CHAPTER 3

Animation Editing – Timing & Spacing

The number of drawings used in any move determines the amount of time that action will take on the screen. 

The Illusion of Life: Disney Animation – Frank Thomas and Ollie Johnston

A firm grasp of timing for animation is a key principle to understand. Timing can have a strong impact on both the pacing of an animation sequence and the believability of physical motion.

With regards to physical motion or character animation, if the timing is off, it will be immediately noticeable to the viewer that the animation is wrong, the sense of physical weight, mass, and inertia will be lost. With regards to pacing of a sequence, object animation as well as camera sequencing is also key in creating strong pacing that matches the mood of the shot.

Effective use of Timing & Spacing needs to be applied throughout animation. Without effective timing & spacing, none of the other principles can be applied effectively.
Timing & Spacing – Anticipation to Follow-through and Overlap

In Chapter 2, we looked at the baseball pitcher sequence; minor edits were required to the key Timing & Spacing through the Time Slider to provide contrast between the pre-lead in and build up to start of action. In Chapter 6, we’ll be looking at follow-through and overlapping action on the second half of the sequence. Again, the effective use of Timing & Spacing will be required to create believability in the motion. Analyzing the spacing and timing intervals and difference among the overall body motion, upper torso motion, and arms is key to creating believability in the animation (see Fig. 3.0.1).

In Chapter 7, we’ll be working on secondary animation with a hand animation rig (see Fig. 3.0.2). Again, effective edits of the keyframe Timing & Spacing on the hand controls are critical to create believability in the hand motion and gesture. Elements do not move at the same time – root joints lead the motion with appendages or secondary joints following the motion – the wrist leads with the main finger joints then finger tips following through. The timing intervals need to make sense.

Timing & Spacing – Appeal – Mood & Characterization

Differences between timing & spacing intervals in animation can also significantly change the mood or tone of the animation. Contrasts in the timing beats can make character animation appear subdued, lively, bright,
evil, or angry; in fact, any number of different moods can be created through effective use of Timing & Spacing. Knowing what type of timing your character should move on is critical in creating characterized performances with appeal. Effective use of Timing & Spacing to create appeal for character performance is discussed in more detail in Chapter 10 (see Fig. 3.0.3).

Timing & Spacing – Framing the Action – Camera Cuts and Action

For longer animation sequences, pre-planning of the Timing & Spacing intervals through both the storyboard and Animatic is key to creating engaging shots. In Chapter 5, we’ll be looking at layout for the F16 fighter sequence where effective use of Timing & Spacing is required to create both anticipation of the action and engagement during the main dogfight (see Fig. 3.0.4). Planning the Timing & Spacing intervals between the animated elements and the timing on the camera shots themselves is a necessity at the pre-production phase of the animation.

As you can see, Timing & Spacing can be applied to character animation, object animation, camera animation, and pre-production. In fact, it needs to be considered throughout this book when working through the exercises.

For the tutorials that follow in this chapter, we’ll focus on Timing & Spacing for character animation. In the first tutorial, we’ll analyze the Timing & Spacing intervals used on some of the other character animations covered in the book. Two of the key areas to understand how to apply timing and spacing are on walk cycles and run cycles, which we’ll look at.
In the second tutorial, we will focus specifically on overall timing & spacing edits for a single animation sequence of a baseball batter, which will also be a focus in the next chapter when we look at ease in & ease out.

### Chapter 3.1 – Timing & Spacing – Analysis

#### Timing & Spacing Pt. 1 – Jump Animation – Spacing Contrast

Contrast in Timing & Spacing on character animation is critical when creating dynamic and fluid animation.

For action or athletic motion, the contrasts should be broader and more defined. This helps to make the action more readable and the animation punchier.

Exaggerated Timing & Spacing can also help to heighten or exaggerate several of the other key animation principles, including: anticipation, ease in & ease out, and follow-through.

Using effective Timing & Spacing for broad athletic action will also help to give the character more mass and weight while in motion and increase the believability of the animation for the viewer.

- Open the scene file from the project directory named —
  **3.1_01_Spacing_Jump.ma**

The scene file includes a character jump animation (see Fig. 3.1.1).

We will work on creating the pose blocking for the jump animation in detail in Chapter 11.

- Playback the animation (Alt + V) to appraise the overall timing & spacing on the jump.

**Note**

The animation plays from right to left of the Perspective Viewport, which is the same as the screenshots used as illustration here, which also read from first pose at right to end pose at left. (see Fig. 3.1.1).

The overall spacing on the jump animation is pretty broad. The contrasts between the poses are quite broad, with the character going from upright pose to coiled pose at start, to elongated outstretched poses at mid-point of the jump (see Fig. 3.1.1, right to left screens).

There is broad contrast between the overall timing & spacing on the main shape or silhouette of the body as well as contrast between the timing & spacing on the body parts (arms and legs).
If we take a look at specific sections of the Jump sequence, we can see how the timing & spacing enhances the animation:

**Start Section – Stance to Pre-Jump** (see Fig. 3.1.2.1, right to left screens)

- Frames 0–8 – “Fast In” Stance Pose to crouch one-third second (see Fig. 3.1.2.1, right screen)
- Frames 8–14 – “Anticipation” – Pause before coil back (see Fig. 3.1.2.1, middle screen)
- Frames 14–24 – “Ease-In” Coil back to gather energy (see Fig. 3.1.2.1, left screen)

**Jump Section 1 – Pre-Jump to Mid-Point** (see Fig. 3.1.2.2, right to left screens)

- 7 Frames (24–31) = “Ease In” starting to accelerate to stance/jump (see Fig. 3.1.2.2, right screen)
- 5 Frames (31–36) = Accelerating into air (see Fig. 3.1.2.2, middle screen)
- 3 Frames (36–39) = Broad spacing as momentum increases at mid-point of jump (see Fig. 3.1.2.2, left screen)
Contrast between the timing & spacing intervals on the jump animation is critical in creating weight, mass, follow-through, anticipation, and ease in & ease out in the animation. Effective spacing ensures that the animation does not look even or mechanical, which can be one of the pitfalls of computer animation.

Using ghosting or cycling through the animation frame by frame can help to evaluate and modify the spacing and timing to refine the motion. For acceleration, spacing intervals should get gradually broader, before slowing as gravity takes effect (see the bouncing ball animation from Chapter 1 and Fig. 3.1.2.2).

**Timing & Spacing Pt. 2 – Walk Spacing**

Let’s take a look at the overall timing & spacing for a walk cycle.

- Open the scene file from the project directory named – 3.1_02_Spacing_Walk.ma
- The scene file is retargeted Motion Capture data of a character walk.

**Note**

The process of remapping the Motion Capture data onto the character is discussed in detail in Chapter 12.

The Playback start time/Playback end time frames are framed on a portion of the animation (frames 70–143 – see Fig. 3.1.3).

During this portion of the animation, the character does a full walk cycle, going from what we call the “passing pose” weighted on the right leg through two steps back to similar “passing pose” on right leg (see Fig. 3.1.3). The sequence is a full cycle.

Playback the animation (Alt + V) and scrub the Time Slider to appraise the Timing & Spacing on this part of the walk. If you look at the spacing on the walk, you’ll notice that:

- The spacing on the stride length when hitting what we call the “Contact Pose” on both strides is fairly even at:
  - Frame 93 Contact Pose 1 – Left leg leads (see Fig. 3.1.3, second screen from left).
  - Frame 124 Contact Pose 2 – Right leg leads (see Fig. 3.1.3, fourth screen from left).
• The timing intervals between the passing poses is fairly even:
  • Frame 70 – First Passing Pose.
  • Frame 107 – Second Passing Pose (107 − 70 = 37 frames).
  • Frame 143 – Third Passing Pose (143 − 107 = 36 frames).
• The distance traveled by the hips between the major Contact Poses and Passing Poses is also fairly consistent (shown by the faded ghost on the screenshots – see Fig. 3.1.3).

As the timing & spacing of the major poses at this phase of the animation (frames 70–143) is fairly even, the walk looks balanced and even.

Let’s take a look at another part of the overall walk animation in the scene:
• From the active Panel, select the Panels menu at the top and choose:
  • Panels > Perspective > persp1 (see Fig. 3.1.4).
• From the Range Slider, or numeric input fields for Start/End Playback range, set the following:
  • Start Time = 126.00; End Time = 201.00 (see Fig. 3.1.4).

![Fig 3.1.4 Framing the uneven walk animation.]

• Playback the framed section of the animation (Alt + V).

The spacing between the main contact poses and passing poses are quite different from the previous example (see Fig. 3.1.5).

![Fig 3.1.5 Walk spacing – uneven stride.]

• The distances between the leg strides on the main contact poses at frames 126, 160, and 201 are uneven.
• The second step onto the left leg (at frame 160) is shorter than the stride length on the start and end frames of the sequence (see Fig. 3.1.5, middle screen).
Tradigital Maya

- On the contact pose at the end, the right leg strides more to the side (character’s right), which counters the uneveness of the short middle stride (see Fig. 3.1.5, screen at far right).

The character appears to shuffle due to the uneveness of the stride length. Although this section of the animation could not be used as source for a walk loop animation, the unevenness is natural looking and fits the overall walk animation in the scene (when Playback framed from frames 1 to 488).

**Overall Timing for Walks**

Go back to the original Playback framing for the scene (frames 70–143) and switch back to Perspective > persp from the Panel menu. Alternately, just reopen the scene file.

You’ll notice that the walk is pretty slow for this part; overall, the walk animation for the whole scene looks labored.

- The Playback Speed is set to 60 fps (from the Animation preferences).

**Note**

60 fps is a common recording rate used when recording Motion Capture.

- There are 73 frames on the walk cycle (from start passing pose (frame 70) to end passing pose (at frame 143) (see Fig. 3.1.3).
- 73 frames at 60 fps is around 1.2 seconds.

This timing in this Playback section is suited to a slow strolling walk cycle.

An even natural walk cycle at “march time” would be a bit faster, with full cycle (two steps) taking exactly 1 second.

When working on walk or run cycle animations, you only really need to concentrate on creating half of the loop animation. If you think of a walk, there are two full steps in a loop cycle and, as we saw from the previous section, the spacing between the steps should be the same.

For a walk cycle animation, the animation from the start- to mid-point of the walk can effectively be duplicated or mirrored to create the full loop, this ensures that the walk is evenly spaced and cycles correctly. Therefore, you only need to concentrate on creating step from start contact pose to mid-point to opposite contact pose (see Fig. 3.1.6).

**Note**

If you are working on a longer walk sequence animation, you may consider breaking up the cycled walk poses, so that they are more uneven and the walk looks less mechanical.
When working at standard 24 fps, a standard “march time” 1 second walk cycle can be keyed on “threes” – with each step taking 0.5 seconds (12 frames at 24 fps).

- Frame 1 (Contact Pose 1 – legs at full extension) (see Fig. 3.1.6, first screen).
- Frame 4 (Down Pose – hips dip) (see Fig. 3.1.6, second screen).
- Frame 7 (Passing Pose – weight transfers over foot) (see Fig. 3.1.6, third screen).
- Frame 10 (Up Pose – hips rise) (see Fig. 3.1.6, fourth screen).
- Frame 13 (Contact Pose 2 – legs at full extension – mirrored from frame 1) (see Fig. 3.1.6, fifth screen).

Timing & Spacing Pt. 3 – Run Spacing – Overall Spacing

The overall timing & spacing on a run cycle animation is a lot broader than a walk cycle. Let’s take a look at the timing & spacing on the run cycle animation that we worked with in Chapter 1.

- Open the scene file from the project directory named –
  3.1_03_Spacing_Run.ma

The Playback Speed is set to 24 fps (from the Animation preferences).

- The run cycle is looped and is 16 frames long (two steps = complete cycle).
- Each step has eight frames (1/3 of a second). The run speed is a jog (see Fig. 3.1.7, single step).
- A faster run or sprint would be quicker at: six frames (run) or four frames per step (very fast sprint).
If we look at the pose spacing on the run step, the main difference on a run cycle is:

- The character does not have both feet in contact with the ground at same time at any point in the run cycle (at start/end contact pose).
- Only single foot is planted at the start point (see Fig. 3.1.7, screen on far left), mid-point (see Fig. 3.1.7, final screen on right), and end points of the cycle.
- The stride length on the legs is a lot broader than on the walk cycle (see Fig. 3.1.7, screens on far left/right).
- At a couple of points in the cycle, the feet are off the ground, with the hips raised (see Fig. 3.1.7, third screenshot from left). At this point, the feet are switching before contact.
- The passing point is earlier in the cycle (see Fig. 3.1.7, second screenshot from left).
- At frame 3, the hips have passed over the planted foot and there is an extended distance traveled from the passing pose to get back to the next foot plant (see Fig. 3.1.7, second to fourth screens from left).

Overall, the posing for a run cycle is more dynamic than a walk cycle. The more exaggerated the angle of the body pose and longer the stride length are, the broader the spacing should be (the timing should also be faster). It is important to appraise the timing & spacing while blocking the animation to make sure that it fits.

As with a walk cycle, the run cycle still needs to have matching mirrored poses at the main passing/contact poses in the animation. The process of blocking and mirroring the poses for the run cycle is discussed in detail in Chapter 8.

**Timing & Spacing Pt. 4 – Run Spacing – Foot/Hip Spacing**

If you look at the walk and run examples, there is contrast in the timing & spacing between the separate body parts. In particular on the run, there is broad contrast between the timing & spacing on the hip and foot poses; this is due to both the transfer of weight and the follow-through on the elements during the stride (see Figs 3.1.8 and 3.1.9). Scrub the Time Slider to check the timing and spacing intervals on the run:

- From frame 00 (contact pose) to frame 03 (passing pose), there is broad spacing on the right leg swing. As the leg is quite long on the character, this is exaggerated (see Fig. 3.1.8, left screen).
- From frame 03 (passing pose) to frame 06 (pre-contact pose), there is even more contrast on the leg swing distance when compared with the hips travel, as it swings forward to plant (see Fig. 3.1.8, middle screen).
- From frame 06 (pre-contact pose) to frame 09 (contact pose), the spacing is reversed - the foot plants and stops for a few frames and the hips begin to follow-through (see Fig. 3.1.9, right screen).
If you look at the spacing intervals on the leg after the foot plant, the spacing is quite different:

- From frames 11 to 16 – the right leg trails the leading left leg and hips, which are striding forward (see Fig. 3.1.9, left screen).
- From frames 16 to 19 – the right leg swings forward quickly to the next stride (as the hips move forwards through space to the next step on the run (see Fig. 3.1.9, right screen). The leg trails the hip motion during the initial phase (up to frame 16) with the follow-through motion happening on the leg after. Each element does not move at the same time.

Chapter 3.2 – Re-timing Action – Character Baseball Swing

Introducing the Character Asset

The character asset that we’ll be working with in this section is similar in resolution and detail to the baseball pitcher character mesh that we worked with in Chapter 2.1 (see Fig. 3.2.1).

- Open the start file for the tutorial – 3.2_00_Start_Timing.ma
The control setup for the character is the same setup used on the female character that we worked with in Chapter 1.4. The full setup for the character rig, skinning, and control setup is discussed in Chapter 9.3, which can be viewed on the Web site.

**Note**
We will not be working in detail with all the separate controls for the character in this section; instead we will be focusing on re-timing the animation.

However, as we’ll be working with this character asset in later chapters, let’s take a look at the setup for display and preview of the rig in Maya.

**Display Layers**
From the Channel Box/Layer Editor (Ctrl + A Toggle), there are a couple of Display Layers setup that can be toggled while working. Effectively managing what’s displayed in the scene in Maya is critical while animating and reviewing the animation (see Fig. 3.2.1).

Three separate Display Layers are set up for the following elements:
1. The Control Objects (the colored wire objects for animation, Display Layer named-Bball_02_RIG_Curve_CNTRLS).
2. The underlying character skeleton (Layer named-Bball_02_RIG_Skeleton).
3. The character mesh (Layer named BBall_02_GEO).

**Note**
The skeleton and character mesh Display Layers should be set to Reference (R) or Template (T) display modes to prevent selection.
Maya's Shading menu has a couple of options to toggle whether:

1. The Joints are displayed in X-ray mode (Shading > X-Ray Joints), which is useful for preview.
2. Option to modify the thickness of lines (Shading > Thicker Lines). Increasing the thickness of lines can help in display and selection of the Wire Control Objects (see Fig. 3.2.1, fourth screenshot from left).

When animating and previewing work, it can also be useful to toggle the shading modes in the Viewport (from Shading menu or 4/5/6 shortcut keys).

- Displaying the model as “Smooth Shade” (5) with Wireframe on Shaded mode can help when posing, as the wireframe lines help describe the form as well as help identify any breakages in the character mesh when posing with the rig (see Fig. 3.2.1, first and second screenshots from left).
- Toggling whether the lights are used in scene can help describe the form on the mesh more clearly while animating (toggle between 5 and 7, to “Use Default Lighting” (5) or “All Lights” (7)).
- The character mesh also includes normal and specular maps for additional detail. Toggle the Viewport Renderer to Maya’s “Viewport 2.0” or “High quality Rendering” modes from the Panel > Renderer menu to view these on the model (see Fig. 3.2.1, fifth screenshot from left).

Timing & Spacing

With the scene file open, ensure that “Playback Speed” is set to “Real-Time [24 fps]” from Maya’s “Animation Preferences,” and Playback the animation in the scene (Alt + V shortcut).

From frames 15 to 40 – The baseball batter swings from a coiled readiness pose to hit the ball and then follow-through with the bat across opposite shoulder (see Fig. 3.2.2, left to right screenshots).

The pose blocking for the baseball swing animation is covered later in this book in Chapter 6.3.
By previewing the animation, you’ll notice that the motion does not look realistic, as the timing is too slow.

This is common when starting an animation or blocking out key poses. On the sequence, the animation Control Objects are keyed at regular five-frame intervals (see Fig. 3.2.2).

When blocking out animation, you should typically only be focusing on the overall posing and checking the transitions between the key poses through scrubbing the Maya Time Slider.

In this section, we’ll look at the process to make overall edits to the timing between the key poses to make the animation more fluid and believable. We will work on global edits to the timing & spacing on the animation and then make iterative timing changes to selective elements to get the animation closer to final.

**Object Selection Masks**

When working on character animation in Maya, it can be useful to utilize the selection masks available from the Maya Shelf. Setting selection mask can help when you are only working on animating a specific group of similar objects.

**Note**

Using Maya’s Display Layers and Show options can also be used as either an alternative to aid selection or in combination with the selection masks.

For the character setup in the scene, the only elements that are animated in the scene are the NURBS curve control objects (colored wireframe objects around the character). Set the selection mask to only select these elements:

- From the Maya Shelf, press the left mouse button on the pop-up menu icon to the left of the selection mask and select – All objects off (see Fig. 3.2.3, top screenshot).
- Click the “Select curve objects” icon (small squiggle icon) on from the shelf to select only Curve objects from scene (see Fig. 3.2.3, bottom screenshot).
- Set the current Panel to Perspective View (Panels > Perspective > persp) and frame the character in the Viewport (see Fig. 3.2.4, left screenshot).
- Click the left mouse button in the top left corner of the Panel and drag a marquee selection over the whole screen.
All of the NURBS curve Control Objects should be selected and highlighted in white, except for single object, which will be highlighted in green, as it was selected last (see Fig. 3.2.4, middle screenshot).

**FIG 3.2.4** Selecting curve objects (with selection filter) and modifying Key Tick Size.

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**Note**

Be aware that the current set selection mask will remain active while working. If required, turn off the selection mask if you are working on scene and need to select other elements from the Panel.

With the NURBS curve Control Objects selected, the keys will be visible as red ticks on the Time Slider. The size of the Key Ticks can be modified to aid the selection and edits made in this chapter section.

- Go to “Window > Settings/Preferences > Time Slider > Key Tick Size” and set the Key Tick Size = 15 (see Fig. 3.2.4, right screenshot).

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**Editing Timing & Spacing – First Half of Swing Animation**

In Chapter 1.3, we looked at the different methods for editing key timing on a character arm swing, both through editing keys directly on the Time Slider and through the Dope Sheet.

With all the Control Objects selected, we can make global edits to the overall timing through editing the keys on the Time Slider. On Playback, the sequence is far too slow with the current timing, let’s look at re-timing the first half of the swing animation (frames 15–25).

- Make sure that all the Control Objects are still selected from the previous step (see Fig. 3.2.4).
- On the Time Slider, click, at frame 20 with the left mouse button, then hold the shift key and click and drag right with the left mouse button to expand the selection to select from frame 20 to past frame 40 (see Fig. 3.2.5, top screenshot).
With the keys from frames 20 to 40 selected and highlighted, click the left mouse button on the small <> arrow icon at the middle of the highlighted selection and then drag left with the mouse button to shift the keys back three frames – the keys on frames 20–40 should be moved earlier by three frames (see Fig. 3.2.5, second screenshot from top).

On the Time Slider, click at frame 22 with the left mouse button, then hold the shift key and click and drag right with the left mouse button to expand the selection to select from frames 22 to 38 (see Fig. 3.2.5, third screenshot from top).

With the keys from frames 22 to 38 selected and highlighted, click the left mouse button on the small <> arrow icon at the middle of the highlighted selection and then drag left with the mouse button to shift the keys back two frames – the keys on frames 22–38 should be moved earlier by two frames (see Fig. 3.2.5, fourth screenshot from top).

The edits have shifted the keys from frames 20 and 25 to frames 17 and 20, respectively. Instead of 11 frames between the start of the swing (frame 15) and the mid-point of swing (frame 25), there are now only six frames (frames 15–20). The time between these poses has been reduced by about half, so the motion is twice as fast.

Playing back the animation validates that the timing is a lot punchier on the down swing to the mid-point of the swing at the start frames.

Scrubbing the Time Slider can help to validate the timing and spacing intervals between the poses.

Using the Step Forward/Step Backward One Frame buttons on the Playback Controls (Alt +, /Alt +.) is also a useful workflow to use to check the pose difference between each frame. Stepping through each frame from frames 15 to 20 shows that there is a lot of motion or spacing between the poses at each frame, creating faster motion on Playback (see Fig. 3.2.6).

Scene file with the timing modified for the start frames is included with the project scene files as – 3.2_01_Re-Time_StartSwing(IN).ma.
Editing Timing & Spacing – Second Half of Swing Animation

If we Playback the animation to check the overall timing, we can see that, although the timing looks right for the first part of the swing, the second part of the swing from frame 20 still looks too slow.

Stepping forward a frame at a time through the shot shows that the bat swings from frames 15 to 20 considerably, almost 180° from behind the head to the side of body (see Figs 3.2.6 and 3.2.7, screenshots on left). From frames 20 to 25, the bat only swings around 90° across the body, over the same period of time. The spacing between the poses is less on each successive frame, slowing the motion (see Fig. 3.2.7, screenshots on right).

If we look at the timing and spacing on the final part of the swing, from frames 25 to 35, we can see that there is even less motion between each successive frame when cycling through the animation (see Fig. 3.2.8, screenshots from left to right). Over the 10 frames, the character swings the bat only around 45° from full extension to across the shoulder.

Although there would be some slow out (or ease out) at this phase of the animation, the pose intervals between each frame are so slight that the character appears to be moving in slow motion at the end of the animation (see Fig. 3.2.8).

Let’s take a look at editing the timing intervals between frames 25 and 35 to make the animation punchier:

- Use the same workflow as before to select all the Animated Curve Control Objects (see Fig. 3.2.4).
- With the Control Objects selected, click the left mouse button at frame 25, and then with the shift key depressed drag to frame 36 to select the keys between frames 25 and 35 (see Fig. 3.2.9, top screenshot).
• With the keys from frames 25 to 35 selected and highlighted, click the left mouse button on the small < > arrow icon at the middle of the highlighted selection and then drag left with the mouse button to shift the keys back 1 frame (see Fig. 3.2.9, second screenshot from top).
• Click the left mouse button at frame 29 and then with the shift key de-pressed drag to frame 35 to select the keys between 29 and 34 (see Fig. 3.2.9, third screenshot from top).
• With the keys from frames 29 to 34 selected and highlighted, click the left mouse button on the small <> arrow icon at the middle of the highlighted selection and then drag left with the mouse button to shift the keys back two frames (see Fig. 3.2.9, fourth screenshot from top).
• Finally, select the key at frame 32 and shift it back to frames to frame 30 (see Fig. 3.2.9, bottom screenshot).

On Playback (Alt + V), the timing edits make the animation looks more natural. The overall timing of the second half of the sequence is more realistic and fits the first half edits.

Using the same process as before, we can step through the frames to validate the timing edits (Playback Controls = Step Forward/Step Backward One Frame (Alt +, /Alt +).

Frames 24–30
At the end of the swing, there are now only six frames (1/4 second) between the character swinging the bat around 45° from full extension to across the shoulder (see Fig. 3.2.10, left to right). The spacing between the poses at each frame is fairly even – meaning that the motion does not noticeably speed up or slow down. Compare this with the previous timing, where the motion was spread over 10 frames from frames 25 to 35 (see Fig. 3.2.8, left to right) – the motion has been speed up.

Fig 3.2.10  Validating timing edits – frames 24–30.
Frames 20–24
At the contact point on the swing, there are now only four frames on the motion (frames 20–24 – see Fig. 3.2.11, left to right). The key previously at frame 25 has been shifted to frame 24 – although this only reduces the timing by one-fifth, there is contrast between the poses as there is an in-between key at frame 22. The pose at frame 22 is closer to the pose at frame 20 – this effectively slows the motion between frames 20 and 22 and conversely makes the spacing between the poses at frames 22 and 24 broader. The broader motion between the poses at frames 22 and 24 creates punch in the animation and a “fast out” as the wrist swings in contact with the ball (see Fig. 3.2.11, screenshots on right).

Scene file with the timing modified for the second half of the swing is included with the project scene files as – **3.2_02_Re-Time_EndSwing(OUT).ma**.

Timing & Spacing – Isolated Elements
Similar workflows can be used to analyze and edit the timing intervals on isolated elements of the animation. In fact, the most common workflow when animating is to block out the overall timing and then make iterative selected edits to timing of detail areas in the animation. This refinement process will typically require looking at the posing and timing on selected body parts as the animation is polished.

If we take a look at the timing of the feet on the edited animation **(3.2_02_Re-Time_EndSwing(OUT).ma)**, we can see that the motion on the trailing planted right foot looks off. As soon as the left foot is planted (at frame 17), the right foot begins to pivot and roll from the toe and ball of the foot. This motion is twinned with the rotation on the hips that are twisting into the swing (see Fig. 3.2.12). This is unnatural looking, as the foot is moving at the same time as the hips – it also makes the motion look “soft” or a bit “spongy.”
We can make a couple of quick edits to the motion, so that it looks more natural. For this, we’ll use the Dope Sheet to appraise and modify the timing for the elements:

- Using the same workflow as before, select all the wire Curve Control Objects in the scene.
- Open the Dope Sheet Window from:
  - Window > Animation Editors > Dope Sheet (see Fig. 3.2.13, left screenshot).
- Expand the Dope Sheet window to show all the selected Control Objects and keyframes (see Fig. 3.2.13, right screenshot).

In addition to an overview of all the animated elements and timing, the Dope Sheet also provides a benefit in that it allows us to see all the separate animated channels on the object. For the foot control that we want to edit, attribute is set up to control the foot roll. Setup for this is covered in the Character Rigging section in Chapter 9.3 and we’ll be working on animating with this control through the Channel Box in a couple of the other chapters; for now, let’s take a look at the keys from the Dope Sheet:

- Make sure that the right foot control is selected and listed in the Dope Sheet Editor.

**Note**

You may need to scroll the left pane of the Dope Sheet Editor to see it listed, it’s named as BBALL02_RIG_BASE_FSP_Foot_R_CTRL.

- With the left mouse button, click the small + icon beside the object name to expand the animated channels (see Fig. 3.2.14).
- The following animated channels should be visible:
  - Roll/Heel Roll/Toe Roll/Heel Pivot/Toe Pivot (see Fig. 3.2.14).
For the foot pivot and roll, the animated channels are Ball Roll and Toe Roll. To make the animation look more natural, the keys should be offset a few frames, slightly after the hips start to twist on the swing. This will look more natural, as the hips are leading the motion and forcing the foot to rotate and pivot as the body turns. This edit will also add natural “Follow-through” to the animation to create more believability.

- With the object still selected and Dope Sheet Editor open, select and highlight the following channels from the left pane: Ball Roll/Toe Roll.

**Note**

Use Ctrl + LMB to multi-select the two channels. When channels are first selected, all the keys are also selected and highlighted in the Dope Sheet.

- Activate the Move Tool (W) and pull the keys + three frames, so that the animation starts slightly later, at frame 20 instead of frame 17 (see Fig. 3.2.15).

If you scrub the Time Slider, you’ll see that the foot pivot and roll is now delayed, which looks more natural when compared with the timing on the hips.

At around frame 20, you’ll notice that the knee looks twisted and doesn’t match the edited angle of the foot (see Fig. 3.2.16, left screenshot). This is due to the timing being un-modified on the knee Control Object:

- Make sure that the right knee control is selected and listed in the Dope Sheet Editor.

**Note**

You may need to scroll the left pane of the Dope Sheet Editor to see it listed, it’s named – BBALL02_RIG_BASE_FSP_Leg_R_Pole.

- Click the + icon beside the Control Object name in the left pane of the Dope Sheet window to expand the channels and select the Translate Channel (see Fig. 3.2.16, left screenshot).
• With the Select Tool, marquee select the keys between frames 17 and 27. The keys should highlight in yellow (see Fig. 3.2.16, left screenshot).
• Activate the Move Tool (W) and shift the keys + two frames, so that the motion now starts at frame 19 instead of frame 17 (see Fig. 3.2.16, right screenshot).

Scrub the Time Slider and cycle through the frames using the Step Forward key on the Playback Controls to check and validate the timing edits.

The twist on the knee and foot is now delayed to follow the rotation of the hips more naturally. The foot does not start to pivot until the hips are already in motion, and the heel does not push out fully until the hips and knee are at full extension. Although the knee does not begin to turn until after the hips, it still leads the foot turn by a single frame, which could be extended. Overall, the motion timing is more believable, as there is overlap and follow-through added to enhance the selected elements timing (see Fig. 3.2.17).

Scene file with the timing modified for the foot roll and pivot and knee is included with the project scene files as – 3.2_03_Re-Time_Foot_Pivot.ma.