up to balance out again.

Before studying further, take a walk around the room for a while. Closely observe the movement of each part of your body. You will soon observe that each body part has a unique set of motions, be it your feet, your arms or your head. While taking a walk, observe that how you lean forward into a walk and then the way your legs catch up your body to prevent it from falling.

The process of walking is a bit complex. Along with your feet the other body parts such as the hips, arms, spines, shoulders and head all moves as one system to maintain the body balance. The complex mechanics of walking becomes a lot clearer if observed joint by joint rather than analysing the whole system at once.

Breakdown of a basic walk, i.e., step by step, is defined in the following sections. We have animated a simple skeleton for clarity, so you can clearly identify how each joint moves.

- **Feet and legs**

The body is pushed forward by the feet and legs. You should always try to bend the joints slightly, even at full leg extension, so as to keep your character look natural.

- **Hips, Spine And Shoulders**

The centre of gravity of the human body is at the hips; all balance as well as the rest of the body's motion start there. While analysing a walk, it is best to observe the motion of the hips . First, the hips revolve forward and backward with the legs along the axis of the spines; for example, if your right leg is forward, your right hip would rotate forward. Then , at the passing position, the other leg stretches the hip out of the centre resulting in brushing of hips from side to side.

These two movements are then transferred through the spine to the shoulders, which replicate the hips to maintain balance.

- **The Arms**

The arms usually hang loose unless the character is holding something or gesturing someone. However, while walking they move like pendulums, pushing a few frames behind the movement of the hips and shoulders. Even if the arms are at full extension, try keeping them slightly tilted at the elbows, to make them look real.

- **The Head And Spine From The Side**

If you observe the spine from one side, you can view its general posture. Depending on the character's attitude, it may be very stiff or bended over. In a regular walk, the head tries to maintain its level while the eyes point to the direction of the walk, in this process the head bobs around slightly to stay balanced. If the character is in an energized or agitated state, this bobbing will be more evident. The head may also bend a little for a sad character or may move in move in both directions to look around as per the scene.

2.2.2 ANIMATING A WALK

Once you have understood the underlying mechanics, you can design your own animated walk. A walk cycle is tough to create if you are employing traditional animation techniques, and it can be just as complex on a computer.

The first thing you need to concentrate on is the timing of the walk and the number of frames it takes for the walk. That is a tough problem to solve, though it depend on character, for instance, large, small or scrappy. Whether your character is running or walking? Is it happy or somber? You have to consider all these factors to determine the time it takes for your character to take its first walk.

A regular walking gait will required one - third to two -third of a second per step. For instance, 8- 16 frames at 24 frames per second or may be 10-20 frames at 30 fps with an average about half second per step. A full cycle is about second per cycle. Usually bigger character moves and walk slower than smaller character. Smaller character walk faster. Also, men have slightly slower walk than women. If your character is sad than it will walk slowly than happy one.

One benefit of working with a computer is that it has software that allows you to scale the duration of the animation. If the character tends to walk too slowly, you can increase the speed by reworking the keys.

2.2.3 Keeping Character's Feet On The Ground

Keeping your character feet locked to the ground is the most important thing to remember when animating a walk. The friction between the ground and the feet push him forward. The illusion of friction is lost if the feet slide around and the animation does not look realistic.

Keeping the feet lock on ground depends on your software and its available features. To assist you in this task, many packages have tools while others do not. A few popular methods are as follows:

- **IK with locks**

Many packages available with ik permit you to lock or pin an object, such as foot or hand either to a point in space or with some other objects such as the floor. As ik makes sure that a character's grounded foot stays in the same spot for the duration of the step, it is one of the preffered animation walk methods. Knowing that the animation feet is locked, it releases the animator's mind from other details and allows him to concentrate more on animating the character.

- **Forward Kinematics With Locks**

You can moves the end of the chain by using inverse kinematics and the computer identifies a solution, by simply rotating automatically some joints to place the skeleton together. This solution is not optimal some times, because it forces you to rotate the joints manually. Plug ins like kinetix biped for 3d studio max and meme-x's lock and key for light wave enable you to lock the feet to the ground and the skeleton is manipulated with or without ik.

- **Footstep Generators**

Certain packages have footstep generators. 3d studio max biped and softimage's multiped are the most popular among these. These plug-ins allows you to toss down footprints on the ground, down ladders, up hills or whether you wish. The program automatically moves the character legs and feet's. In the true sense of word, this is not animation. An algorithm typically generates the motion that calculates the character's physical weight and dynamics.

To get the initial pass of the walk into the computer it is great to use such a plus- ins but that is just what it will do. As the animator, your responsibility is to manage the process and add personality to the walk. You must move back to the animation and tweak the postures and to give your character its individuality, motion on a second and third pass.

- **Inverse Or Broken Hierarchies**

Ik is not required in this method and it can work with any package that supports forward kinematics. If a normal skeleton is considered, the hips are places at the top while the legs and spines are placed below. This setup ,may creates problem if you do not have the method to lock the feet, as movement of the hips will move the spines, legs and feet.

The hierarchy is reversed upside- down and broken at the hips in the inverse hierarchy method. The feet are placed as parents of the legs thus allowing you to place the feet where you want them. As the feet are parents, you can be sure that they would not move unless you are certain that they should be moved.

If the feet are the parents than what about the hips? In a hierarchy as the object cannot have two parents , the hips must be detached from the legs and should be forced to move freely above them. The hips are animated in the next step so that they catch up with the legs. As the exact matching of the hips and the legs can be problematic, it is preferable to use this method for character whose hips are hidden like a character in a skirt. This works well if bones are used as the character skin tends to complicate most of the hip alignment problems. Viewers generally first notices the feet slipping before they notice that the hips are not connected well; this seems to be the lesser of two evils.

- **Using Guides**

In the placement of feet, you can always use guides to aid, if you are not able to use the preceding methods. In any package,. You can keep null dummies, objects or transparent objects along with the character's feet and they can be used as virtual placeholders. You have a reference point. If the foot moves inadvertently, it allows you to put the foot back where it belongs.

You can stimulate an onion- skin effect in some packages by ghosting the preceding frames. This helps in providing a good simulation of the traditional animators light table. As you can see the position of the feet on the previous frames, it is simple to align them on the current frame.

Finally, wet-erase overhead projector pens are used by some animators and the guides are drawn directly on the computer screen. Damp cloth erases the mark. Be careful, if you hold the wrong pen as it can make permanent marks on the screen. A good method would be the use of a sticky note placed on the screen and marked with a pencil.

2.2.4 Cyclical Motion

For the animator, it is advantageous to create walking motion as a cyclical motion in comparison with straight- ahead animation, since walking is a cyclical motion. A cyclical motion can save an inordinate amount of animation time, if it is done properly. Single cyclical motion can be applied to various environments. In a cityscape, your character and his cyclical motion can simply be placed as a country road as the walk motion is similar.

You do not have to replicate your efforts, as by simply repeating a sequence of drawings and swapping only the background painting, you can draw a lot to place the character in a different location. Classical animators used this trick. To make the shot look completely different in 3d , you have an option to change the lighting, camera and environment.

There are drawbacks of using cyclical motion. First, a cycle is repetitive; it will look unproductive and flat if viewed for a long period. Second, cycles work best on a flat terrain. So if the character walks around a corner or up a hill , the cycle might not match up as required . It can be hard to stop a cycle once it starts in some of the programs. For instance, if your character walks to a house and stop there, the cycle must be halted and the character must be keyframed again from that point. Animating a cycle is synonymous to making your character walk on a treadmill.the tricks is that the body does not move around the ground or the ground may move past the character, at the exact same pace the feet are moving. If not done property the character's feet appear to slip a little. The foot on the ground also requires moving exactly the same distance on each frame. Now, if the length of the steps differs, the feet appear as if they are slipping.

The following exercise demonstrates the only way by which you can create a two-legged walk animation. This is definitely not the only way to animate, but it does include many major points discussed. You can employ these ways as jumping off points for developing your own techniques.

2.2.5 Walking Tips

While working on animating multiple characters, it is always better to simplify the animation process, create them walk at the same rate; however, it is not a great idea. Giving your characters the same appearance makes your character appear as if they are marching in unison, which can move away from the shot. It is always better to use the walk cycles in such a way that it gaits to characters. If one vharacter walks at the rate of 12 frames per step, then the other should walk slightly slow or fast- may be 10 or 15 frames per step. You make your shots more different and interesting by mixing them up.

2.2.6 Walking In Pictures

The walk usually starts with the feet at the "extended position," where the feet are farthest apart and the character’s weight shifts to the forward foot.



As the weight of the body is transferred to the forward foot, the forward knee bends to absorb the shock. This is called the "recoil position," and is the lowest point in the walk.



Halfway through the first step, the forward knee straightens out and lifts the body to it’s highest point. In this "passing position," the free foot passes the supporting leg.



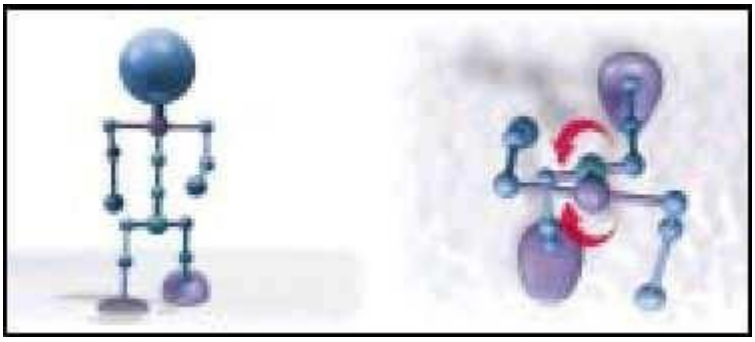
As the character moves forward, the weight-bearing foot lifts off the ground at the heel, transmitting the force to the ball of the foot. The body starts to fall forward. The free foot swings forward like a pendulum to meet the ground and catch the body's weight.



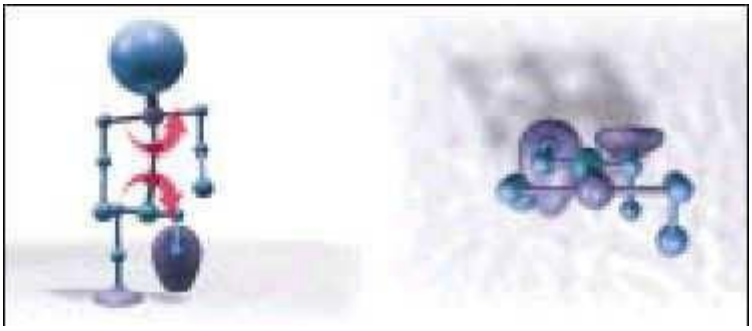
The free leg makes contact with the ground, completing half the cycle. The second half is an exact mirror of the first. If it differs, the character may appear to limp.



When the feet are fully extended, the hips rotate along the axis of the spine. To keep balance, the shoulders swing in the opposite direction. From the front, the spine looks relatively straight. But from the top, you can see the hips and shoulders twist in opposite directions.



At the passing position, the front view shows the weight of the free leg pulling the hip out of center, causing a counter-rotation in the shoulders. From the top, however, the hips and shoulders are nearly parallel.



At the extension of the second leg, the hips and shoulders again are flat when viewed from the front. From the top, however, you can see the completed rotation of the hips and shoulders.



Because walking is kind of like falling forward, the body should be angled forward slightly at the hips for most walks. The spine will arch up slightly to keep the chest and head over the hips. However, this line of action can change with the character's attitude.



CHECK YOUR PROGRESS

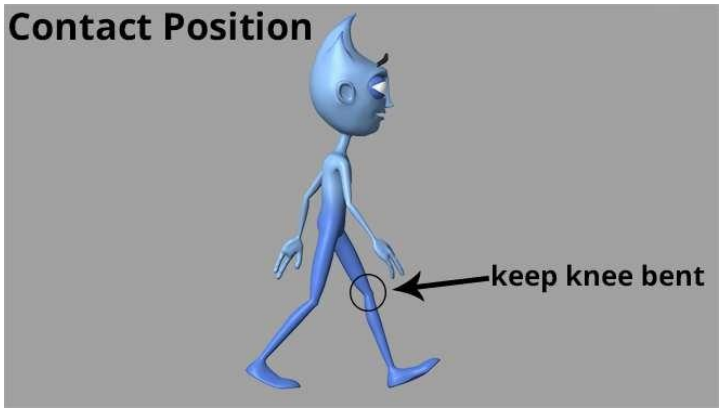
1. Define walking.
2. What factors are taken into consideration while animating a Walk?
3. What is cyclical motion?

2.3 Walking Exercise

Step 1 – Find video reference

This step should come as a no-brainer, but it's so important that it is worth mentioning. Video reference is the animator's best tool. Before starting your walk cycle you need to study how the human body moves during a walk.

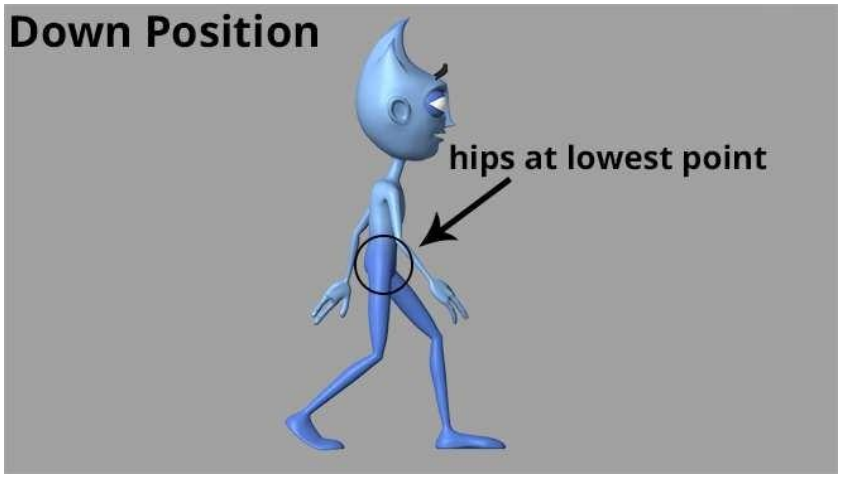
How do the hips rotate? Where is the weight centered? How many frames does it take for each step? These are the types of questions you should be answering while you study your reference. Even if you find your video reference online, try making your own video reference so you can feel the motions your own body makes as you walk. Remember this is just for your own reference so you don't need an amazing camera for this; any cell phone camera will suffice.



Step 2 – Create the contact position

There are four main positions in a walk that you must block in first. These are the foundation for your animation, as without them, your walk won't feel like a walk. The first of these is the contact pose.

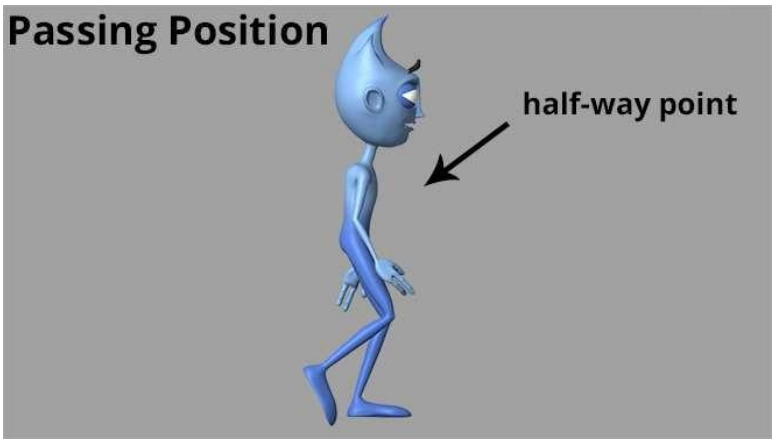
This is the moment when the leg is at full extension and the foot is first contacting the ground. This pose is the start and end of each step and sets the stage for how your walk is going to look. When creating the contact pose don't hyper extend the leg, or have it perfectly straight. Instead keep a slight bend, so as to eliminate some of the popping in the knees that may occur.



Step 3 – Create the down position

When creating a realistic walk cycle, the weight of your character goes down just after the contact. To translate this in your character you will need to create the down position.

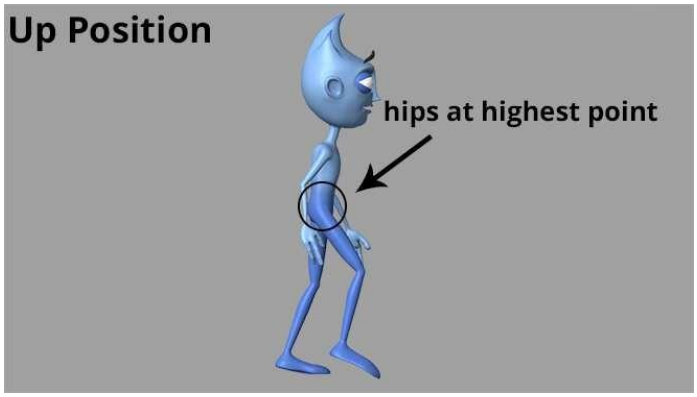
This pose shows that the character's full weight has been shifted over to the contacting foot. Since this is the lowest position in the walk, it helps show the weight of the character by how far their hips drop. Make sure not to over do it. To create a more natural walk, make sure your character isn't bobbing up and down.



Step 4 – Create the passing position

The next pose you'll need to create is the pose for when one of your character's legs passes the other. For this, the weight of your character will start to go up for the passing position.

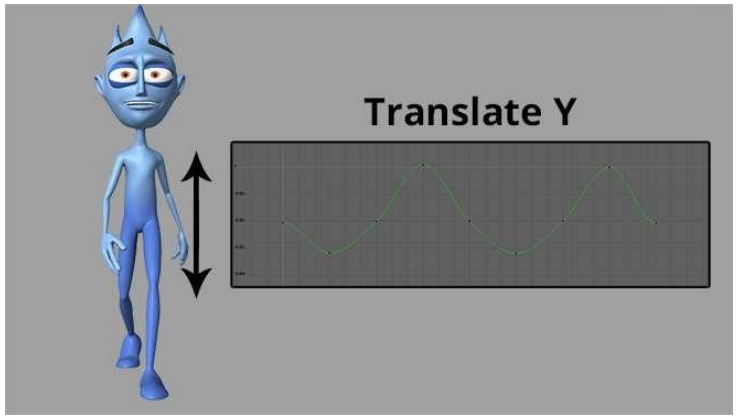
In order to keep that from looking off balance, the weight of your character needs to be over the supporting foot. At this point in the walk the foot is off the ground, your character should be midway through the stride and both arms are at the side of the character. Think of this as the half-way pose.



Step 5 – Create the up position

This is the last of the four main positions in a walk cycle. The character is at the highest point of the walk during the up position and the leg is swinging out at this point as it is preparing to plant on the ground. This position can be thought of as the falling point of the walk.

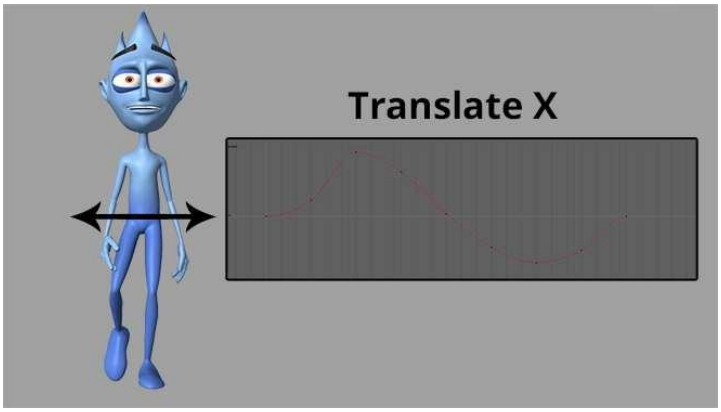
The character's weight should be leaning forward and at this point the heel of the back foot is the contact position for the foot, so make sure it is rotated up. After your character has the up position blocked in, you should repeat steps two through five to create these four main positions for the opposite leg. Once both steps are blocked in you can simply cycle the animation before starting to refine the animation.



Step 6 – Refine the up and down weight

The weight of your character is something you want to get correct first. To get the proper weight you'll want to adjust the up and down parameter (usually the Translate Y) for the root control.

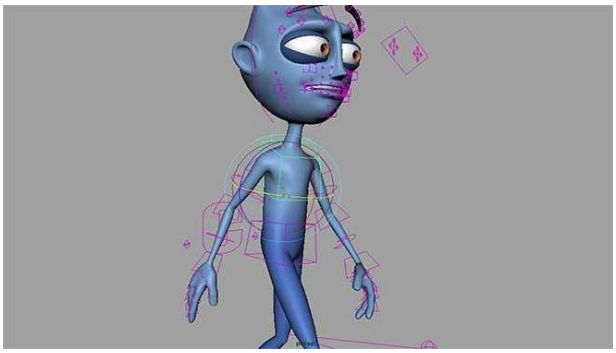
A good way to get the proper weight is to think of your character's hips as a ball bouncing as it goes up and down. Use this visualization to help you as you adjust the curves to get something similar to a bouncing ball. You may notice this has an affect on the legs, but don't worry about that yet! With most animation you'll want to refine the shot from the root control down. This is simply because any changes you make to the root will affect the legs, so you should make sure everything up the hierarchy looks good before fixing the legs.



Step 7 – Refine the side to side weight

After you've got the up and down movement looking and feeling correct, it's time to go in and refine the side to side movement (usually the Translate X). A good rule of thumb to go by for this is to have the hips directly above the planted foot. Doing this will ensure your character feels balanced when their weight is shifted from side to side.

Make sure the spacing is correct by adjusting the curves in your graph editor. In most cases there is no need to add extra keys at this point as you can most likely get it looking believable by just manipulating the tangent handles.



Step 8 – Refine the chest movement

The upper body of the character can add so much life and appeal to your walk. If your character has big, broad chest rotations it can give the character a bit of an attitude. Depending on what look you're going for you can use this to your advantage or you can try to keep it relatively subtle.

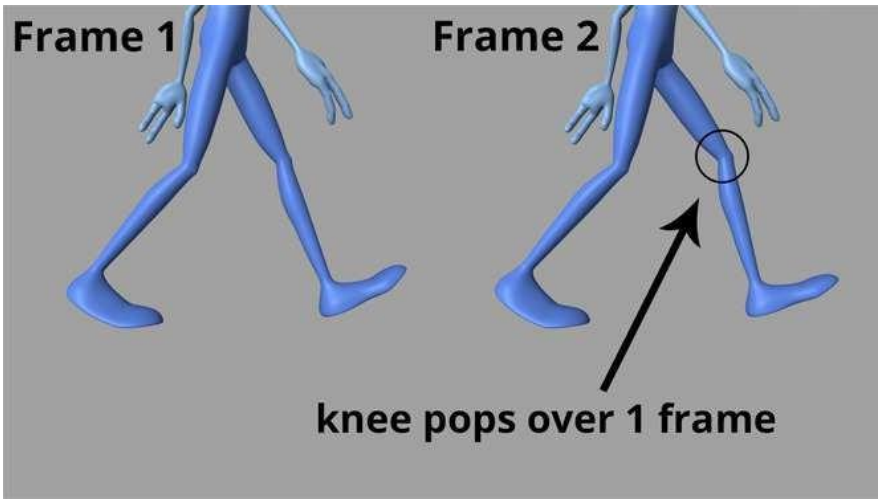
Keep in mind that even if you don't want to add some attitude to your character, you'll still want to incorporate some rotation in the chest to increase its believability. If the arms are moving, so is the chest. No one walks with a chest that is perfectly still.



Step 9 – Add drag and lead and follow to the arms

Once the chest is refined and looking great it's time to go in and adjust the arms. This is the point where you can start adding nice lead and follow, and drag in the arm joints. For example, think of the arms as a chain of movement that mimics the chest. The shoulders move first, followed by the upper arm, the elbow, and finally the wrist.

Have fun with this one and experiment with the amount of overlap and drag that you incorporate into the animation.

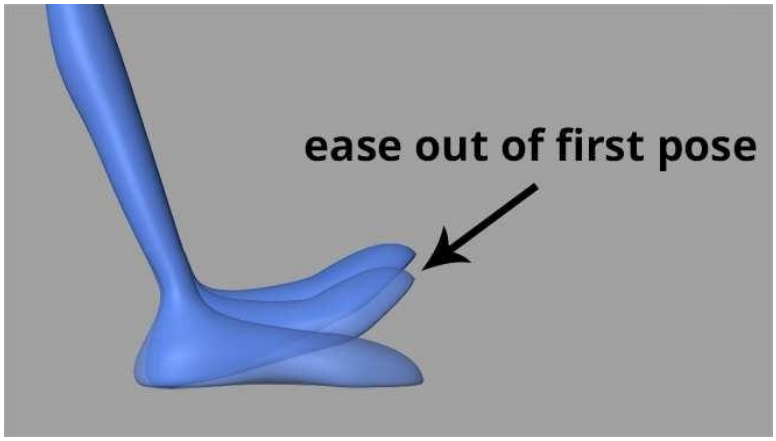


Step 10 – Fix any knee popping

After all the work on the upper body is complete, now it's time to focus your attention on fixing any issues with the legs. Usually this means addressing the popping in the knees that will most likely be occurring at this point. This issue is relatively simple to fix. You have a couple options and which one you use will depend on your particular project.

The first technique you can utilize is to take advantage of a leg stretch control that may be available on your rig. If your rig has this, try to shrink or stretch the leg slightly to get rid of the popping. Don't over do it though! This should be used sparingly.

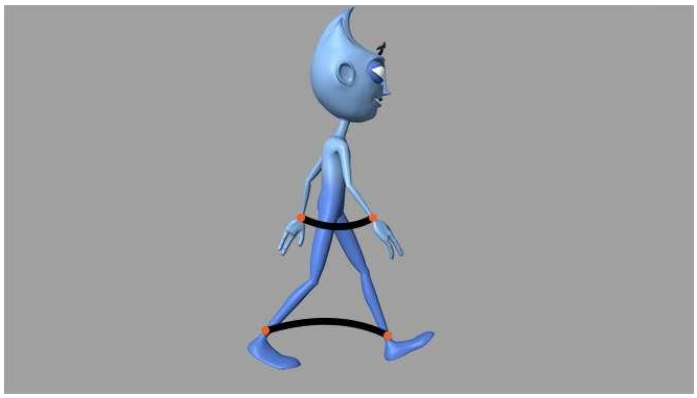
If your rig doesn't have a leg stretch control, an alternative technique you can use is to adjust the hip control to eliminate any popping. The amount of tweaking necessary to eliminate the knee popping should be minimal if you kept a slight bend in the knee when you created the contact position.



Step 11 – Flap the feet

A great way to sell the weight of the character is to have the feet slap firmly on the ground. The feet should go from a raised position to flat within one or two frames. Ease out of the first pose and plant on the next.

By doing this it will give the feet a snappier feel and sell the weight of the character. You can even raise the toe up to add a bit of drag during the ease out pose.



Step 12 – Polish your walk

The final step is to push the walk to the next level. Add the fine details that will enhance the animation. Track all the arcs of the feet and hands. Add some drag in the fingers and head. Refer back to your video reference to find the things that you think will benefit the animation and add in that final 10% of the walk cycle.

2.4 Pushing A Box

Ik blending function in maya is used to make an animation in which an object pushes a box. Ik blending allows you to switch between fk and ik by keying the state of the ik solver, so that both of the characters arms can swing freely while walking, and then lock onto the box by switching to ik. The steps are as follows:

I. Open the scene called pushingboxstart.ma on the dvd. Play the animation and you will see the character move and then stand in front of a box. At frame 110, set a key on the ik blender attribute with its value set to 0. Make sure that the keys is created by keying just the selected attribute.

II. In the side view, move the ik handles in front of the body. Key the transmission.

III. In frame 140, select both arm ik handles and turn on ik by setting the ik blender attribute to 1. Highlights this attribute in the channel box, right click it, and choose key selected.

IV. Scrub the current time indicator between frames 110 to 140 and you will see the arms moving between them smoothly. Adjust the placement of the ik handles and animate pole vectors from frames 110 to 140 to add elbow animation, so the elbow are pointing down more. Also, rotate the ik handles so the character has both hands against the box at frame 140.

V. Animate the pelvis control, foot controls, arm iks and box to make the box move forward. You can make the box appear to be heavy or light by using different trimmings.

CHECK YOUR PROGRESS

4. What is a walk cycle?
5. How do you start animating a walk?
6. How many frames will you have to create for making a cyclical walk motion?

2.5 SUMMARY

- Much balance and coordination is required while walking, yet without even thinking much about it, you can walk. Your walking style conveys alot about your personality.
- Walking is defined as controlled falling. With each step you take, you tend to lean forward, fall slightly and then balance again by your outstretched foot.
- If you want to design a character, first make out how it walks. There are many tools available for animating walks. Thus, you can automate almost all or most of the walking process.
- Once you have understood the underlying mechanics you can design your own animated walk. A walk cycle is tough to create if you employ traditional animation techniques.

- Keeping your character feet firmly locked to the ground is the most important thing to remember when animating a walk.
- For the animator, it is advantageous to create walking motion as a cyclical motion in comparison with straight ahead animation, since walking is a cyclical motion.
- While working on animation multiple characters, it is always better to simplify the animation process, make them walk at the same rate; however it is not a great idea.

2.6 Key Terms

- **Broken hierarchies:** it can work with any package that support forward kinematics. This setup may create problems if you do not have the methods to lock the feet, as movement of the hips will move the spine, legs and feet.
- **Footstep generators:** these plus-ins allow you to toss down footprints on the ground, down ladders, up hills wherever you wish. The character legs and feet are automatically moved by the program to match.
- **Forward kinematics with locks:**this solution sometimes is not optimal because it forces you to rotate the joints manually.
- **Keyframes**: it contains the computers interpolated values of the nearest keyframe to those of the next keyframe.

2.7 Questions And Exercises

Short- Answer Question

1. What are the drawbacks of using cycle?
2. Give a few examples of tools for animating walk?
3. What is the drawback of broken hierarchies?
4. What is the benefit of footstep generators?
5. What is the drawbacks of forward kinematics with lock?
6. Why is ik with locks one of the preffered walk animation methods?
7. What is keyframe?

Long-Answer Questions

1. Explain the mechanics of walking.
2. Explain walk animating.

3. Discuss walking in pictures.
4. Descibe a walking exercise.

The capability to lock your characters feet to the ground is significant, but not essential

2.8 FURTHER READING

Introducing Autodesk Maya 2016: Autodesk Official Press

UNIT 3 ANIMATION TOOLS

Structure

3.0 Introduction

3.1 Unit Objectives

3.2 File Referencing

3.2.1 Creating References: Hierarchical Scene Management; 3.2.2 Proxy References;

3.2.3 Proxies with Shared Edits; 3.2.4 Proxy Referencing Workflows; 3.2.5 Proxy Tags

3.2.6 Reference Editor, 3.2.7 Managing References; 3.2.8 Viewing Selected References

3.3 Non-Linear Animation

3.4 Using Trax Editor

3.5 Create Character Set

3.5.1 Features of Character Setup

3.6 Animation Retargeting

3.7 Retargeting Workflow

3.7.1 Setting a Neutral Pose and Target Skeletons

3.7.2 Labelling the Joints and Target Skeletons

3.7.3 Set the Retargeting Solver Options

3.8 Tutorial on Retargeting

3.9 Summary

3.10 Key Terms

3.11 Questions and Exercises

3.0 INTRODUCTION

In this unit you will learn about animation tools. A set of tools is located at the bottom of the window. It stretches along the width of the working area just beneath the multiple views. This set of tool helps control how you view your animation, you timeline and how you view your scene. The technique of file referencing helps to function with complex and large scenes.

In addition, you will learn about file references, which provide many workflow possibilities for functioning with large and complex scenes. You will be able to use trax editor which will help you to create character set. You will ve able to use trax editor which will help you to create character set. Character setup includes using Maya's deformers, skeletons, skinning , constraints and character features. Further, you will learn about animation retargeting. Animation retargeting is a process by which animation data from one skeleton is used to another skeleton. Finally, tutorial on retargeting is also given.

3.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Understand the concept of file referencing
- Describe how to create references
- Explain proxy references
- Provide the concept of references editor
- Explain how to manage references
- Describe the use of trax editor
- Explain how to create character set
- Provide details of animation retargeting

3.2 FILE REFERENCING

File referencing provides many workflow possibilities for functioning with large and complex scenes

3.2.1 Creating References: Hierarchical Scene Management

Hierarchical scene management

Objects, materials, and animation sequences that exist in the scene can be easily organized in a hierarchical manner based on the production requirements. A pre-planned file referencing structure allows a production team to collaborate concurrently and efficiently on their project.

Scene segmentation

Complex scenes can be managed better when divided into various multi-level referenced files. When the contents of a scene are assembled as small units that are referenced into a scene, the references can be loaded or unloaded from the scene as required. This gives you the option of loading and working on their particular segment of the scene without affecting the work of others. For example, a cityscape scene could be segmented so that one team works on the buildings and miscellaneous street props, another on the trees and vegetation, and another on the animated characters. Loading one segment of a larger scene provides additional benefits such as performance improvements.

When you create file references, you can provide the reference a unique name called a namespace. Using namespaces lets you reference the same object in a scene multiple times without the risk of creating object name clashes. See Namespaces.

Asset reuse

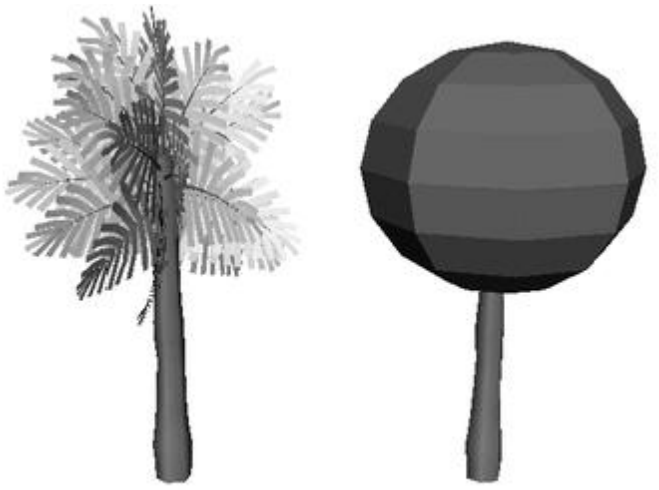
Scene assets for a project ideally need exist only once, and can be reused by being referenced multiple times, by multiple users, in many different scene files if required. For example, a prop such as a tree can be referenced many times into a large scene of a cityscape, and repositioned as necessary without affecting the referenced file. Scene assets, such as models, materials, and animations, can be worked on separately without affecting assets. As a second example, a technical director creates a rigged character used for all the shots; that master rig is then used for various animations. Any issues with the rigged character can be fixed once rather than re-importing the model into many different scenes.

Asset proxies

Complex scenes can be substituted by referencing less complex proxy scenes that can be used as simple spatial references. This improves interactivity, faster animation playback, and assists in accelerating the iterative nature of lighting and rendering tests when in production.

3.2.2 Proxy References

Proxy references let you substitute one or more file references by creating a set of possible substitute references, known as *proxies*, for a given file reference. Proxy references are files that you create to visually or spatially stand in for an existing file reference. In most cases, proxy references are used to temporarily simplify complex scenes by substituting simpler versions of the objects into the scene. This allows production work to proceed without the overhead of the complex components of the original scene. When a scene is simplified in this manner, Maya's performance improves.



Original file reference of tree
1,800 polygon faces

Proxy reference
170 polygon faces

Proxy references reduce the visual clutter in a scene by allowing you to focus on the elements you need to work on while still maintaining a spatial context of the scene's elements.

For example, you can substitute a scene that contains primitive objects that exist in the same position, size, and scale as a similar scene that contains more complex and detailed versions of furniture for an office. By substituting a simple primitive-based proxy version of the scene, you can obtain better interactive performance when dollying, tumbling, or playing back animation. Because the primitive objects also represent where the more detailed versions of the furniture elements exist spatially in the original file reference, the user can more easily concentrate on animating their character or camera.

Creating proxy references

To create a proxy reference for a scene you must first create a scene that contains the proxy reference data. This could involve creating a scene that generally matches the contents of a pre-existing scene but contains simplified versions of your characters, props, and assets. The items in this scene should be set up and positioned exactly the same way as your more complex version of the scene, so that a spatial correlation is created between the *high* and *low* detail versions of the scenes. Once the high detail version of the scene is referenced, the low detail version can be added as its proxy reference using the Reference Editor.

A proxy reference can only be created for an existing file reference. A proxy cannot exist by itself.

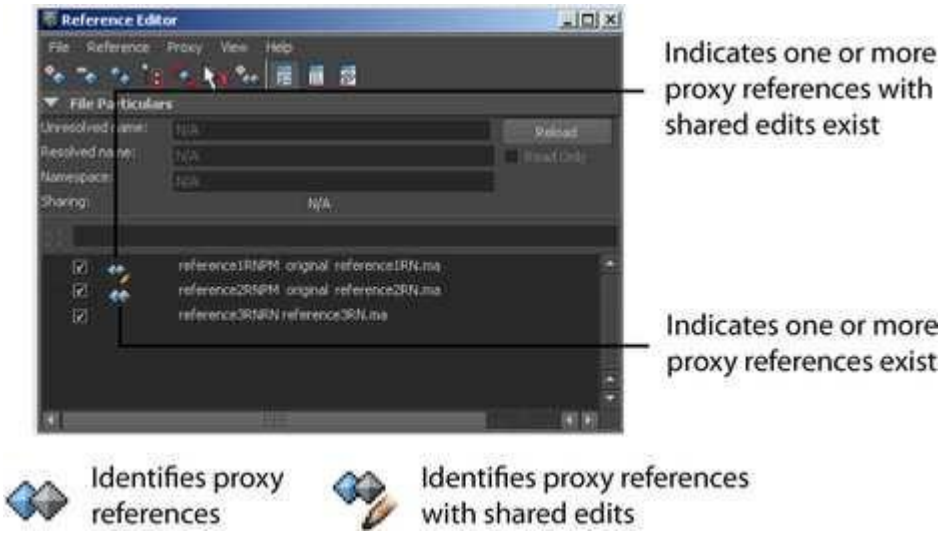
When a proxy reference is first created a *proxy set* is also created. When the proxy set is created, the original file reference as well as the selected proxy reference are organized under a new proxy manager node. You can then select which file (the original reference or the proxy reference) to load in the scene using the Reference Editor or by right-clicking an object in the scene and making the appropriate selection from the marking menu.

3.2.3 Proxies with Shared Edits

You can share edits between proxy references. This is useful in situations where animation or transform data is shared between members of a proxy set. If a proxy set is created with shared edits, an edit made to a proxy reference is shared by all the other members of that proxy set. Any edit that can be applied to a reference file can be shared.

When first creating a proxy set, you can either make the proxies all share edits, or make all proxies have individual edits. If a proxy with shared edits is added, the proxy, as well as any subsequent proxies added to the set, then shares edits.

When a proxy set is created with shared edits, the original reference becomes a proxy reference within the new proxy set. In the Reference Editor, an icon is displayed to indicate the existence of one or more proxies for the reference, and to indicate that all proxies share a common set of edits.



If a proxy set is initially created with Shared Edits turned off, each member of that proxy set has its own independent set of edits.

Note: Maya keeps track of the Shared Edits option. If you create a new proxy set usingProxy > Add Proxy, Maya uses the Shared Edits status of the last proxy set that you created.

You must define whether a proxy set can share edits when you first create it. The shared edits setting cannot be changed once a proxy set has been created.

If a proxy set is created with shared edits, Maya keeps track of the edits applied to the active proxy. Whenever a different proxy from the proxy set is made active, Maya attempts to apply the existing edits to the newly active proxy. Maya also keeps track of any edits that cannot be applied. Such edits may be applied when a subsequent proxy is made active.

Shared edits can be useful when animating a low resolution proxy of a high resolution character. Provided the node names are identical, shared edits are applied to both the low resolution and high resolution representations of the character.

Note:

- *Edits applied to one proxy disappear when switching to another proxy if the node names in the different files don't match. See File referencing tips, specifically the sections "Sharing animation between proxy references" and "Editing referenced files" for complete details on the limitations of using proxy references.*
- *Using Save Reference Edits on a reference that contains proxies using Shared Editssaves it to the current loaded proxy only. Since the shared edits are deleted after that function, the other proxies do not get these edits anymore.*

3.2.4 Proxy Referencing Workflows

Proxy references let you substitute different files in the scene that have been previously organized within a proxy set. You must have an existing file reference in order to add one or more corresponding proxy references to the proxy set. An example of a generalized proxy workflow is provided below:

Example 1: Creating proxies for a file reference

1. Create the files you want to use as proxy references.

For example, if you have a full resolution version of your scene, you can create simpler, lower resolution copies of this scene. That is, the copies could contain identical content with identical naming structures, but have simplified versions of the objects. As a result, you might have three versions of the scene: a high resolution version called*Scene_HiRes.ma*, a medium resolution version called *Scene_MedRes.ma*, and a low resolution version *Scene_LowRes.ma*.

2. Create a file reference for the full resolution version of the scene, and give it a proxy tag name of *HiRes*.

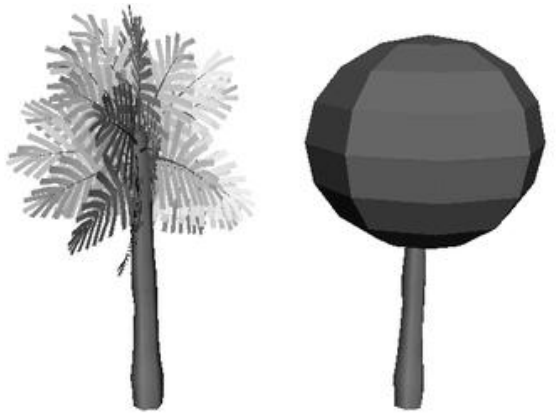
3. In the Reference Editor, select the file reference you just created and then add one of the other files as a proxy reference using the Reference Editor's Proxy menu.

In this example, when you add the file *Scene_MedRes.ma* as a proxy, ensure you apply a proxy tag named *MedRes*.

4. Repeat step 3 for the *Scene_LowRes.ma* file to add it to the proxy set ensuring you apply the appropriate proxy tag name (*LowRes*).

You can load or unload multiple proxy references in the scene simultaneously by selecting the multiple file references within the Reference Editor, and then select the appropriate proxy tag name (provided you have been consistent with your proxy tag naming).

The next example shows you how to add a proxy reference using the Reference Editor, identify it with a unique tag, and then load it into the scene.



File reference of tree model
1,800 polygon faces

Proxy reference
170 polygon faces

A scene contains a file reference to a scene containing a tree model. The referenced tree will be substituted with a simpler proxy reference.

Example 2: Adding and loading a proxy reference

1. In the Reference Editor, from the list of file references, select the existing file reference for the detailed model of the tree.

In this example, the file reference is named *tree*.

2. In the Reference Editor, select Proxy > Add Proxy > ❐.

The Proxy Options window appears.

3. In the Proxy Options window, set the Proxy Tag Options by typing loRes in the text string field.

4. Click the Proxy button.

The file browser appears showing the current default project scene directory (or the last directory that was accessed by the file browser when referencing a file).

5. In the file browser, select the *treeSimple* scene you want as the proxy reference.

6. Click Proxy to add the selected file as a proxy reference to the existing file reference.

The proxy file is added to the list of available proxies within the proxy set and the loRes proxy tag is applied. This is indicated by the icon in the Reference Editor. The proxy file will not appear in the scene until you load it.

Note:

Whenever you add a proxy reference to an existing file reference, it is not immediately loaded into the scene until you specify that you want it to be loaded.

7. In the Reference Editor, with the existing file reference still highlighted, select Proxy > Reload Proxy As.

8. Select *loRes* from the pop-up menu that appears.

Maya updates the file reference by loading the *treeSimple* proxy reference (tagged*loRes*) into the scene.

3.2.5 Proxy Tags

Proxy tags are unique names you assign to proxy references to more easily manage those proxy references from within the Reference Editor. You can apply a proxy tag to a file or proxy reference when you:

- Initially create a file reference using the Reference Options window.
- Add a proxy reference to an existing file reference using the Proxy Options window.

Note:

When you apply a proxy tag to a file reference, the tag is not used until a proxy set is created for the file reference. A proxy set is created when the first proxy is added to the file reference.

The Proxy Tag options lets you specify the label/tag you want applied to a file or proxy reference when it is first created. Once a proxy tag is applied it appears in the list of proxy

references within the Reference Editor. Proxy tags also let you globally load, unload, or switch between proxies based on their tag.

Maya keeps track of, and can distinguish between, the last proxy tag used for a file reference, and the last proxy tag used for a proxy reference. This ability streamlines the tagging process regardless of your preferred workflow.

For example, you may want to tag multiple file references in succession with a tag named*hiRes* when you first create each one. In this case, you need only type the tag name once and it is automatically assigned to successive file reference tags. If you want to tag multiple proxies for those same references, you only need type in the proxy tag name for the proxy once, and the proxy tag will be remembered for successive proxies.

Alternatively, you may want to create and tag one file reference named *hiRes* and then immediately create and tag its corresponding proxy reference named *loRes*. You can then create the next file reference and it will automatically be assigned the tag *hiRes*, then create its proxy reference, and it will automatically be assigned the tag *loRes*. Because Maya can distinguish between the most recent file reference and proxy reference tags specified, this alternating tagging workflow is possible. For more information see Proxy Menu.

Proxy Tags can be used for many other proxy situations; for example, *modelFur* vs.*modelNoFur*, or *SceneDynamics* vs. *SceneNoDynamics*.

Notes

- *If a file reference has not been assigned a unique proxy tag prior to the creation of the first proxy in the scene, the file reference will be assigned a proxy tag named original to differentiate the original file reference from the first proxy. Once a tag has been specified for a file reference, it will continue to be used as the default file reference tag until another is specified. That is, Maya only uses the default original tag if the user has not previously explicitly specified a tag for a file reference.*
- *If a proxy tag is not specified when the first proxy reference is created in the scene, Maya will automatically apply a unique proxy tag based on the name of the reference node. Once a proxy tag has been specified for a proxy reference, it will continue to be the default tag for proxy references until another is specified. Maya only uses a default proxy tag name when the user has not previously specified an explicit tag name for a proxy reference.*

Renaming proxy tags

You can now rename proxy tags for references and proxies using the Reference Editor. This is useful if you want to keep your proxy tags organized or descriptive, or if you want to reuse proxy tags to streamline the process of switching proxies.

Note:You cannot use the same proxy tag more than once within any given proxy set. All proxy tags in a set must be unique.

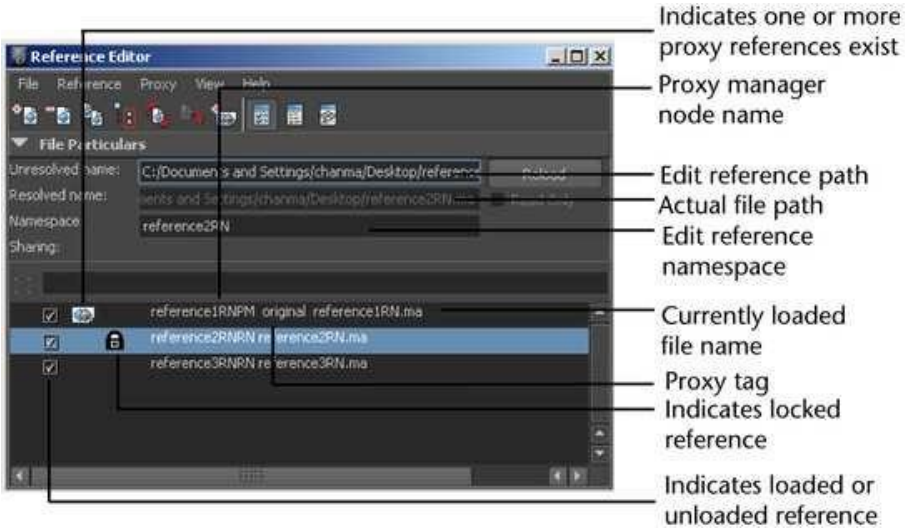
3.2.6 Reference Editor

To open the Reference Editor

- In the main menu bar: File > Reference Editor
- In scene view: Panels > Panel > Reference Editor

The Reference Editor lets you manage the file and proxy references in your scene.

You can also manage and edit file and proxy references using the Outliner.



The following table provides a brief overview of task using the Reference Editor.

To...	**Do this**
Create a file reference.	Select File > Create Reference. See Creating file references.
Unload a reference.	Select the reference you want to unload, and then select Reference > Unload Reference. SeeLoad and unload file references.
Reload a previously loaded reference.	Select Reference > Reload Reference. See Load and unload file references.
Lock or unlock a reference	Select the reference you want to lock or unlock, and then select Reference > Lock Reference orReference > Unlock Reference. See Locking a file reference.

To...	Do this
Replace a reference with a proxy reference.	1. Select the existing file reference you want to add the proxy reference, and then select Proxy > Add Proxy. 2. In the file browser, navigate to the file you want as the proxy reference, and click Reference .
Remove a proxy reference.	Select the proxy reference you want to remove, and then select Proxy > Remove Proxy.
Duplicate a reference	Select the reference you want to duplicate, and then select Reference > Duplicate Reference. See Duplicate file references.
Remove a reference	Select the reference you want to remove, and then select Reference > Remove Reference
Save reference edits	Select the reference that has reference edits you want to save, and then select File > Save Reference Edits. See Reference edits.
Export changes made to a reference in your scene to an edits file. You can then assign these edits to another referenced object.	1. Select the reference that has reference edits you want to assign. 2. Select File > Export to Offline File. See Export to an offline file.
Assign reference edits to another referenced object. The reference edits must first be exported to an edit file.	1. Select the reference to which to you want to assign reference edits and select File > Assign Offline File. 2. In the browse window, select the edits file that contains the edits you want to apply. See Assign an offline file.

3.2.7 Managing References

Planning the file and node naming conventions for the parent scenes and referenced files is important and will greatly add to the success of the implementation of file referencing in your production environment. In particular plan to ensure that:

- All files are uniquely named: the same file name should not be used more than once in any project. When Maya doesn't find a file that it is looking for, it will look in other places relative to the current project, and as specified by the current environment variables that may have been set. For example, a project could have numerous files called light.ma; a desk light, a streetlight, and a low resolution (light poly count) version of a character. To prevent any file referencing ambiguities, these files should be more explicitly named: deskLight.ma, streetLight.ma, and lightCharRig.ma.
- If possible, you should avoid naming files so that file names begin with a number. If you try to reference the file from the command line, you may experience problems. For more information, see Executing system commands.
- The Use Namespaces option is turned on when first referencing a file to ensure all nodes within a file are explicitly and uniquely named. For example, an object named tree1 within a file called mapleTree will have a node named mapleTree:tree1 when the file is referenced into the parent scene. The other nodes associated with that object will also be named in a similar manner. For more information, see Namespaces.

Alternatively, you can specify namespaces of shorter length than the default file name when it makes sense. A shorter node name streamlines your workflow when working with Maya's editors (Channel Box, Outliner, Layer Editor, and so on). You create a custom namespace by typing the desired text string in the Create Reference option window. For example, you could select to use a custom namespace called mt instead of the word mapleTree. The tree1 node name in the above example would be called mt:tree1. This reduces the length of the name (and any typing) that may be required when working in Maya.

3.2.7.1 Locking a file reference

File references can be locked using a Lock option to prevent them from being accidentally modified when they are referenced in your scene. When on, the Lock option prevents edits to all attributes and nodes associated with the file reference. You can access the Lockoption from the Outliner Reference menu, Create Reference Options window, andReference Editor.

In the Outliner, an  icon indicates that the reference is locked, while in the Reference Editor, an  icon indicates that the reference is locked.

When using the Lock option be aware of the following:

- If you reference a file that has locked attributes, they remain locked regardless of whether or not you turn on Lock when you create the reference.

- You cannot assign reference edits to a locked reference.
- Loading and unloading references does not affect their locked state.
- You can use a MEL script to specify which attributes you want excluded from a reference's lock state. Regardless of which attributes are excluded, the Lock option always locks all of the nodes for the referenced file.

Customizing lock settings to exclude attributes

When a reference is locked, all nodes and attributes, with the exception of a few specific attributes and node types, are locked by default. You can use MEL procedures to customize the reference Lock option so that it excludes specific attributes. When excluded, these attributes can be edited.

There are two MEL procedures you can use to customize the lock settings to exclude attributes. One procedure specifies individual attributes to exclude, while another procedure specifies which attributes to exclude by node type. Using this procedure, an entire set of attributes for a given node type are excluded from locking. The MEL procedures are included with Maya, and can be found in the scripts folder of the Maya installation directory.

Note: You can override the MEL procedures that ship with Maya by creating your own customized MEL procedures. Your MEL procedures must be named exactly the same as the ones that ship with Maya. You must additionally ensure the files are placed in the Maya script path.

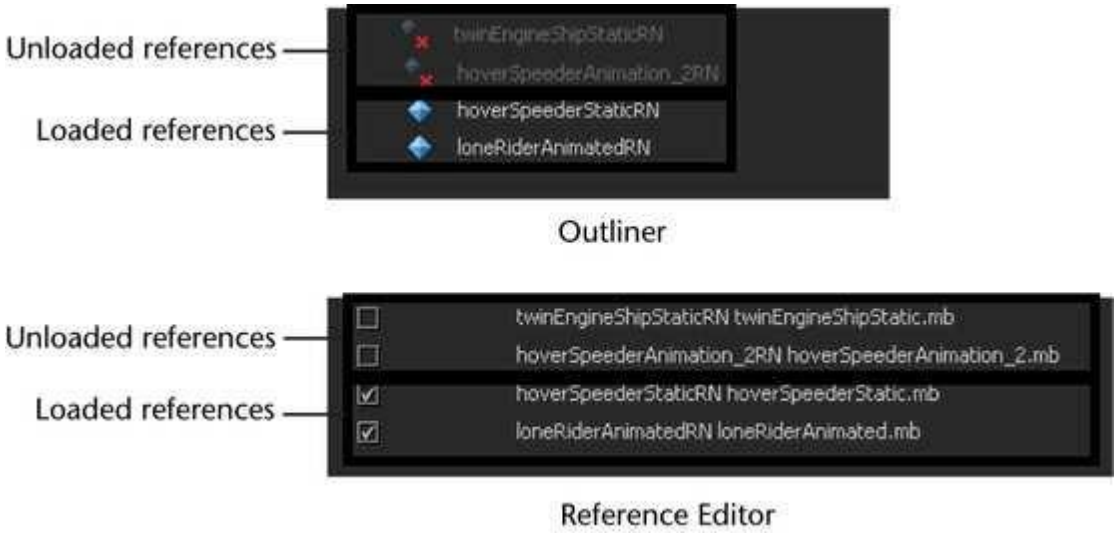
3.2.7.2 Keeping track of edits to file references

This section contains a general overview of the fundamental concepts, terms, and operations associated with file referencing.

Loaded and unloaded references

After a child scene has been referenced into an open parent scene, the contents of the child scene are placed in memory and displayed in the scene. This initial state for a referenced file is referred to as being *loaded*. Other child scenes can be loaded in the open parent scene simultaneously. When a referenced scene is *unloaded*, the connection between the referenced child scene and the parent scene is suspended and the contents of the referenced scene file is no longer loaded in memory. You can load, unload, or re-load referenced child scenes from within the open parent scene file.

You can load and unload references from the Outliner or Reference Editor.

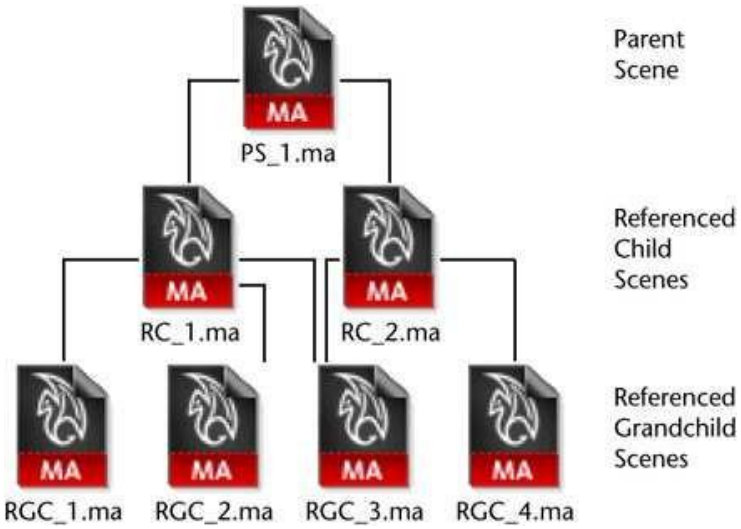


Reference edits

You can apply edits to referenced objects in the open parent scene without modifying the original referenced child scenes. Any edits applied to the referenced objects while working in the parent scene remain stored in a node a called a *reference node*. A reference node is created for each child scene when it is referenced into a parent scene. The reference node keeps track of how the parent scene uses and modifies objects contained within a child scene. You choose to keep edits to references isolated to the parent scene or apply them to the reference source files.

Reference hierarchies

Parent scenes can reference other parent scenes to create a hierarchy of nested references. A parent scene can both reference other files and be a referenced child of another parent scene based on its relative position within the file referencing hierarchy. When this occurs, the child scene files are referred to as grandchild scene files. This hierarchical referencing of a parent scene, child scenes, and other grandchild files is referred to as *multi-level referencing*.



A hierarchy of multi-level references is one method for segmenting various components and levels of display complexity within a large scene.

Note:

A referenced file cannot reference its parent scene or any other file that resides above it in the reference hierarchy.

Foster parent nodes

Foster parents are created any time a node from the referencing scene is parented to a referenced node. For example, if you reference geometry and then parent an object under it, a foster parent node is created when you unload your reference.

The foster parent node ensures that parenting is properly reapplied when you reload a reference. Since files are saved with references unloaded, both export and save automatically generates foster parent nodes.

To export the file without foster parent nodes, you can export with Preserve Referencesturned off. However, this bakes all referenced nodes into the exported scene file. Foster parent nodes only exist for the duration the reference is unloaded; they do not persist after the reference has been reloaded.

3.2.7.3 File referencing tips

Managing files for file referencing

File and node naming

Planning the file and node naming conventions for the parent scenes and referenced files is important and will greatly add to the success of the implementation of file referencing in your production environment. In particular plan to ensure that:

- All files are uniquely named: the same file name should not be used more than once in any project. When Maya doesn't find a file that it is looking for, it will look in other places relative to the current project, and as specified by the current environment variables that may have been set. For example, a project could have numerous files called light.ma; a desk light, a streetlight, and a low resolution (light poly count) version of a character. To prevent any file referencing ambiguities, these files should be more explicitly named: deskLight.ma, streetLight.ma, and lightCharRig.ma.
- If possible, you should avoid naming files so that file names begin with a number. If you try to reference the file from the command line, you may experience problems.
- The Use Namespaces option is turned on when first referencing a file to ensure all nodes within a file are explicitly and uniquely named. For example, an object named tree1 within a file called mapleTree will have a node named mapleTree:tree1 when the file is referenced into the parent scene. The other nodes associated with that object will also be named in a similar manner. For more information.

Alternatively, you can specify namespaces of shorter length than the default file name when it makes sense. A shorter node name streamlines your workflow when working with Maya's editors (Channel Box, Outliner, Layer Editor, and so on). You create a custom namespace by typing the desired text string in the Create Reference option window. For example, you could

select to use a custom namespace called mt instead of the word mapleTree. The tree1 node name in the above example would be called mt:tree1. This reduces the length of the name (and any typing) that may be required when working in Maya.

Note: If you create a reference with the namespace option, a namespace is created. This is ensures that none of the referenced nodes have name clashes with any existing nodes. Removing that reference should remove the associated namespace.

If you add non-referenced nodes to the reference namespace, this can cause name clashes with referenced nodes (for example, if the reference is unloaded when a node is added to the namespace), and prevents the namespace from being deleted when the reference is removed.

Note: Namespaces are the preferred method for managing naming when working with file references in Maya. It is not recommended that you employ Maya's renaming prefix convention when using file referencing. While the DAG path or long name of a node may make it unique when using renaming prefixes they do not work consistently within file referencing and will complicate the hierarchical DAG changes which causes problems later on.

File formats

Saving files in the Maya ascii file format (.ma) is preferred when using file referencing. Maya ascii files can be opened and edited in your favorite text editor, and are easier to troubleshoot if the file or some components of the file do not load as expected.

Note: It is not recommended that you reference files in other file formats (for example, dxf, obj, wire, and so on) when using file referencing. When possible convert files to a native Maya format by loading and resaving files in the .ma format.

File paths

File referencing only supports absolute paths and paths with environment variables. Relative path names are not supported when using file referencing. An environment variable can be used as a superior alternative to a relative path as it is explicit and customizable to each user's file structure.

Relative path (not supported):

scenes/street.ma

Absolute path (supported): C:/projects/cityscene/scenes/street.ma

Environment variable path (supported): $myProject/scenes/street.ma

File hierarchy assembly

When planning to use file referencing in your production environment, consider your team's workflow practices (modelers, riggers, animators, materials and so on), as well as the overall requirements for the project before you determine your scene's hierarchy.

In general, you should reference files in a bottom up manner (that is, reference small items into bigger items). This bottom up structure allows you to easily load or unload any segments of the scene that are not required by the user. For example, when creating a city parent scene, a door and other related components should first be referenced into a building file. Then reference the building into the street file, and then reference the street file into the city parent scene.

When building a character, reference the model into the rigged file. Then reference the rigged file into the environment where the character will be animated. This ensures that a change to the rig is correctly propagated to all environment files that may use the character.

File reference locator

The file reference locator option is useful when you need to move a file reference in the scene view via its group node. The locator also acts as a visual cue for the reference whenever the reference is unloaded. The locator option is only available in the Reference Options window when the Group option is selected. The locator option groups the contents of the referenced file under a locator, annotated with the reference node name. You can load or unload a reference within the scene by right-clicking on the locator and selecting from the context sensitive menu.

Instancing file references

Instancing of objects can be used to aid scene management by further reducing the amount of data in a scene. For example, if a street scene is to be filled with streetlights, the streetlight file can be referenced in once and then the remaining streetlights instanced. If the streetlight file is unloaded, all the streetlights in the scene will disappear because of their instancing relationship to the original streetlight file.

If you have a reference file and instance an object within it and then later remove the reference file, both versions of the objects will be removed in the parent scene. A transform node will be left behind in the parent scene for the instance. This node remains in case other changes have been applied to the instance by the user in the parent scene.

Do not rename a node or change a hierarchy in a referenced file if the parent scene contains objects that are instanced. Such a change will make the instance disappear; Maya will be looking for an object that no longer exists. Maya's instancing is name-based. By renaming the object in the reference file, you make the original go away such that the parent scene can no longer find it.

Note: *Proxies will only instance the active file reference. If a file reference is instanced and the proxy is switched, the instances will not display.*

File referencing and shading

Avoiding use of the default shader

If you reference a file in which you've altered the default shader (lambert1), these changes are superseded by the default shader of the parent file. To avoid this situation, create a new shader in the child file and assign that rather than using the default shader.

Shared shader networks

If you reference a file into your current scene with shared shading networks enabled, the shading networks from the referenced scene are combined with those in the current scene (including those of any references). This avoids creating duplicate shading networks when you want the same ones used throughout your scene, including the reference.

Shading networks can only be shared if the shading networks are identical. Maya considers two shading networks to be identical only if all the nodes included in it have both the same name and type while traveling upstream from the shading group.

While the name and type of each node in the shading network must be identical in order for the shading network to be shared, the actual values in each node are not considered. So, a node in a child scene with one value (for example, blue) is considered identical to a node in the parent scene with a different value (for example, red) as long as its name and type match.

However, certain shading networks cannot be shared. They are:

- networks that include DAG objects (such as those that include the place3dTexture node)
- networks with animation applied to a node
- networks with an expression applied to a node

If any of these items appear in the shading network, the network is not shared when the file is referenced with shared shading networks enabled.

Any items that exist downstream of the shading network are also not shared. The only items shared are those items upstream of the shading network.

Note:*All edits to referenced nodes that are shared are stored on one common shared reference node. Shared references can only be deleted from the Reference Editor using the Remove Reference menu item. The shared reference node remains for any references that were shared and is only removed when the last shared reference is removed.*

Dynamic attributes that are added to a shading network that is subsequently shared may be lost unless the same attributes are created on each of the shading networks to be shared prior to sharing.

Shared display layers

If you reference a file into your current scene with shared display layers enabled, the display layers from the referenced scene are combined with those in the current scene (including those of any references). This avoids creating duplicate display layers when you want the same ones used throughout your scene, including the reference.

Maya uses the display layer name to determine how the referenced display layer is added to the current scene. If a display layer name already exists in the parent scene, any objects assigned to an identically-named display layer in a child scene are added to the original parent display layer when they are referenced.

If a child scene contains a display layer that does not exist in the parent scene, the display layer from the child scene appears in theDisplay Layer editor of the parent scene when the child scene is referenced. If these child scenes are later removed from the parent scene, their associated display layers are removed from the Display Layer editor as well.

Shared display layers are automatically placed in the default namespace.

Note:*All edits to referenced nodes that are shared are stored on one common shared reference node. Shared references can only be deleted from the Reference Editor using the Remove Reference menu item. The shared reference node remains for any references that were shared and is only removed when the last shared reference is removed.*

File referencing helper script

A number of file referencing helper scripts are available as part of the Maya Bonus Tools. Bonus Tools is a free collection of useful Maya scripts and plug-ins that are available from the Autodesk Web site.

To download the Bonus Tools from the Autodesk web site

1. In Maya, select Download Bonus Tools from the Advance section of the Help menu.

You will need to register in order to obtain access to some areas of the Autodesk Web site. Once installed, the Bonus Tools appear within Maya in their own drop-down menu.

Illegal character handling for namespace

Previously, for Maya versions 2010 and below, the characters '<' and '>' would get converted to '_' if encountered in a node name or namespace name. Any leading invalid characters are removed, and all others are converted to underscore.

For example, in Maya 2009:

namespace -add "<foo>"

// Result: foo_

createNode transform -n "<bar>"

// Result: bar_

namespace -add "foo<bar>"

//Result: foo_bar_

For Maya 2011 and above, the characters '<' and '>' will still be removed and converted to '_' for node names. However, for namespace names, Maya will consider everything in between those characters as a placeholder namespace. Therefore, you should update your code if you are using these characters and relying on Maya to correct them. For example, in Maya 2013:

namespace -add "<foo>"

// Result: <foo>

createNode transform -n "<bar>"

// Result: bar_

namespace -add "foo<bar>"

//Result: foo_bar_

Unknown reference nodes

When a pre-Maya 6.5 file that contains references is converted to a later version Maya file, a reference node named "_UNKNOWN_REF_NODE_" may be created and/or a special "_UNKNOWN_REF_NODE_" entry may be added to existing reference nodes.

This node type was used to store any edits that were made prior to 6.5 until those edits could be applied.

Once all references in the scene have been loaded, all edits should be applied and the _UNKNOWN_REF_NODE_ areas and nodes should disappear. If there are any edits which can not be applied (for example, nodes in the original reference file that were renamed or deleted), the _UNKNOWN_REF_NODE_ will remain in the file.

If you need to remove these reference nodes, you can do so by querying for the _UNKNOWN_REF_NODE_ and deleting it. That is, this specific node type cannot be deleted using the Reference Editor. In the Script Editor:

delete "_UNKNOWN_REF_NODE_"

File reference optimization and errors

By default, if you reference the same file twice, on file open Maya copies the existing nodes instead of re-reading them from disk. Occasionally, using this built-in multiple reference optimization feature of file referencing can cause errors. The MAYA_FORCE_REF_READ environment variable turns off the file referencing optimization and forces reference files to be explicitly read in all cases. This fixes Maya's behavior in some situations that would otherwise be evaluated incorrectly.

3.2.7.4 Saving reference edits to grandchilds files

You can save reference edits to a grandchild file. The multi-level save reference feature supports edits in a similar way as the single-level case but is more limited because of the added complexity of the reference structure.

Consider this scenario. You are making a computer game that requires a city map with different blocks and parks.

The reference hierarchy is as follows:

Parent File: Map.mb

Child File: CityBlock.mb

Grandchild File: Park.mb

Great-Grandchild File: Grass.mb

You are currently working on the map file and you reference the city block file (which is referencing the park file).You can modify the park file from the map file and save the edits to the Park.mb file. However, if you try to modify the grass file (which is referenced by the park file), this would not be allowed because the file is below the grandchild file in the file hierarchy.

Limitations

There are a few limitations to the save reference feature in the multi-level case:

- Save reference does not work if the target file is a shared reference file.
- Save reference does not work if any ancestor files are shared reference files (that is, the hierarchy path cannot contain a shared reference file).
- You cannot save to any file below grandchild files.

3.2.7.5 File reference and node structure

Foster parent nodes

Foster parents are created any time a node from the referencing scene is parented to a referenced node. That is, if you reference geometry, and then parent something under it, a foster parent node is created when you unload your reference.

This is how referencing ensures that parenting is properly reapplied when you reload a reference. Since files are saved with references unloaded, both export and save automatically generates fosterParent nodes.

To export the file without any foster parent nodes, you can export with Preserve References turned off. However, this bakes all referenced nodes into the exported scene file.

Foster parent nodes only exist for the duration the reference is unloaded; they do not persist after the reference has been reloaded.

3.2.7.6 Working with file references

1. Access the **Reference Options** window by doing one of the following:

- - click a blank area in the **Outliner** and select Reference > Create Reference > ❑ from the menu that appears.
- Select File > Create Reference> ❑.

The **Reference Options** window appears.

2. In the **Reference Options** window, set the options that apply to your new file reference.
3. Click **Reference**.
4. In the file browser, navigate to the file you want to reference, click its name and click **Reference**.

The reference file and its contents are loaded in the scene and its reference node appears in the **Outliner** indicated by an  icon. Objects belonging to referenced files are indicated by an  icon.

File reference creation options

See the table below for options commonly used when creating file references.

To...	Do this
Create a reference with a locator.	1. Access the **Reference Options** window. 2. Ensure the **Group** and **Locator** options are turned on. 3. Click **Reference**.
Defer the loading of a reference.	1. Access the **Reference Options** window. 2. In the **General Options**, turn on **Deferred**. When the reference is created, it is added to the scene in an unloaded state, and only appears when it is ma ually loaded.
Create a reference with a namespace. See Namespaces.	1. Access the **Reference Options** window. 2. In the **Namespace Options** section, Ensure that **Use Namespaces** is on. See Create namespaces when referencing or importing.

Create a reference with shared display layers.	1. Access the **Reference Options** window. 2. In the **Shared Node Options**, turn on **Display Layers**. When the reference is created, the layers associated with the child scene are integrated into the parent scene.
Create a reference with shared shading networks.	1. Access the **Reference Options** window. 2. In the **Shared Node Options**, turn on **Shading Networks**. When the reference is created, the shading networks associated with the child scene are integrated into the parent scene.

3.2.7.8 Edit reference paths in the Reference Editor

You can edit reference paths using the Reference Editor. You can also customize theUnresolved Name field so that it includes a specified prefix.

To edit a reference path

1. Open the Reference Editor by selecting File > Reference Editor.
2. In the Unresolved Name field, type the new path or enter an environment variable, and then click Reload to load the reference from that location.

If Maya cannot find the referenced file in the specified location, it looks in several default locations to find the file.

Customize the Unresolved name with a prefix

You use the following Python script to customize the Unresolved name field so that, instead of the absolute path, the file path is displayed with a prefix of your choice.

```
import os.path

import maya.cmds as cmds

import maya.mel as mel

import maya.OpenMaya as OpenMaya

mel.eval('string $MyScenes; putenv $MyScenes "C:/Documents and Settings/admin/My Documents/maya/projects/default/scenes/"')

def foo(retCode, fileObject, clientData):
```

```
    print "Callback was given %s" % fileObject.rawFullName()
    rel = "$MyScenes/"
    rel = rel + (os.path.basename(fileObject.rawFullName()))
    print "Callback changed this to %s" % rel
    fileObject.setRawFullName(rel)
    OpenMaya.MScriptUtil.setBool(retCode, True)
id = OpenMaya.MSceneMessage.addCheckFileCallback(OpenMaya.MSceneMessage.kBeforeReferenceCheck, foo)
# for deleting the callback
OpenMaya.MMessage.removeCallback(id)
```

Note:Relative path names are not supported when using file referencing. Another alternative is to use environment variables to customize the display of your file paths.

3.2.8 Viewing Selected References

If you have a number of file references in a scene, you can choose which ones to display in the Reference Editor by using the editor's View options and reference view sets. Reference view sets are bookmarks that display a specific subset of the references in the current scene.

Using the Reference Editor View options you can:

- View selected reference
- View all references
- Create reference view sets
- Toggle between views and reference view sets

Tip:

The View menu items are also available from the context-sensitive menu in the Reference Editor. To display this menu, select and -click a file reference, and then select a menu item.

Create and edit reference view sets

To create a reference view set

1. In the Reference Editor, select the references you want to add to the reference set.
2. Select View > View Selected References.

Only the selected references display in the References Editor, and new reference view (referenceViewSet1) is listed in the View menu. Use this bookmark to toggle between current view and other reference view sets.

Note: By default, reference view sets are named reference View Set, and are numbered sequentially.

To rename a Reference View Set

1. In the View menu of the Reference Editor, select the option box (❑) next to the Reference View Set you want to rename.

The Edit Reference View Set window appears.

2. Type a new name for the Reference View Set and click Rename.

To delete a Reference View Set

1. In the View menu of the Reference Editor, select the option box next to the Reference View Set you want to delete.

The Edit Reference View Set window appears.

2. Click Delete.

Tip: The View menu items are also available from the context-sensitive menu in the Reference Editor. To display this menu, select a file reference and right-click the item.

3.3 NON-LINEAR ANIMATION

After animating a character or object with keyframes or motion capture, you can collect its animation data into a single, editable sequence. This animation sequence is called an animation *clip*. While you may create animation clips in a specific order with a specific storyline in mind, nonlinear animation refers to the process of moving, rearranging, manipulating, and blending those clips to produce a new series of motions.

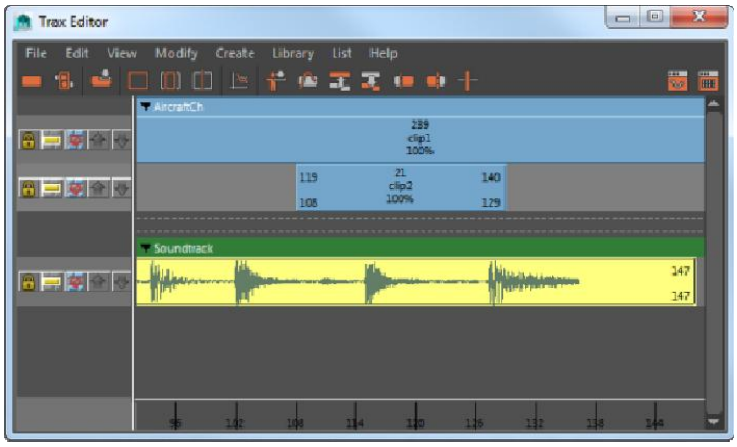
In Maya, there are two types of clip: source clips and regular clips. Maya preserves and protects a character's original animation curves by storing them in *source clips*. You *do not*use source clips to animate your characters. Instead, you use copies or *instances* of source clips called *regular clips* to animate your characters in a nonlinear way.

Moving, manipulating, and blending regular clips to produce a smooth series of motions for a character is the basis of *nonlinear animation*. In Maya, you manage all these aspects of a character's nonlinear animation using the Trax Editor.

You can also use the Camera Sequencer, which lets you lay out and manage camera shots, then produce rendered movie footage of the animation in your scene. In the Camera Sequencer, shots are represented as a set of rectangles arranged on tracks, and you define and manipulate which camera is active at any point in time by manipulating the camera shots.

When you’re satisfied with the layout and timing of camera shots, you can playblast movie clips of the animation.

What is the Trax Editor?



The Trax Editor is a high-level animation tool that lets you select and control characters and their animation clips, layer and blend animation sequences, synchronize your animation and audio clips, and drag-and-drop animation clips between mapped characters.

For example, suppose you keyframed a character’s walk and you now want to turn it into a walk cycle. You can create a clip for the keyframe animation sequence, *scale* and *trim* the clip to get it to be the right length and to have similar start and end poses, and then *cycle*the clip to create a proper walk cycle. If you wanted to change the walk cycle’s pace or rhythm, you can then create a *time warp* curve for the clip, or if you wanted to turn the walk into a *march*, you can manipulate the character and key into the clip directly. You can do all this to the character’s walk sequence without destroying the original keyframe animation because you are working with clips.

3.4 USING TRAX EDITOR

To open the Trax Editor:

- From the main menu bar: Windows > Animation Editors > Trax Editor
- In the scene view: Panels > Panel > Trax Editor
- In the Graph Editor window: 

The Trax Editor is a nonlinear animation tool. With the Trax Editor, you can manipulate and arrange your animation sequences from a higher level than from the Graph Editor or Dope Sheet. See What is the Trax Editor? You can also manipulate geometry cache clips in Trax. See Geometry Caching.



The Trax Editor window has four work areas:

- Trax menu bar

Contains character and clip or object and geometry cache clip related options that let you perform all required actions for creating and editing your animation or deformations nonlinearly. (See Trax Editor menus.)

- Trax toolbar

Contains a selection of buttons that let you quickly access some of the functionality contained in the Trax menu bar.

- Track control area

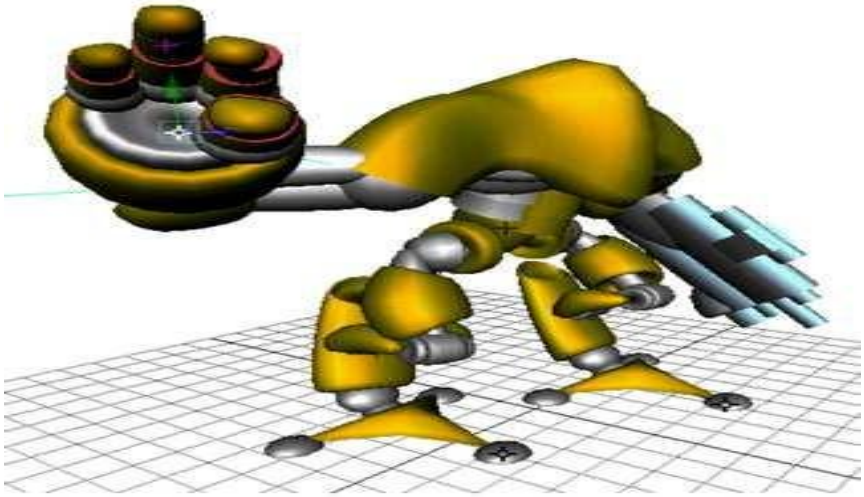
Contains buttons that let you control the playback of each track's animation or deformations.

- Track view area

Contains all the tracks, animation clips, geometry cache clips, and audio clips for your loaded characters or objects.

3.5 CREATE CHARACTER SET

Character sets let you group attributes from multiple objects into a single node that you can then select and key. Character sets are useful when you want to animate multiple attributes from many different objects all at the same time. For example, you can use a character set to bring together in one node all the joint rotations of a character's legs. The character set could be anything: a well-armed robot, an automobile, or even some seemingly unrelated collection of objects.



Character created by Jason Schleifer

For example, suppose you have created a snowman that consists of several NURBS spheres and cylinders parented into a hierarchy, along with several IK handles and some locators that include certain attribute controls (by adding new attributes from the Attribute Editorand using Animate > Set Driven Key > Set). By selecting all these entities that you want to animate together and creating a character node, you bring all the attributes of these entities together. You can name the character node “snowman,” and when you select the “snowman” character node, you have immediate access to all of the snowman’s attributes that you might want to animate. All the keyable attributes (channels) relevant for animating the snowman can be immediately accessible from the Channel Box, for instance. You can then set keys all on all the channels or on just some of them. Without the character node, you would have to select and animate the various objects that make up the snowman separately.

The real power of character sets is that they let you leverage Maya’s animation features to animate at the character level. Character sets provide the kind of intuitive interaction typically associated with traditional animation techniques, in particular with Maya’s nonlinear character animation tool, the Trax Editor. The Trax Editor takes character animation to a powerful level of artistic control and productivity (see Nonlinear Animation in Maya) for more information. Finally, you can build libraries of character sets that are all organized in a common manner.

In summary, Maya’s character set feature brings together all of a character’s attributes that are essential for its animation. By bringing these attributes together, you can set up a character that is much easier and faster to animate. Animators can take advantage of Maya’s animation features to work on the character as a whole, and do not have to worry about the more technical details of a character’s setup.

Note: Maya Assets also let you organize a group of attributes under a single node and key them at the same time. There are a few important differences between character sets and Assets:

- Character sets are required for creating animation clips in the Trax Editor.
- Character sets make a connection from the character node to the member attributes, while Assets do not.

- Assets let you control the layout and ordering of member attributes in the Attribute Editor and Channel Box.

3.6 ANIMATION RETARGETING

Animation retargeting is a process by which animation data from one skeleton is used to another (see Figure 6.9). Sometimes skeleton are identical. At other times , the skeleton can have diverse scales but the same orientations of their bones and bone hierarchies . Also, there are times when the skeletons to be shared are with animation which are completely different. The situation determine the method of retargeting.

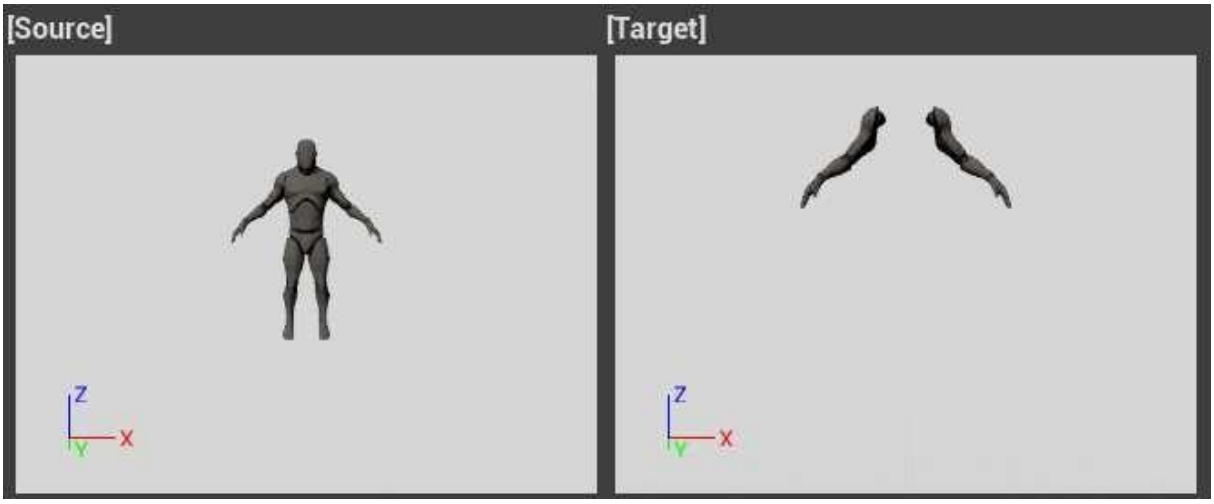


Fig 3.9 Animation Retargeting

Retargeting animation for skeletons that are precisely the same is known as ‘Auto Retargeting ‘. This is the easiest from of porting animation data from one skeleton to another. The data can be baked in one key per frame or the controller key values can be implemented. Whenever you see multiple copies of the same character in a game you are looking at auto retargeting. The animation data is applied to copy of a skeleton that is similar in every way to the source skeleton. For the source side of animation data was originally created on. Of course, this applies to skeleton. For the source side of animation work, this method is particularly useful for cinematics.

Base retargeting

The term ‘base retargeting’ is used for skeletons of the same hierarchal chain and orientations but different in proportions. 3D studio Max’s Biped is a classic example of base retargeting. All joints orientation are the same, but the proportions can be dramatically dissimilar. This is one of the most extensively used retargeting method as then increase up or down the positional and scale portion of a transform by the difference in the proportion. Another advantage of this method is that your bottom pose does not have to be the same for skeletons involved in the retargeting process. However there several problems can occur using this method. IK retargeting is not always perfect, particularly with regard to where hands grip

weapons. Other common problems with this method include initial offset errors in orientation for the clavicles, spine, arms, hands and fingers. These errors can emerge as super shrugged shoulders and hunched backs.

Mapped retargeting

A mapped retargeting stores the retargeting information for a skeleton pair, allowing retargeting to be reapplied, if required, automatically. Once retargeting has been finalized it is a good idea to save a mapping file for the skeletons, in case further motion needs to be applied in the future, after retargeting has been removed from the target skeleton. The mapped method can also improve weapon grip issues if you are constraining IK Goals instead of arm bone orientations.

3.7. RETARGETING WORKFLOW

You can productively retarget animation from one skeleton by following few steps:

3.7.1 Setting a neutral pose and target skeleton

1. Position your character into the pose you want as its neutral pose.
2. Select the root of your skeleton.
3. Select Skeleton > Retargeting > Set Neutral Pose.

See Skeleton > Retargeting > Set Neutral Pose.

Your character's current pose is set as its neutral pose and the neutral Pose tab appears on the root joint's node.

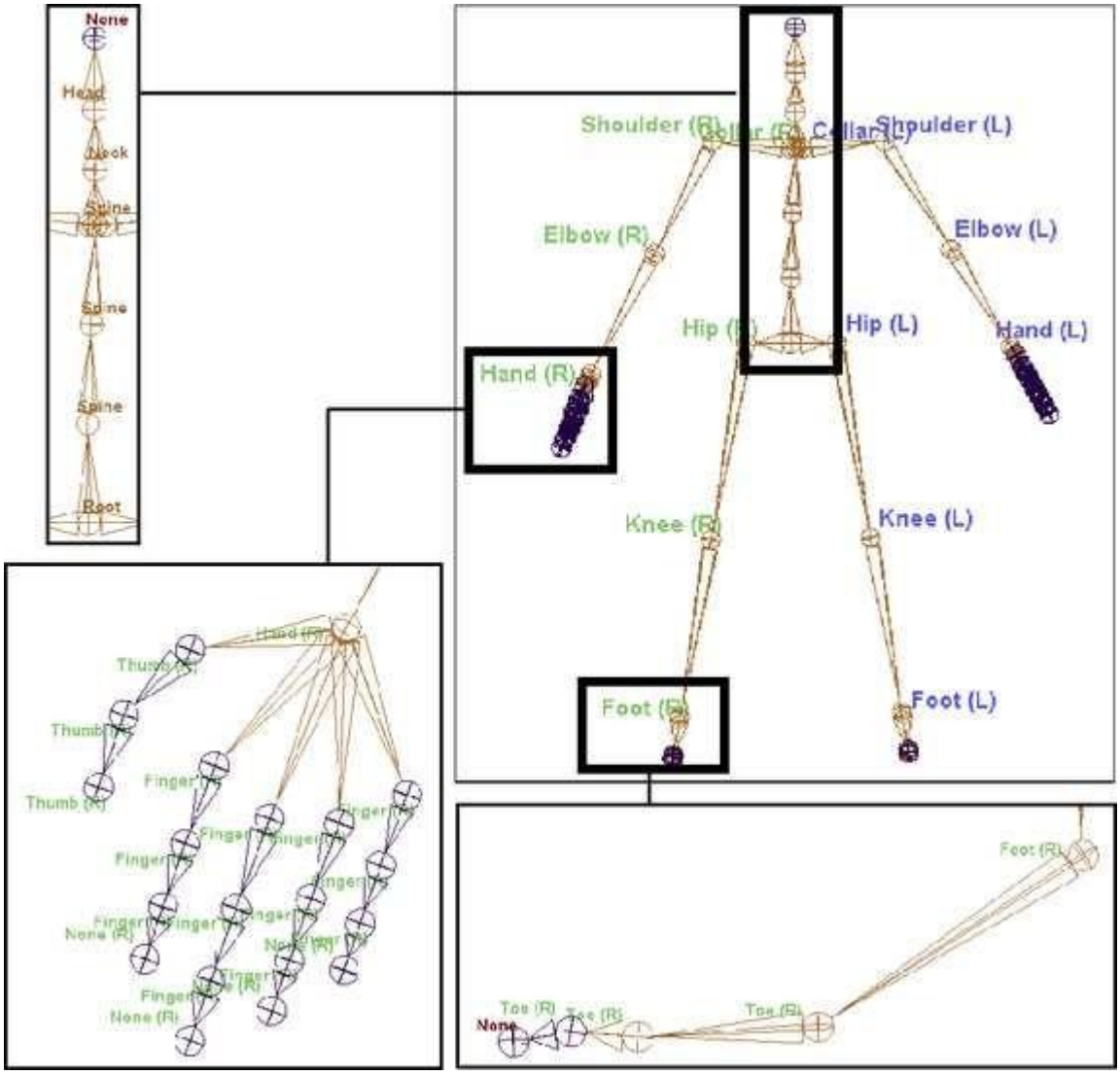
3.7.2 Labelling the Joint and Target Skeletons

Label a skeleton's joints

- There are a few methods for labelling the joints of your skeleton:
- Use Skeleton > Joint Labelling > Add Joint Labels to automatically label each joint in a selected joint chain or individual selected joints. See Automatically label a skeleton's joints.
- Select a joint and edit its label from the Attribute Editor. See Adjusting joint labels.

Note:

- As you label your joints, each label appears beside their respective joints in the scene view. If you do not see the joint labels in the scene view, see Toggle the visibility of joint labels.



Automatically label a skeleton's joints

To automatically label the joints of your skeleton's limbs

For the limbs of your source and target skeletons, do the following:

1. Select Skeleton > Joint Labelling > Show All Labels.

Joints labels will now appear in the scene view. See Skeleton > Joint Labelling > Show All Labels.

2. Select
3.
4. > Add Joint Labels.

5. In the scene view, select the parent or top joint of each limb (joint chain) in your skeleton and do the following:

    - Select Skeleton > Joint Labelling > Add Joint Labels, then select a side label (Label Centre , Label Left, Label Right) in the Add Joint Labels menu.
    - Select Skeleton > Joint Labelling > Add Joint Labels, then select a type label (Label Armor Label Leg).

Each joint, from the selected parent down its joint chain's hierarchy, is automatically labelled according to their positions in their respective joint chain.

For example, if you select the left shoulder joint of a skeleton and click Label Left and then Label Arm in the Add Joint Labels menu, then that joint will be labelled as *Shoulder(L)*, the next joint in the chain will be automatically labelled as *Elbow(L)*, and the next joint will be labelled as *Hand(L)* and so on.

Note:

For arms, the forearm joint is labelled as an *elbow* joint. For legs, the ankle joint is labelled as a *foot* joint.

If you want to adjust or change the labels of your joints, Adjusting joint labels.

Label using retargeting joint labelling

To label your character's joints using the retargeting joint labelling menu, take the following step:

- Select Skeleton >Joint Labelling > Show All labels. Joints labels will now appear in the scene view. See Skeleton > Joint labelling > Show All Labels.
- Select Skeleton >Joint Labelling > Add Retargeting Labels. The Retargeting Joint labelling menu appears. See Skeleton> Joint > Add retargeting Labelling > Add Retargeting labels.
- Tear-off the Retargeting joint labelling menu.
- In the scene view, select a joint and do following :
- Click a side label in the joint Labelling menu. Joint type label.
- Click a type label in the joint labelling menu.

The side and type labels come into view beside the current joint; for example, if you are select Label Right as the side label and label knee as the type label, then the knee(R) will emerge beside the joint in the scene view.

- Repeat the above step for the joints you want to label.

Adjusting joint labels

To set or adjust individual joint labels from the Attribute Editor

1. Select the joint in your source or target skeleton whose labelling you want to change and open the Attribute Editor.
2. In the Joint section of your joint node's tab, expand Joint Mapping.

The Side and Type drop-down menus appear.

3. Set or change the joint's Side and Type labels as desired.

3.7.3. Set the Retargeting solver options.

It retarget the animation on one skeleton (source) to that of another (target) skeleton.

Skeleton > Retargeting>Retarget Skeleton>

The retarget skeleton Option window lets you set retargeting solver's options.

The retargeting solver is what looks at animation on the source skeleton's joints and retargets them to the corresponding , labelled joint of target skeleton.

Neutral pose

Specifies whether define neutral pose(the pose set with skeleton > Retargeting >set netural pose) Will it be a pose at specified frame. See Set a skeleton's neutral pose and Skeleton> Retargeting > Set Neutral Pose.

One of the following option needs to be selected:

- **To set the pose**

Set the natural pose as the pose you set with Skeleton > Retargeting > set Neutral pose. If you have already set a neutral pose for each skeleton using set neutral pose, use this option. Pose is on by default.

- **To set the Frame**

Specifies the frame to use set the neutral poses of the source and target skeletons.

- **To set Neutral Pose Frame**

Specifies the frame to use to set the neutral poses of the source and target skeletons.

- **To set maintain offset**

Maintain the source and target skeleton's global position so that the target skeleton does not move to position of source skeleton when you retarget.

Lower body

Lower body solution

Lets you choose how the body animation of the source skeleton is retargeted to the lower part target solution.

1. **Joint rotation only:** When it is only joint rotation are retargeted. This option is used when you are mapping animation between rigs that have the some bone length; for example, if you are retargeting animation from a low resolution rigs of the same skeleton

2. **Scaled foot placement:** When it is on all animation data retargeted. This option is used if you are mapping animation between rigs that have the same bone length; for example, if you are retargeting animation from a low resolution rig to high resolution rig of the same skeleton.This option takes into account the position and orientation of the source's feet and solves the retarget by translating/ the target's feet like the source's feet. This ensures that the target skeleton's foot placement looks natural and that its feet move in relation to its proportion-not those of the source skeleton. This option is on by default.

3. **Absolute foot placement :** When is on, it ensures that the target skeleton's feet land at the same points as those of the source. Use this option when you need the target skeleton's feet to land at very specific locations. For example, you would use this when you are retargeting a fight sequence or dance you would use this when you are retargeting a fight sequence or dance routine.

Lower body scale

It specifies how the animation on the hip, knee ,ankle, foot, and toe joints of the source skeleton is retargeted to the corresponding leg joints of the target skeleton.

For example, if you are retargeting animation from a giant to dwarf you should select the Hip to Foot option because it best handles he retargeting of animation between skeleton whose legs have dissimilar bone lengths.

It is available only when the scaled Foot placement is on.

Hip to Foot

It calculate the lower body scale for target using the source's hip to foot scale.

Hip to Toe

It calculate the lower body scale for the target using the source's hip to toe scale.

Overall Height

It calculate the lower body scale for the target using the current Lower scale Factor value.

Lower scale Factor

It help you to specify a custom scale factor for target's lower-body animation, which is only available when other are on.

Upper body

Upper body solution

Lets you choose how the body animation of the source skeleton is retargeted to the upper part target solution.'

Joint rotation only

When on only joint rotation are retargeted. Use this option if you are mapping animation between rigs that have the same bone length for example, if you are retargeting animation from a low resolution rig to a high resolution rig of the same skeleton.

Scaled Hand Placement

When on all animation data is retargeted. Use this option if you are retargeting motion from a giant to dwarf.

This option takes into takes into account the position and orientation of the source's hand and solves the retarget by orienting and positioning the target's hand like the source hands.

3.8 Retargeting

You can retarget animation data from the joints of one skeleton (source) to the joints of another skeleton (target). The *source* skeleton is the skeleton *from* which you want to retarget its animation data, and the *target* skeleton is the skeleton *to* which you want to retarget the source's animation.

Retargeting in Maya is based on the Autodesk HumanIK character solver. Once you have defined your character's skeletal structure using the HumanIK, you can transfer animation between skeletons that have the same or different skeletal structures and proportions.

Note: The HumanIK retargeting workflow provides a live retargeting process that replaces the retargeting solution in previous versions of Maya.

3.9 SUMMARY

- File referencing method provides many workflow possibilities for functioning with large and complex scene, e.g., hierarchical scene management, scene segmentation, asset reuse, asset proxies, etc.
- Proxy references let us replace with one or more file references for a given file references. These files are constructed to visually or spatially atand in for an exixting file reference. This allows production work to continue without the overhead of the complex components of the original scene.

- When a scene is simplified in this manner, Mays's performance improves. The reference Editor lets you manage the file and proxy references within your scene.
- In the Reference Editor you can: (a) form file references for your scene, (b) insert proxy references to existing file references, (c) load and unload file and proxy preferences from the scene, (d) amend existing namespaces for file references, (e) change file and proxy references, (g) set aside edits made within the parent scene back to the referenced file and(h) eliminate file and proxy preferences from your scene.
- You can orient and edit the attribute of the referenced data in a parent scene without altering the original data in the referenced child scene files. Many of the same are possible when you employ referenced scene are possible when you employ referenced data in your currently open parent scene.
- These edits get saved in the reference node of the currently open parent scene. File referencing permits you to handle complex scene hierarchies.
- Animation retargeting is a process by which animation data from one skeleton is used to naother skeleton. Sometimes, the skeletons are identical. This is the easiest form of porting animation data from one skeleton to another.

3.10 KEY TERMS

- **Character sets:** When referencing character sets, renaming a member of that set or renaming the character itself is not permitted if the referenced file modifies or connects to the renamed object.
- **Display layer editor:** It allows to sort of layers alphabeticallyu which will assist with organisation.
- **Keyframes:** A keyframe on an attribute connects the attribute being framed to a new node.
- **Namespace:** It is scoping mechanism for identifying objects. You generate a namespace and within that namespace, all object names have to be exclusive.
- **Proxy tags:** These are unique names you assign to proxy references to more easily manage those proxy references from within the Reference Editor.
- **Reference Editor:** It lets you manage the file and proxy references within your scene.

3.11 QUESTIONS AND EXERCISE

Short-Answer Questions

1. Define 'file referencing'.

2. Write a short note on managing references.
3. Define the different features of character setup.
4. What is a character set?
5. How are joints labelled?

Long-Answer Questions

1. Explain the process of locking a file reference.
2. What is trax editor? Explain.
3. What are the features of character setup? Elaborate.
4. Discuss animation retargeting.
5. Explain retargeting workflow.

3.12 FURTHER READING

Introducing Autodesk Maya 2016: Autodesk Official Press