# Tutorials: Animation

# Autodesk® 3ds Max®

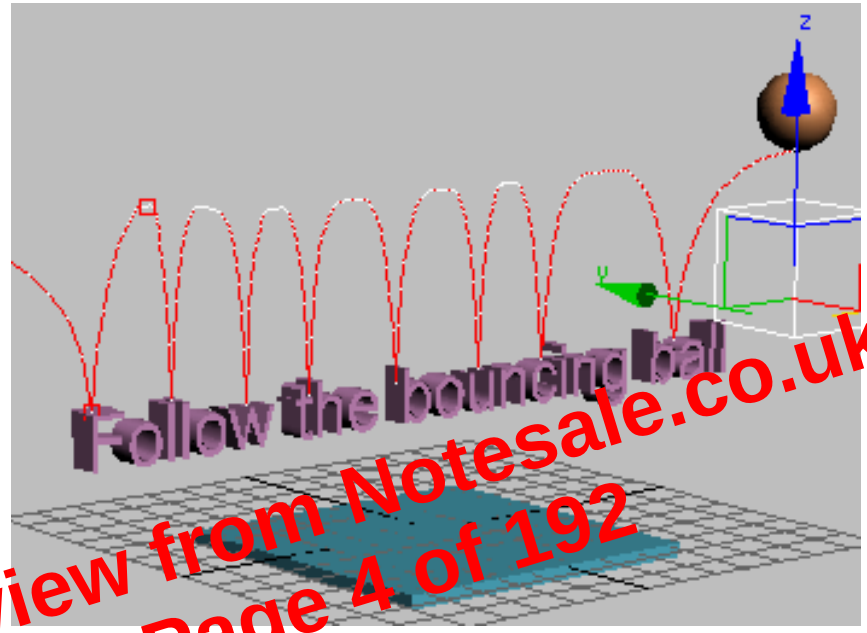
2010



Autodesk®

# Animating with Auto Key: Bouncing a Ball

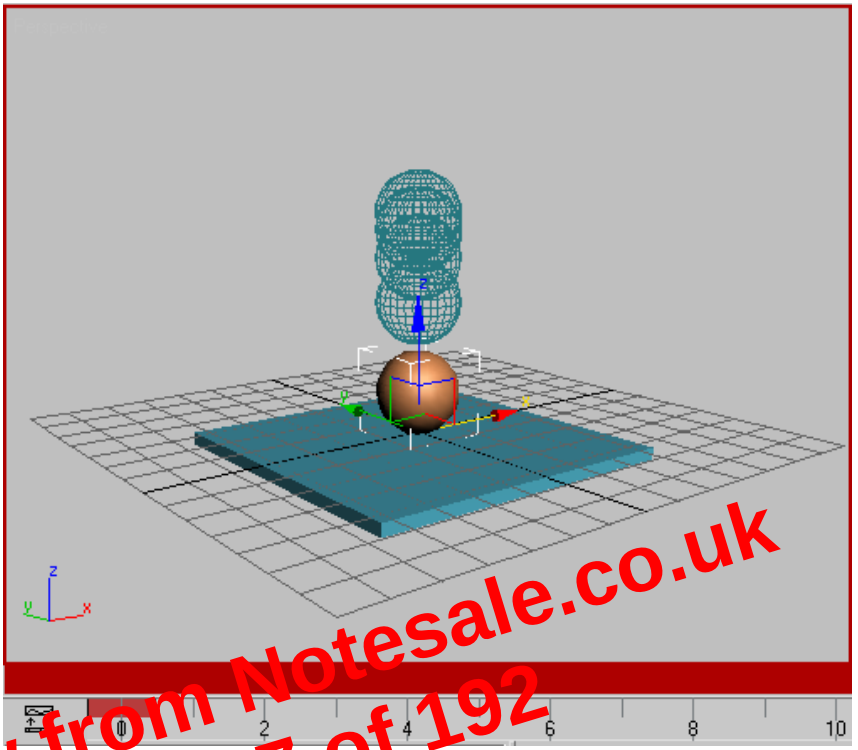
A bouncing ball is a common first project for new animators. This classic example is an excellent tool for explaining basic animation processes in 3ds Max.






In this tutorial, you will learn how to:

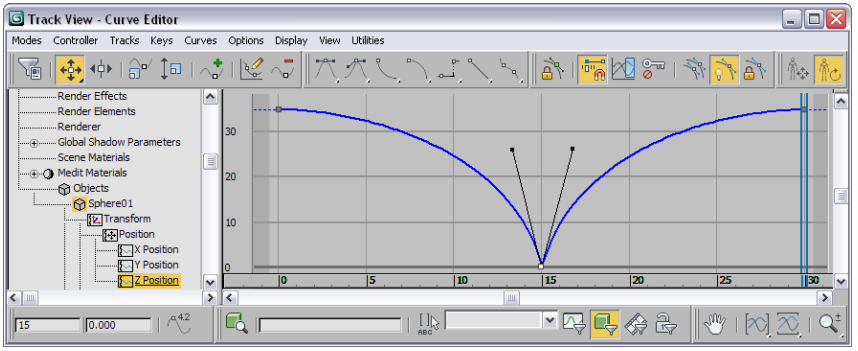
- Create animation using transforms.
- Cop keys in the track bar.
- Use ghosting to visualize in-betweens.
- Use tangent handles in the Function Curve Editor to control in-betweens.
- Create looping animation using Parameter Out-of-Range Types.
- Animate using dummy objects.
- Use Layout mode.
- Apply Multiplier curves.
- Work with the Dope Sheet Editor to speed up animation and reverse time.




Interactive update and shooting



3 Move the time slider to frame 30, then adjust the right tangency handle so it approximately matches the left one.



By manipulating this handle you can get different effects. The upward movement of the ball as it bounces off the table will determine the perception of the weight of the ball. The ball will appear to be bouncy, like a tennis ball, if the two handles are similar. The ball will appear to hang in space if enough of the in-betweens are drawn close to the topmost position.

4  Turn off Views > Show Ghosting and then play the animation. Concentrate on the movement of the ball. Adjust the curve handles some more while the animation plays. Observe the effect.

The ball leaves the table as quickly as it hit it, then begins to slow down as it rises.

5 Play the animation, and then stop.

The ball has bounce now. It looks like there is gravity at work here.

When you see something you like in the viewport, it's a reminder that you should save your work. It's easy to forget while you're being creative.

6 Save your work as **mybounce.max**.

You've made the ball bounce once. In the next section, you'll learn to repeat the bouncing of the ball using Out-of-Range types in Track View.



## Adding Parameter Curve Out-of-Range Types

You can repeat a series of keys over and over in a variety of ways, without having to make copies of them and position them along the time line. In this lesson, you'll add Parameter Curve Out-Of-Range Types to the ball's position keys. Out-Of-Range Types let you choose how you want the animation to repeat beyond the range of the current keys. They have the advantage that when you change one set of keys, the changes are reflected throughout the animation

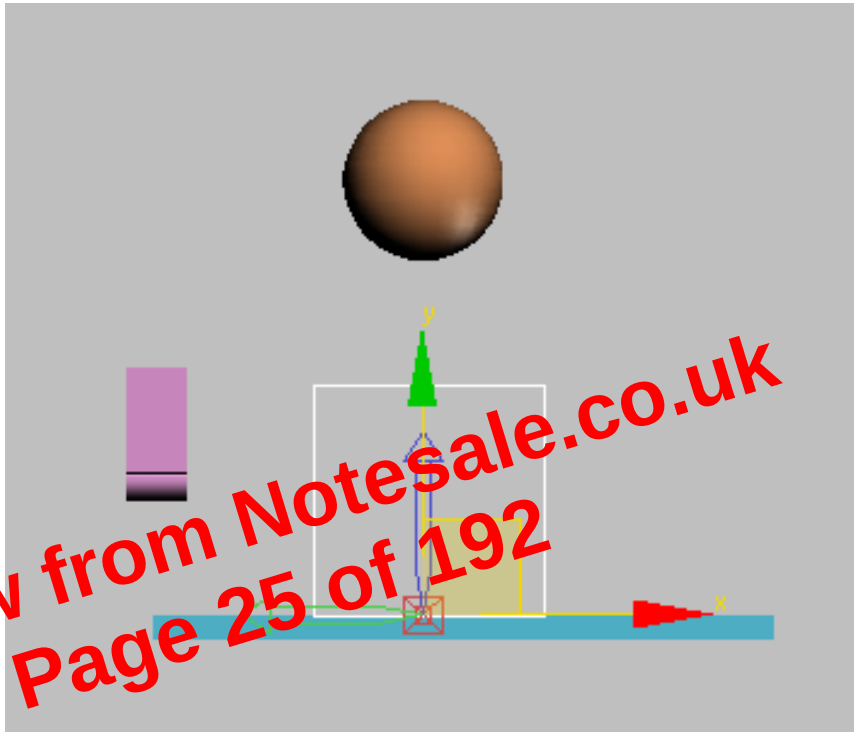
Most of the tools in Track View are available both from menu choices and from toolbars. This feature is also on the Controllers menu.

**Repeat keyframed motion:**

1 Continue from the previous lesson, or open *bounce_repeat.max*. This is a 3ds Max scene with the ball bouncing once.

You don't want to move in any other axis, since the dummy is already centered properly in the other axes.

**TIP** You can increase the size of the transform gizmo by pressing the = key repeatedly until the gizmo is the size you want.




**= key used to grow the transform gizmo**



**11** Turn off Affect Object Only.

Now you will link the ball to the dummy. The dummy will become the parent to the bouncing ball.

**Link the ball to the dummy:**

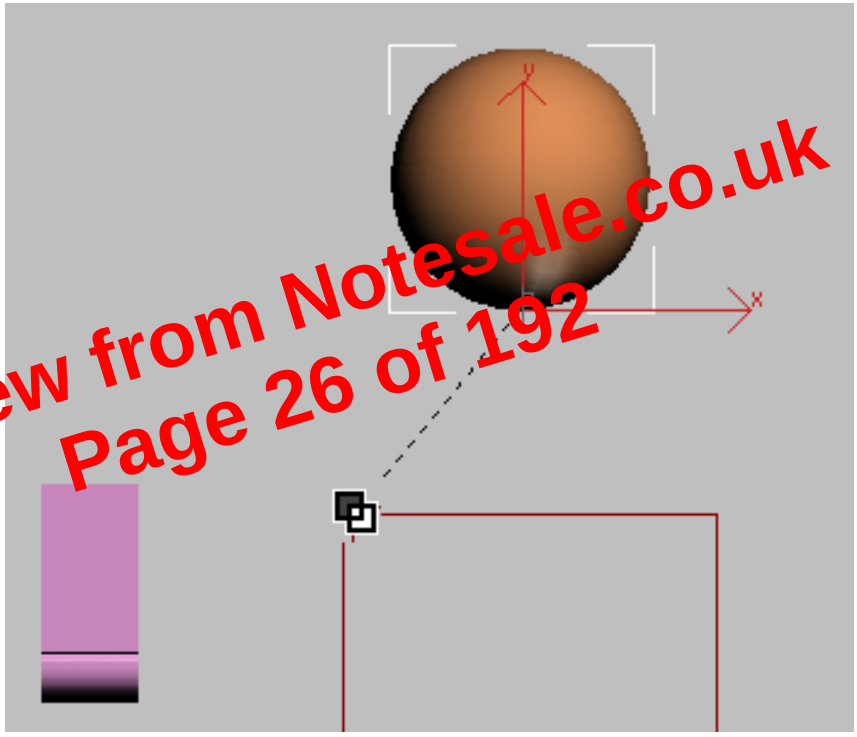
**1** In the Front viewport, zoom in so you can see the dummy and the ball.

2  On the main toolbar, turn on Select And Link.

3 Move the cursor over the ball, then press and hold the mouse button.

The cursor changes to two interlinked boxes.

4 Move the mouse to the dummy. A rubber-band line follows the cursor. When the cursor passes over the dummy, it changes again. One box is white, showing you this object (the dummy) will be the parent of the first object (the ball). When the cursor has changed, release the mouse button.



**Link the ball to the dummy**

You just linked the ball to the dummy.

You can also create linkages in Schematic View. For something this simple, it's easier to link directly in the viewport.

5 Move the time slider, then the dummy so the ball bounces on the following letters at these frames.

- **F** at frame 15
- **ll** at frame 45
- **w** at frame 75
- **th** at frame 105
- **b** at frame 135
- **u** at frame 165
- **c** at frame 195
- **ba** at frame 225



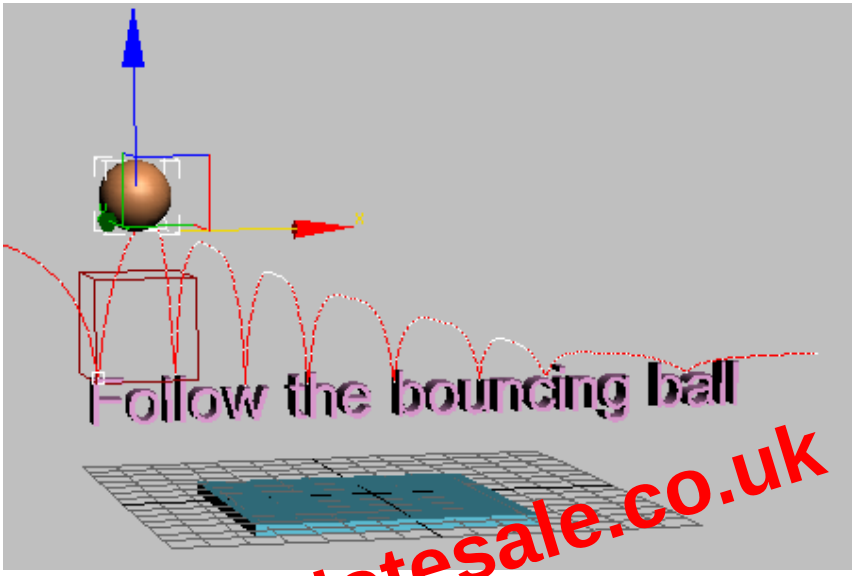

6 At frame 240, move the dummy so the ball move away from the letters.

7 Play the animation and observe the results.

8 Save your work as **mybounce_text.max**. If you had any trouble, you can open the file *bounce_text.max* to see the correct animation so far.

Next you will learn to use a multiplier curve to affect the height of the bouncing ball.

Don't move it below the horizontal zero value, or you will get some strange effects.

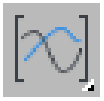



**Multiplier curve shown on trajectory**



**TIP** You can type in precision values on the Key Stats: Track View toolbar.

While working with Multiplier curves, if you're not sure you like the result, you can just turn them off. Select the Multiplier curve in the Controller window, then on the Curves menu choose On/Off.

7  Click Zoom Horizontal Extents on in the Navigation toolbar to see the entire curve again.

## Using the Dope Sheet Editor

Track View also has a mode called Dope Sheet, which lets you work with keys and ranges. In this lesson, you'll use the range function to make your animation go faster. You'll also use the Time tools to reverse your animation.

**Speed up the animation:**

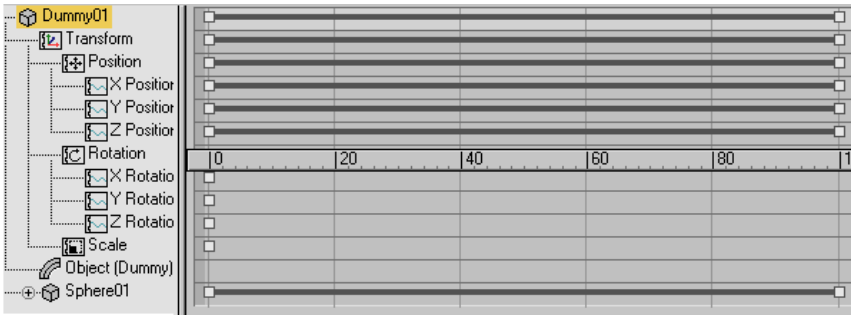
The bouncing ball doesn't have enough pep. To speed up the animation, you'll use Edit Ranges in Dope Sheet mode.

1. Continue from before or open *bounce_multiplied.max*.
2. Select the dummy object in the viewport. Then, on the Graph Editors menu, choose Track View — Dope Sheet.
3.  On the Keys: Dope Sheet toolbar, click Edit Ranges. By default, the Keys: Dope Sheet toolbar is on the top left.

   The Keys window now displays the ranges for the animation.
4. In the Controller window, highlight the item label *Dummy01*. This way you will adjust the ranges of all the dummy's tracks at the same time.

   Before making changes to the dummy, you want to make sure that you also are making changes to the bouncing ball as well. Since the bouncing ball is the child of the dummy, you'll use the Modify Child Keys button.
5.  On the Display Dope Sheet toolbar, click Modify Child Keys to turn it on.

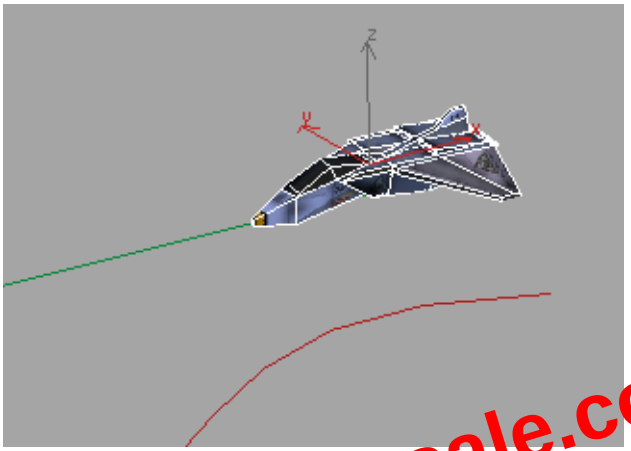
   Now the changes you make to the dummy range will also be applied to the bouncing ball.
6. Click the end of the Dummy range and drag it to the left to around frame 100.




**Range bars used to speed up the animation**

**Fly the spacefighter along blended paths:**

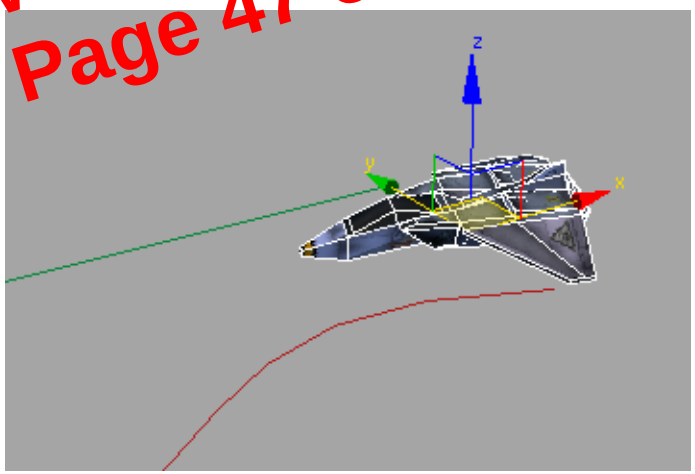
1  Select *SpaceFighter* and open the Motion panel.




The spacefighter is already constrained to *Path01*.

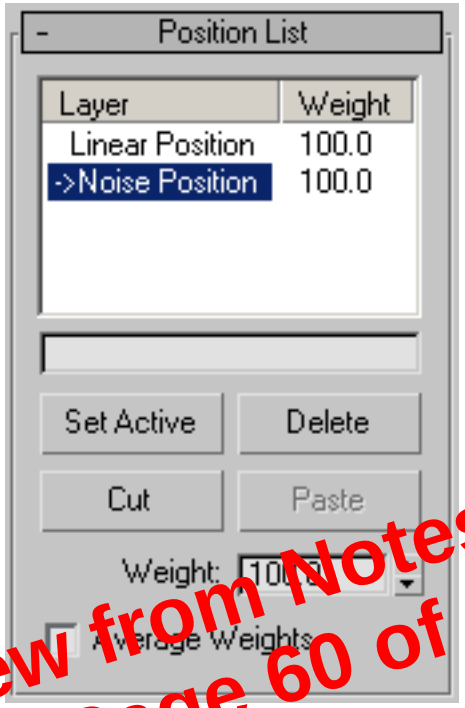
2 On the Path Parameters rollout, click the Add Path button.

3 Select *Path02*, the red path.




The spacefighter is now positioned halfway between the two paths. This is because each path is influencing the spacefighter equally.

Doing this automatically adds a List Controller to the *Wingman01*. The Position List contains the original Linear Position and the new Noise Position controller with default Weight settings of 100.0 percent.






4 Play the animation and note the erratic flying of *Wingman01*.

5 Stop the playback and change the Weight of the Noise Position controller to **25.0** percent.

Now the flight path of the *Wingman01* spacefighter is affected by slight battle damage.

6 Save the scene as **MyFlight04.max**.

### A Wingman Is Called Away

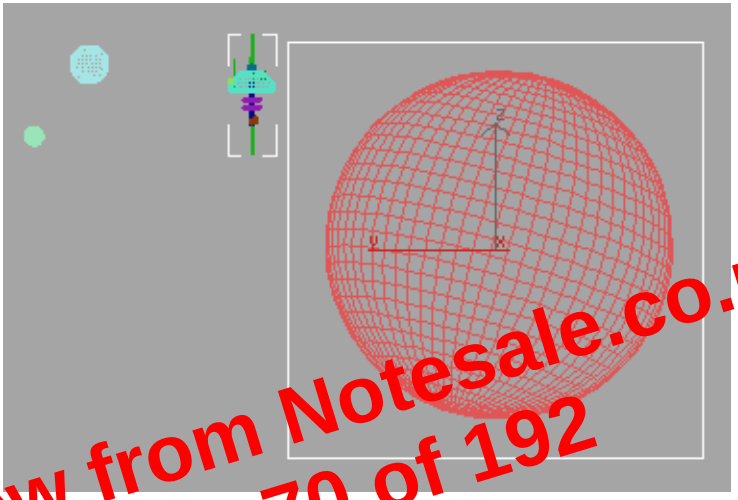
Now it looks like *Wingman02* has received a transmission and is being ordered to peel off and fly somewhere else. You'll revisit the Link Constraint to make *Wingman02* follow the *FlightLeader* for a little while then take off on another path. Continue from the last lesson, or open *flyingspacefighter07.max*.

**Rotate Mars and its moons:**

The first part of this lesson focuses on the three heavenly bodies you see in the scene. You will set up a dummy object to control the rotation of Mars and its moons, Deimos and Phobos.

1 In the Left viewport, create a Dummy object around Mars. Name the dummy object **MarsControl**.

Make the dummy a little larger than the planet so it's easier to pick.





2 With the dummy object still selected, choose Tools menu > Align > Align, and click Mars.

3 In the Align Selection (Mars) dialog, do the following:

- Turn on X, Y and Z Position in the Align Position (Screen) group.
- Turn on X, Y and Z Axis in the Align Orientation (Local) group.
- Click OK to accept the settings.

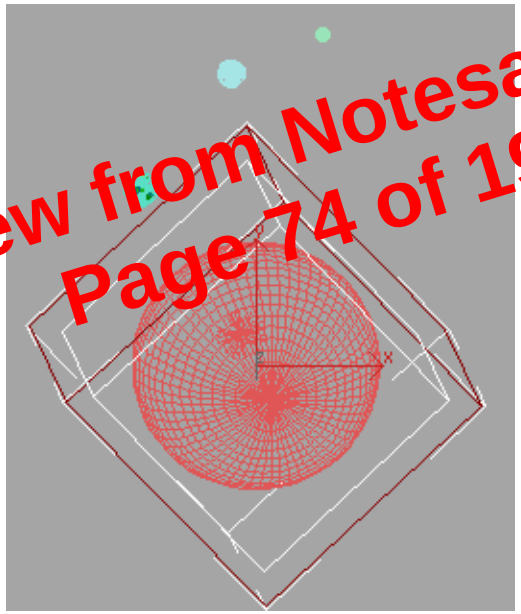
2  Open the Assign Controller rollout on the Motion panel, and select Rotation : Euler XYZ.

3  Click the Assign Controller button, and choose TCB Rotation. Click OK.

4 While *StationControl* is still selected, choose Tools menu > Align > Align, and click *Mars*.

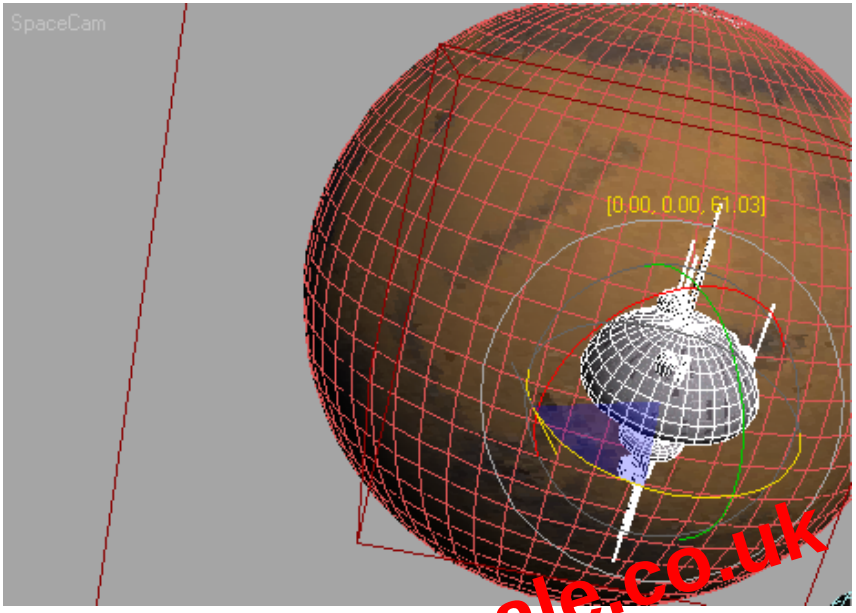
5 In the Align Selection (Mars) dialog, do the following:

- Turn on X, Y and Z Position in the Align Position (Screen) group.
- Turn on X, Y and Z Axis in the Align Orientation (Local) group.
- Click OK to accept the settings.





These are the same settings you made when aligning *MarsControl* to Mars in the previous section.






7 Turn off Auto Key.

8 Play the animation.

Now the Space Station rotates about its own axis while it's in geosynchronous orbit around Mars. Maximize the SpaceCam viewport for a better view.

9 Save your work as **MySpaceStation02**.

### Summary

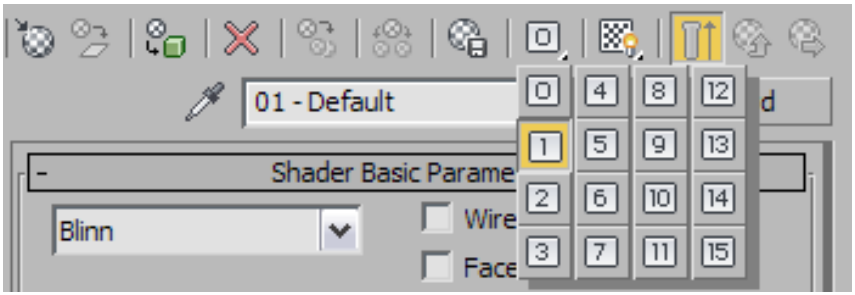
This tutorial gave you a general introduction to using controllers and constraints to create and manage animation.

## Creating Explosions

In this tutorial, you'll hit an asteroid with a glowing laser blast, blowing the asteroid to bits and creating a fiery explosion.

**Set up an effects channel:**

1  On the Material Editor toolbar, click the Material ID Channel flyout, and choose channel 1.




Later in this tutorial, you'll use the channel number to create a glow.

2 Close the Material Editor.



## Animating the Asteroid

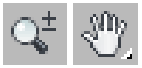
Now you'll animate the asteroid so it tumbles before it's hit by the laserblast.

**Animate the asteroid:**

1  Turn on Auto Key, if it is not already on.

2 Activate the Camera viewport and move the time slider to frame 0.

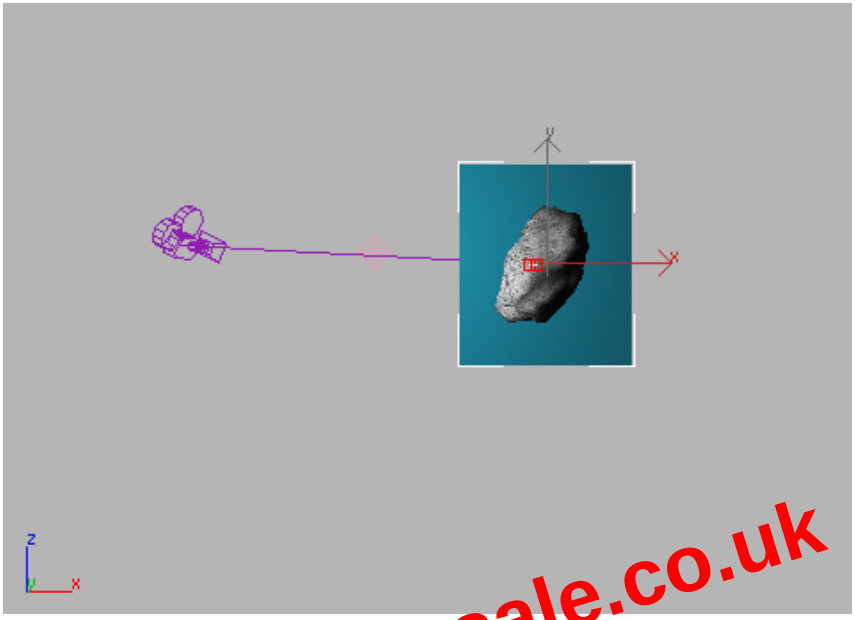
3  Select And Move the asteroid down in the Z axis approximately **–135** units, or until it is positioned just inside the camera's view.

3  Use Zoom and Pan to navigate the viewport so the asteroid is in or near the center of the view.



4  Go to the Create panel > Geometry > Standard Primitives category. On the Object Type rollout, click Plane.

5 In the Front viewport, drag a plane over the asteroid.



**TIP** You can turn off snaps by pressing the S key. This is handy for toggling the snaps settings when you are in the process of creating or moving an object.

6 In the Name And Color rollout, change the name to **Explosion Plane01**.

7 In the Parameters rollout, set the Length and Width of the plane to **300.0**. Set the Length and Width Segs (segments) to **1**.

The size and complexity of the Plane update in the viewport.

8 Press Alt+W to return to four viewports.

9  Turn on Select And Move. Press H and select the *ExplosionPlane01* object from the list, then activate the Top viewport.

10 Move the plane along its Y axis so it's behind the asteroid.

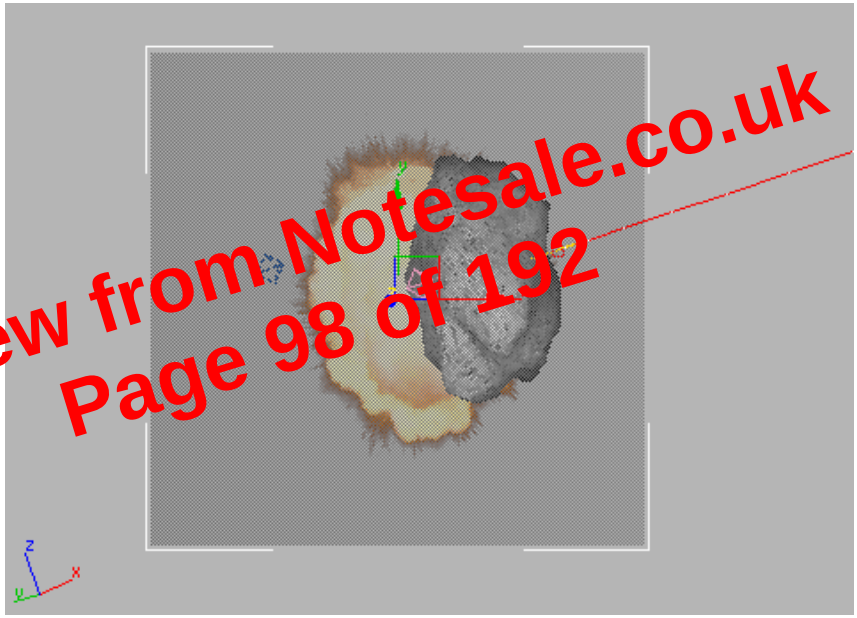
5 A Clone Options dialog is displayed. The program has automatically named the new plane *Explosion Plane02*. Leave the settings at their default, and click OK.

**NOTE** The copy of the plane is now selected, and the Selection Lock Toggle automatically turns off.

**Set properties of the new plane, and make a named selection set:**

1 Right-click the new plane and choose Object Properties. In the Display Properties group turn on See-Through. Click OK.

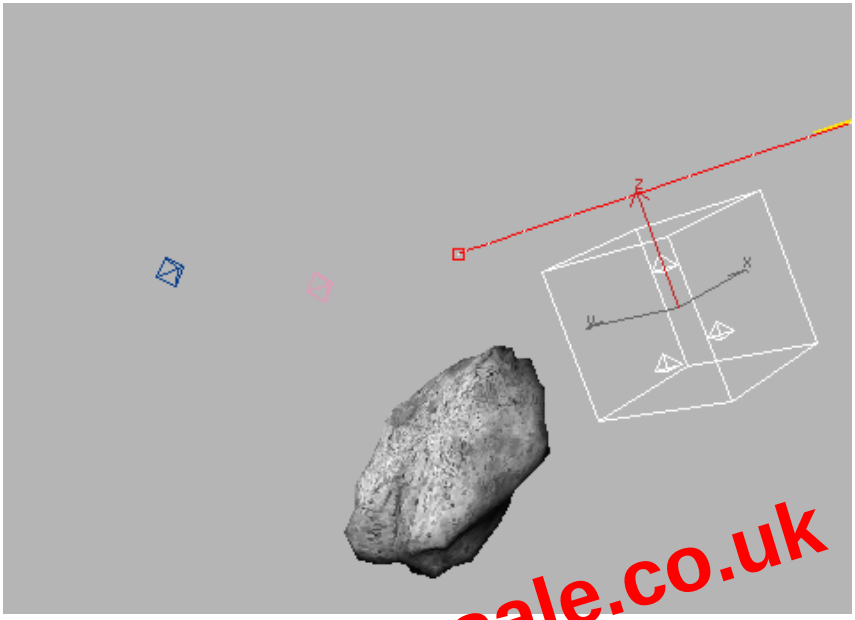
The cloned explosion plane now lets you see through it in the viewport. This doesn't affect the rendering.



**See-through plane in camera viewport**



2 Select the two plane objects. In the Named Selection Sets field on the toolbar, type the name **Explosions** and press Enter.



**Perspective viewport view of the PArray gizmo**



4 In the Basic Parameters rollout, click Pick Object, and then click the asteroid in a viewport.

The name of the asteroid, in this case *Sphere01*, is displayed below the Pick Object button to show that the particle system has been linked to the asteroid.

**Expand the command panel and adjust the PArray settings:**

Next, you'll expand the command panel so you can see more of the particle system rollouts.

1 Move the cursor to the left edge of the command panel.

The cursor changes to a double arrow.

2 Click and drag the edge of the panel to the left.

A second column of the command panel appears.

3 Click the Particle Type rollout to open it.

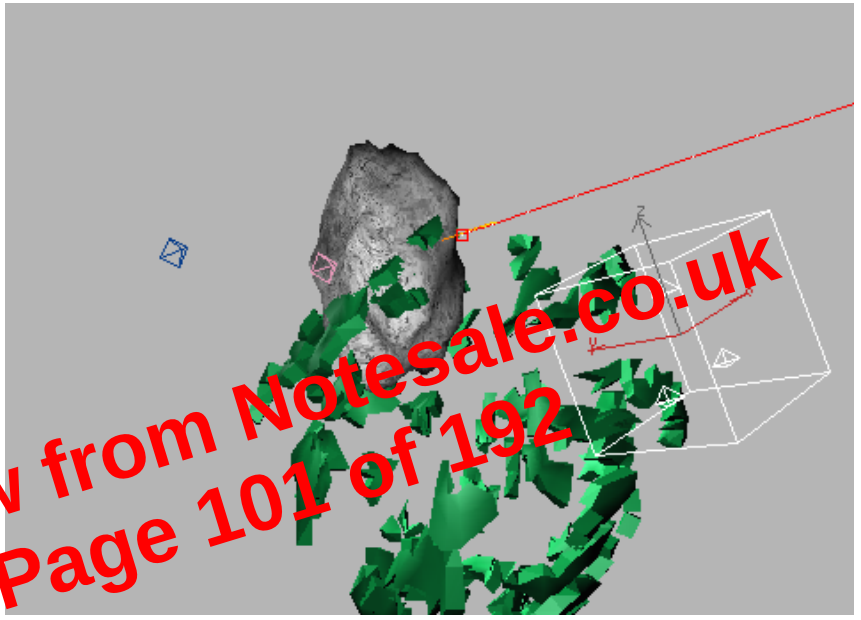
The Particle Type rollout is now displayed in the second column.

4 In the Particle Type rollout > Particle Types group, choose Object Fragments.

5 In the Object Fragment Controls group, set Thickness to **11.0**.

6 Choose Number Of Chunks and set Minimum to **75**.

7 In the Basic Parameters rollout > Viewport Display group, choose Mesh. Move the time slider to see asteroid chunks appear in the viewport.



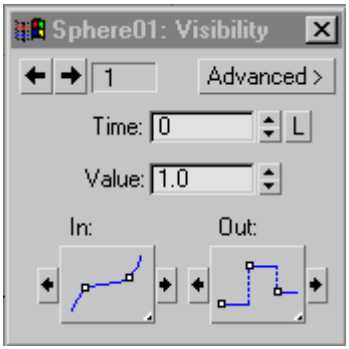


## Adding Materials to the Particles

**Add materials:**

1 In the Particle Type rollout > Mat'l Mapping and Source group, choose Picked Emitter.

2 Click the Get Material From button.




This will make the object visible until the next key.

4 Drag the time slider and observe the animation in the viewport.
The asteroid disappears and the fragments fly outward.

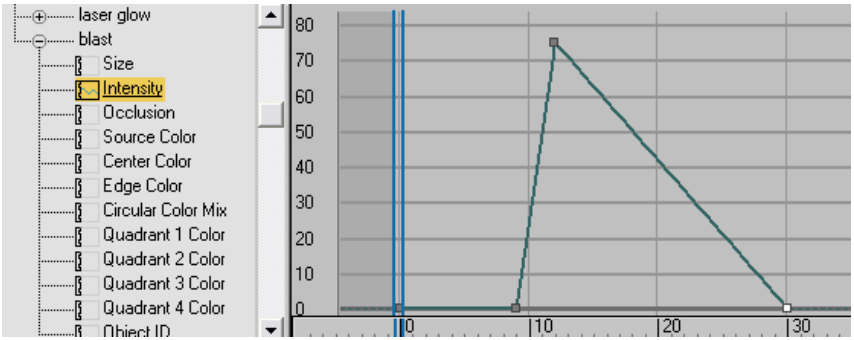


5 Close the Visibility dialog by clicking the X button in its title bar.

**Render a frame to preview the explosion effect:**

1 Right-click the camera viewport and choose Unhide All.

16 You can see the shape of the intensity curve you just created by choosing Modes > Curve Editor. (You might have to expand tracks and scroll to find the blast > Intensity track once again.)




**Animated intensity displayed in the Curve Editor**

When the explosion begins, the Intensity rapidly rises to 75.0, then more slowly fades until at frame 30 it is zero once again.



## Adding Streaks with Radial Blur

You can get a nice streaking effect using the Blur render effect. Adding a blur is just like adding a lens effect.

**Add a blur effect:**

1 In the *Camera01* viewport, select the PArray gizmo, right-click it, and choose Object Properties from the quad menu.

2 In the G-Buffer group, use the spinner to set the Object ID to **2**. Click OK.

3 Choose Rendering menu > Effects.

4 Click the Add button, choose Blur, and click OK.

**Set up the blur effect:**

1 In the Blur Parameters rollout > Blur Type panel, choose Radial.

2 On the Pixel Selections panel, turn off Whole Image, and turn on Object ID.



In this tutorial, you will learn how to:

- Use List controllers to manage animated components of a model
- Define controller behavior through the use of expressions
- Use the MAXScript recorder to automate the assignment of List controllers
- Create a toolbar to hold custom tools
- Use wiring and expressions to rig objects for animation

Skill level: Advanced

Time to complete: 1+ hours

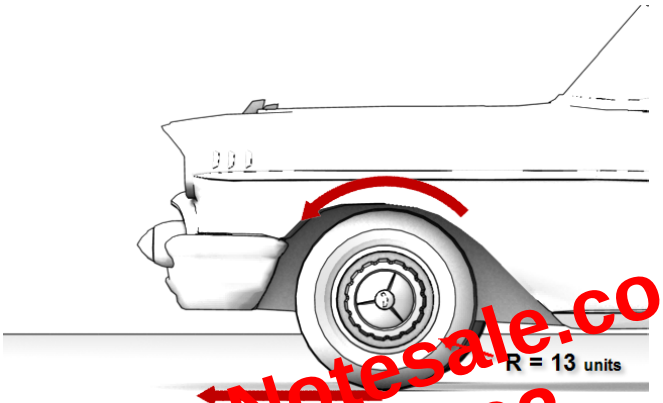
## Using List Controllers

A controller in 3ds Max is a plug-in that manages the values involved in keyframe animation, such as changes in object scaling, color, or translation. List controllers combine two or more controllers and can be very useful when combining relationships between objects.

In the next lesson, you will learn how to animate the rotation of the car wheels.

## Rotating the Wheels

In this lesson, you will learn how to rotate the wheels by an amount that corresponds to the distance travelled by the car model.






Let's start by taking a look at the trigonometry involved in calculating the wheel rotation.

In any circular object, the amount of rotation (α) is defined by the radius of the circle and the arc length encompassed by the angle. That amount of rotation (α) expressed in radians is equal to the arc length, divided by the radius of the circle (arc length / R), where:

- the **radius** of the car wheel is constant and equal in this case to 13 units.
- the **arc length**, when flattened, represents the distance travelled by the car and its wheels.

**Add subcontrollers for Y rotation:**

In the previous procedure, you learned how to add controllers that determine car wheel rotation for the length of distance travelled by the model along the World X axis. However, if you tried to rotate the car in any way, wheel rotation would be reduced or stop altogether. You therefore need to add controllers that account for the car's displacement in a Y direction.

1. In the Top viewport, select the car body object and rotate it 90 degrees clockwise so that its front bumper points at 12 o'clock.

   The car is now oriented on the World Y axis, so you will begin working in this coordinate system.

2. If required, adjust the view in the Perspective viewport until you can see the front left side of the car.

3. Move the car forward and backward on the Y axis. Note that the wheels do not rotate.

   To get the wheels rotating, you will need additional animation controllers, ones that will control the car's displacement in the Y direction. You will add these as sub-controllers, so you do not overwrite the controllers already in place.

4. Go to the bottom-left corner of the interface, right-click the MAXScript area and click Open Listener Window.

5. On the MacroRecorder panel, highlight the line that reads:

   **$.rotation.controller.Available.controller = Euler_XYZ ()**

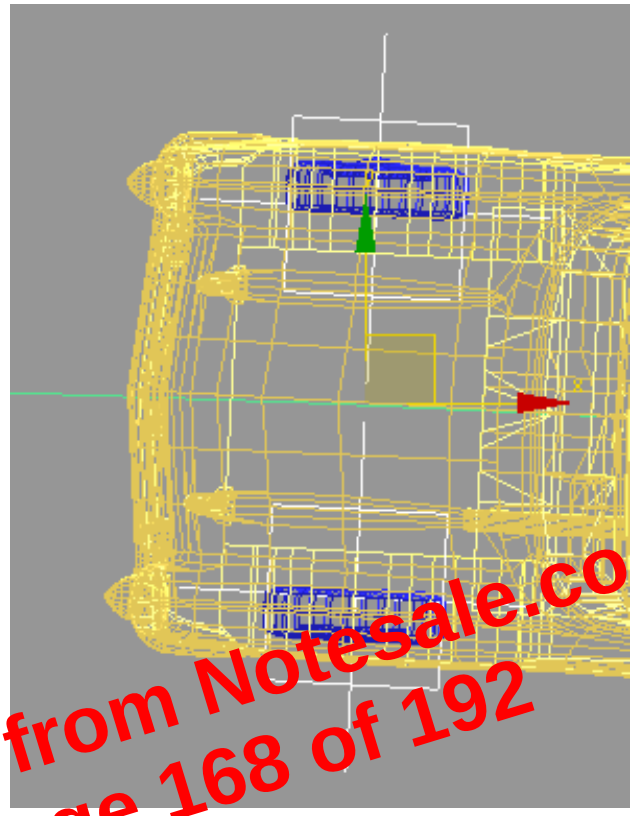
   Be sure to include the line's carriage return when you make your selection.

6. Press Ctrl+C to copy this line to memory. If you are not continuing from the previous lesson, this line will not be available from the Open Listener window. If this is the case, copy the line from this .pdf document.

7. Close the MAXScript Listener window, then select the front left wheel (*Wheel-FL*).

8. On the bottom-left corner of the interface, click inside the white entry box, press Ctrl+V to paste the line of code, then press Enter.

9. On the Motion panel > PRS Parameters rollout, make sure that the Rotation button is active verify that a new sub-controller has been added to the rotation list.



Point helpers aligned to front left and right wheels



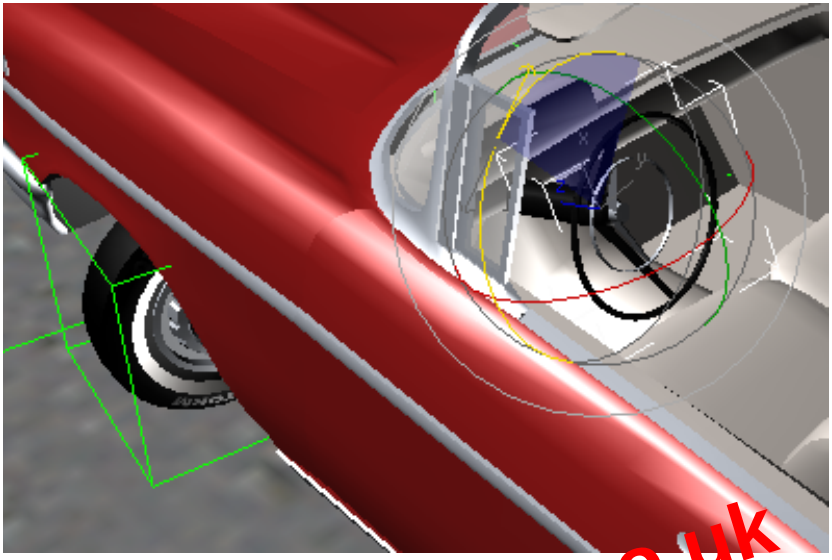
You will now rework the hierarchy and parent/child relationships of the car setup to prepare for the body roll you will rig in the next lesson.

16  On the main toolbar, click Select And Link.

**Link the wheel helpers to the car helper:**

1 Ctrl+select the two wheel helper objects, then drag to the *Dummy_CAR* object.

This links the helpers as children of the *Dummy_CAR* object.



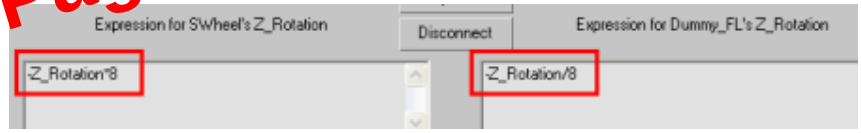
**Steering wheel and front wheel turn in opposite directions**



11 Cancel or undo the rotation you made in the previous step.

12 In the left-hand Expressions panel, under "Expression for SWheel's Z_Rotation", type: **-Z_Rotation*8**.

13 In the right panel, under "Expression for Dummy_FL's Z_Rotation", type: **-Z_Rotation/8**.




The minus (-) operator ensures that the two rotations are aligned, and the *8 and /8 factors ensure that the front left wheel pivots (rotates in Z) eight times less than the rotation of the steering wheel.

14 Click Update and test your work by rotating the steering wheel on its local Z axis again.

Note the more realistic behavior.

15 Repeat steps 4 to 14 to wire the steering wheel and the front right wheel helper.

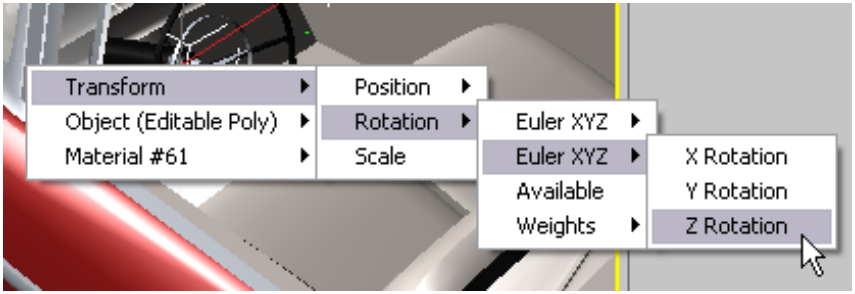

**Steering wheel rotation at -280 degrees about the Z axis**



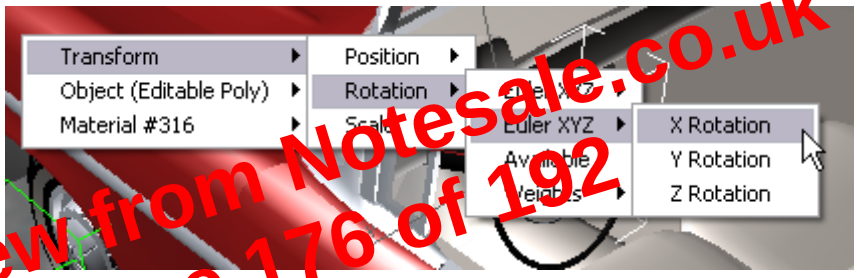
6 Go to frame 115, the point where the car is in the middle of the second turn, and rotate the steering wheel until the Z axis status bar reads 500.

6 Select the steering wheel again, then right-click on it and from the Quad menu, choose Wire Parameters.

7 Choose Transform > Rotation > (2nd) Euler XYZ > Z Rotation.




8 Select the car body and choose Transform > Rotation > (2nd) Euler XYZ > X Rotation.






9 On the Parameter Wiring dialog, set the control direction to the right so the steering wheel rotation in Z controls the body roll in X.

10 On the right-hand Expressions panel, complete the expression so it reads: **Z_Rotation/40**, then click Connect.

---

**NOTE** The /40 factor in the expression divides the steering wheel rotation by 40 to ensure body roll rotation is significantly smaller than the rotation of the steering wheel. If you like, try experimenting with other values.

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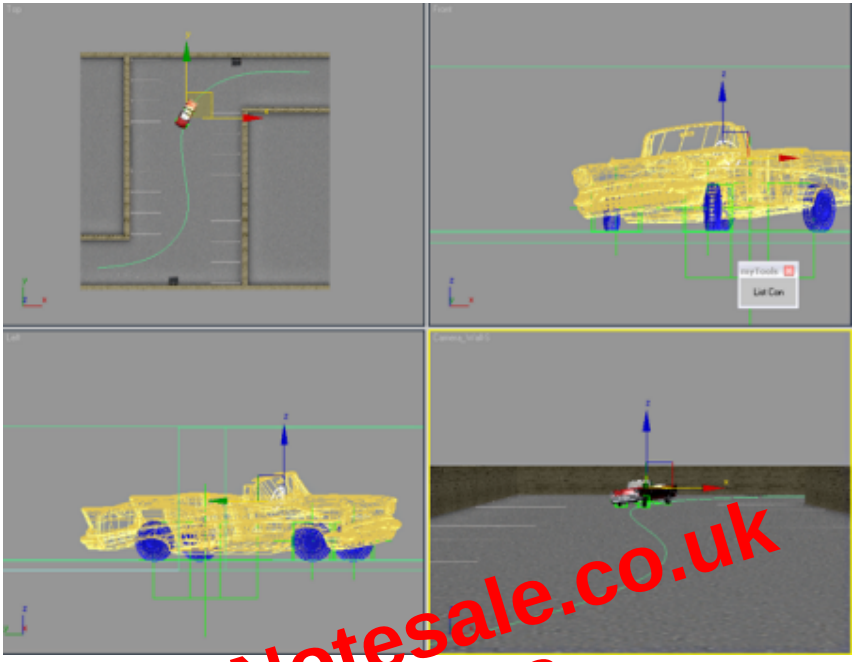
11 Click the Camera viewport label and choose Camera > Camera_Wall_S then scrub the animation to see the effect of the body roll.



**Body roll visible in Front, Left and Camera viewports.**



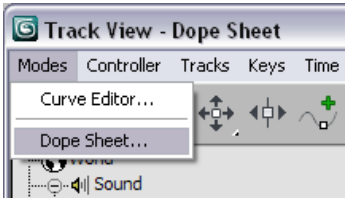
12. Save your file as **mycar_rig_06.max**.

## Adjust Driver Viewpoint

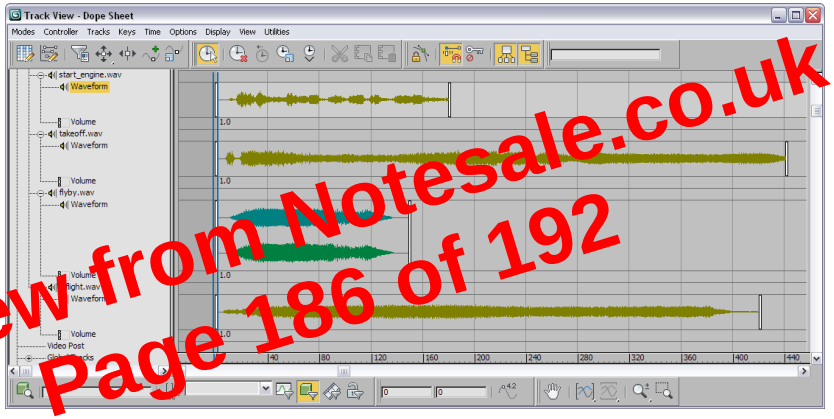
As a driver, when you use a steering wheel to initiate a turn, your eyes tend to follow the direction of the turn. When you turn left, you look left: when you turn right, you look right. In this lesson, your final task is to make the viewpoint of the driver react to the rotation of the steering wheel.

In this tutorial, it would be helpful to view all the waveforms together, so you can better adjust the timing of their audio segments. You can view multiple waveforms from the Dope Sheet.

3 On the Curve Editor menu, choose Modes > Dope Sheet.




4 Collapse the master track to view just the waveforms and volume components of the four individual sound tracks.

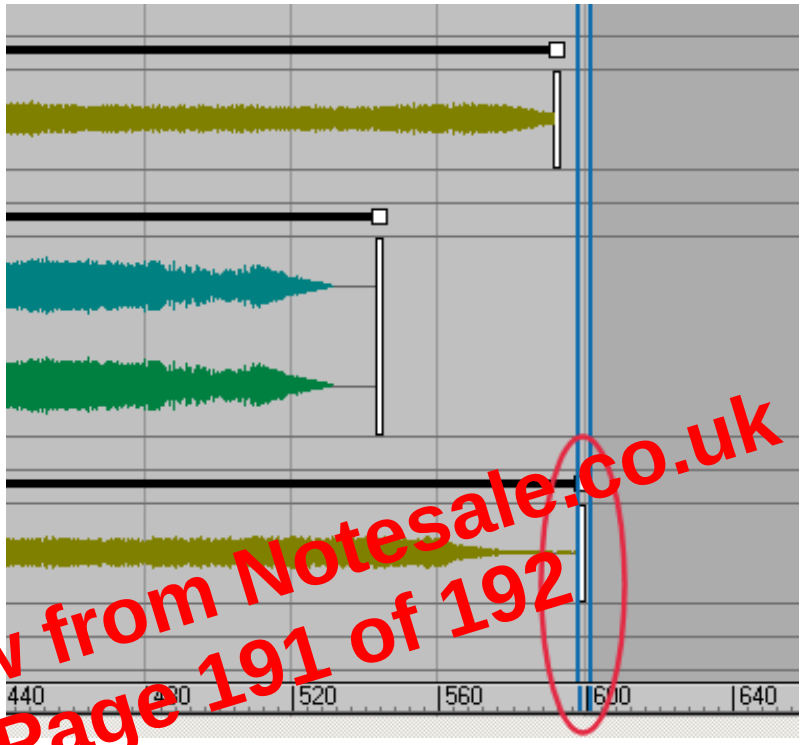





The first, second, and fourth sound tracks were recorded in mono and show a single waveform. The third sound track, *flyby.wav*, was recorded in stereo and displays two waveforms, one for its left and another for its right channel.

5 Play the animation forward to hear the sound files.

14 On the Dope Sheet, reposition the *inflight.wav* range bar so that the waveform fades out at the end of the animation, as shown in the next illustration.






15 Replay the animation to hear how all the audio segments fit together.

By default, the audio plays forward as you play the animation forward; there is no audio when you scrub animation in reverse.

16 To hear the audio in reverse when scrubbing, highlight, then right-click the Sound track in the Curve Editor or Dope Sheet and from the quad menu choose Properties. In the ProSound dialog > Playback controls, turn on Permit Backwards Scrubbing.