16

Systems, Hierarchy, and Kinematics

Learning Objectives

After completing this chapter, you will be able to:

- *Create a Ring Array system*
- *Create a Sunlight system*
- *Create a Daylight system*
- *Understand hierarchy and kinematics*
- *Create a bone system*
- *Understand IK solver, interactive IK, and applied IK*
- *Create a biped system*



INTRODUCTION

In 3ds Max, Systems is an object set that consists of objects, linkages, and controllers. There are five types of systems: **Bones**, **Ring Array**, **Sunlight**, **Daylight**, and **Biped**, refer to Figure 16-1. These systems help you to create complex animations with much ease.

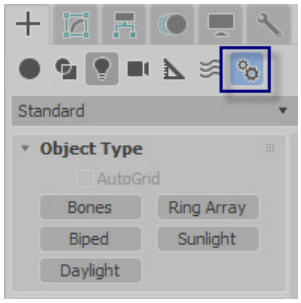


Figure 16-1 *The Systems in the* ***Command Panel***

To create the systems, choose **Create > Systems** in the **Command Panel**; the **Standard** option will be displayed in the drop-down list. Also, the **Object Type** rollout will be displayed, as shown in Figure 16-1. There are various tools in the **Object Type** rollout to create systems. In this chapter, you will learn to create and modify different types of systems using these tools.

Creating a Ring Array System

Command Panel: Create > Systems > Standard > Object Type rollout > Ring Array

A Ring Array system consists of a number of boxes in a circular pattern with a dummy object placed at its center, refer to Figure 16-2.

The dummy object is a wireframe box with a pivot point at its center. The pivot point is used as a center for transformations such as rotation and movement. Note that the dummy object cannot be rendered. You will learn more about the dummy objects in the later chapters.

To create a Ring Array system, choose the **Ring Array** tool from **Create > Systems > Standard > Object Type** rollout in the **Command Panel**; the **Name and Color** and **Parameters** rollouts will be displayed. Next, in the Top viewport, press and hold the left mouse button to specify the center of the Ring Array system, and then drag the cursor to define the radius of the array. Next, release the left mouse button; a dummy object will be created at the center. Also, four boxes will be created in a circular pattern around it, as shown in Figure 16-2. To modify the parameters of the Ring Array system, use the options in the **Parameters** rollout. This rollout is discussed next.

Parameters Rollout

To modify the parameters of a Ring Array system, select one of the boxes in the viewport and choose the **Motion** tab in the **Command Panel**; the **Parameters** rollout will be displayed, as shown in Figure 16-3. Set the value in the **Radius** spinner to specify the radius of the Ring Array system. Set the value in the **Amplitude** spinner to specify the amplitude of ring's sine curve. It is a height offset from the local origin of the dummy object located at the center. Set the value in the **Cycles** spinner to specify the number of peaks in the ring's curve of the Ring Array system. Set the value in the **Phase** spinner to offset the phase of the wave. If you set the whole numbers in this spinner, then the Ring Array system will not be affected, only the decimal values will affect the Ring Array system. Set the value in the **Number** spinner to specify the number of boxes in the Ring Array system.



Note

To modify the parameters of the Ring Array system, you need to choose the ***Motion*** *tab in the* ***Command Panel****. However, if you need to modify the parameters of only the boxes in the Ring Array system, then choose the* ***Modify*** *tab in the* ***Command Panel****.*

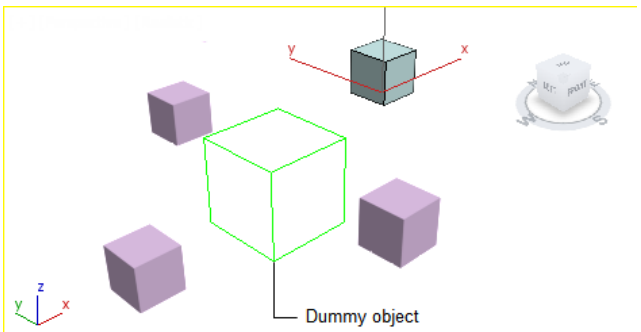


Figure 16-2 *The Ring Array system*

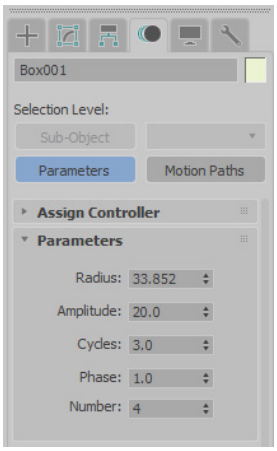


Figure 16-3 *The* ***Parameters*** *rollout in the* ***Motion*** *tab*

Using Different Objects in a Ring Array System

You can replace the boxes in a Ring Array system with other objects. To do so, first create a Ring Array system and then create an object in the viewport with which you want to replace the boxes in the Ring Array system. Make sure that the Ring Array system and the object you want to replace are selected in the viewport. Next, choose the **Curve Editor** tool from the **Main Toolbar**; the **Track View -Curve Editor** dialog box will be displayed. The hierarchy tree on the left of this dialog box controls the objects in the viewport. In the hierarchy tree, select the name of the object with which you want to replace the boxes of the Ring Array system, as shown in Figure 16-4, and then right-click on it; a quad menu will be displayed. Choose the **Copy** option from the quad menu. Next, select one of the boxes in the hierarchy tree, as shown in Figure 16-5. Right-click on it and choose the **Paste** option from the quad menu; the **Paste** dialog box will be displayed, as shown in Figure 16-6. Select the **Copy** or **Instance** radio button in the **Paste as** area. Also, select the **Replace all instances** check box in the **Paste Target** area to replace all boxes of the Ring Array system with the same object. Then, choose the **OK** button; the boxes in the Ring Array system will be replaced by the object created in the viewport, as shown in Figure 16-7.

Animating a Ring Array System

You can animate the radius, amplitude, cycles, and phase of a Ring Array system. To do so, choose the **Toggle Auto Key Mode** button from animation playback controls, and then modify the parameters in the **Parameters** rollout at different frames. The parameters will be available only at the time of creation of the Ring Array system and are not available in the Modify panel. Choose the **Toggle Auto Key Mode** button again to exit the animation mode.

To apply any transformation such as rotation, move, or scale to the Ring Array system, you need to select the dummy object. Also, you can apply the modifiers to the boxes of the Ring Array system. The modifier that you apply to any one of the boxes will be applied automatically to the other boxes of the Ring Array system.

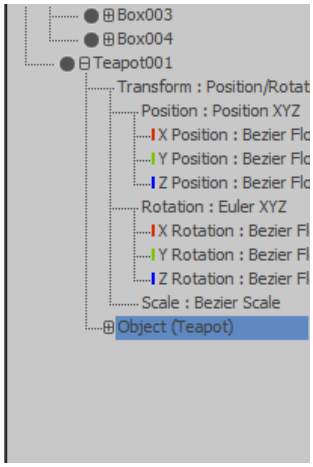


Figure 16-4 *The object selected in the hierarchy tree to replace the boxes of the Ring Array system*

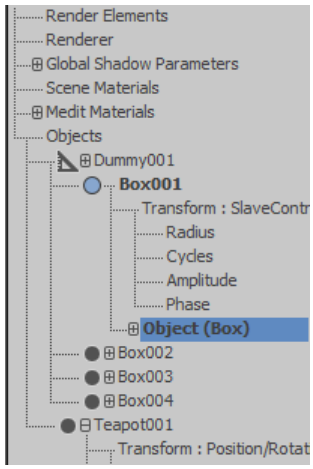


Figure 16-5 *The box selected in the hierarchy tree to be replaced with the object*

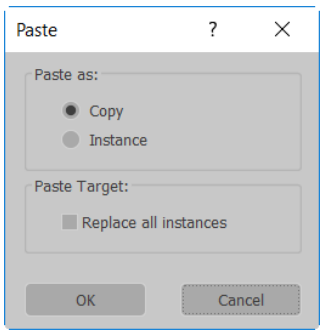


Figure 16-6 *The* ***Paste*** *dialog box*

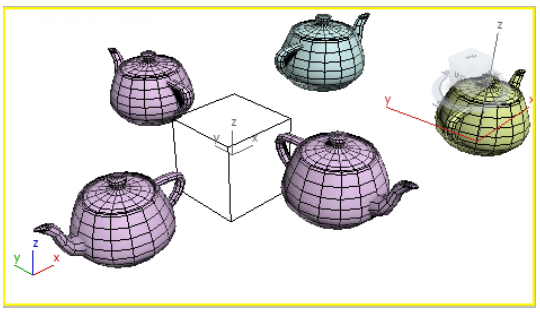


Figure 16-7 *The boxes of the Ring Array system replaced with the object (teapot)*

Creating a Sunlight System

Command Panel: Create > Systems > Standard > Object Type rollout > Sunlight

The Sunlight system is used to produce the light effects similar to the geographically accurate effects of the sun over the earth at a particular location, time, and so on, refer to Figures 16-8 and 16-9. You can also animate the position of the sun to get a better idea of the shadows cast by sun at different positions. The Sunlight system uses a directional light.

To create a Sunlight system in the scene, choose the **Sunlight** tool from **Create > Systems > Standard > Object Type** rollout in the **Command Panel**; the **Name and Color** and **Control Parameters** rollouts will be displayed. Next, in the Top viewport, press and hold the left mouse button at the center of the scene to specify the center of the Sunlight system and then drag the cursor to define the radius of the system. Release the left mouse button; a compass rose will be

created in the viewports, refer to Figure 16-10. Now, drag the cursor up or down to specify the distance of the directional light from the compass rose and then click on the screen to set the distance; the compass rose and the directional light will be created in the viewports, refer to Figure 16-10. Next, left-click in any of the viewport to exit the **Sunlight** tool.

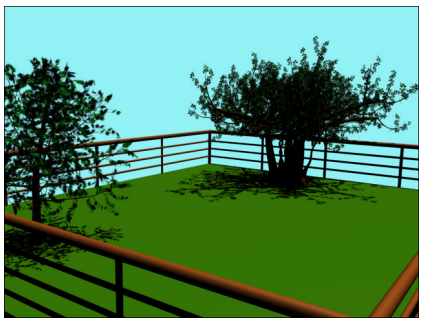


Figure 16-8 *The scene after creating the Sunlight system*

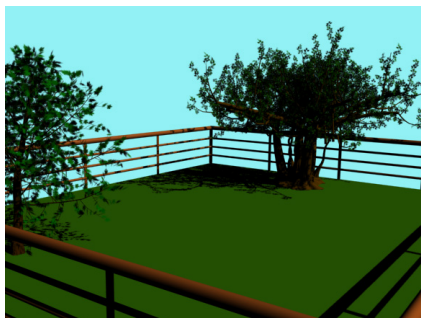


Figure 16-9 *The scene after changing the position of the sun*

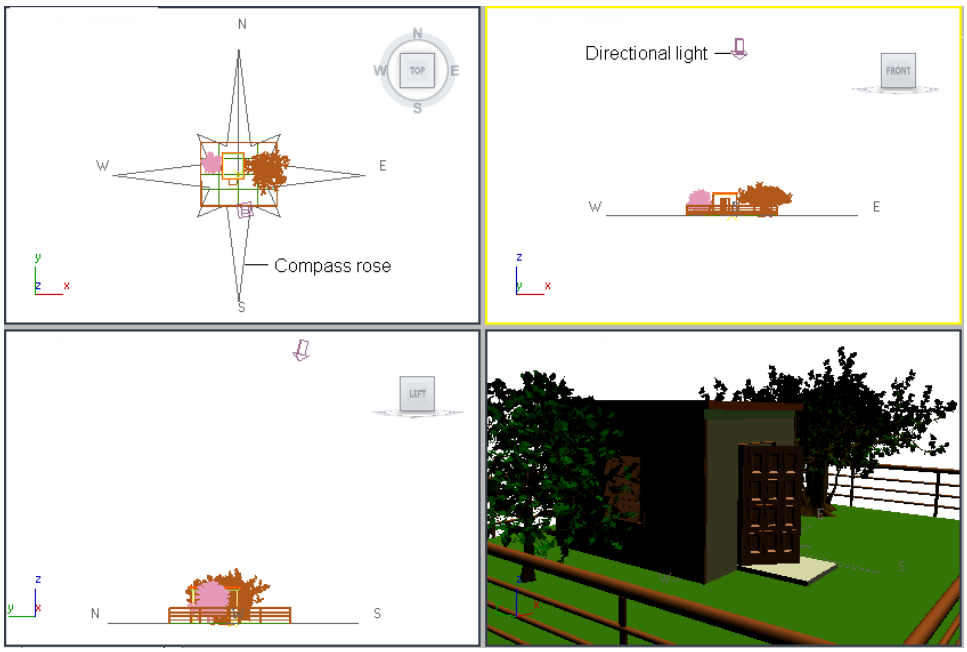


Figure 16-10 *The Sunlight system in all viewports*

By default, the name of the light and the compass rose will be *Sun001* and *Compass001*, respectively. To modify the parameters of the Sunlight system, you need to use the options in the **Control Parameters** rollout. This rollout is discussed next.

Control Parameters Rollout

To modify the parameters of the Sunlight system, select *Sun001* in the viewport and choose the **Motion** tab in the **Command Panel**; the **Control Parameters** rollout will be displayed, as shown in Figure 16-11. The options in this rollout are discussed next.



Note

*After selecting Sun001 in the viewport if you choose the **Modify** tab instead of the **Motion** tab in the **Command Panel**, then the rollouts of the directional light will be displayed.*

On choosing the **Motion** tab, the settings of the sun are displayed, refer to Figure 16-11. On the top of this rollout, there are two text boxes: **Azimuth** and **Altitude**. The **Azimuth** text box indicates the compass direction of the sun in degrees. The **Altitude** text box indicates the height of the sun above the horizon in degrees. The values displayed in these text boxes depend on the other settings in the **Control Parameters** rollout. The different areas in this rollout are discussed next.

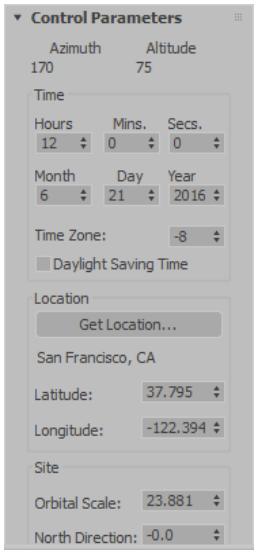


***Figure 16-11** The **Control Parameters** rollout*

Time Area

The options in this area are used to set the time, date, and time zone. Set the values in the **Hours**, **Mins.**, and **Secs.** spinners to specify the time of the day. Set the values in the **Month**, **Day**, and **Year** spinners to specify the date. Set the value in the **Time Zone** spinner to specify the time zone. The value in this spinner ranges from -12 to 12.

Location Area

The options in this area are used to set the geographical location of the scene. Choose the **Get Location** button; the **Geographic Location** dialog box will be displayed, as shown in Figure 16-12. You can select the continent from the **Map** drop-down list in this dialog box; the respective map will be displayed. Now, select the location or the city for the scene from the **City** area on the left side of this dialog box and then choose the **OK** button; the selected location will be displayed in the text box below the **Get Location** button in the **Control Parameters** rollout. Also, the position of *Sun001* will be changed in the viewport according to the selected location. If you change the location, then the values in the **Latitude** and **Longitude** spinners will also change accordingly.

Site Area

The options in this area are used to set the direction of compass rose. Set the value in the **Orbital Scale** spinner to define the distance between the *Sun001* and *Compass001*. Set the value in the **North Direction** spinner to define the rotational direction of the compass rose in the scene.

To modify the radius of the compass rose, select the *Compass001* in the viewport, and then choose the **Modify** tab; the **Parameters** rollout will be displayed, as shown in Figure 16-13. Next, set the value in the **Radius** spinner; the radius of the compass rose will change.

Creating a Daylight System

Menu bar:	Create > Systems > Daylight system
Command Panel:	Create > Systems > Standard > Object Type rollout > Daylight

The Daylight system is similar to the Sunlight system with the difference that the Daylight system uses a combination of two lights, namely sunlight and skylight. You can use the IES sun or target

direct light (standard light) as the sunlight in the Daylight system. The IES sky light or skylight (standard light) can be used as the skylight in the Daylight system.

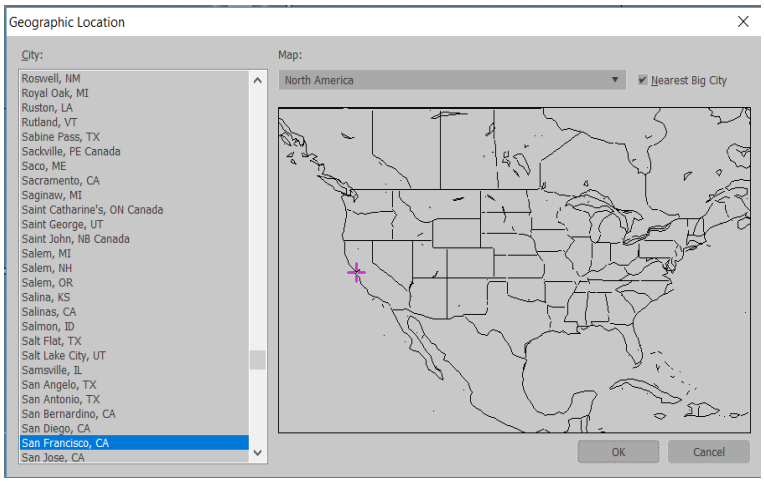


Figure 16-12 *The* ***Geographic Location*** *dialog box*

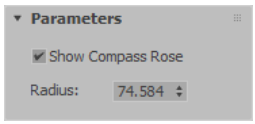


Figure 16-13 *The* ***Parameters*** *rollout*

To create a Daylight system in your scene, choose the **Daylight** tool from **Create > Systems > Standard > Object Type** rollout in the **Command Panel**; the **Daylight System Creation** message box will be displayed. This message box prompts you to use the Logarithmic Exposure Control, as shown in Figure 16-14. Choose the **Yes** button in this message box.

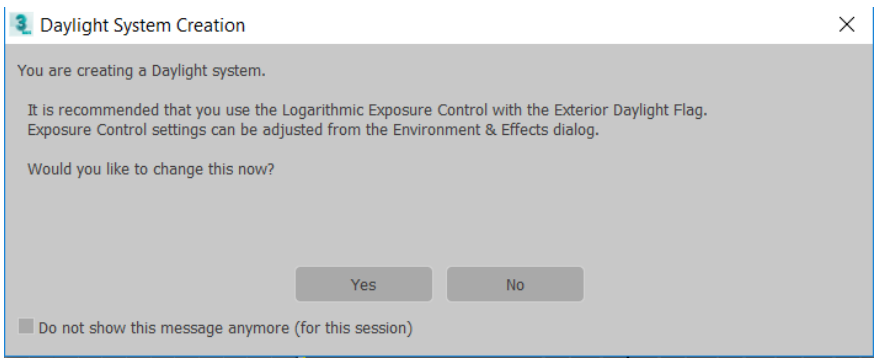


Figure 16-14 *The* ***Daylight System Creation*** *message box*

Next, create the Daylight system using the same method as discussed for the Sunlight system; a compass rose and a combination of the sunlight and skylight will be displayed in the viewports, as shown in Figure 16-15. By default, the name of the light and the compass rose will be *Daylight001* and *Compass001*, respectively. The *Daylight001* light consists of two lights, namely sunlight and skylight. To modify the parameters of the Daylight system, you need to use the options in the **Control Parameters** rollout. This rollout is discussed next.

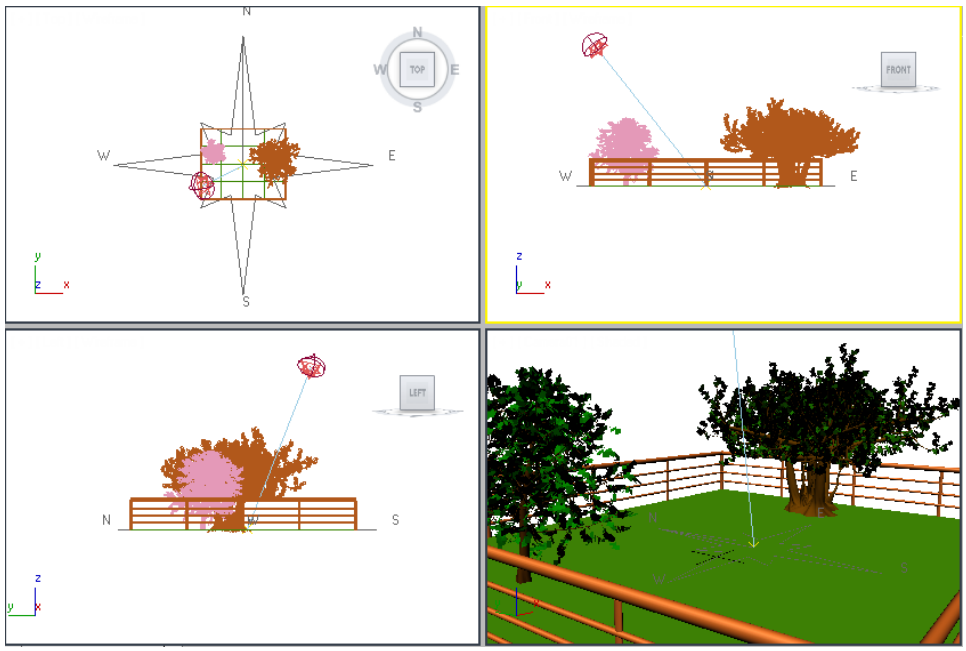


Figure 16-15 The Daylight system created in viewports

Control Parameters Rollout

To modify the parameters of the Daylight system, select the *Daylight001* in the viewport and choose the **Motion** tab in the **Command Panel**; the **Control Parameters** rollout will be displayed. Most of the options in this rollout are the same as those discussed for the Sunlight system.

Additionally, there is a **Manual** radio button on the top of this rollout. By default, this radio button is cleared and therefore, you can modify the parameters using the options displayed in the **Control Parameters** rollout. On selecting the **Manual** radio button, you can manually set the position of the light in the viewport. Also, you can manually set the intensity of the light by setting the value in the **Multiplier** spinner in the **Intensity/Color/Attenuation** rollout. To do so, select the *Daylight001* in the viewport. Choose the **Modify** tab in the **Command Panel**; various rollouts will be displayed in the Modify panel. Most of the rollouts are same as those discussed in Chapter 11. The **Daylight Parameters** rollout is discussed next.

Daylight Parameters Rollout

The options in this rollout are used to select the type of sunlight and the skylight used in the Daylight system, refer to Figure 16-16. The **Active** check box on the right of the **Sunlight** label is selected by default. It is used to turn on the sunlight in the viewport. You can select the light to be used as the sunlight from this drop-down list located below **Sunlight** label.

The **Active** check box on the right of the **Skylight** label is selected by default. It is used to turn on the skylight in the viewport. Select the option to be used as skylight from this drop-down list located below the **Skylight** label.

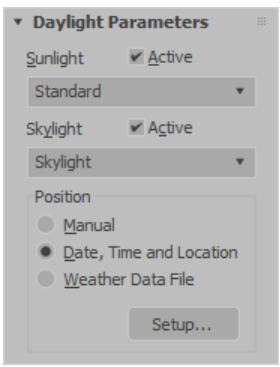


*Figure 16-16 The **Daylight Parameters** rollout*

In the **Position** area, the **Date**, **Time and Location** radio button is selected by default. It is used to set the time, date, and location of the Daylight system. Choose the **Setup** button; the **Control Parameters** rollout will be displayed in the **Motion** tab, where you can set the time, location, and other parameters of the Daylight system in this rollout. Select the **Manual** radio button in the **Position** area to manually set the position and intensity of the *Daylight001* in the viewport. Select the **Weather Data File** radio button to derive the angle and intensity of the sun from a weather data (EPW) file.



Note

When you select required sunlight or skylight option from the drop-down list, corresponding rollouts with options to modify the selected light will be displayed.

HIERARCHY AND KINEMATICS

The ability to link objects together to create a chain is known as hierarchy. When you create a complex computer animation then the hierarchy is the most important tool to simplify the animation process. In a hierarchy, the movement, rotation, or scaling of an object is controlled by another object. It creates a parent-child relationship that is very similar to a family tree. The object that is being controlled is known as the child object and the object that controls another object is known as the parent object. The parent object is controlled by a superior parent object, known as the ancestor object of the first child object. The child object that does not have any child is known as the leaf object. The parent object that is superior to all objects in a hierarchy is known as the root object.

When you create an animation by moving, rotating, or scaling the parent object, the transformations will automatically be transferred to its child objects. In this case, there is no need to create separate animation for the child objects. For example, if you have created a car model in which main body of the car is parent object while all other parts of the car are child objects, then transformation applied to main body of the car will automatically be transferred to all other parts of the car.

A hierarchy is basically used to simplify a complex animation. With this feature, you can link a number of objects to a single object and transfer its animation to the linked objects. It is also very useful for creating the character animation. In 3ds Max, there are two methods for animating the forward kinematics (FK) and inverse kinematics (IK) hierarchies. These hierarchies are created by linking the objects. The inverse kinematics is more advanced than the forward kinematics. These kinematics are discussed next.

Forward and Inverse Kinematics

In forward kinematics, the child objects are animated based on the transformations in the parent object. It is a one-way system in which if a parent object moves, then the child objects will also move. But, if the child objects move, then the parent object will not be affected. In other words, you can control the top object of the hierarchy to animate the entire chain. While creating a hierarchy, the forward kinematics is created by default. The inverse kinematics (IK) is just opposite of the forward kinematics. In inverse kinematics, you can animate an object at the bottom of the hierarchy to control the entire chain. In this kinematics, if you move a child object, then the movement will be transferred to each ancestor in the hierarchy.

Creating a Hierarchy



To create a hierarchy, you need to link the objects that will generate a chain. First, create the objects in the viewport that you need to link together. Then, decide which one of them will be the parent object and which one will be the child object. Next, select one of the child objects in the viewport and then choose the **Select and Link** tool from the **Main Toolbar**. Now, move the cursor over the child object; the cursor will get changed, refer to Figure 16-17. Then, press and hold the left mouse button on the child object and drag the cursor to the parent object; a dotted line will be displayed between the child and parent objects, as shown in Figure 16-17. Next, release the left mouse button over the parent object; the parent object will blink for a second and will be linked to the child object. Next, choose the **Select Object** tool to exit the command. You can link more than one child objects to the parent object using the same procedure. Now, move the parent object in the viewport,



To unlink the child object, select the child object in the viewport and then choose the **Unlink Selection** tool from the **Main Toolbar**.

Hierarchy Tab



The **Hierarchy** tab is used to modify hierarchical linkage between the objects. To do so, select a linkage from the hierarchical linkage in the viewport and choose the **Hierarchy** tab in the **Command Panel**. The **Pivot** button is chosen by default in the **Hierarchy** tab. As discussed in the earlier chapters, the options displayed on choosing the **Pivot** button are used to adjust the pivot point of the object. Choose the **Link Info** button in the **Hierarchy** tab; the **Locks** and **Inherit** rollouts will be displayed, as shown in Figure 16-18.

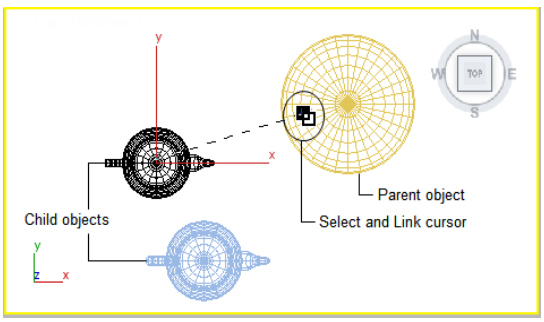


Figure 16-17 *The child object linked to the parent object using the* ***Select and Link*** *tool*

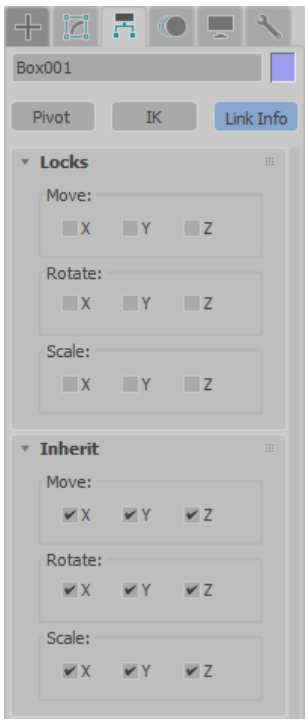


Figure 16-18 *The* ***Link Info*** *button chosen in the* ***Hierarchy*** *tab*

The options in the **Locks** rollout are used to lock the transformations of an object about any of its local axes. In the **Locks** rollout, there are three areas, **Move**, **Rotate**, and **Scale**. Each area has **X**, **Y**, and **Z** check boxes. To lock a transform, select the corresponding check boxes in these areas. The options in the **Inherit** rollout are used to control the transforms that the child objects inherit from the parent object. In this rollout, there are three areas, **Move**, **Rotate**, and **Scale**. Each area has **X**, **Y**, and **Z** check boxes. By default, all check boxes in each area are selected. As a result, the child object inherits all transforms on all axes. To restrict the child object to inherit the transformation of the parent object, first select the child object and then clear the corresponding check box from the respective area.

Creating Bones System

Command Panel: Create > Systems > Standard > Object Type rollout > Bones

The bones system is created by linking the bones and joints in a hierarchy. You can animate and transform this hierarchy either using the forward kinematics or the inverse kinematics. However, animating the bones system using the inverse kinematics is easier. You can animate any type of the characters as well as the machineries using the bones system. To create bones system, choose the **Bones** tool from **Create > Systems > Standard > Object Type** rollout in the **Command Panel**; the **Name and Color**, **IK Chain Assignment**, and **Bone Parameters** rollouts will be displayed. Next, click any of the viewport to create the base of the hierarchy. Now, move the cursor up or down to define the length of the bone and click in the viewport again to end the creation of the first bone. Similarly, start creating the second bone. Repeat the same process to continue the creation of hierarchy. Next, right-click in the viewport to exit the command; a hierarchy of bones will be created, as shown in Figure 16-19. When you right-click to exit the command, a small bone will be created at the end of the hierarchy. This small bone is used at the time of assigning an IK about which you will learn later in this chapter.

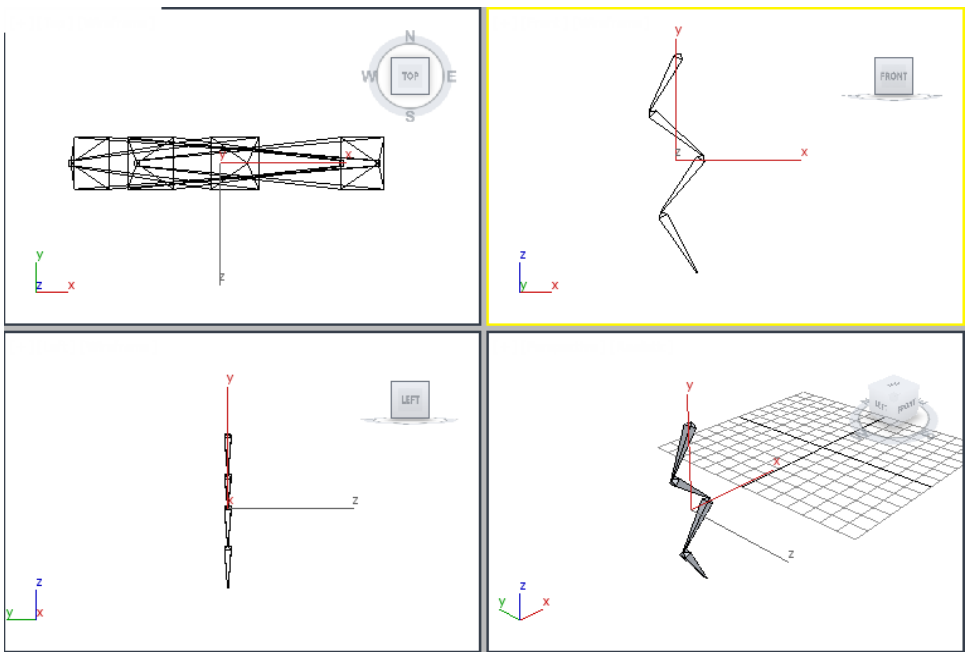


Figure 16-19 *The hierarchy of bones created*



Note

When you create bones in the viewport, first bone will be the parent bone and others will be the child bones of the first bone. The bones created in continuation form a hierarchy of bones. Also, the bone created first will be at the top in the hierarchy and the bone created last will be at the bottom in the hierarchy.

To modify the appearance of bone in the viewport, select the bone in the viewport and then choose the **Modify** tab in the **Command Panel**; the **Bones Parameters** rollout will be displayed. This rollout is discussed next.

Bones Parameters Rollout

There are two areas in this rollout to modify the appearance of bones, refer to Figure 16-20. These areas are discussed next.

Bone Object Area

The **Bone Object** area comprises of some tools. Set the values in the **Width** and **Height** spinners to specify the width and height of the selected bone. Set the value in the **Taper** spinner to specify the taper amount of the bone in percentage.

Bone Fins Area

The options in this area are used to add fins to the bones to increase their thickness, refer to Figure 16-21. Fins help in improving the animation of bulky characters. Select the **Side Fins**, **Front Fin**, and **Back Fin** check boxes to add fins on the sides, front, and back of the bones, respectively. Set the values in the **Size**, **Start Taper**, and **End Taper** spinners to specify the size, start taper, and end taper values of the fins.

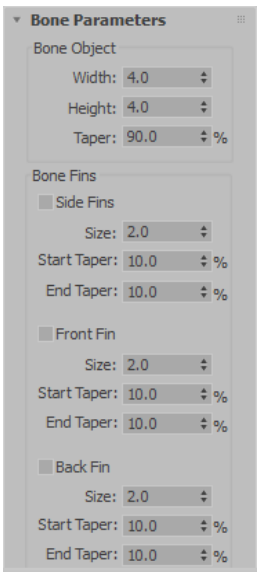


***Figure 16-20** The **Bone Parameters** rollout*

Making the Bones Visible on Rendering

By default, the bones created in the viewport will not be visible at rendering. To make them visible, select the bones in the viewport and right-click on them; a quad menu will be displayed. Choose the **Object Properties** option; the **Object Properties** dialog box will be displayed. By default, the **General** tab is chosen in this dialog box. In the **Rendering Control** area, select the **Renderable** check box and then choose the **OK** button to exit the **Object Properties** dialog box; the bones will be visible at rendering.

Modifying the Bones

Generally, the length of the bones is set while creating them in the viewport. After creating them, if you need to edit the length and other properties of the bones, then select the bone in the viewport. Choose **Animation > Bone Tools** from the menu bar; the **Bone Tools** dialog box will be displayed, as shown in Figure 16-22. The rollouts in this dialog box are discussed next.

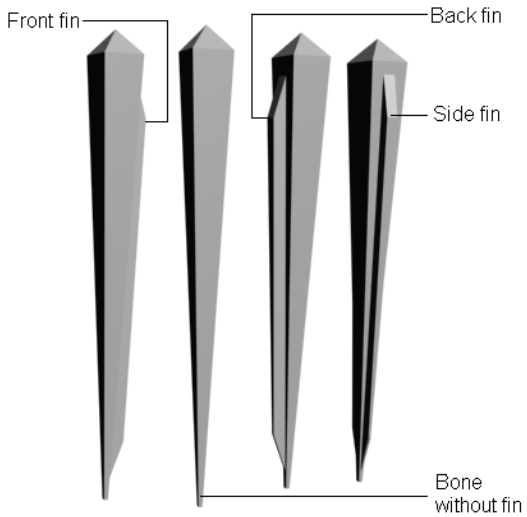


Figure 16-21 The bones with the fins added to them

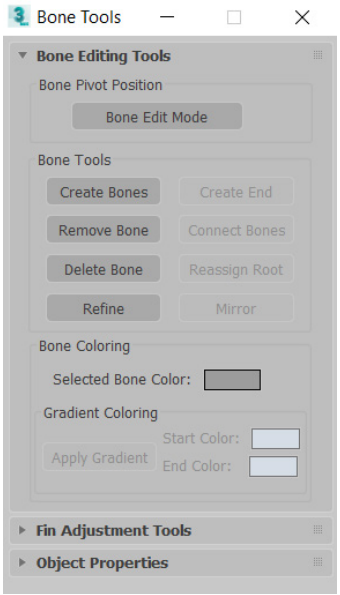


*Figure 16-22 The **Bone Tools** dialog box*

Bone Editing Tools Rollout

The areas in this rollout are used to set the geometry and color of the selected bones. These areas are discussed next.

Bone Pivot Position Area

The **Bone Edit Mode** button in this area is used to edit the length and position of the bone in the viewport. To do so, choose the **Bone Edit Mode** button and then choose the **Select and Move** tool and move the bone along any axes in the viewport.

Bone Tools Area

The **Bone Tools** area consists of different buttons that are used to create, remove, delete, and refine the bones. Choose the **Create Bones** button from this area; the **Bones** tool in the **Command Panel** will be activated, which can be used to create a bone in the viewport. If you choose the **Create End** button, a small bone will be created at the end of the bone system. You can choose the **Remove Bone** button to remove the selected bone. When you remove a bone, its parent bone stretches to cover the pivot point of the removed bone. Choose the **Connect Bones** button to connect the selected bone to another bone in the viewport. Choose the **Delete Bone** button to delete the selected bone and also to remove its parent-child relationship. Choose the **Reassign Root** button; the selected bone will become the parent bone in the hierarchy. To split the selected bone, choose the **Refine** button and then select a bone in the viewport; the bone will split. Choose the **Mirror** button; the **Bone Mirror** dialog box will be displayed. Set the parameters in this dialog box and choose the **OK** button; the selected bone will be mirrored in the viewport.

Bone Coloring Area

The options in this area are used to modify the color of the bone.

Fin Adjustment Tools Rollout

The options in the **Fin Adjustment Tools** rollout are used to modify the settings of the fins of the selected bones in the viewport.

Object Properties Rollout

In this rollout, set the parameters for other objects to be used as bones in the viewport. First, select the hierarchy in the viewport and then expand the **Object Properties** rollout in the **Bone Tools** dialog box. Now, select the **Bone On** check box; the selected objects in the hierarchy will behave as bones.

Understanding IK Solver, Interactive IK, and Applied IK

An IK Solver creates an inverse kinematic solution to rotate and position the links in a hierarchy. It applies an IK controller to each bone for controlling the motion of the child objects in a linkage. The hierarchy to which an IK solver is applied will be animated interactively. The behavior and controls on the linkage depend on the type of IK solver that you have selected.

In an Interactive IK, the IK solution is applied only to the specified keyframes. To apply the Interactive IK, select the end of the hierarchy in the viewport and then choose the **Hierarchy** tab in the **Command Panel**. Next, choose the **IK** button in the **Hierarchy** tab and then choose the **Interactive IK** button in the **Inverse Kinematics** rollout. Next, apply the transforms to the bones in the system.

The Applied IK is used to create the accurate motion in the hierarchy of linked objects. In this case, you need to bind the end of a hierarchy to the animated follow objects. After binding, select any object in your kinematic chain and choose the **Apply IK** button in the **Inverse Kinematics** rollout of the **Hierarchy** tab in the **Command Panel**; the IK solution will be calculated for each frame in the animation and it will create transform keys for every object in the IK chain.

Creating a Bone Hierarchy with an IK Solver

To create a bone system with an IK solver, choose the **Bones** tool from **Create > Systems > Standard > Object Type** rollout in the **Command Panel**; the **Name and Color**, **IK Chain Assignment**, and **Bone Parameters** rollouts will be displayed. In the **IK Chain Assignment** rollout, select the required IK solver from the **IK Solver** drop-down list. Then, select the **Assign To Children** check box, refer to Figure 16-23. Next, create bones in the viewport as discussed earlier; the selected IK solver will automatically be applied to them.

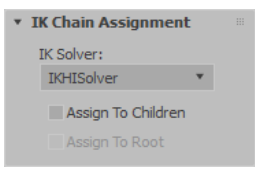


***Figure 16-23** The **IK Chain Assignment** rollout*

You can also apply the IK solvers after creating the hierarchy of the bones. To do so, select the bone in the hierarchy and then choose **Animation > IK Solvers** from the menu bar; a cascading menu will be displayed. Now, choose the required IK solver from the cascading menu and then select another bone in the hierarchy in the viewport to define the IK chain.

Creating a Biped System

Command Panel: Create > Systems > Standard > Object Type rollout > Biped

The Biped system is used to create a biped model that has a two-legged figure. It is used to animate the characters such as humans and animals. To create a biped system, choose the **Biped** tool from **Create > Systems > Standard > Object Type** rollout in the **Command Panel**; the **Name and Color** and **Create Biped** rollouts will be displayed. In the Top viewport, press and hold the left mouse button, and then drag the cursor to define the height of the biped model. Release the left mouse button; the biped model will be displayed in all viewports, as shown in Figure 16-24.

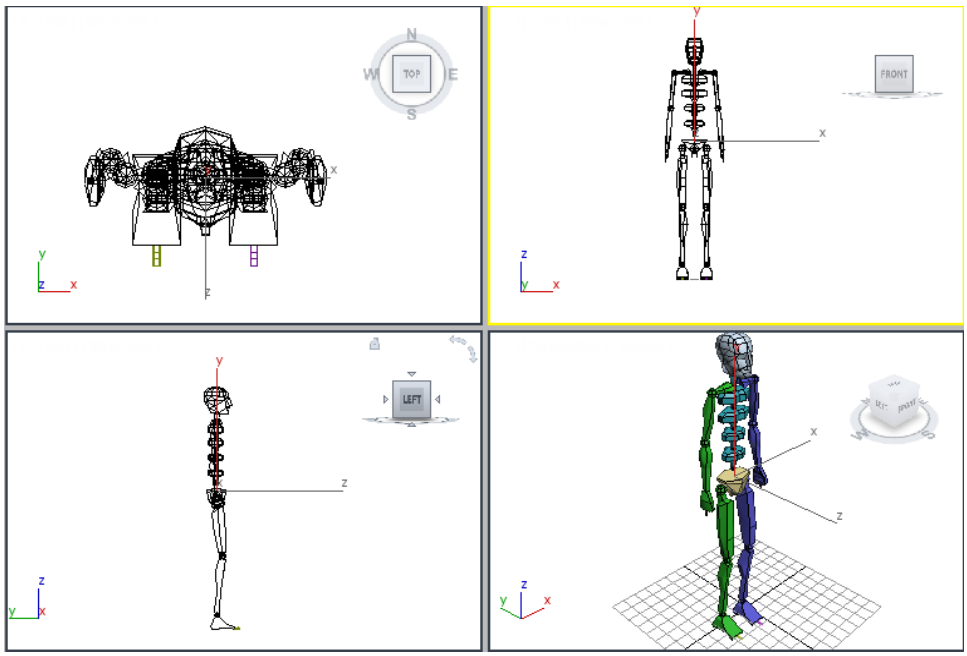


Figure 16-24 *The biped model displayed in viewports*

Choose the **Select by Name** tool from the **Main Toolbar** to view the names of all bones in the biped system; the **Select From Scene** dialog box will be displayed. Make sure that the **Display Bones** button is chosen in the dialog box to display the names of the biped bones. Among all the bones in a biped system, the *Bip001* bone is the root bone.

You can modify the biped parameters before creating the biped model using the **Create Biped** rollout displayed on invoking the **Biped** tool. However, to modify the biped model after creating it, select the *Bip001* bone in the biped model. Choose the **Motion** tab in the **Command Panel**; various rollouts will be displayed. In the **Biped** rollout, choose the **Figure Mode** button; the **Structure** rollout will be displayed. Now, expand the **Structure** rollout to modify the parameters of the biped model. Most of the options in the **Structure** rollout are same as in the **Create Biped** rollout. The **Create Biped** rollout is discussed next.

Note

Before creating a biped model, you need to create a character mesh and then you need to put the biped model in it to animate the character mesh created.

Create Biped Rollout

The options in this rollout are used to define the method of creation of a biped system. You can also modify the number of bones in different parts of the body using this rollout. The areas in this rollout are discussed next.

Creation Method Area

The radio buttons in this area are used to define the method of creation of the biped system. The **Drag Height** radio button is selected by default. It is used to create the biped system as discussed earlier. If you select the **Drag Position** radio button, then to create a biped system, you need to press and hold the left mouse button and move the mouse in the viewport to set the position of the biped model, and then release the left mouse button.

The text box in the **Root Name** area displays the name of the root bone that is superior to all parent bones.

Body Type Area

The drop-down list in this area is used to select the type of body of the biped model. By default, the **Skeleton** option is selected in this drop-down list and it is used to create a skeleton in the viewport. Select the **Male**, **Female**, or **Classic** option from the drop-down list to create a biped model based on the character in the scene; the biped model will be created, as shown in Figure 16-25. Set the values in the **Neck Links**, **Spine Links**, and other spinners to set the number of bones in the biped model.

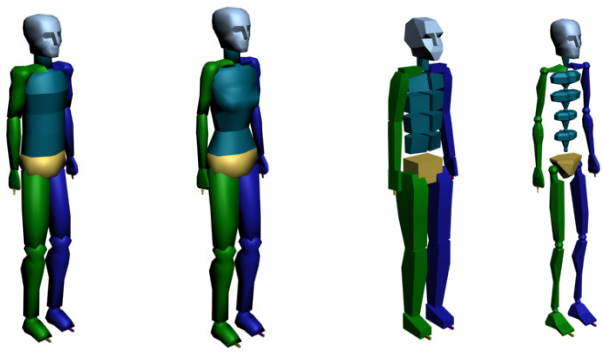


Figure 16-25 *The male, female, classic, and skeleton type biped models*



Note

Biped body parts cannot be removed but you can hide unwanted parts of the biped.

TUTORIALS

Tutorial 1

In this tutorial, you will create an animated scene to study the shadow pattern according to the position of the sun over the earth at a particular location, date, and time. The shadow at one of the frames is shown in Figure 16-26. **(Expected time: 30 min)**



Figure 16-26 *The shadow pattern in the scene*

The following steps are required to complete this tutorial:

a. Create the project folder.
b. Create a ground and a tree.
c. Create the camera.
d. Create the Sunlight system.
e. Animate the Sunlight system.
f. Save and render the scene.

Creating the Project Folder

Create a new project folder with the name *c16_tut1* at *\Documents\3dsmax2024* and then save the file with the name *c16tut1*, as discussed in Tutorial 1 of Chapter 2.

Creating a Ground and a Tree

In this section, you will create the ground by using the **Plane** tool.

1. Choose the **Plane** tool from **Standard Primitives** and create a plane in the Top viewport, as discussed earlier.

2. Change the name of the plane to *ground*. Also, assign the grass material to it, as discussed in the earlier chapters.

3. Choose the **Foliage** tool from **Create > Geometry > AEC Extended** in the **Command Panel** and create a tree in the Top viewport, as discussed earlier. Set the height of the tree according to *ground*. Align the tree at the center of the ground in all viewports, refer to Figure 16-27.

Creating the Camera

In this section, you will create the camera in the scene by using the **Free** camera tool.

1. Choose the **Free** tool from **Create > Cameras > Standard > Object Type** rollout in the **Command Panel** to create a free camera in the viewport.

2. Create a Free camera in the Front viewport. The camera is automatically named as *Camera001*. Align the *Camera001* in all viewports, refer to Figure 16-27.

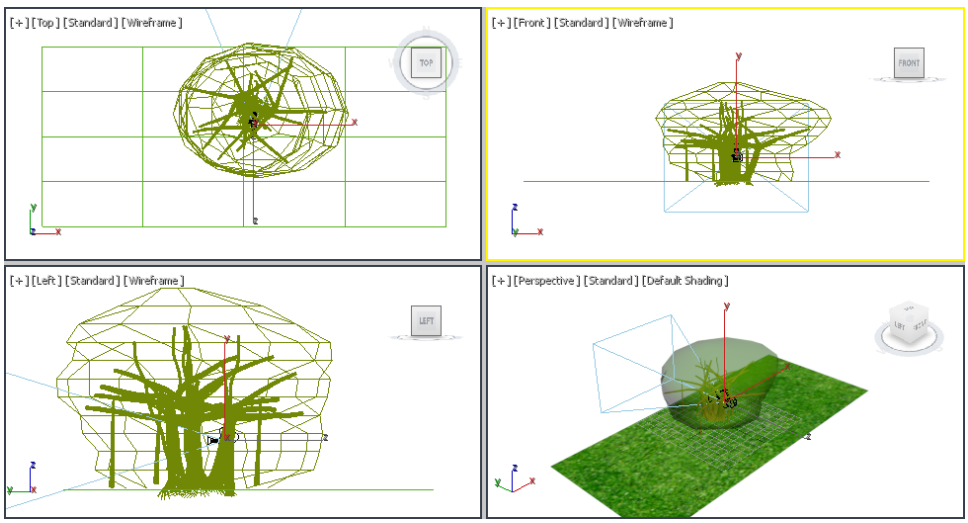


Figure 16-27 *Alignment of the Camera001 in viewports*

You need to press the C key in the Perspective viewport to display the camera view. Adjust the camera view as per your requirements.

Creating the Sunlight System

In this section, you will create the Sunlight system by using the **Sunlight** tool.

1. Choose the **Zoom** tool and zoom out the Top viewport to make room for creating the Sunlight system.

2. Choose **Create > Systems** in the **Command Panel**; various tools are displayed in the **Object Type** rollout. Choose the **Sunlight** tool from the **Object Type** rollout.

3. In the Top viewport, press and hold the left mouse button at the center of the scene to specify the center of the Sunlight system and then drag the cursor to define the radius of the system. Now, release the left mouse button; a compass rose is created. Now, drag the cursor again and click in the viewport to set the distance of the light from the compass rose, as shown in Figure 16-28; the compass rose and the directional light are created in the viewports. Next, right-click in the viewport to exit the command.

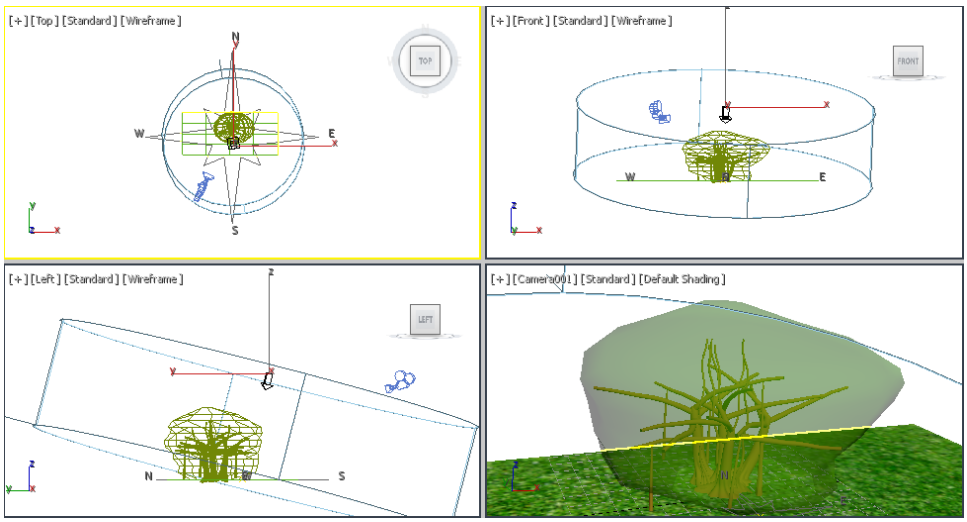


Figure 16-28 *The Sunlight system created in viewports*

The compass rose and the directional light are automatically named as *Compass001* and *Sun001*, respectively.

4. Choose the **Zoom Extents All** tool to see the objects in every viewport.

Animating the Sunlight System

In this section, you will study the shadow pattern to change the position of *Sun001* at different frames in the time slider.

1. Choose the **Time Configuration** button from the timeline; the **Time Configuration** dialog box is displayed. In the **End Time** spinner of the **Animation** area, set the value to **500**. Now, choose the **OK** button; the total number of frames in the track bar is increased.

2. Select *Sun001* in any viewport and choose the **Motion** tab in the **Command Panel**; the **Control Parameters** rollout is displayed.

   By default, the Sunlight system is placed at the latitude of San Francisco, CA. Also, the sun is set at 12 hours. You can modify the location of the sun in the **Location** area by choosing the **Get Location** button.

   Next, you need to change the position of *Sun001* by modifying the time given in the **Time** area of the **Control Parameters** rollout.

3. Drag the time slider to frame 0. In the **Time** area of the **Control Parameters** rollout, set the value in the **Hours** spinner to **7** and press ENTER.

4. Make sure that *Sun001* is selected in the viewport. Choose the **Toggle Auto Key Mode** button to enter the animation mode; the track bar, the **Toggle Auto Key Mode** button, and the active viewport turn red.

5. Drag the time slider to frame 40, as shown in Figure 16-29. In the **Time** area of the **Control Parameters** rollout, set the value in the **Hours** spinner to **8**; the arrows of the **Hours**, **Mins.**, and **Secs.** spinners turn red.

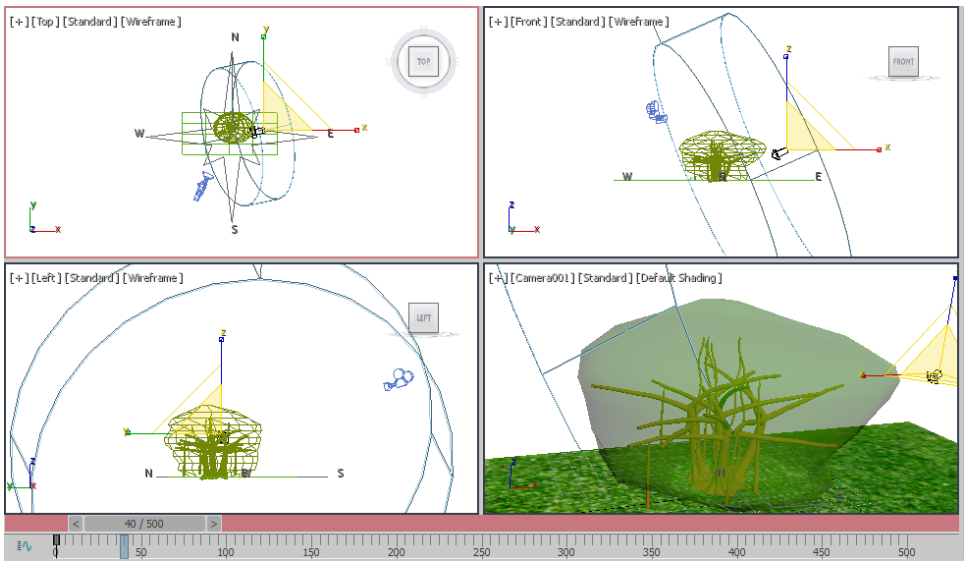


Figure 16-29 *The time slider at frame 40*

6. Drag the time slider to frame 80. In the **Time** area of the **Control Parameters** rollout, set the value in the **Hours** spinner to **9**.

7. Drag the time slider to 40-frames increments and increase the time in the **Hours** spinner by one hour at each increment. Continue this process until the value in the **Hours** spinner is set to **18**. Note that, at this point, the last frame number should be 440.

8. Choose the **Toggle Auto Key Mode** button again to turn off the animation mode.

9. Choose the **Play Animation** button to view the effect of the Sunlight system in Camera viewport.

Saving and Rendering the Scene

In this section, you will save the scene and then render it. You can also view the final rendered image sequence by downloading the *c16_3dsmax_2024_rndr.zip* file from *www.cadcim.com*. The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2024: A Comprehensive Guide*

1. Change the background color of the scene to blue, as discussed in earlier chapters.

2. Choose **Save** from the **File** menu.

3. For rendering the scene, refer to Tutorial 1 of Chapter 14.

After the completion of the rendering process, the final output of the animation is saved in the *AVI* format at the specified location. You can view the final output of the animation by opening the corresponding *AVI* file.

Tutorial 2

In this tutorial, you will create the footsteps animation of a biped model. The footsteps animation at a frame is shown in Figure 16-30. **(Expected time: 45 min)**



Figure 16-30 *The biped model animation*

The following steps are required to complete this tutorial:

a. Create the project folder.
b. Create a biped model.
c. Create the footsteps animation for the model.
d. Save and render the scene.

Creating the Project Folder

Create a new project folder with the name *c16_tut2* at *\Documents\3dsmax2024* and then save the file with the name *c16tut2*, as discussed in Tutorial 1 of Chapter 2.

Creating a Biped Model

In this section, you will create a biped model by using the **Biped** tool.

1. Activate the Top viewport. Then, choose the **Biped** tool from **Create > Systems > Standard > Object Type** rollout in the **Command Panel**; various rollouts are displayed.

2. In the **Create Biped** rollout, select the **Drag Position** radio button in the **Creation Method** area and click at the center of the Top viewport; a biped model is displayed in all viewports.

All bones in the biped model are named automatically. The *Bip001* bone is the root bone in the hierarchy and is selected by default after the creation of the model.

3. Choose the **Zoom Extents All** tool; the biped model is displayed in the viewports, as shown in Figure 16-31.

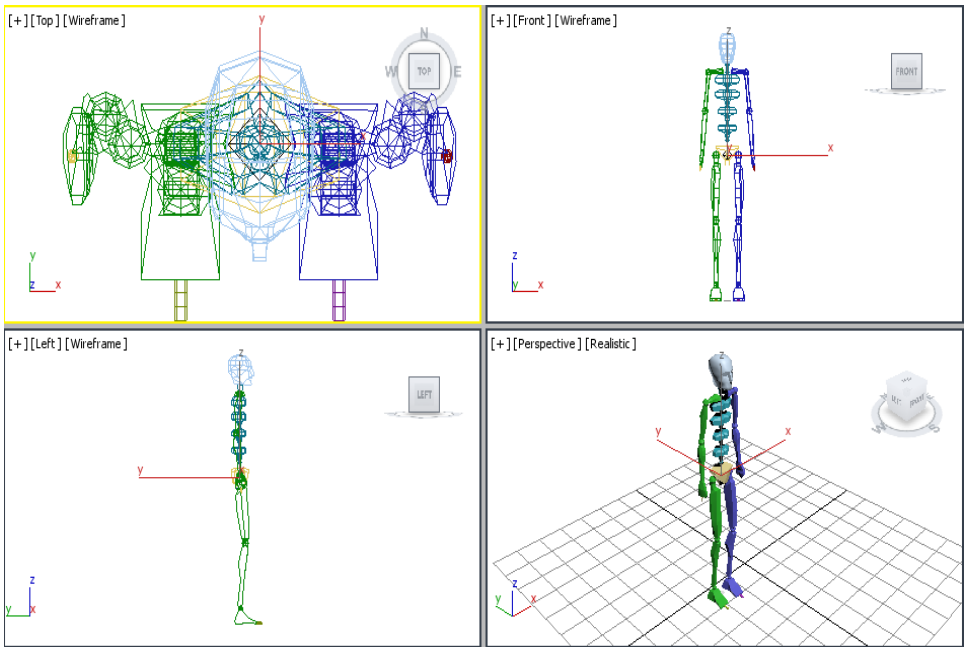


Figure 16-31 *The biped model displayed in viewports*

Creating the Footsteps Animation for the Model

In this section, you will create the footsteps animation for the biped model.

1. Make sure that *Bip001* is selected in the viewport and choose the **Motion** tab in the **Command Panel**; various rollouts are displayed.

2. Expand the **Biped** rollout and then choose the **Footstep Mode** button; the **Footstep Creation**, **Footstep Operations**, and **Dynamics & Adaptation** rollouts are displayed, as shown in Figure 16-32.

3. Choose the **Zoom** tool and zoom out the Top viewport until one-fourth of the original biped model is visible. Also, set the view of the Top viewport using the **Pan** tool, as shown in Figure 16-33.

4. In the **Footstep Creation** rollout, make sure that the **Walk** button is chosen.

5. Choose the **Create Footsteps (at current frame)** button in the **Footstep Creation** rollout and then move the cursor over the Top viewport; the shape of the cursor changes. Now, click in the Top viewport to create the footsteps, as shown in Figure 16-34.

6. Choose the **Select and Move** tool and align the footsteps in the Top viewport, as shown in Figure 16-35. Also, rotate some of the footsteps by 45-degree in the clockwise direction, as shown in Figure 16-36.

   Next, you need to create keys for the animation of biped model.

7. In the **Footstep Operations** rollout, choose the **Create Keys for Inactive Footsteps** button; keys are created for the biped animation according to the footsteps.

8. Choose the **Select Object** tool and then choose the **Zoom Extents All** tool.

9. Now, activate the Perspective viewport and choose the **Play Animation** button; the biped model starts moving according to the footsteps created, refer to Figure 16-37.

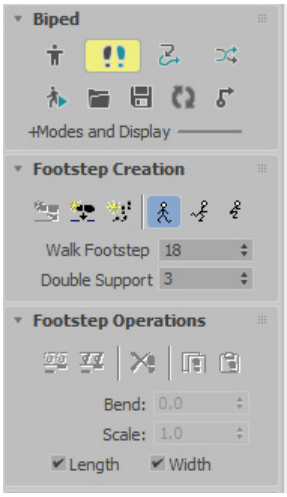


Figure 16-32 *The rollouts displayed after choosing the* ***Footstep Mode*** *button*

10. If you want to add more footsteps in the viewport, then choose the **Select by Name** tool; the **Select From Scene** dialog box is displayed. Now, select *Bip001* bone and choose the **OK** button to close the dialog box.

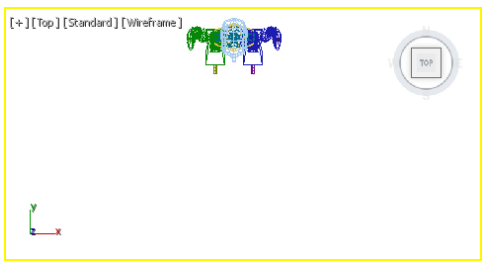


Figure 16-33 *The Top viewport after using the* ***Zoom*** *and* ***Pan*** *tools*

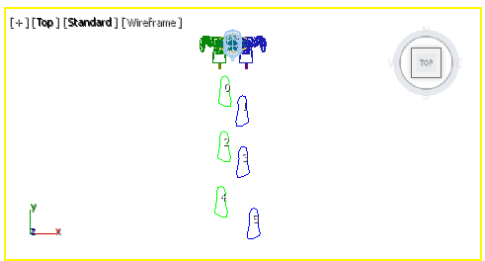


Figure 16-34 *The footsteps created in the Top viewport*

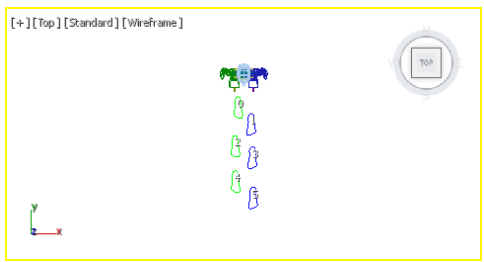


Figure 16-35 *The footsteps aligned using the* ***Select and Move*** *tool*

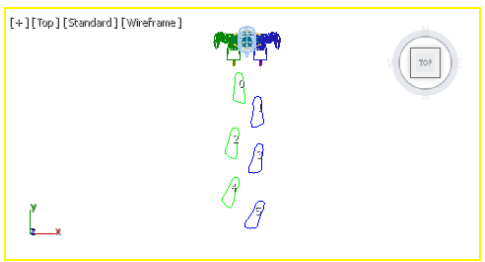


Figure 16-36 *The footsteps after rotating them in the Top viewport*

11. Choose the **Motion** tab in the **Command Panel** if not already chosen and then choose the **Footstep Mode** button in the **Biped** rollout.

12. In the **Footstep Creation** rollout, make sure the **Walk** button is chosen and then choose the **Create Footsteps (append)** button.

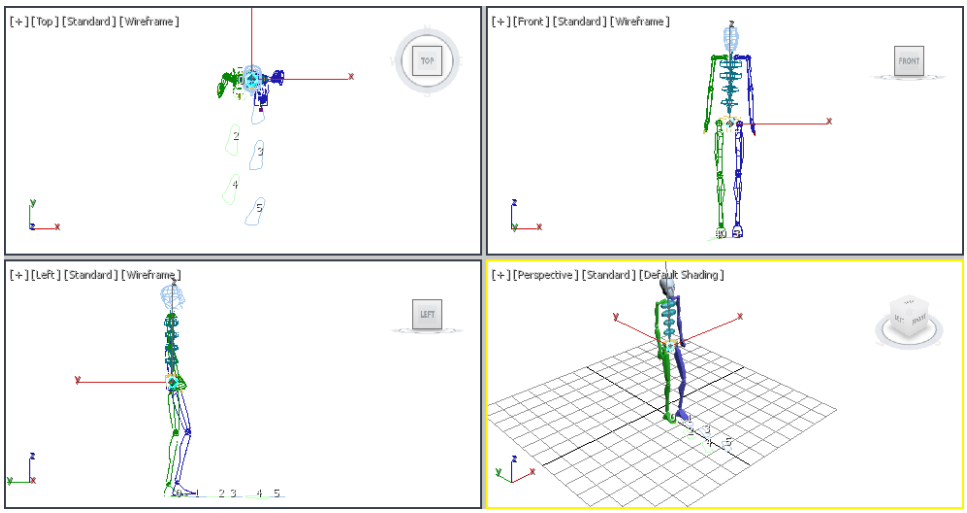


Figure 16-37 *The biped model moving after choosing the* ***Play Animation*** *button*

13. Move the cursor over the Top viewport; the shape of the cursor changes. Now, create additional footsteps in the Top viewport and align them as required, as shown in Figure 16-38.

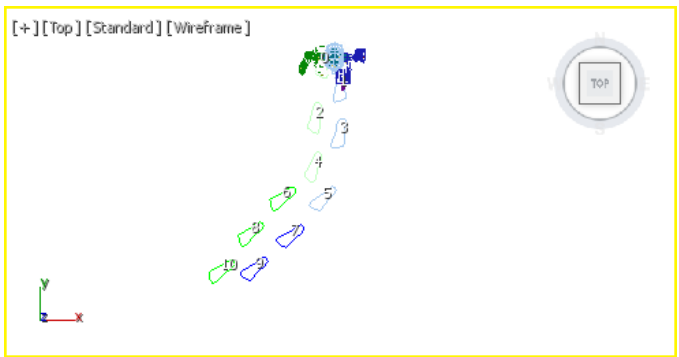


Figure 16-38 *New footsteps created in the Top viewport*

14. In the **Footstep Operations** rollout, choose the **Create Keys for Inactive Footsteps** button; keys are created for the biped animation according to the newly created footsteps.

15. Choose the **Select Object** tool and then the **Zoom Extents All** tool.

16. Activate the Perspective viewport and choose the **Play Animation** button; the biped model starts moving according to the newly created footsteps, as shown in Figure 16-39.

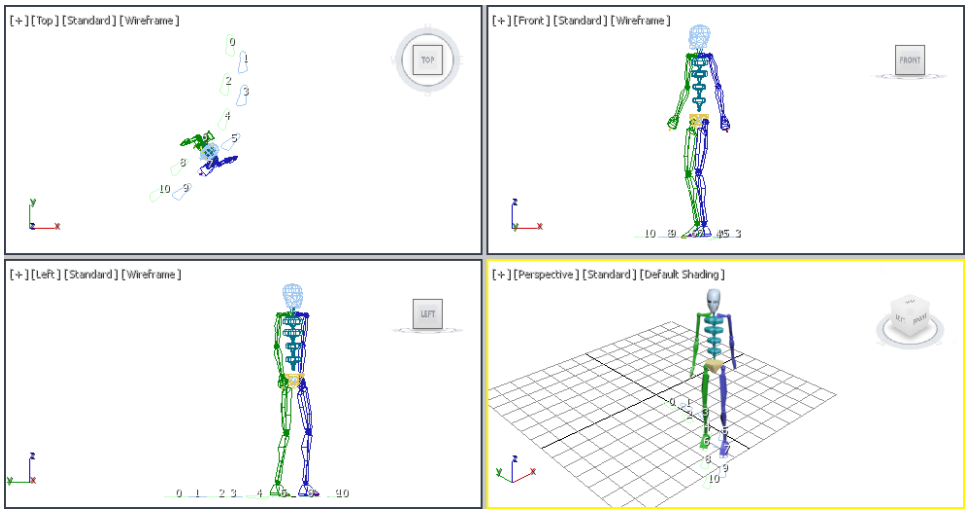


Figure 16-39 *The biped model moving according to the newly created footsteps*

Next, you will create multiple footsteps automatically.

17. Now, you need to hide the biped model in the scene. To do so, press CTRL+A to select all bone objects in the scene and then CTRL+click on *Bip001* footsteps in the **Scene Explorer**. Right click; a quad-menu is displayed. Select the **Hide Selection** option from the Quad menu.

    Next, create another biped model in the viewport, as discussed in the previous section and then choose the **Zoom Extents All** tool to view it in the viewports.

18. Expand the **Biped** rollout in the **Motion** panel, if it is not already expanded. Choose the **Footstep Mode** button in this rollout.

19. In the **Footstep Creation** rollout, choose the **Run** button.

20. Choose the **Create Multiple Footsteps** button in the **Footstep Creation** rollout; the **Create Multiple Footsteps: Run** dialog box is displayed.



21. In the **General** area of this dialog box, set the value **6** in the **Number of Footsteps** spinner to specify the number of footsteps and then choose the **OK** button. You can also set other parameters in the **Create Multiple Footsteps: Run** dialog box, as required.

    Next, you need to create keys for the biped model.

22. In the **Footstep Operations** rollout, choose the **Create Keys for Inactive Footsteps** button; keys are created for the biped animation.

23. Choose the **Zoom Extents All** tool.

24. Activate the Perspective viewport and choose the **Play Animation** button; the biped model starts running, as shown in Figure 16-40.

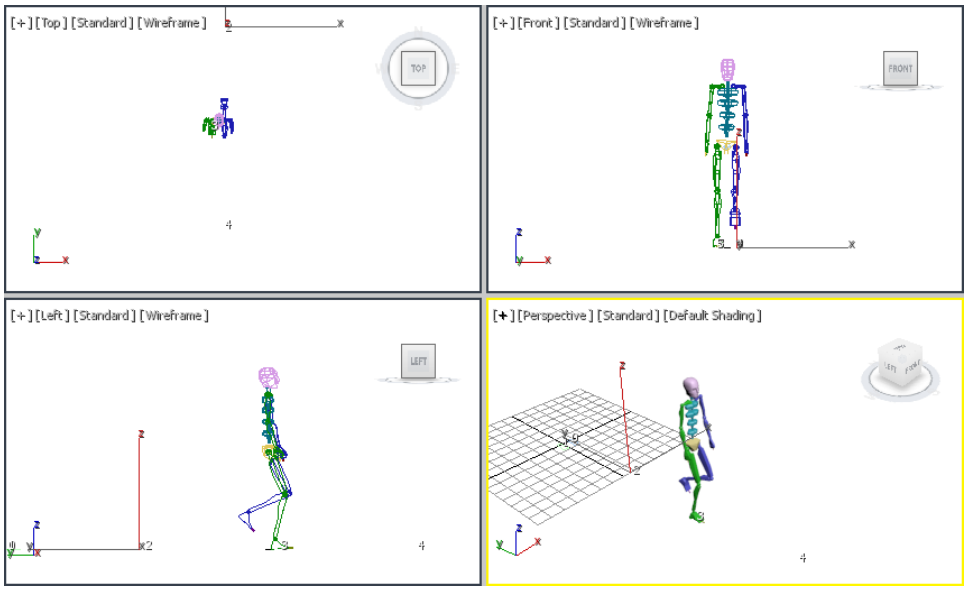


Figure 16-40 *The running biped model in viewports*

Note

When you create keys for the biped model, various keys are created automatically for each bone in the biped model. Therefore, you can modify the keys created for arms, legs, spine, and head according to the animation you want to create for the biped model. To do so, select a bone in the viewport; the keys created for the selected bone are displayed in the track bar. Now, choose the ***Toggle Auto Key Mode*** *button and modify the bone using the transforms such as move, rotate, and scale on the keys in the track bar.*

25. Make sure that *Bip002* bone of the biped model is selected in the viewport and the **Motion** tab is chosen in the **Command Panel**.

26. Choose the **Save File** button in the **Biped** rollout; the **Save As** dialog box is displayed. Browse to the folder in which you want to save the file. Enter **Run** as the name of the animation file in the **File name** text box and make sure that the **(*.BIP)** option is selected in the **Save as type** drop-down list.

27. Choose the **Save** button; the animation of the biped model is saved with the name *Run.bip* at the specified location. Now, you can use the same biped animation for another scene.

    Next, you will load the biped animation from the saved *BIP* file.

28. Hide **Bip002** and unhide **Bip001**. Choose the **Select by Name** tool; the **Select From Scene** dialog box is displayed. Now, select *Bip001* bone and choose the **OK** button to close the dialog box.

29. Choose the **Motion** tab in the **Command Panel**. In the **Biped** rollout, choose the **Load File** button; the **Open** dialog box is displayed. Browse to the *Run.bip* file, select the file, and then choose the **Open** button; the animation saved in the *Run.bip* file is loaded into the biped model.



30. Choose the **Play Animation** button; the biped model starts running, as shown in Figure 16-41.

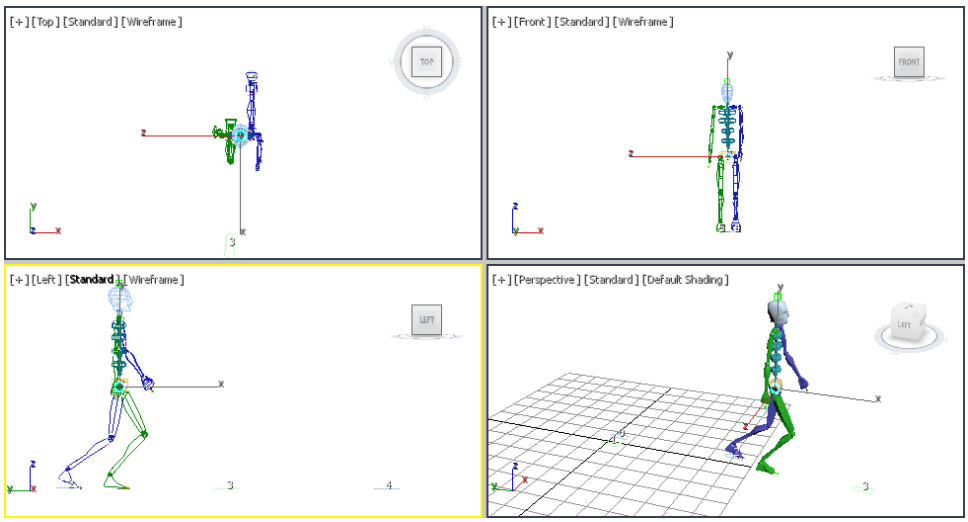


Figure 16-41 *The Bip001 in running position after loading the Run.bip file*

Saving and Rendering the Scene

In this section, you will save the scene and then render it. You can also view the final rendered image sequence by downloading the file *c16_3dsmax_2024_rndr.zip* from *www.cadcim.com*. The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2024: A Comprehensive Guide*

1. Change the background color of the scene to white, as discussed in Tutorial 1 of Chapter 2.

2. Choose **Save** from the **File** menu.

3. For rendering, refer to Tutorial 1 of Chapter 14.

Self-Evaluation Test

Answer the following questions and then compare them to those given at the end of this chapter:

1. Which of the following lights can be used as sunlight in the Daylight system?

(a) **IES Sun** (b) **Free Spot**
(c) **Omni** (d) **IES Sky**

2. Which of the following lights is used as skylight in the Daylight system?

(a) **IES Sky** (b) **Target Spot**
(c) **Free Spot** (d) **Omni**

3. Which of the following tools is used to create a bone system in Autodesk 3ds Max?

(a) **Bones** (b) **Biped**
(c) **Point** (d) **Dummy**

4. Which of the following rollouts is used to modify the parameters of the Daylight system?

(a) **Control Parameters** (b) **IK Chain Assignment**
(c) **Parameters** (d) All of these

5. The Daylight system uses a combination of two lights, namely _____ and _____.

6. In _____ kinematics, you can animate the object at the bottom of the hierarchy to control the entire chain.

7. To modify the parameters of the Ring Array system, you need to choose the _____ tab in the **Command Panel**.

8. The **Systems** are used to combine objects, linkages, and controllers to create an object set that will have all these features. (T/F)

9. A dummy object in the Ring Array system cannot be rendered. (T/F)

10. The ability to link objects together to create a chain is known as hierarchy. (T/F)

Review Questions

Answer the following questions:

1. Which of the following options is used to create an inverse kinematic solution to rotate and position the links in a hierarchy?

(a) **IK Solver** (b) **Interactive IK**
(c) **Applied IK** (d) All of these

2. Which of the following options is used to create an inverse kinematic solution only for the specified keyframes?

(a) **IK Solver** (b) **Interactive IK**
(c) **Applied IK** (d) All of these

3. Which of the following options is used to create an accurate motion in the hierarchy of linked objects?

   (a) **IK Solver** (b) **Interactive IK**
   (c) **Applied IK** (d) All of these

4. Which of the following systems is used to create a hierarchical linkage of bones and joints?

   (a) Biped system (b) Ring Array system
   (c) Sunlight system (d) Daylight system

5. The _____ tab is used to modify the hierarchical linkage between the objects.

6. You can animate and transform the hierarchy of bones using the _____ as well as the _____.

7. The options in the _____ rollout are used to set the fins of the selected bones in the viewport.

8. You cannot replace the boxes in a Ring Array system with other objects. (T/F)

9. You can generate the light effect using a Sunlight system according to the position of the sun over the earth at a particular location, date, and time. (T/F)

10. In forward kinematics, if a parent object moves, then the child objects will also move accordingly. (T/F)

EXERCISE

The rendered output of the scene used in the following exercise can be accessed by downloading the *c16_3dsmax_2024_exr.zip* file from *www.cadcim.com*. The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2024: A Comprehensive Guide*

Exercise 1

Create an animated merry-go-round using the Ring Array system. The position of the swing at different frames is shown in Figures 16-42 through 16-44. **(Expected time: 25 min)**

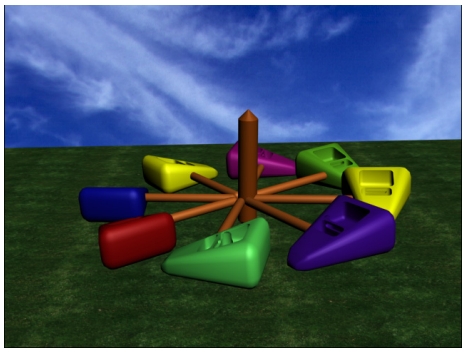


Figure 16-42 *Model to be created in Exercise 1(view 1)*

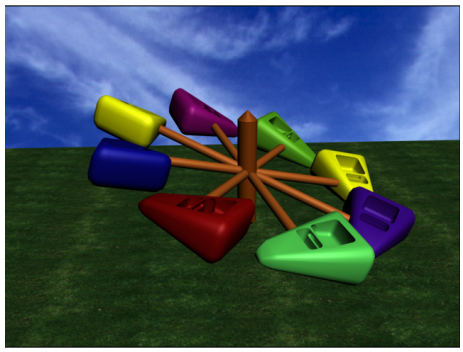


Figure 16-43 *Model to be created in Exercise 1(view 2)*

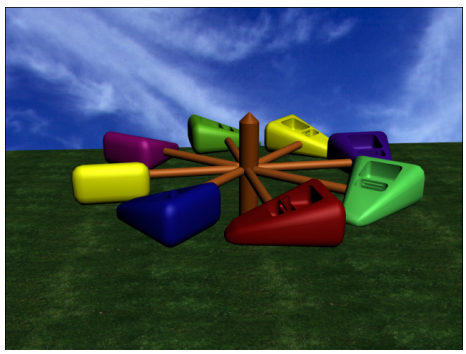


Figure 16-44 *Model to be created in Exercise 1 (view 3)*

Hints:

1. Create the merry-go-round using **Extended Primitives**.

2. Link the parts of the merry-go-round with the dummy objects of the Ring Array system.

3. Replace the boxes of the Ring Array system with the merry-go-round using the **Curve Editor (Open)** tool.

4. Animate the dummy object accordingly.

Answers to Self-Evaluation Test

1. a, **2.** a, **3.** a, **4.** a, **5.** sunlight, skylight, **6.** inverse, **7. Motion**, **8.** T, **9.** T, **10.** T