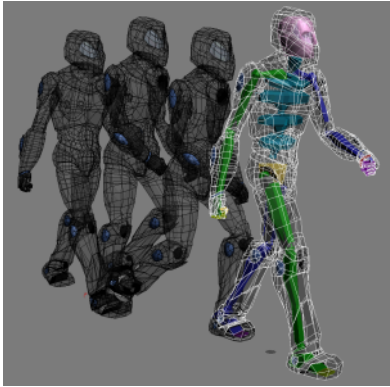


Animating with Freeform

This tutorial shows you how to animate a biped using the freeform technique. This method does not use footsteps; instead, you are responsible for animating

every part of the biped. Freeform animation gives an animator fine control over the biped's motion.



In this tutorial, you will learn how to:

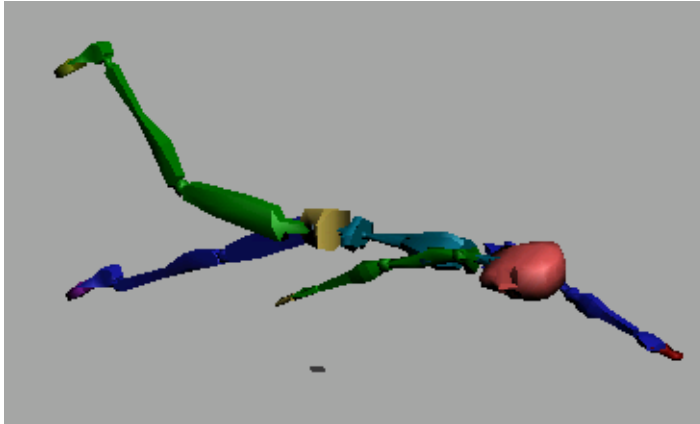
- Use planted, sliding, and free keys.
- Create a traditional walk cycle using animated pivot points.
- Create a stretchy leg and a shaky walk using Biped SubAnim controllers.
- Create animated 3ds Max bones from a biped animation.

Skill level: Beginner to Intermediate

Time to complete: 2 hours

Creating a Simple Freeform Animation

This lesson provides an introduction to using freeform animation techniques with Biped.




In this lesson, you will animate a biped swimming in place. You'll use freeform animation methods to produce the kicking legs and arm strokes.

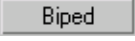
In order to create this motion, you'll use a combination of rotations and moves. You'll also make use of Copy and Paste Posture Opposite to animate one arm and copy its tracks to the other.


Set up the lesson:


- 1 Reset 3ds Max.

- 2  On the Create panel, click the Systems button.

Create a biped and load a FIG file:

- 1  Click the Biped button and then create a biped in the Front viewport.

- 2  Go to the Motion panel.


- 3  Turn on Figure Mode and click Load File. The Open dialog displays.

- 4 Open the file *cs4_tut_rtgame.fig*. This file is in the folder `\sceneassets\animations\`.


The biped takes on new structural elements saved in the FIG file. This simplified figure has one large toe on each foot and one large finger on each hand, and its spine contains two segments instead of four.



The biped with FIG file applied.

- 5  Turn off Figure mode.

NOTE You cannot animate in Figure mode.

- 6  Select all the biped objects, and then click Zoom Extents All.
- 7 Save the scene as **MySwimmer01.max**.


Start a freeform animation:


You start a freeform animation by activating automatic key recording and transforming any part of the biped.

- 1 Right-click the Left viewport.

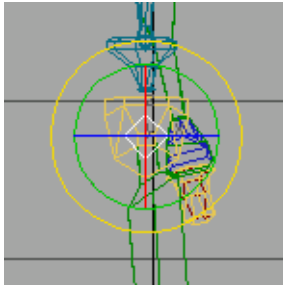
This activates the Left viewport without affecting the selection in the scene.

- 2 Press Alt+W to maximize the viewport for a closer view of the biped. The biped should be in wireframe. Change the shading display of the Left viewport if it is not wireframe.

- 3  Turn on Auto Key.
The button turns red, and the active viewport is outlined in red.

- 4  On the Track Selection rollout on the Motion panel, click Body Rotation.

NOTE Activating any of the Body ... buttons on the Track Selection rollout automatically selects the center of mass (COM) object.



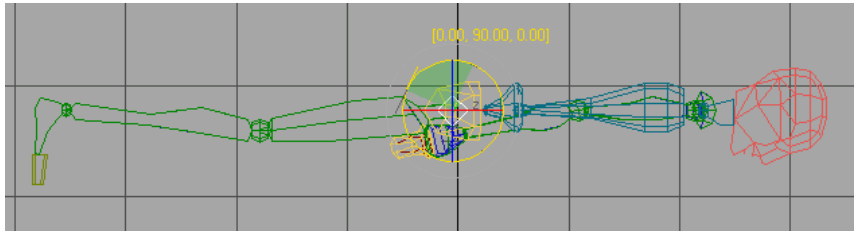
Rotation transform gizmo

The rotation transform gizmo lets you easily rotate an object about a chosen axis. As you move your cursor over the gizmo in the viewport, the axis circles turn yellow, indicating the axis around which the rotation will occur:


- The red circle, displayed as a vertical line in this viewport, affects the X axis.
- The green circle affects the Y axis.
- The blue circle, displayed as a horizontal line in this viewport, affects the Z axis.
- The light gray circle, displayed around the green circle, allows free rotation around all three axes.


- 5 Move your cursor over the green circle.
The cursor turns yellow, meaning that any rotation is locked to that axis.
- 6 Rotate the center of mass approximately 90 degrees about the Y axis.
Watch the coordinate readout near the gizmo to see how far you're rotating the biped. Rotate until the biped is lying prone.

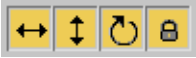
TIP If you like, you can press A to turn on Angle Snap, which lets you easily rotate to 90 degrees.



An animation key appears at the far left of the track bar, at frame 0.
You can select all three COM tracks under Track Selection to create keyframes simultaneously. Try this:

- 7  On the Track Selection Rollout, click Lock COM Keying, and then click the Body Rotation button.

- 8  On the Track Selection rollout click both the Body Horizontal and Body Vertical buttons so that both tracks are selected.

 All the multiple tracks for the COM are now active.

- 9  Expand the Key Info rollout and click Set Key.

This sets keys for all the COM tracks at frame 0. The trackbar key shows a multi-color display, indicating that both position and rotation keys have been created.

- 10 Click Lock COM Keying again to unlock the COM tracks.

TIP It's a good idea to set a key at the start of your animation for the three COM tracks.

Pose one leg:

Now that the biped is prone, you're ready to animate the swimming motion. First, you'll position the legs. You'll work on the right leg first, setting up its position at frame 0.

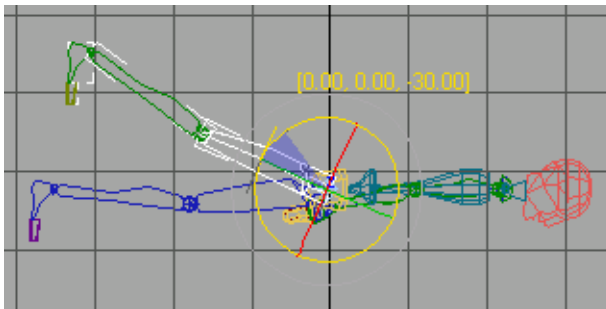
- 1 Press Alt+W so you can see all four viewports again.
- 2 Select *Bip01 R Thigh* by clicking the lines of the thigh in the Left viewport.

TIP As you hold your cursor over an object in the viewport, the object's name is displayed in a tooltip. You can also select an object by pressing H to choose objects from the selection list.



The right thigh is selected.

-
- 3 Rotate *Bip01 R Thigh* approximately -30 degrees about the Z-axis. The right leg is rotated, but the right foot is pointing straight down.

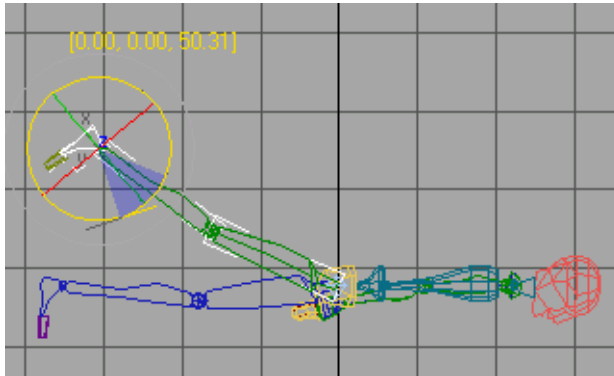


- 4 Press Page Down twice to select the right foot.

TIP The Page Up and Page Down keys let you quickly navigate through the objects that make up a biped.

- 5 Rotate *Bip01 R Foot* about -50 degrees around the Z-axis.

The foot looks more natural in this position.

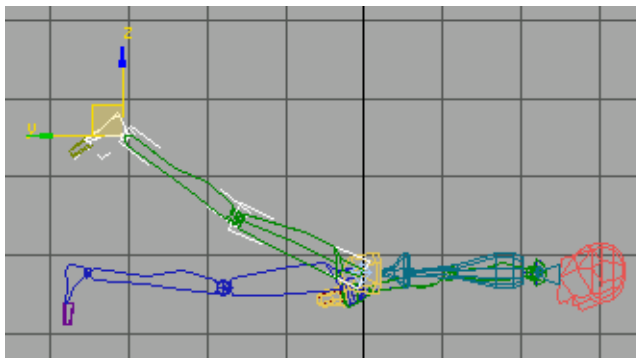


So far you've used only forward kinematics to animate the biped. Next you'll use inverse kinematics by moving the foot to move the entire leg.

- 6 Right-click the same foot and choose Move from the quad menu.

TIP You can choose the transform tools either from the main toolbar or by right-clicking to open the quad menu.

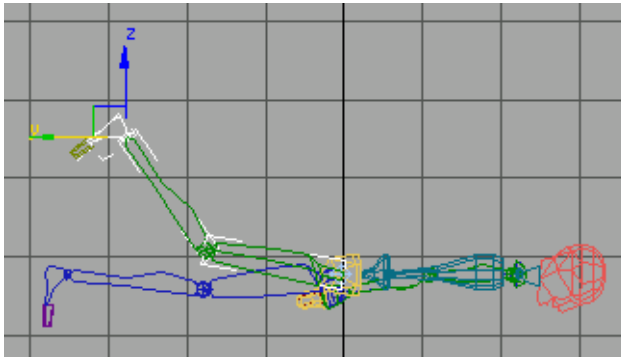
The Transform gizmo switches to an axis tripod showing two of three arrows in this viewport. They are displayed at right angles with the Z axis pointing up and the Y axis pointing left.



Ready to move the foot.

- 7 In the Left viewport, move the cursor over the Y axis of the gizmo until it turns yellow, then move the foot a little to the right.

The knee bends to accommodate the new position of the foot.



The knee bends.

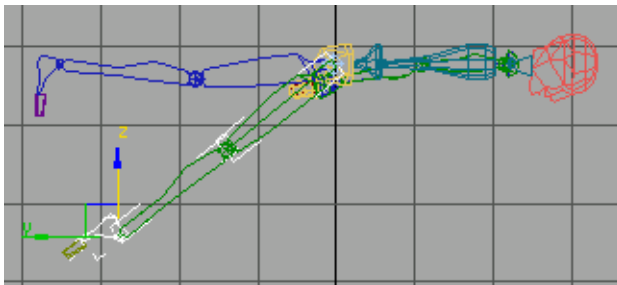
In this move, you've just used *inverse kinematics*. The foot, calf, and thigh are linked together in a hierarchical chain. By moving the end of the chain, the foot, you rotated the lower and upper leg objects.

- 8 Save the scene as **MySwimmer02.max**.

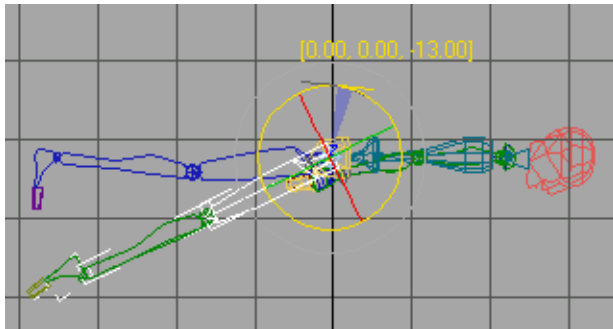
Animate the leg:

Everything you've done so far has been at frame 0. Now you'll move forward in time and animate the pose at frame 10.

- 1 Move the time slider to frame 10.
- 2 Move the foot downward on the Z axis until the knee straightens out.



- 3 Press Page Up twice to select *Bip01 R Thigh*.
- 4 Right-click and choose Rotate from the quad menu, then rotate the *Bip01 R Thigh* approximately -10 degrees about the Z axis.



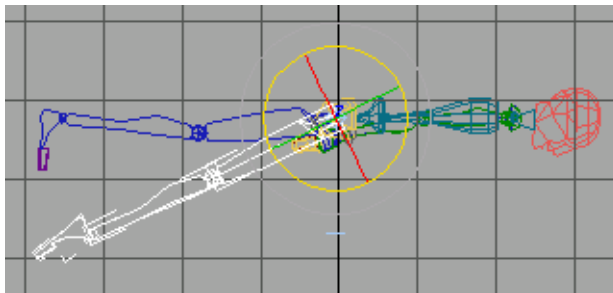
Rotating the thigh.

- 5 Move the time slider back and forth between frame 0 and frame 10. The leg moves up and down.


Use copy and paste:

Now you'll use some specialized Biped tools to pose and animate the opposite leg.


- 1 Return the time slider to frame 10.
- 2 Double-click *Bip01 R Thigh*. The entire leg is selected from the thigh down to the toes.



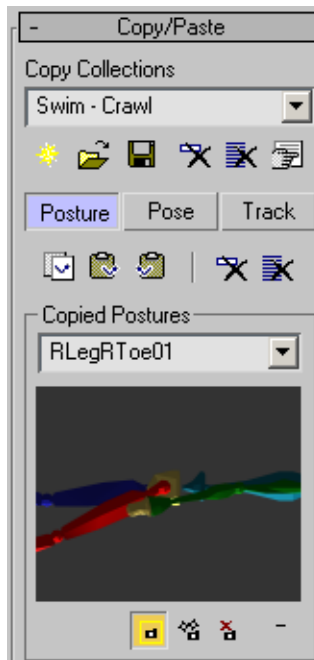
- 3 On the Motion panel, expand the Copy/Paste rollout. The Copy/Paste functionality includes the creation of collections. You must create a collection before you can start creating postures.

- 4  On the Copy/Paste rollout, click the Create Collection button. This creates a collection named *Col01*. Rename it to **Swim – Crawl**.


- 5  Make sure that the Posture button is activated.

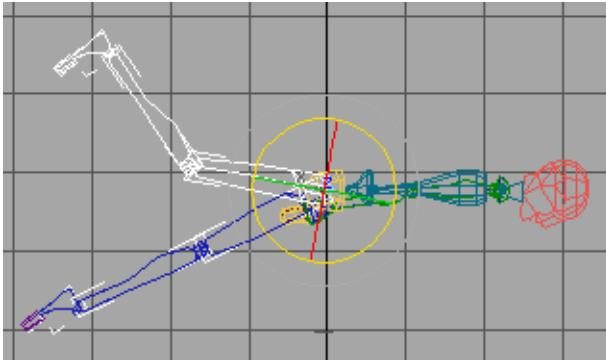
- 6  Also make sure that Capture Snapshot From Viewport is chosen, just above the Paste Options group. This forces the thumbnail of the pose to be taken from the active viewport. This particular posture, for example, is better seen from the Left viewport rather than the Front.


- 7  Click Copy Posture.



The posture of the right leg is copied into a buffer. Change the name of the Copied Posture to **RLeg – downkick**.

- 8  Move the time slider back to frame 0. Click Paste Posture Opposite. The left leg rotates downward. The right leg hierarchy is still selected.

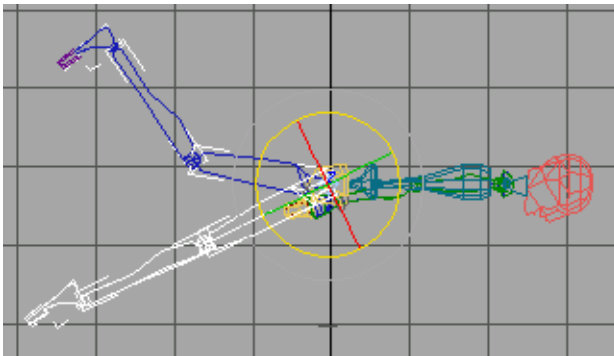


- 9  At frame 0, choose Copy Posture again.

- 10 Move the time slider to frame 10.

- 11  Click Paste Posture Opposite again.

Now the left leg is raised, and the right leg is down.




- 12 Move the time slider back and forth between frames 0 and 10 and watch the legs kick.


Now you'll repeat this process to make the legs kick several times.

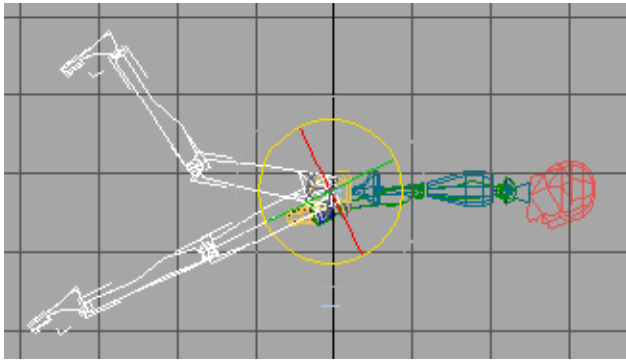
- 13 Save the scene as **MySwimmer03.max**.


Use Paste Posture to create multiple kicks:

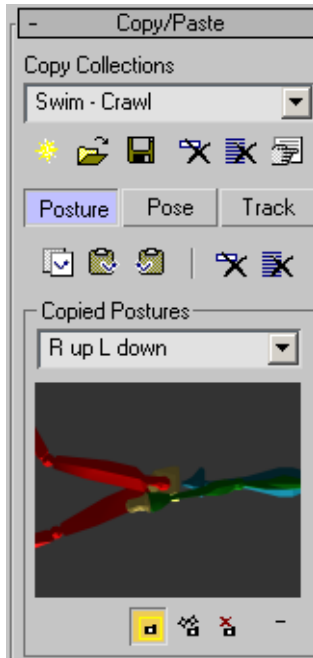
You can use the Copy Posture tools to quickly duplicate all the leg keys from one frame to another to create repeated kicking motions.

- 1  Make sure that Auto Key is still on and move the time slider to frame 0.

- 2  On the Track Selection rollout, click Symmetrical.
Now both legs are selected.



- 3  Click Copy Posture at frame 0. Name the copied posture **R up L down**.




Both legs are added to the collection.

- 4 Move the time slider to frame 20.

TIP You can type in the frame number in the Current Frame time control.



- 5  At frame 20, click Paste Posture.
- 6 Go to frame 30 and click Paste Posture Opposite. From this point forward you can click either Paste or Paste Opposite as you create a kicking cycle. For a smooth kick cycle, simply alternate the posture every 10 frames up to frame 80. The track bar displays a total of nine keys for the animation of the legs.



- 7 In the Copy Collections group click the Save Collection button to save your collection. Name the collection **Swim – Crawl**. The CPY extension is automatically added to the name.
- 8 Save the scene as **MySwimmer04.max**.

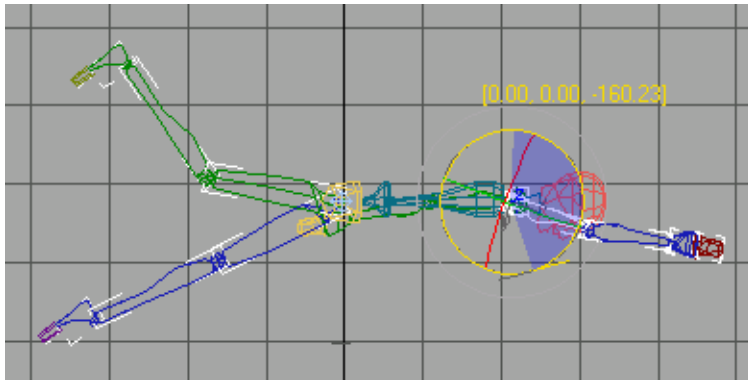
Animating a kicking leg was fairly easy, requiring only two poses: one with the leg up, and one with the leg down. Animating the arms is more complex. To animate the stroke of an arm, you'll need five poses:

- The arm outstretched
- The arm down
- The arm back
- The arm drawn up out of the water near the ear
- The arm entering the water

When one arm is animated correctly, you'll use Copy Track and Paste Opposite Track to animate the second arm. You'll adjust the timing of the second arm by sliding the keys in the track bar.

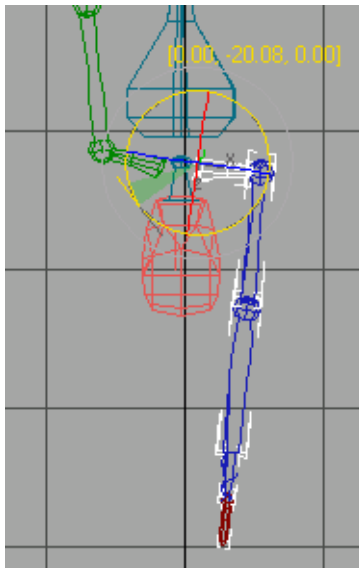
Animate one arm:

- 1  Make sure that Auto Key is still on, and move the time slider to frame 0.
- 2 Press H and select *Bip01 L UpperArm* from the Select From Scene dialog.
- 3  In the Left viewport, select and rotate *Bip01 L UpperArm* approximately -160 degrees about the Z axis, until it is extended in front of the biped.

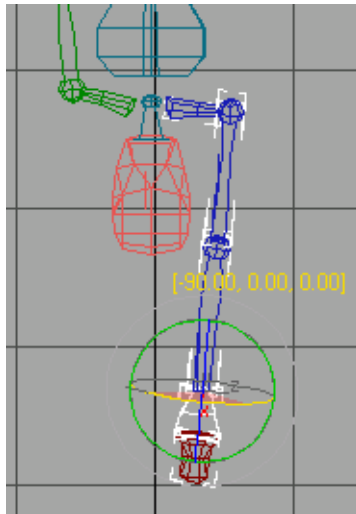


- 4 Right-click the Top viewport and press Page Up to select *Bip01 L Clavicle* and rotate it -20 degrees about the Y axis.

This should prevent the arm from passing through the head.

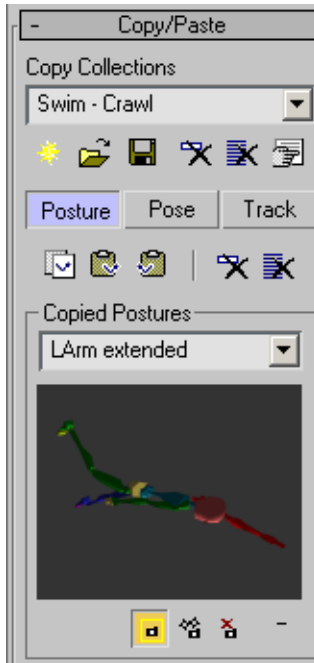


- 5 In the same viewport, press Page Down three times to select *Bip01 L Hand*. Rotate it approximately -90 degrees about the X axis so the palm is facing down.



This completes the first arm pose, so it's a good time to save your data.

- 6 Double-click *Bip01 LClavicle* to select the entire left arm hierarchy.
- 7 Activate the Perspective viewport so that the snapshot will be easier to identify, and then click Copy Posture. Name the pose **LArm extended**.

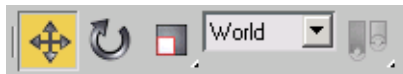


Thumbnail snapshot from perspective viewport.

- 8 Move the time slider to frame 10.



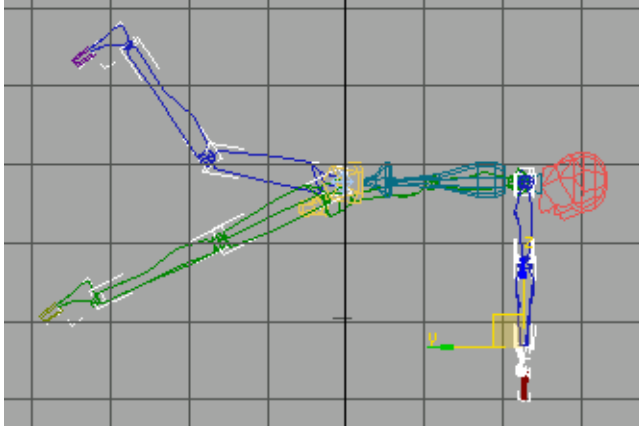
- 9 On the main toolbar, click Select And Move, and then change the Reference Coordinate System to World if necessary.



This will facilitate working with the Transform gizmo in different viewports.

- 10 Right-click in the Left viewport. Move *Bip01 L Hand* downward on the Y and Z axes until it points straight down. This completes the second arm pose.

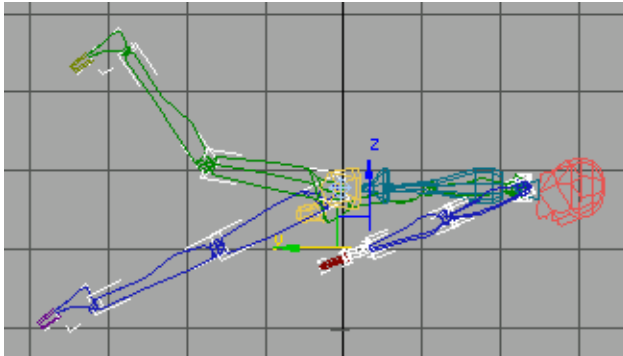
TIP If you grab the Move gizmo by the corner where the two axes meet, you can move selected objects on both axes at once; that is, on the YZ plane.



- 11 Double-click *Bip01 LUpperArm* to select the arm hierarchy and then click Copy Posture. Name the pose **LArm down**.
- 12 Move the time slider to frame 20.

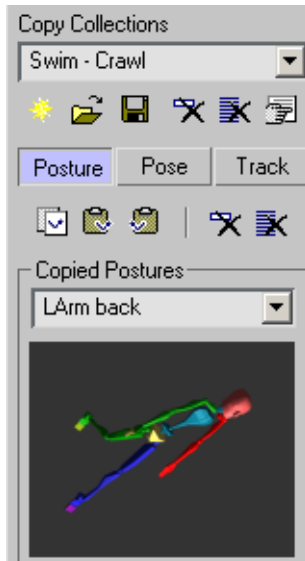


- 13 Select *Bip01 L Hand* and then move the hand along the Y axis toward the legs.



- 14 Activate the Front viewport and press Page Up three times to select *Bip01 L Clavicle*. Rotate this part about 24 degrees around the Z axis. This completes the third arm pose. Save it by double-clicking *Bip01 L UpperArm* in the Top viewport to select the hierarchy, then click Copy Posture. Name the pose **LArm back**. If you activate the Perspective viewport

before you copy the posture, you can adjust the viewport so the pose is clearly visible in the thumbnail.

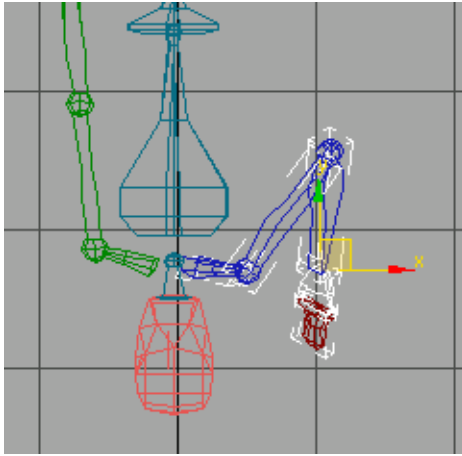


15 Move the time slider to frame 30.

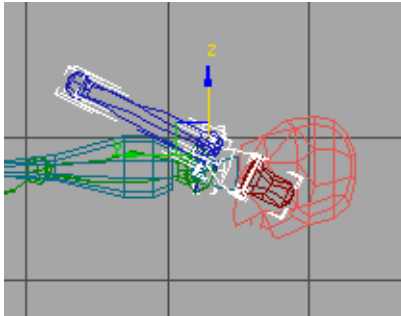
16 Activate the Top viewport.



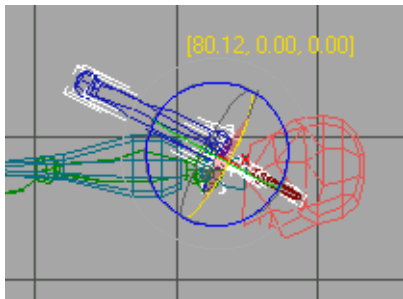
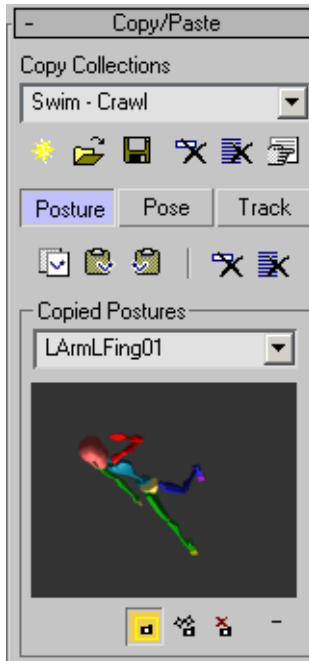
17 Select *Bip01 L Hand* and then move the hand in the XY plane until the hand is level with the shoulder.



- 18 In the Left viewport, move *Bip01 L Hand* on the Z axis so it is near the ear.



- 19 Finally, rotate *Bip01 L Hand* about the X axis so the palm is flat. This completes the fourth arm pose. Save it to the collection by double-clicking the upper arm to select the entire hierarchy, then click Copy Posture. Name it **LArm up**.



- 20 To create the fifth pose go to frame 37.
- 21 In the Left Viewport, move the *Bip01L Hand* object on the Y axis so it is in front of the head, and is level with the shoulders. Double-click the *Bip01 L Upperarm* to select the entire arm hierarchy, activate the Perspective viewport, and then click Copy Posture. Name the posture **LArm stroke**.

NOTE The fifth pose is used to ensure that the rotation of the arm is correct going from the out of water pose to the extended pose.

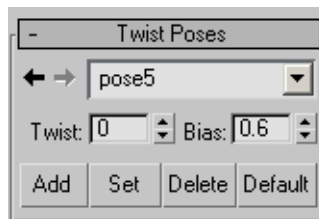
22 Save the scene as **MySwimmer05.max**.

Applying a twist pose:


You can use twist poses to correct upper arm rotations. Twist poses are primarily used to correct arm twisting, but in this case we'll use it to simply position the arm efficiently.

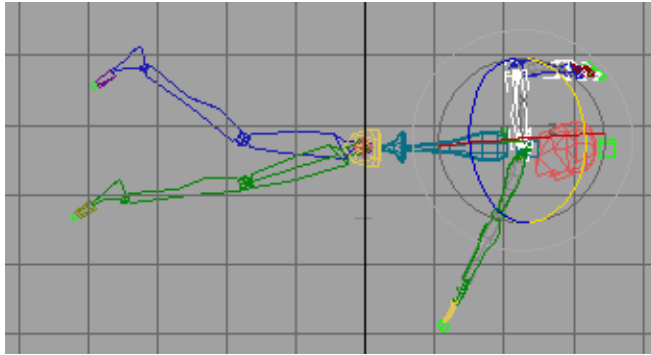
- 1 Turn off Auto Key if it is on.
- 2 Select *Bip01 L Upperarm*.
- 3 Move the time slider to frame 33.
- 4 Expand the Twist Poses rollout.
- 5 In the Twist Poses drop-down list, choose each pose and observe the change to the arm in the viewport.

Consider these default poses as additional copied postures that you can use to “straighten out” problems by defaulting to fixed rotations.



Twist Poses

- 6  When pose 5 is selected the arm will be rotated and positioned correctly. Expand the Key Info rollout and click Set Key to keyframe the twist pose.




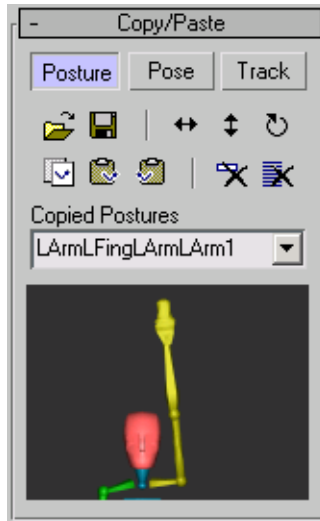
Default Twist pose 5.


TIP Twist poses are designed to help you fix twisting that occurs in the mesh attached to the biped. If you go to Figure Mode, you can enable Twist Links by turning on the Twists check box, then set the number of twist links you would like for the upper arm, forearm, thigh, or “horse-link” (the extra link in the Leg if Leg Links are set to 4). Unfreeze and unhide all and you will be able to see the twist bones that have been added using this method. Once the Twist Links functionality is enabled you can play with the Twist and Bias settings.


Copy the Arm pose:

To complete the arm cycle, in the next few steps you’ll copy the arm pose to frame 40.

- 1  Turn on Auto Key.
- 2 In the Top viewport, double-click *Bip01 L Clavicle* to select the entire left arm.



3  At frame 33, click Copy Posture.

4  Advance the time slider to frame 40 and click Paste Posture.


If you see any unusual rotations or out-of-place movements, you can set additional keys to refine the animation.

5 Move the time slider and watch the animation.

Repeat the animation:

If the animation is going to be 80 frames in length, you'll need to repeat the arm movement.

- 1 Double-click *Bip01 L Clavicle*, to select the entire left arm, if it's not already selected.
- 2 In the trackbar drag a selection window around the keys for frames 10 through 40.
- 3 Hold down the Shift key and copy these keys by dragging them to the right. When the first key is over frame 50, release the mouse button.

- 4  Play the animation. The biped should perform two complete strokes with its left arm.
- 5 Save your scene as **MySwimmer07.max**.

Add rotation to the spine:

Next you'll add some rotations for the spine to make the animation more convincing. This spine of this biped figure (*cs4_tut_rtgame.fig*) has only two segments. You'll rotate the large section representing the upper torso.

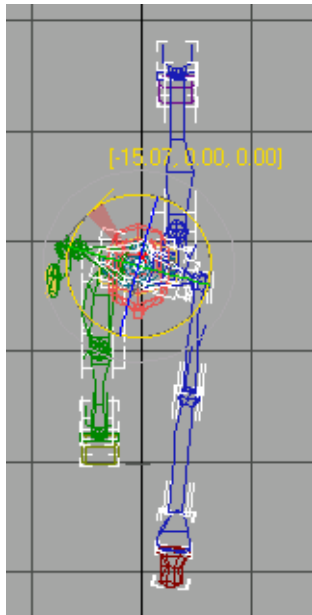
- 1 Make sure that Auto Key is still on.
- 2 Select *Bip01 Spine1*.

NOTE The first spine object is *Bip01 Spine*. The large second spine object is *Bip01 Spine1*.

- 3 Right-click the Front viewport.



- 4 Move the time slider to frame 0, and on the Key Info rollout, click Set Key.
This sets a start key for the rotation.
- 5 Move the time slider to frame 10 and rotate *Bip01 Spine1* approximately **-15** degrees about the X axis.
This makes the body appear to follow the movement of the arm.



Spine rotation

- 6 On the track bar, click the key at frame 0 to select it, then hold down the Shift key and drag a copy to frame 30. Watch the status area to know when you are at frame 30.



The spine now rotates once in the 40-frame cycle.

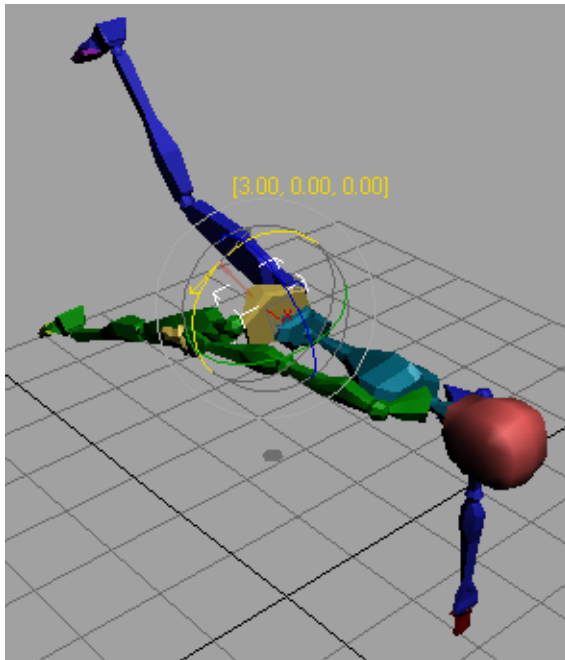
- 7 Select *Bip01 Pelvis*.



- 8 Move the time slider to frame 0 and on the Key Info rollout, click Set Key.

This sets a start key for the rotation.

- 9 Move the time slider to frame 10 and rotate the pelvis a few degrees in X so it follows the movement of the left leg.



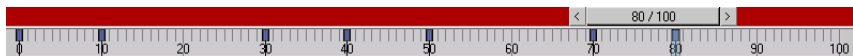
Rotate the pelvis.

- 10 Copy these two keys to frames 20 and 30.

TIP You can also add a few degrees of rotation around the Y axis as well for the pelvis if you like.

Next you'll copy the pelvis and spine rotation keys to repeat the motion.

- 11 Make sure that the pelvis is still selected, then hold down the Ctrl key and click the *Bip01 Spine01* object (the large torso spine object).
- 12 In the track bar, drag a selection rectangle around the four visible keys.
- 13 Hold down the Shift key and drag the keys so the leftmost key is copied to frame 40. Move the time slider back and forth to see the animation.
- 14 Copy the key from frame 0 to frame 80 to complete the set of keys.

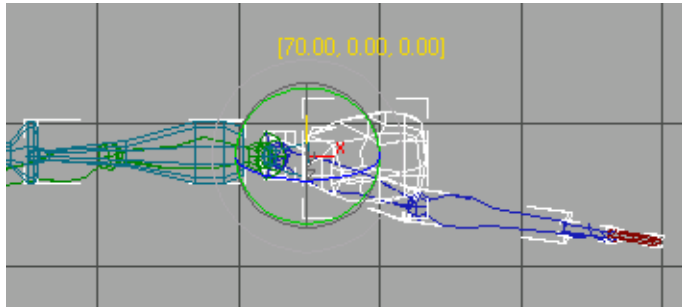


The final set of Bip01 Spine1 keys.

Animate the head:

The biped can breathe as it swims, if you animate the head rotation appropriately.

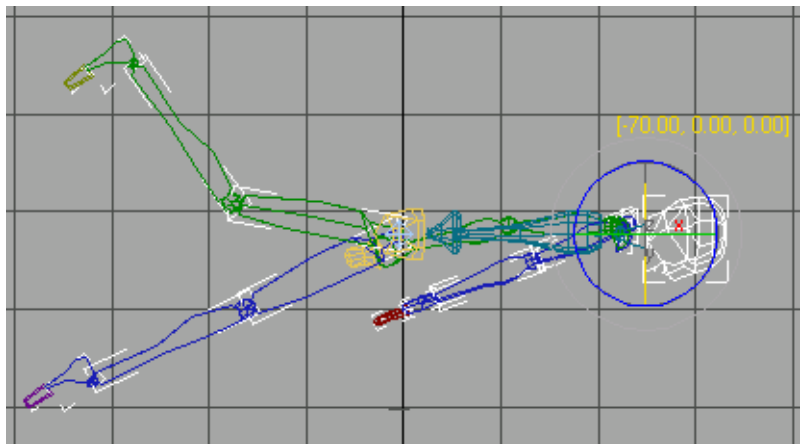
- 1 In the Left viewport, select the biped's head, *Bip01 Head*.
- 2 Move the time slider to frame 0 and rotate the head about **70** degrees around the X axis, so the biped's left ear is pointing down.



Rotate the head for breathing motion.

TIP Watch the Perspective viewport while rotating in the Left viewport.

- 3 At frame 20, rotate the head back down.

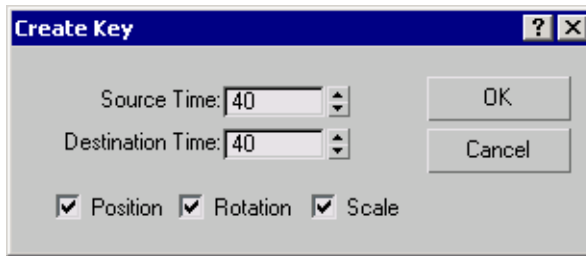


- 4 Hold down the Shift key and drag to copy the key at frame 0 to frame 40. Watch the status area to know when you are at frame 40.

- 5 Move the time slider to observe the head rotation.
Actually, it would look better if the head were turned up at frame 30.
- 6 Slide the key you made at frame 20 along the track bar to frame 30. Do not hold down the Shift key for this step.
The biped lifts and lowers its head once in the 40 frame cycle.

TIP You can move the time slider to frame 30, then slide the key on top of it.

- 7 To explore another way to copy keys, right-click the time slider.
The Create Key dialog is displayed. This lets you create keys by choosing a source and a destination.




TIP You don't have to turn on Auto Key to set keys this way.

- 8 Set Source Time to 30 and Destination Time to 70, and then click OK.
- 9 Right-click the time slider again.
- 10 Set Source Time to 0 and Destination Time to 80, and then click OK.


This completes the head motion, but the right arm motions still need work. That comes next.

Animate the other arm with Copy Tracks:

Copy Tracks lets you copy and paste the animation tracks of selected objects to other objects, or to opposite body parts.

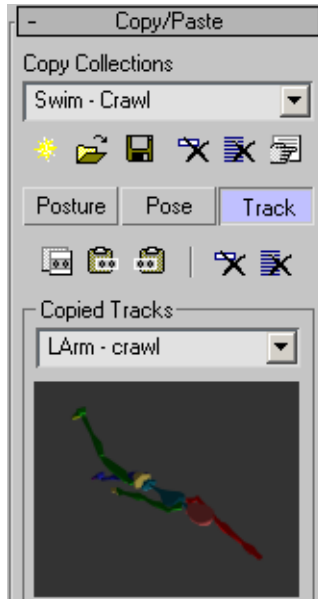
- 1  Make sure that Auto Key is still on.
- 2 In the Top viewport, double-click *Bip01 L Clavicle* to select the entire left arm.

3 Activate the Perspective Viewport.

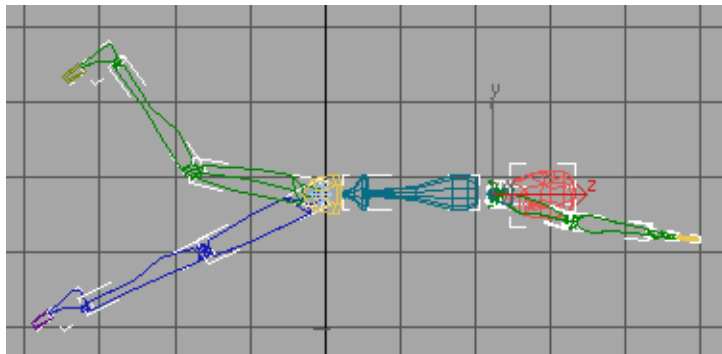
4  On the Copy/Paste rollout, turn on the Track button.


5  Click Copy Track.

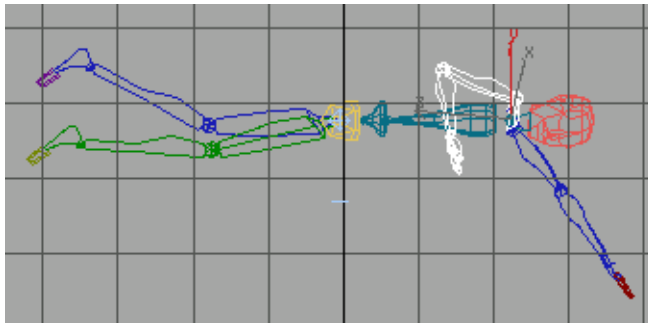
The track is copied to the buffer. Name the track **LArm - Crawl**.




6  Click Paste Track Opposite.







- 7  Play the animation.
The biped is swimming the butterfly stroke. The two arms move together. Next you'll change the timing so the arms alternate.
- 8 In the Top viewport, double-click the *Bip01 R Clavicle*.
The entire right arm is selected in the viewport.
- 9 Drag a box around all the keys in the track bar to select them. Slide all the keys 20 frames to the right.



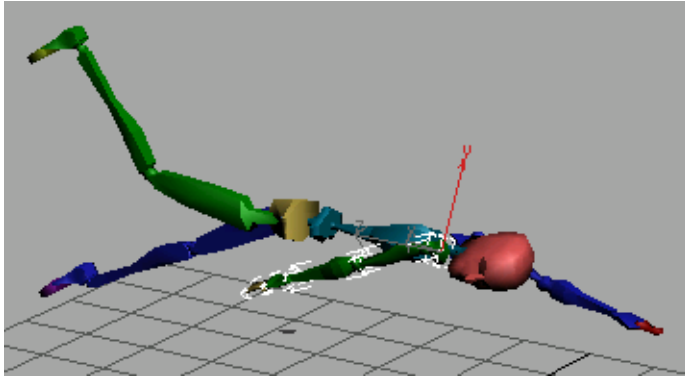
The biped swimming a freestyle stroke.

- 10  Play the animation.
Now the beginning and end are not quite right. The easiest way to correct this is to copy and paste poses.


Fix the beginning and end:

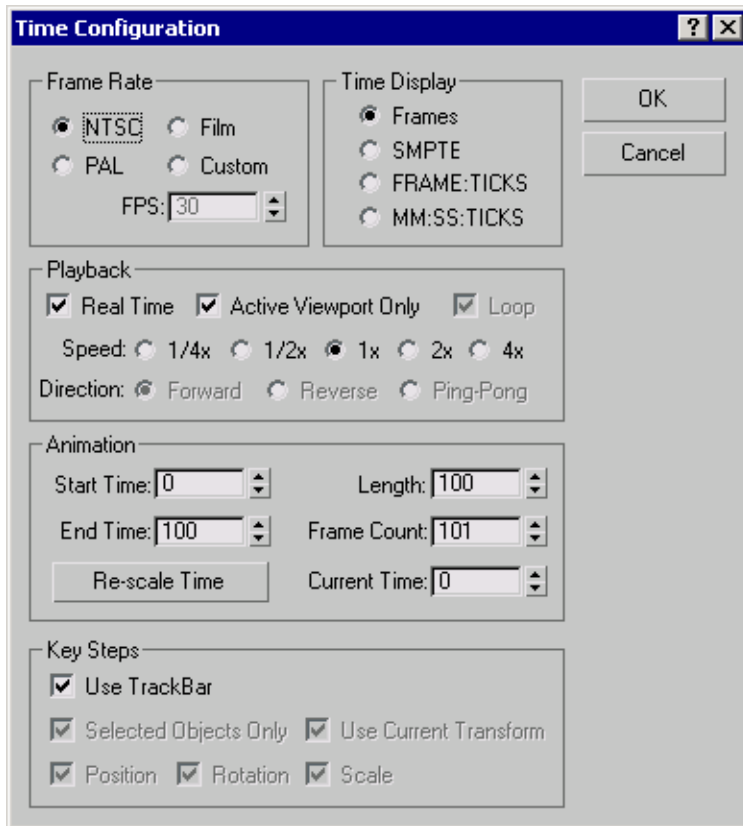
- 1  Make sure that Auto Key is still on.
- 2 In the Top viewport, double-click the *Bip01 R Clavicle* to select the entire right arm, if it's not already selected.
- 3  On the Copy/Paste rollout, click the Posture button.
- 4  Move the time slider to frame 50 and click Copy Posture.
- 5  Move the time slider back to frame 10 and click Paste Posture.

- 6 At frame 40, click Copy Posture, then at frame 0, click Paste Posture.
Now the arms alternate.




To correct the other end of the animation, you can crop the animation to 80 frames.

- 7  In the time controls, click Time Configuration.
The Time Configuration dialog is displayed.




- 8 In the Animation group, change the End Time to **80**. Click OK.

WARNING Do not click Re-scale Time.

- 9  Play the animation.

Save your work:

- 1  In the Biped rollout, click Save File and save the motion as **MySwimmer.bip**.
- 2 Also save your final scene as **MySwimmer08.max**.

Perfecting the animation:

- If you like, you can improve the animation by adding some rotation keys to the pelvis and spine and by adding secondary motion to the feet and hands. Stagger the rotations of the extremities a few frames following the movement of the hands and feet.


Animating a Freeform Walk Cycle

While 3ds Max has a dedicated method (Footstep mode) for creating quick and easy walking animations, you can also create walk cycles with freeform animation.





In this lesson, you'll use animated pivot points and IK blend keys to constrain the feet to the ground plane.

Set up the lesson:

- 1 Restart or reset 3ds Max.
- 2  On the Create panel, click the Systems button.

Create a biped and load a FIG file:

- 1  Click the Biped button and create a biped in the Front viewport.


- 2  Open the Motion panel.

- 3   Turn on Figure Mode and click Load File.
The Open dialog is displayed.


- 4 Open the file *cs4_tut_rtgame.fig*. This file is in the folder `\sceneassets\animations\`.

The biped takes on new structural elements stored in the FIG file. This simplified figure has one large toe on each foot and one large finger on each hand; its spine contains two segments instead of four.



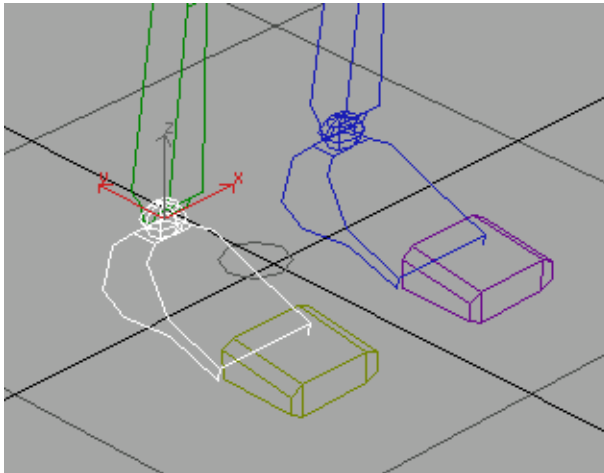
- 5  Turn off Figure mode.


NOTE You cannot animate in Figure mode.

- 6  Click Zoom Extents All.
- 7 Save the scene as **mywalk01.max**.

Set a key:

- 1 Change the Perspective viewport to Wireframe (press F3) and zoom in so the feet are clearly visible.
- 2 Select *Bip01 R Foot*.



- 3  On the Motion panel, in the Key Info rollout, click Set Key. The foot is highlighted in white, and a key appears on the track bar at frame 0. You have just started a freeform animation.




Track bar key at frame 0

Set different types of keys at frame zero:

There are two ways to set character animation keys in 3ds Max. You can use the standard method of keyframing, which involves turning on Auto Key and

transforming objects. It is quick and easy, but if you forget that Auto Key is on, you can set keys unintentionally.


The second method uses the Set Key buttons on the Key Info rollout. These buttons set several parameters at once. This is the method you'll use in the steps that follow.

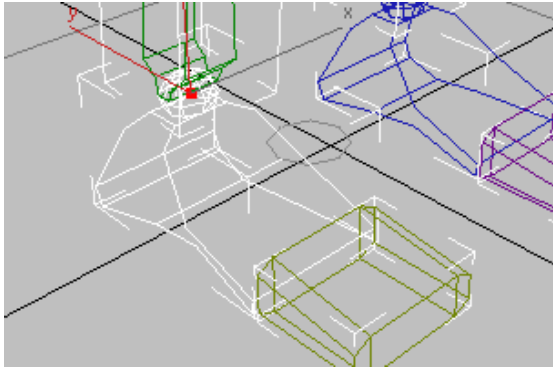
-  On the Track Selection rollout, click Body Vertical.
This selects the biped's center of mass, *Bip01*, and activates the Move tool in one step. You've set a key for the foot, but there is a problem. The foot can go through the ground plane. See for yourself in the next few steps.
- Right-click the Left viewport to activate it without changing the selection set.
- With the Body Vertical track still active on the Track Selection rollout, move the center of mass down in the Left viewport.
The biped moves down through the ground plane (as indicated by the grid in the Perspective viewport).
- Press Ctrl+Z to undo.

Set planted keys:

Now you'll set a planted key. A planted key does three things: it sets IK Blend to 1, turns on Join To Previous IK Key, and also turns on Object Space. Together, these three settings ensure that the foot will not pass through the ground plane.

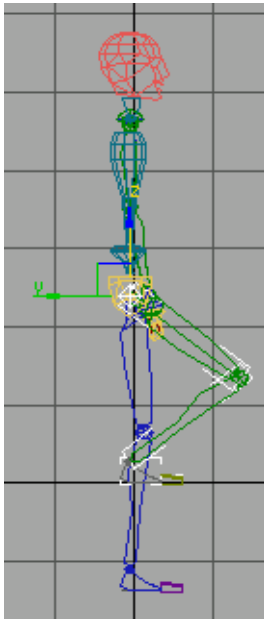
For more information about IK Keys, refer to the "Key Info Rollout" topic in the User Reference.

- In the Perspective viewport, select *Bip01 R Foot* again.
-  On the Key Info rollout, click Set Planted Key.
The red pivot point becomes more pronounced.



- 3 On the Track Selection rollout, click Body Vertical, and move the biped down in the Left viewport.

The foot stays on the ground plane, and the knee bends to accommodate the vertical movement of the biped.



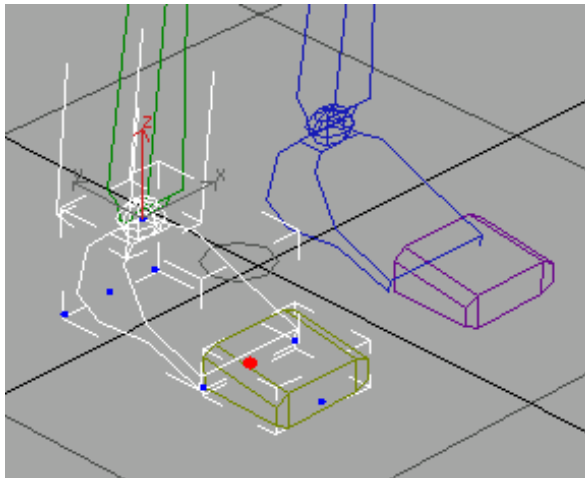
Planted foot stays on ground.

- 4 Press Ctrl+Z again to return the biped to its previous position.


Now you've seen the effect of the planted key on the foot. You can use the same Set Key buttons on pivot points for the feet and hands. Next, you'll replace the key at frame 0 with a new one, changing the pivot point.

Set pivot keys:


- 1 At frame 0, right-click the Perspective viewport and select *Bip01 R Foot*. It still has the planted key from before.
- 2 On the Key Info rollout, open the IK expansion bar and click Select Pivot. All pivot points for the foot are now visible as blue and red dots. The pivot at the ankle is red, showing that this is the currently active pivot point. Wireframe mode lets you clearly see and select the pivot points.
- 3 Click the pivot point on the ball of the foot, at the base of the toes. The new pivot point is displayed in red.



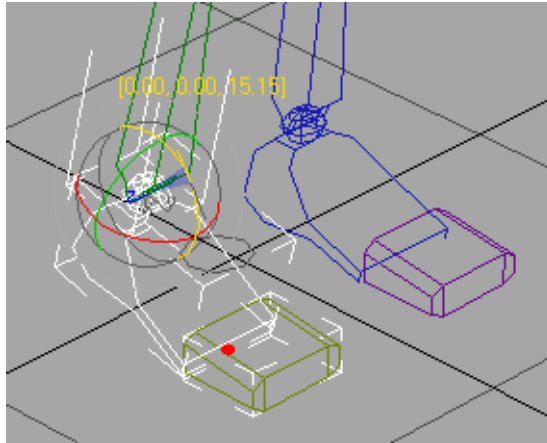
NOTE You don't have to set a key each time you choose the pivot point. However, you should use the Set Key buttons if you want to change the Key parameters.

- 4  Advance the time slider to frame 5, and click Set Key.

- 5 Right-click the foot and choose Rotate from the quad menu. On the main toolbar, make sure that Reference Coordinate System is set to Local.


- 6  Rotate the foot up approximately -15 degrees about the local Z axis to make the heel raise, and then click Set Planted Key.

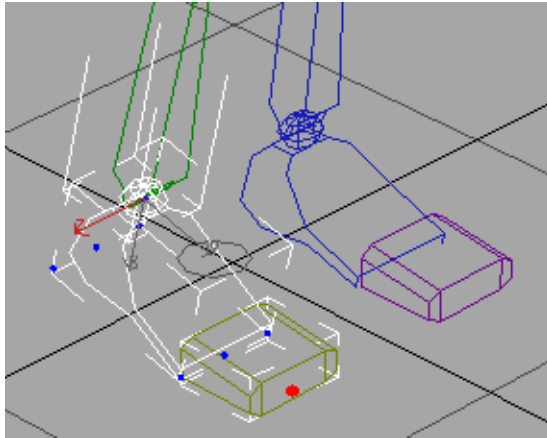
The heel lifts off the ground, the foot rotates on the ball, and the toes stay on the ground.




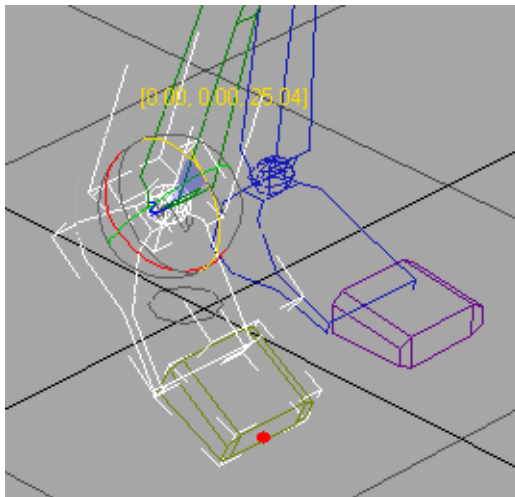
Now you can animate the pivot point to the toes, as the ball of the foot lifts off the ground.


Animate the pivot points:

- 1  Move the time slider to frame 10 and then click Set Key.
- 2 Click Select Pivot and choose the pivot on the end of the toe.



- 3  Click Set Sliding Key to set a key for the pivot.
- 4 Click Select Pivot again, to turn it off.
- 5 In the Perspective viewport, right-click the foot and choose Rotate from the quad menu.
- 6 Rotate the right foot about -25 degrees around the Z axis so the heel continues to raise and roll off the toes.



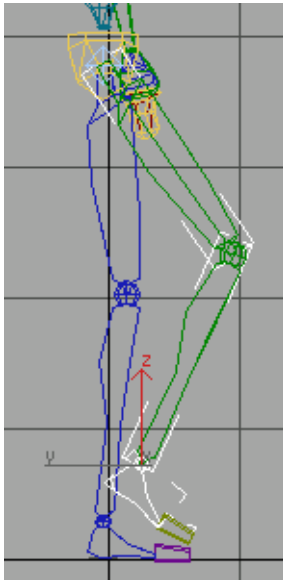
- 7  Click Set Sliding Key to keyframe the foot rotation.

The sliding key does not join to the previous key, but has IK Blend set to 1, which keeps the foot above the ground plane. If you had set a planted key, the foot would jump to a different location as it attempted to join to the previous key.


Lift the foot off the ground:

When the foot lifts off the ground completely, you'll set a free key.

- 1 Move the time slider to frame 15.
- 2 In the Left viewport, right-click the foot and choose Move from the quad menu. Move the foot up off the ground and forward.




By moving the foot, you are seeing an example of Biped's IK system. You are creating rotations for the upper and lower leg links as you move the foot.


- 3  On the Key Info rollout, click Set Free Key to keyframe the lifted position of the foot.
- 4 Move the time slider back and forth to observe the animation so far.

- 5 Save the scene as **MyWalk02.max**.

Lock down the opposite foot:

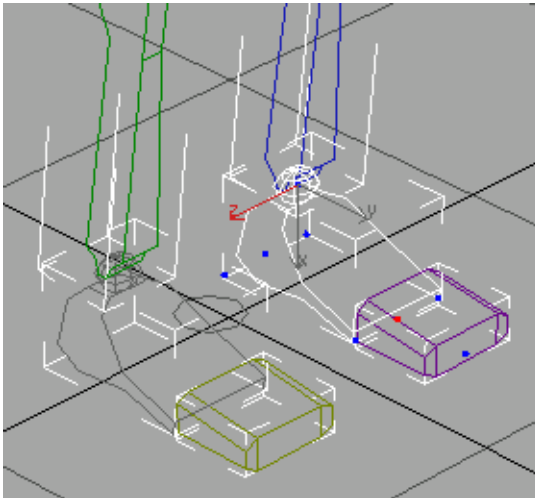
- 1 Move the time slider back to frame 0 and select *Bip01 L Foot*.

- 2  On the Key Info rollout, click Set Key.

- 3  Click Set Planted Key to set an initial key for the left foot at frame 0.

This key locks down the foot for any subsequent movement in upcoming frames. If you were to grab the center of mass and move it down, both legs would bend instead of moving below the ground plane.


- 4 Turn on Select Pivot and pick the pivot point at the ball of the foot.




The left foot with a new pivot point.

- 5 Click Select Pivot to turn it off.

Keyframe the center of mass:

- 1  On the Track Selection rollout, click Body Horizontal.

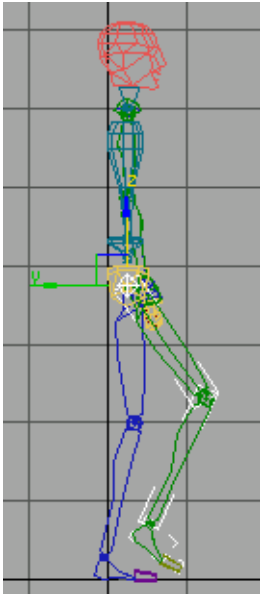
Bip01 is automatically selected.

- 2  At frame 0, click Set Key for *Bip01*.
This creates a start key for the center of mass.
- 3 Move the time slider to frame 15.
- 4 In the Left viewport, use the Move Transform gizmo to move the center of mass so the torso shifts forward, and then set another key.



NOTE Because the center of mass is the root node, you can use only Set Key, not the specialized IK keys.

- 5 Use the Move Transform gizmo to move the center of mass down a little, so the left knee bends slightly, then set another key.
The left leg bends automatically as the center of mass moves down.



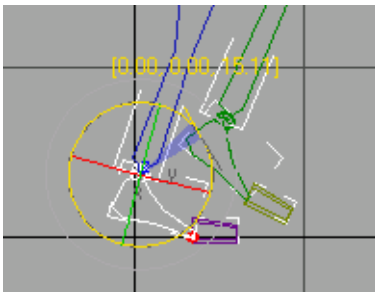
6 Select *Bip01 L Foot*.



7 On the Key Info rollout, set a planted key for the ball of the foot.

8 Right-click the left foot and choose Rotate from the quad menu. Rotate the foot so the heel is lifting up off the ground, and then set another planted key.

The heel is rotated off the ground.



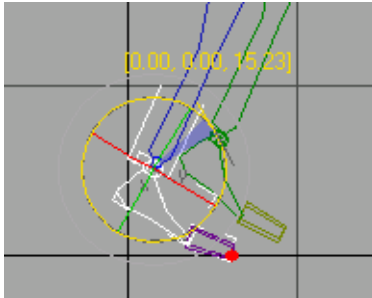
9 Move the time slider to frame 22 and click Set Key.

- 10 Right-click in the Perspective viewport, turn on Select Pivot, and then pick the pivot at the end of the toes of *Bip01 L Foot*.

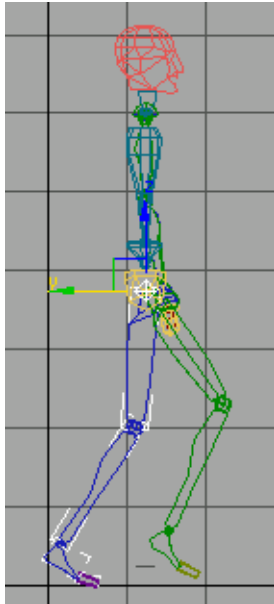


- 11 On the Key Info rollout, click Set Sliding Key, then turn off Select Pivot.


- 12 In the Left viewport, rotate the left foot up a little more and set another sliding key.

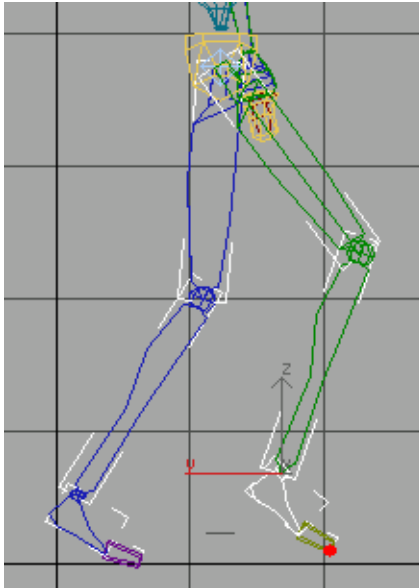


- 13 On the Track Selection rollout, click Body Horizontal. Move the center of mass forward again, and set a key.

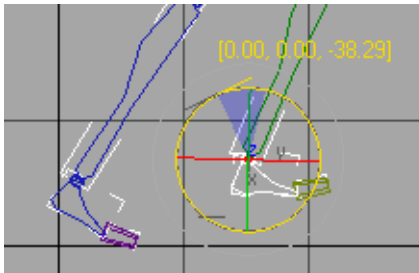


Keyframe the right heel hitting the ground:

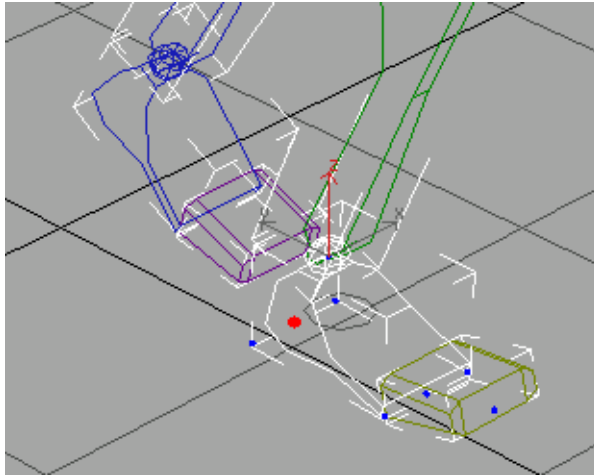
- 1  At frame 22, select *Bip01 R Foot* and move it forward, then set a sliding key.



- 2 Activate Select And Rotate, note the location of the gizmo intersection, and then turn on Select Pivot (this deactivates Rotate). Pick the point at the ankle that lay at the gizmo intersection, and then set a sliding key.
- 3 Turn off Select Pivot. Rotate the foot so it's parallel to the ground, and then set a sliding key.

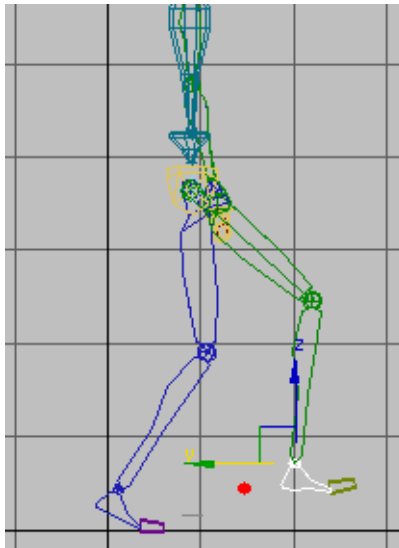


- 4 Turn on Select Pivot, and set the pivot to the heel. Set another sliding key.




The pivot point moved to the heel.

- 5 Turn off Select Pivot. Move the time slider to frame 27.
- 6 In the Left viewport, move the right foot forward a little. Notice that the foot moves away from the pivot point in the viewport.

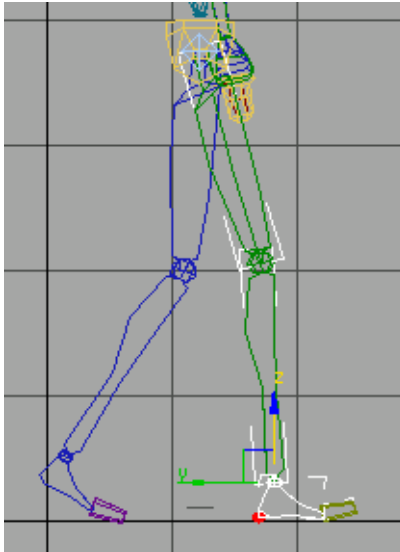


Sliding Key lets foot move away from pivot.

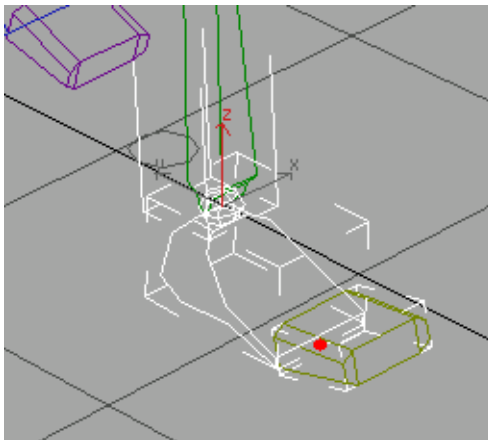
- 7  Set a sliding key.

The pivot point in the viewport moves to the heel of the foot.


- 8 Move the right foot down so it touches the ground, and set another sliding key.

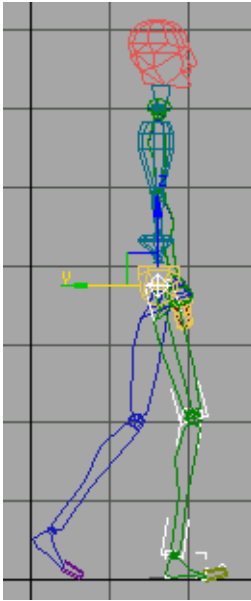



- 9 Turn on Select Pivot. Pick the pivot at the ball of the right foot.





The pivot moved to the ball of the right foot.

- 10  Click Body Horizontal, move the center of mass so that it is over the heel of the right foot and set a key.




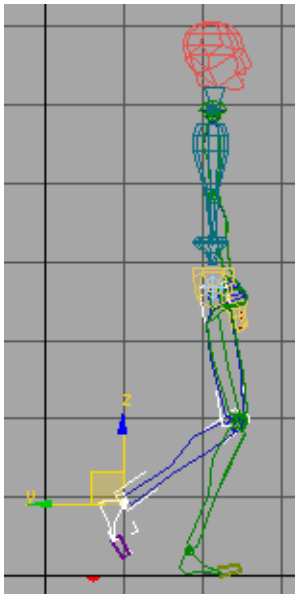
- 11  At frame 27, select *Bip01 L Foot* and set a free key.
- 12 Move the time slider and watch the animation of the foot and the pivot points.
- 13 Save the scene as **MyWalk03.max**.

Continue the walk cycle:

- 1  At frame 27, click Body Vertical so you can move the center of mass.
- 2  Lower the body slightly, so the biped sinks a bit as the right foot flattens onto the floor. Set a key for the center of mass.
- 3 Move the time slider ahead to frame 32. Move the center of mass so it's over the ball of the right foot. Set a key for the center of mass.




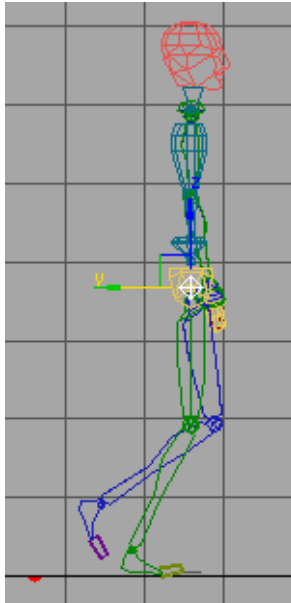
- 4  Move and rotate *Bip01 L Foot* so the heel swings above the ground. Set a free key.




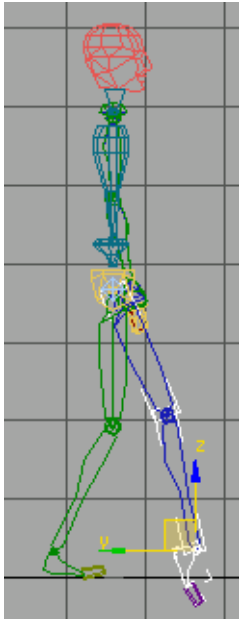
Use this procedure throughout this exercise: Lock one foot by setting planted or sliding keys, move the center of mass, then move the other foot and set a key.

Complete the walk cycle:

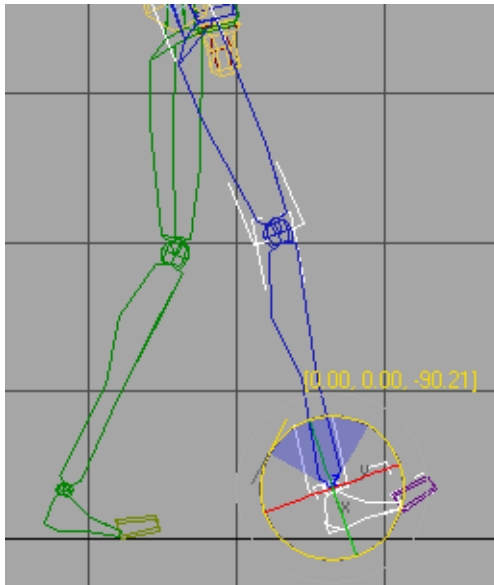
- 1  Move the time slider to frame 37 and click Body Horizontal. Move the center of mass forward and set a key.








- 2  Select *Bip01 L Foot* and move it so the leg is extended in front of the biped. Set a free key.



- 3 Rotate the left foot so the heel is down and the toes point upward. Set another free key.
Now the foot looks better.

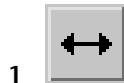


- 4  With the left foot selected, click Select Pivot and select the pivot at the heel. Set a planted key for the pivot.
- 5 Turn off Select Pivot.
- 6 Move to frame 39, and rotate the left foot so it is flat on the ground.
- 7  Set a planted key for the left foot.
- 8  Click Body Horizontal and move the center of mass so the body moves forward.
- 9  Set a key for the center of mass.
- 10  At frame 41, rotate the left toes (*Bip01 L Toe0*) so they are flat on the ground. Set a planted key.
- 11 Select *Bip01 R Foot* and move the time slider back to frame 30. Set a planted key.

- 12 At frame 32, rotate the right toes so they are flat, and set another planted key.
- 13 Move the time slider to frame 37 and rotate the right foot up a little, then set a planted key.
- 14 Move the time slider and review the motion. Add rotations for the toes as needed.
- 15 Save the scene as **MyWalk04.max**.

Display trajectories:

Biped has its own trajectory display. You can use it to observe the movement of the center of mass in the walk cycle. You can also edit the keys on the trajectory directly in the viewport.



- 1 On the Track selection rollout, click Body Horizontal.



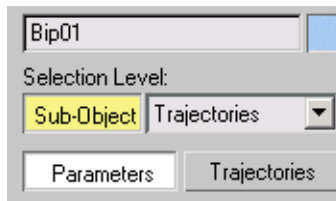
- 2 On the Key Info rollout, turn on Trajectories.

A line appears on the viewports showing the COM's trajectory: the path it moves along during the animation.

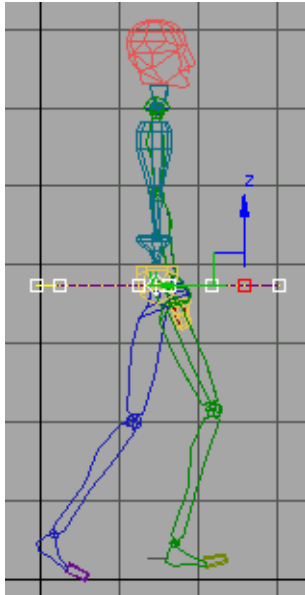
- 3 Scrub the time slider, and watch the biped center of mass moving along its trajectory.



- 4 Choose Select And Move on the main toolbar. At the top of the Motion panel, turn on Sub-Object and then click any key on the trajectory.



- 5 Use the Move Transform gizmo to move the keys to correct the trajectory.



Edit keys in biped trajectory.

- 6 Turn off Sub-Object and Key Info rollout > Trajectories.

WARNING Don't use the standard Trajectories functionality (button near the top of the Motion panel) with Biped. Use the Trajectories button on the Biped rollout > Modes And Display expansion bar > Display group or the Key Info rollout.

Add arm swings:

The character is starting to look like it's walking, but it's still quite stiff. Adding arm swings will put some life in the animation.

The arms swing opposite to the legs. When the right leg is forward, the left arm is forward. Arms bend at the elbow on the forward swing, and stretch out straight on the backward swing.

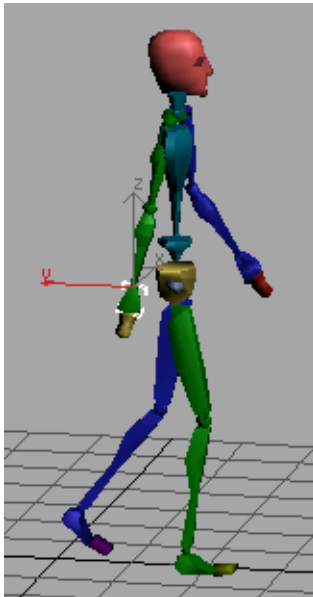
- 1 Move the time slider to decide where to place the arm swings.
The right leg stretches out at frame 27, and you'll keyframe the left arm to swing there.

- 2 Auto Key Turn on Auto Key.

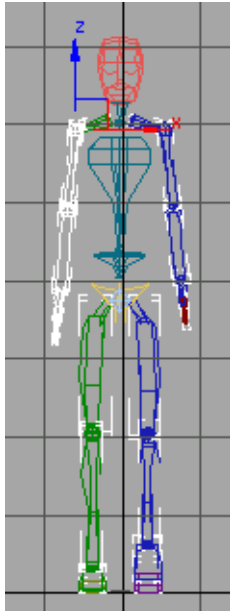
- 3 At frame 0, select and move the left hand slightly, to set a key.
- 4 At frame 0, select and move the right hand slightly, to set a key.
- 5 At frame 27, select and move the left hand so it swings forward. Position the arm so there is a slight bend at the elbow. Since Auto Key is on, you have keyframed the arm by moving it.





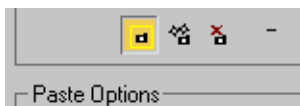
- 6 On the Track Selection rollout, click Opposite. The right hand is selected.
- 7 Move the right hand back slightly, so the arm is stretched out. The left arm is forward and bent a little, while the right arm is back and straight.






- 8 In the Front viewport, double-click *Bip01 R UpperArm*. The entire right arm is selected.

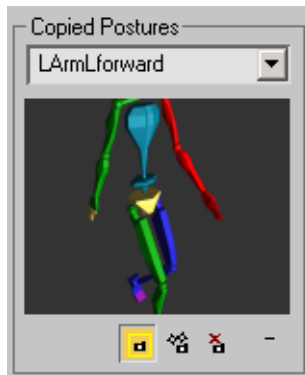



- 9  On the Motion panel, open the Copy/Paste rollout and click Copy Posture.
- 10  Click Create Collection. Name the Collection **walkcycle1**.
- 11 Turn on Create Snapshot from Viewport, just above the Paste Options group.



- 12  Click Copy Posture. Name the Copied Posture **RArm back**.
- 13  At frame 37, click Paste Posture Opposite.
The left arm swings behind the biped.
- 14 At frame 27, double-click *Bip01 L UpperArm*.
The entire left arm is selected.


- 15  On the Copy/Paste rollout, activate the Perspective viewport and click Copy Posture again. Name the posture **LArm forward**.



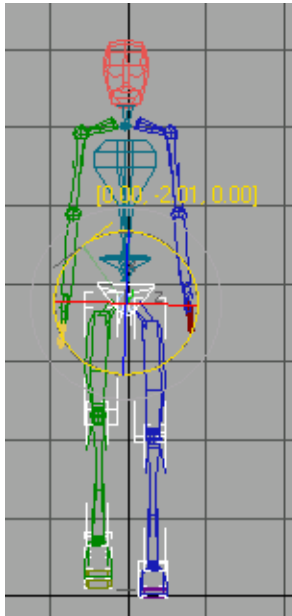
- 16  At frame 37, click Paste Posture Opposite.
The right arm swings in front of the body.
- 17 Turn off Auto Key.
- 18 Move the time slider back and forth to evaluate the animation.
- 19 Save the scene as **MyWalk05.max**.

Add sway to the shoulders and hips:

You've animated the character by moving its hands and feet and center of mass. But the spine, hips, and head are still stationary. You'll add some rotations to the shoulders and hips to complete the walk cycle.


- 1 Select *Bip01 Pelvis* and move the time slider to frame 15.
The left foot is locked at this frame with a planted key.
Be careful where you add the hip rotations. Don't inadvertently disturb the work you've done on the feet so far.
As the legs extend and swing forward, the hips rotate slightly in the direction of the movement.
- 2  Rotate the pelvis about the Y-axis approximately -2 degrees and set a key.

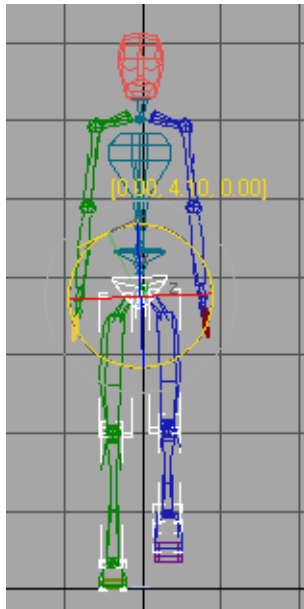
NOTE You can only rotate the pelvis about all three axes.



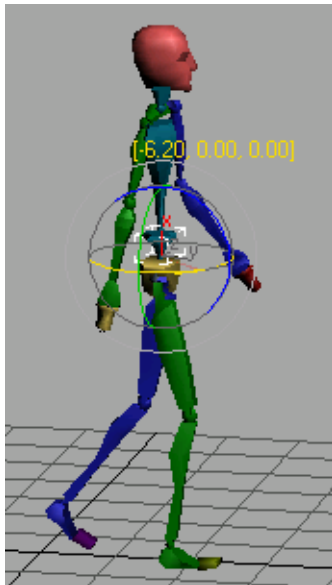
**Rotation added to the hips
from the Front view.**

The pelvis will not accept too much rotation. When you set the key, the pelvis corrects itself to account for the locked foot.

- 3  Move the time slider back to frame 0. Rotate the pelvis back 2 degrees about the Y axis and set a key. Rotate the pelvis back about -3 degrees about the X axis and set a key.



- 4 Move the time slider to frame 32. Rotate the pelvis about 4 degrees around the Y axis, then set a key. Repeat for the X axis and set a key
- 5 Move to frame 39 and rotate the pelvis -2 degrees around the Y axis again, then set a key.
The procedure is the same for the spine. At frame 27, the arms swing out in one direction. At frame 37, they swing in the opposite direction.
- 6 Select the biped spine object, Bip01 Spine.
- 7 At frame 27, rotate the spine in the direction of the arm swing and set a key. It should be about -6 degrees around the X axis.



- 8 At frame 37, rotate the spine approximately 12 degrees about the X axis and set a key.

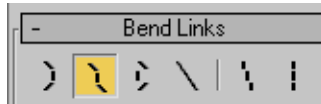
The spine can freely rotate about all three axes. You can make adjustments on each one. Rotate about the Z axis for a more stooped walk. Increase rotation about the X axis to make the walk loose and floppy.

Instead of animating the spine, you can also animate the clavicles to raise or lower the shoulders.

Twist links mode:

The Bend Links rollout includes tools you can use for animation. You can use either the Bend Links or the Twist Links to animate the bending and/or twisting of the spine.

- 1 Choose Figure Mode.
In the Structure Rollout change Spine Links to 5. You can have up to 10 spine links but you will use five to observe the effect.
- 2 Turn off Figure Mode.
- 3 Turn on Auto Key.



- 4 On the Bend Links rollout turn on Twist Links Mode.
- 5 Select the *Bip01 Spine* object. This is the lowest spine object in the biped.
- 6 Go to frame 0 and rotate the object slightly about the X axis to add a key. Do the same about the Y axis.
- 7 Move the time slider to frame 27 and rotate approximately 10 degrees about the X axis so the spine rotates following the swing of the arms. The blue arm is swinging forward, so rotate the spine to match.
- 8 You can also rotate -1 degree about the Y axis.
The slight rotation of the first spine object results in a larger effect further up the hierarchy.
- 9 Repeat at frame 37 in the opposite direction to match the swinging of the green arm outward.
- 10 Save the scene as **MyWalk06.max**.

You have animated a simple walk cycle using freeform animation and IK constraints.

You can use the footstep method of animation to create a walk cycle automatically. To learn about this technique, see [Creating a Distinctive Walk](#) on page 709.

Using Controllers with Biped

You can add controllers on top of Biped animations to create a wide variety of effects. You can use scale controllers to create stretchy legs or arms for cartoon animation, or create the illusion of breathing by adding a scale controller on the spine objects in the chest. You can add noise rotation controllers to the spine to make a biped shake while he walks, or to create twitching or random motion in the limbs or head.

Controllers can be added in the Motion panel, Assign Controllers rollout, or by using the Workbench.

Although this lesson is performed with footsteps, it could have been accomplished just as easily with a freeform animation.

Create stretchy legs with controllers:

In this exercise, you will add a scale controller to a biped's legs to stretch them during a portion of an animation.

1 Open *stretchyleg_start.max*.

2 Play the animation.


The biped walks for 10 paces, zooms to a lower level, and then walks another five steps. You'll add the scale controller, then animate the biped so that its legs stretch during the period of the downward leap.

3 Move the time slider to frame 162, then select the *Bip01 L Thigh* object, the blue leg.


4 On the Motion panel, open the Assign Controller rollout.

5 In the controller list window, expand the Biped SubAnim entry.

Now you can see the three list controllers.

6  Click the plus sign (+) next to *BipScaleList* to expand this controller. Select the entry marked *Available*, then click the Assign Controller button. The Assign Scale Controller dialog appears.

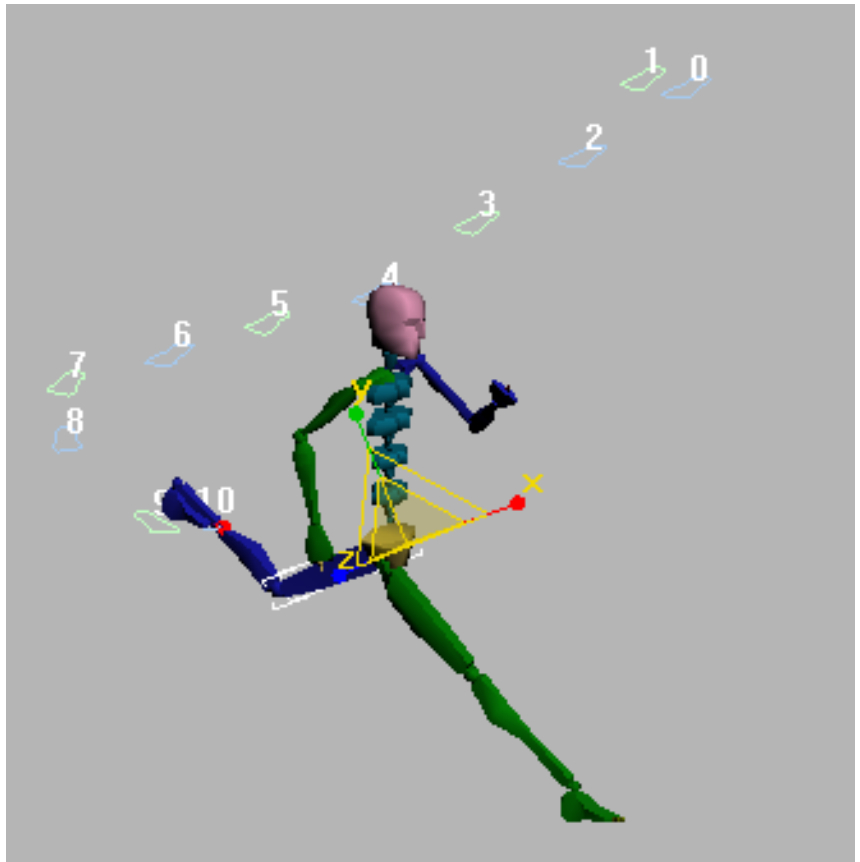
7 Choose Scale XYZ from the list, and click OK to close the dialog.

8  On the 3ds Max main toolbar, click the Select And Scale button. The Scale gizmo is visible on the thigh in the viewport.

9  Turn on Auto Key.

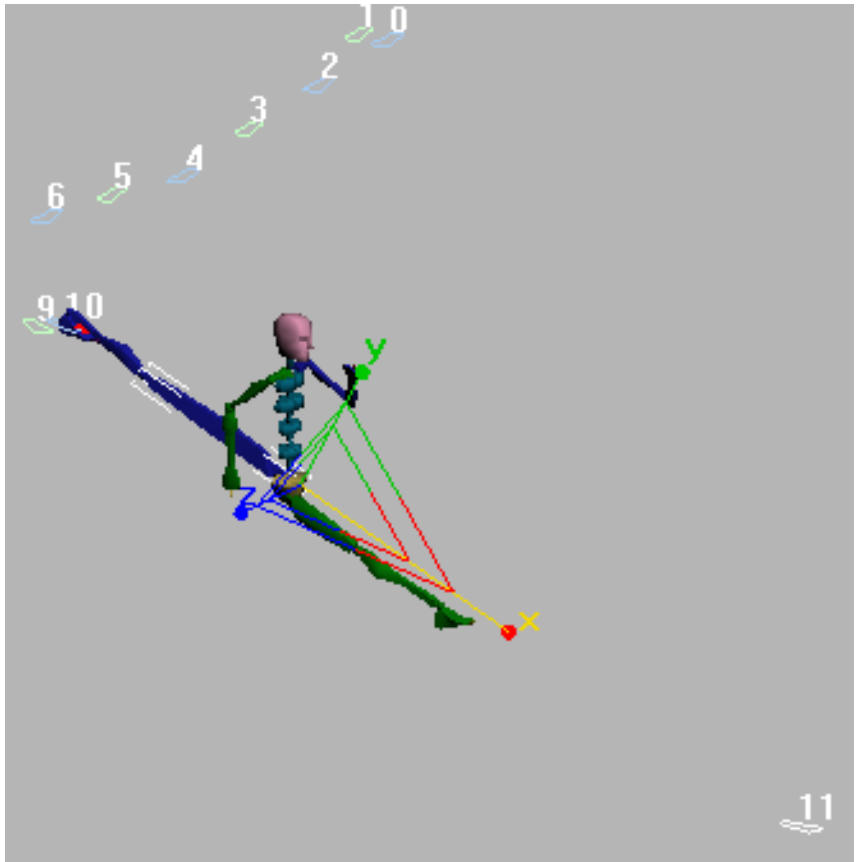
First, you will set a key to start the stretch. You don't want the stretch to start before frame 162. You want the biped to have a normal leg (unstretched) from the start of the animation up to this frame.

10 Using the Scale gizmo, stretch the leg *very* slightly in the X-axis at this frame, so the final value in the Coordinate rollout is 100 (no stretch).

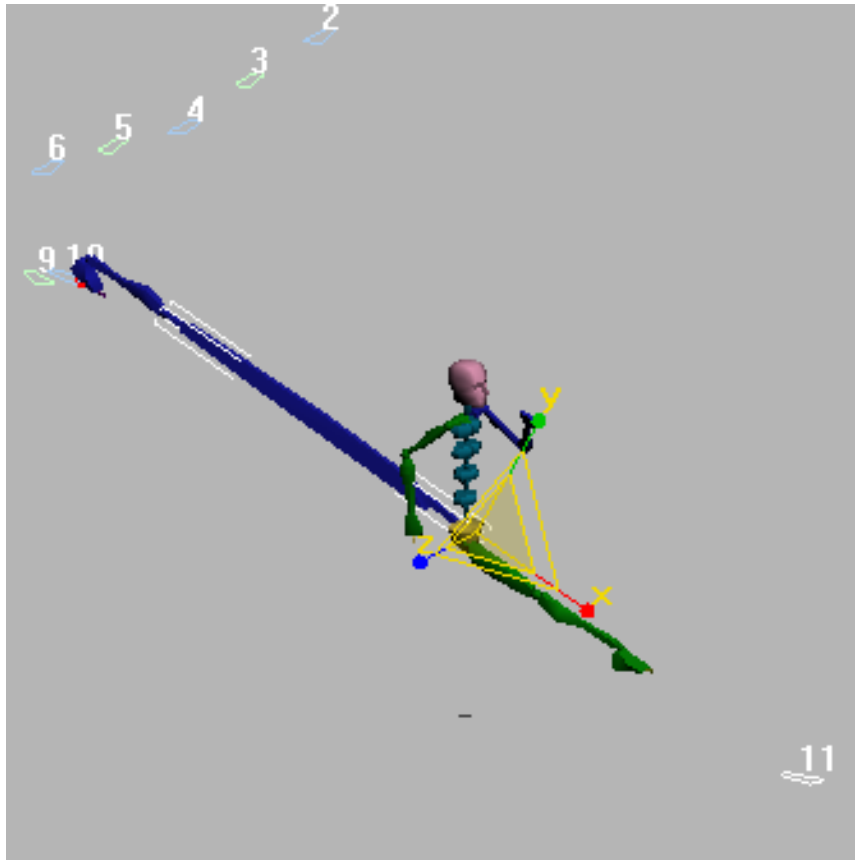


The leg at frame 162 (no stretch).

- 11 Move to frame 164, and stretch the leg so the foot reaches the footstep.

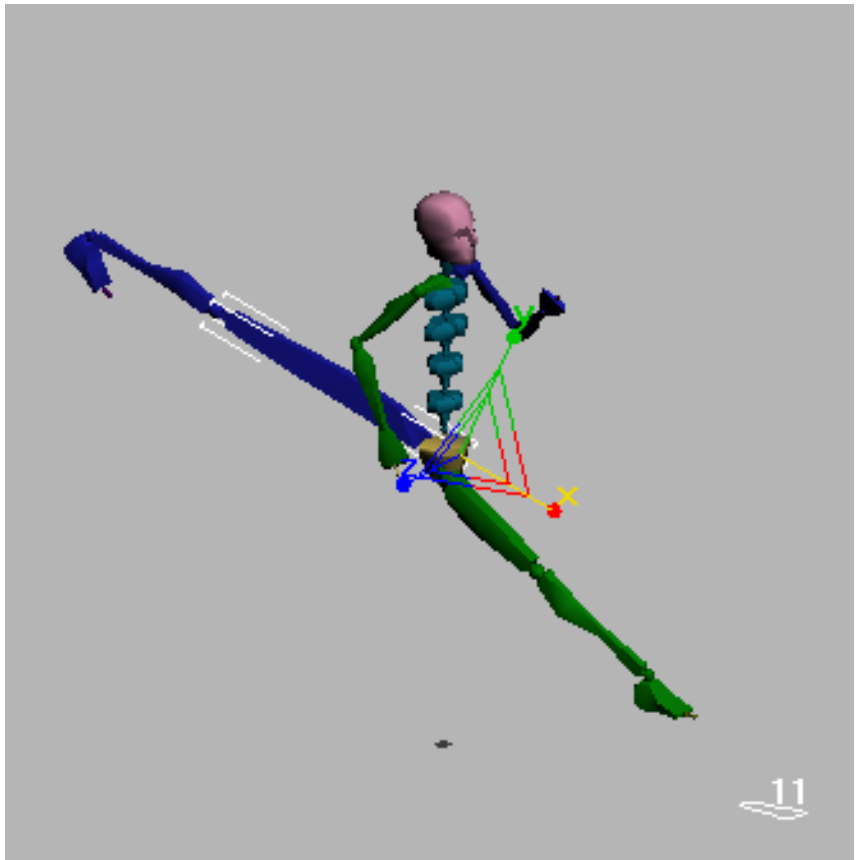


- 12 Move to frame 167, and again stretch the leg in the X-axis, so the foot stays on the footstep gizmo.



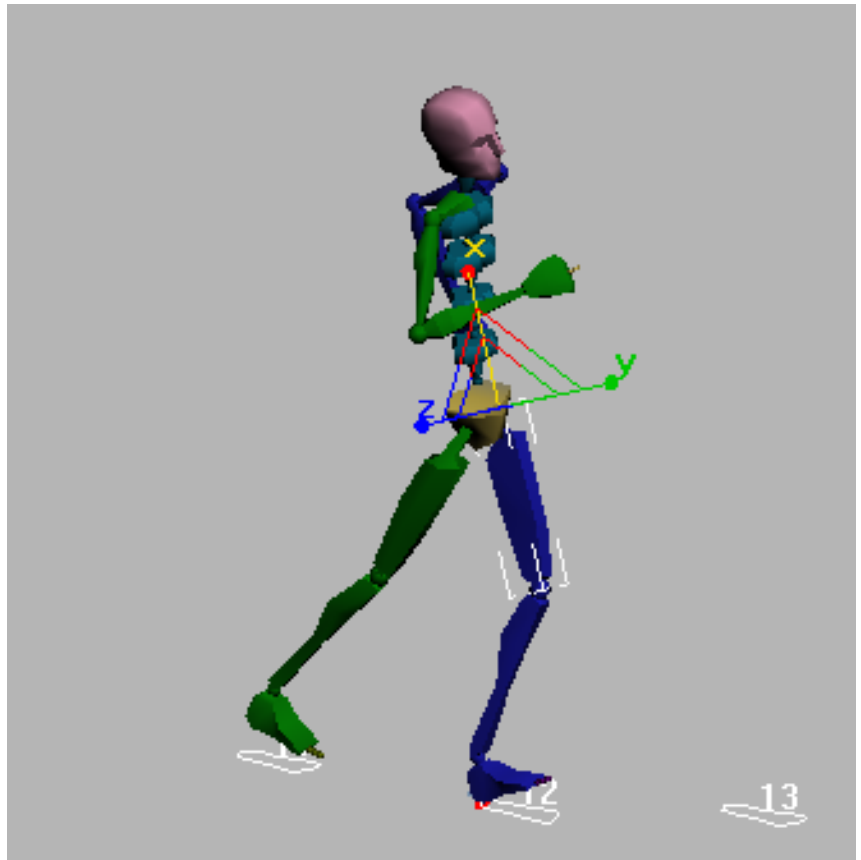
Leg stretch at frame 167.

- 13 Move to frame 169. Here, you begin to shorten the leg stretch.



Leg shortens at frame 169.

- 14 Move to frame 181 and stretch the leg back to normal. Adjust it visually until the leg looks correct.



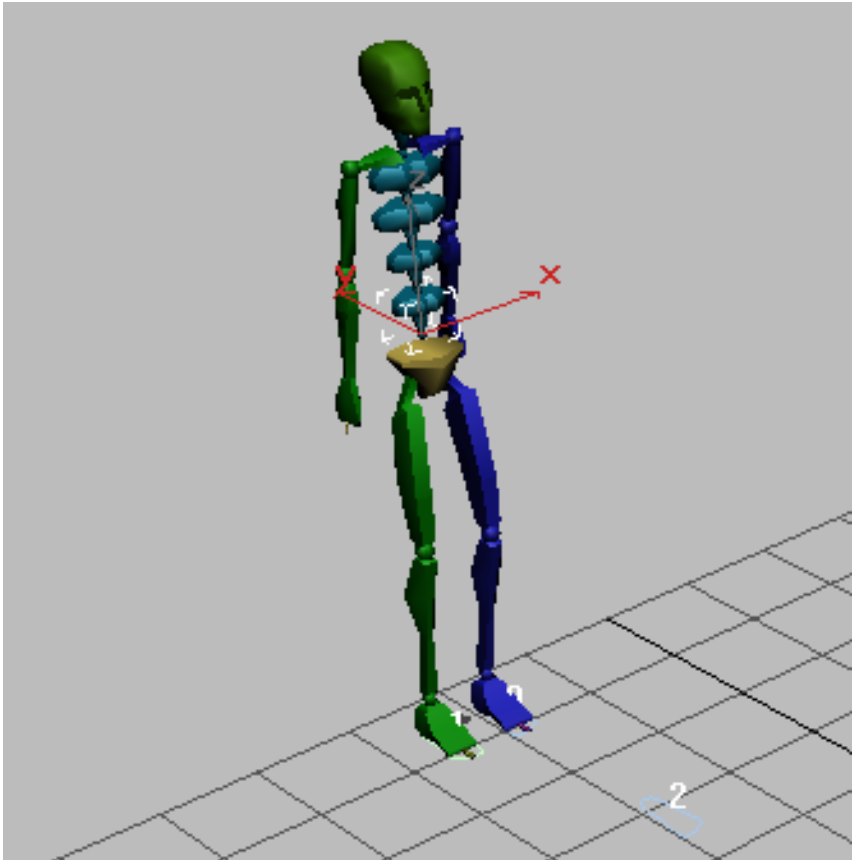
Leg at frame 181 appears normal.

- 15 Play the animation. The biped's back foot stays on the footstep and the leg stretches out as the biped descends to the lower set of footsteps.
For extra credit, add a scale controller to the green thigh, and stretch that leg out, roughly between frames 161 and 171.
- 16 Save your work as **mystretchy_leg.max**, or open *stretchyleg_final.max* for comparison.

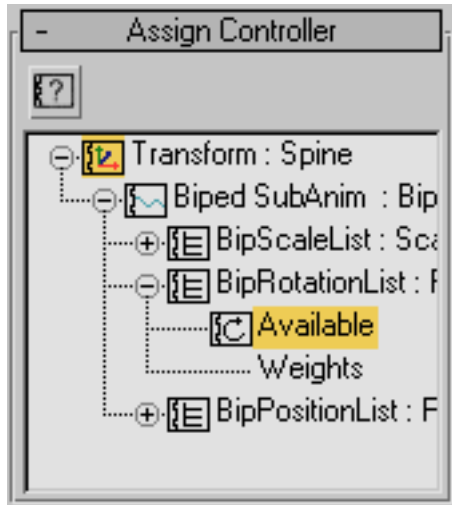
Once you have controllers added to the biped body parts you can animate their parameters, or animate their weights. Here's an example that shows animation of parameters.

Animate the weights of SubAnim controllers:

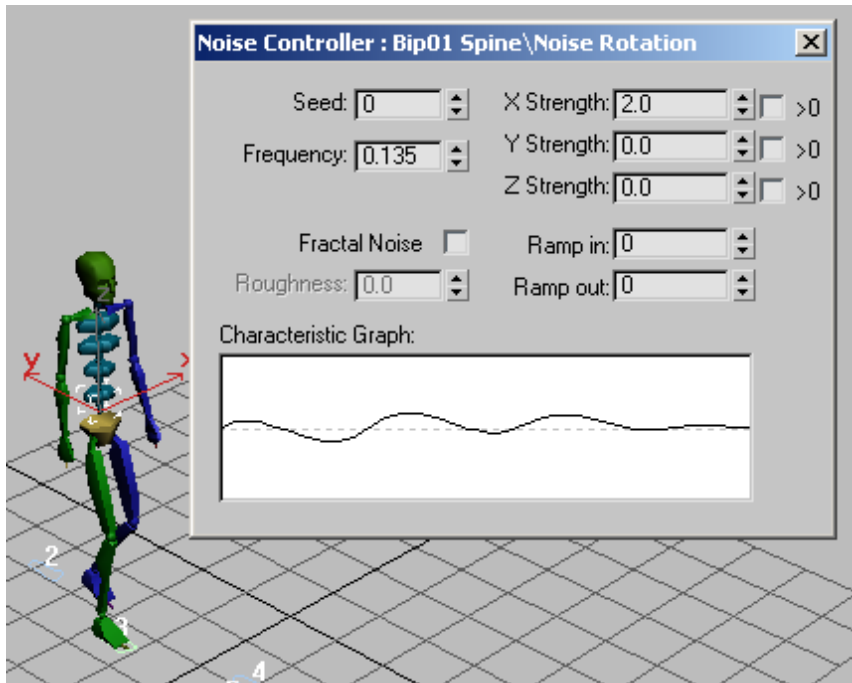
- 1 Open *shake_and_walk_start.max*.
- 2 Play the animation.
The biped takes a few steps, then pauses for a moment or two, then walks on.
- 3 In the Perspective Viewport, select *Bip01 Spine*, the lowest spine object.



- 4 On the Motion panel, open the Assign Controller rollout.
- 5 In the Assign Controller window, expand the Biped SubAnim so you can see the list controllers.
- 6 Expand the *BipRotationList*, and highlight the entry marked *Available*.



- 7 Click the Assign Controller button.
The Assign Rotation Controller dialog appears.
- 8 Choose *Noise Rotation* in the list, and click OK.
The Noise Rotation Properties dialog is displayed. Don't close this dialog.
- 9 Play the animation in the viewport.
The biped shakes drastically as it walks.
- 10 In the Properties floater, turn Fractal Noise off.
- 11 As the animation plays, change the Frequency in the Properties dialog, using the spinner. Lower the value until the shake becomes slower and more rhythmic. Probably a value of **0.2** or less will be good to use, but you can choose whatever you like.
- 12 As the animation plays, change the X, Y and Z values. Set the three values to **0**, then change them individually, one at a time.
To create a shimmy effect, set X Strength to be **2**, Y and Z Strength to **0**.

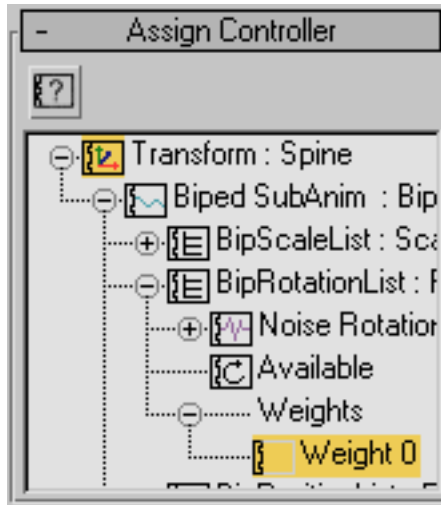


13 Close the Noise Rotation Properties dialog.

In this example, the biped should shake only while walking. The frames from 69 through 191 should not have any shaking. To complete this effect, you will animate the weight of the noise controller.

Animate the weight of the noise controller:

- 1 On the Motion panel, expand the Weight entry of the Noise Rotation controller you added to the spine object. Highlight *Weight 0*.



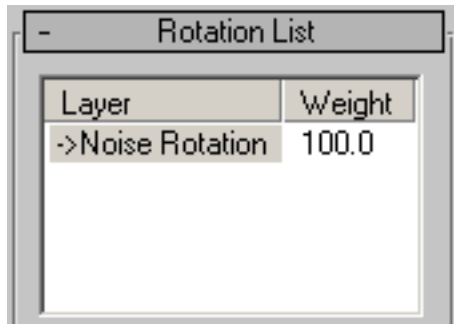
There is a trick to accessing the weights.




- 2  Open the Keyframing Tools rollout and click the Manipulate SubAnims button.

The Motion panel now displays additional rollouts for Position List, Scale List, and Rotation List.

- 3 Scroll to the Rotation List and select the Layer->*Noise Rotation*.



Now you're ready to animate the Weight field.

- 4  Turn on Auto Key
- 5 Move the time slider to frame 70.

- 6 Near the bottom of the Rotation List rollout, right-click the Weight field spinner. This sets it to zero.

TIP Right-clicking any spinner resets it to its lowest possible value.



- 7 Move the time slider to frame 69.

TIP Use the < and > keys on the keyboard to move from frame to frame.

- 8 Change the Rotation List Weight field to **100.0**.
The spinner is outlined in red to show it is animated.
- 9 Drag the time slider back and forth from frame 0 to frame 100 to see the animation. The biped shakes while walking and stops shaking during the pause.
- 10 Next, you make the biped start shaking again at frame 191. At frame 190, set a key with the Noise Rotation Weight set to **0**, and to **100** at frame 191.

TIP At frame 190, hold down the Shift key while you right-click on the spinner. This will set a key without having to change the value.

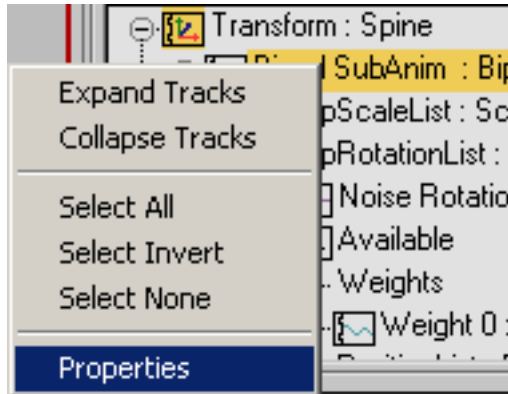
- 11 In the Keyframing rollout, turn off Manipulate SubAnims when you're done.
- 12 Play the animation.
- 13 Save your file as **myshake_and_walk.max**, or open *shake_and_walk_finished.max* for comparison.

If you are exporting to a game engine, or if you want to use this animation with Layers or in the Motion Mixer, you will need to collapse the list controller animation (see following procedure). This will add the controller's animation keys to the tracks of the Biped SubAnim.

NOTE 3ds Max has different behaviors for controllers and constraints. The controller animation will be *layered* onto the existing keys in the Biped SubAnim track. If you have used a constraint, however, it will *replace* the Biped SubAnim tracks.

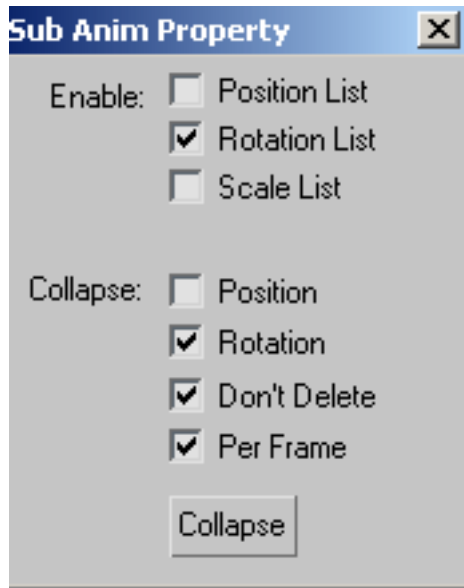
Collapse the list controller track:

- 1 Continue from before, or open *shake_and_walk_finished.max*.
- 2 If you open the file, select the *Bip01 Spine* object in the viewport, open the Motion panel, and expand the Assign Controller rollout.
- 3 In the Assign Controller window, highlight Biped SubAnim and then right-click.
- 4 Choose Properties from the right-click menu.

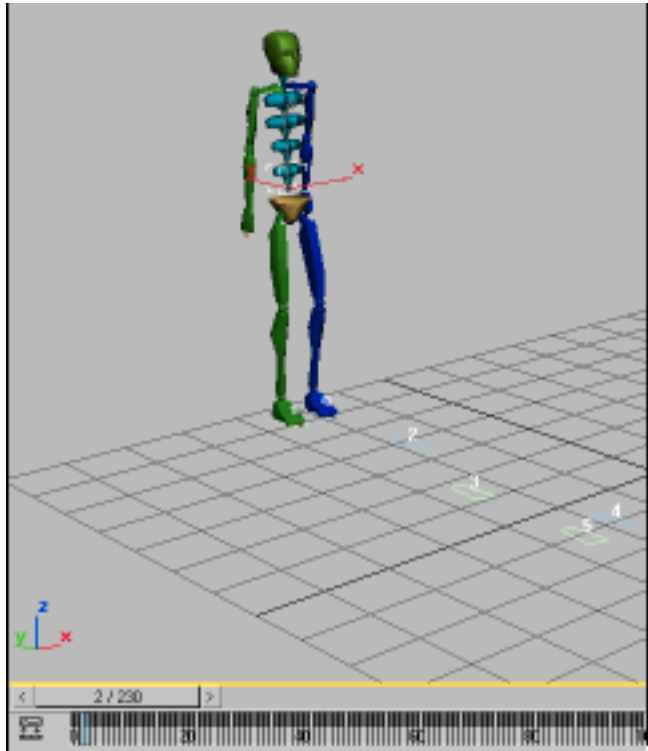


The SubAnim Property dialog appears.

- 5 In the Enable options, turn off Position List and Scale List, so the Rotation List is the only one active.
- 6 In the Collapse options, turn off Position, and turn on Rotation List, Don't Delete, and Per Frame.



- 7 To collapse the rotation track, click the Collapse button at the bottom of the SubAnim Property dialog.
Wait while the calculations take place.
When the collapse is completed, the dialog closes and the track bar fills with keyframes.




- 8 Save your work as **mycollapsed_shaking.max**, or open *shake_and_walk_collapsed.max* for comparison.

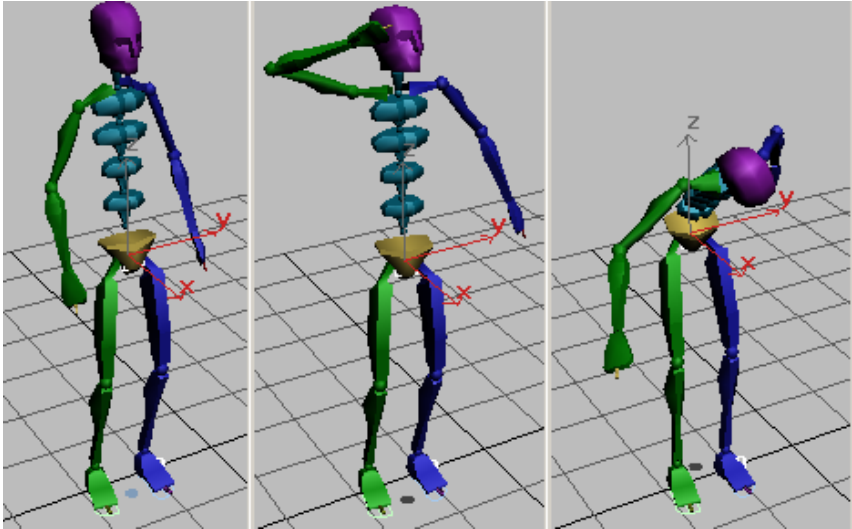
You can use the Workbench to reduce the keys that you've created.

Creating Animated Bones with Biped

You can take the animated biped skeleton and use it to generate a 3ds Max bone structure that follows the same animation, by using the File Export and Import capabilities. In just a few steps, you will be able to take your biped animation and use it without the biped attached.

Create animated bones from bipeds:

- 1  On the Quick Access toolbar, click the Open File button, navigate to the `\animation\character_animation\freeform_animation` folder, and open `createbones_start.max`.



Biped takes a bow.

- 2 Play the animation.
Observe the biped and its movement.



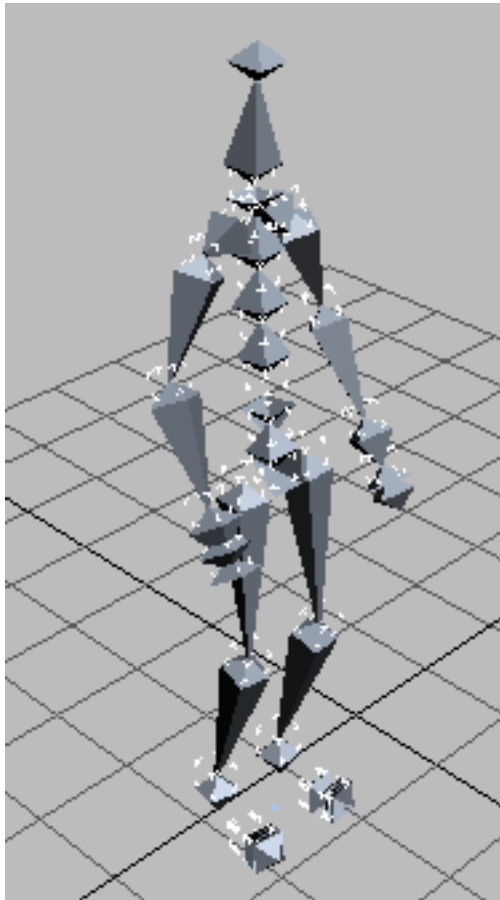
- 3 From the Application menu, choose Export.
- 4 Name the file **mycreatebones.fbx**. From the Save As Type list, choose Autodesk (*.FBX), and then click Save.
This opens the Export FBX dialog.
- 5 Accept all the default values and click OK.
Wait while the exporter calculates the TRS animation.



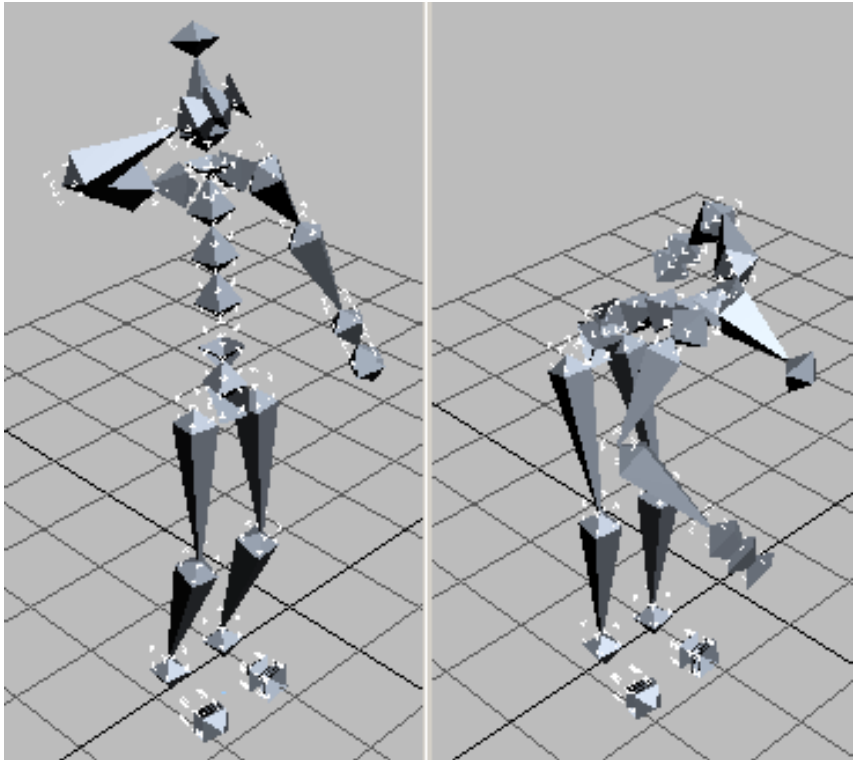
- 6 From the Application menu choose Reset.
The biped disappears and the viewports reset.



- 7 From the Application menu, choose Import and open the file you just exported.
The import dialog appears.
- 8 In the Import Configuration group, click the More button next to Bones. Use the Advanced Bone Options dialog that opens to set the Bone Objects > Width and Length both to **3**.
- 9 Click OK to close the dialog. Click OK again to import the FBX file and create the bones.
A bone skeleton appears in the viewport.



- 10 Play the animation.
The skeleton has the identical animation as the original biped.



11 Save your file as **mycreatebones.max** or open *createbones_final.max* for comparison.

Summary

This tutorial showed you a variety of ways to animate a Biped without using Footsteps mode. In addition, it showed how you can apply a Biped animation to a skeleton made from 3ds Max Bones.