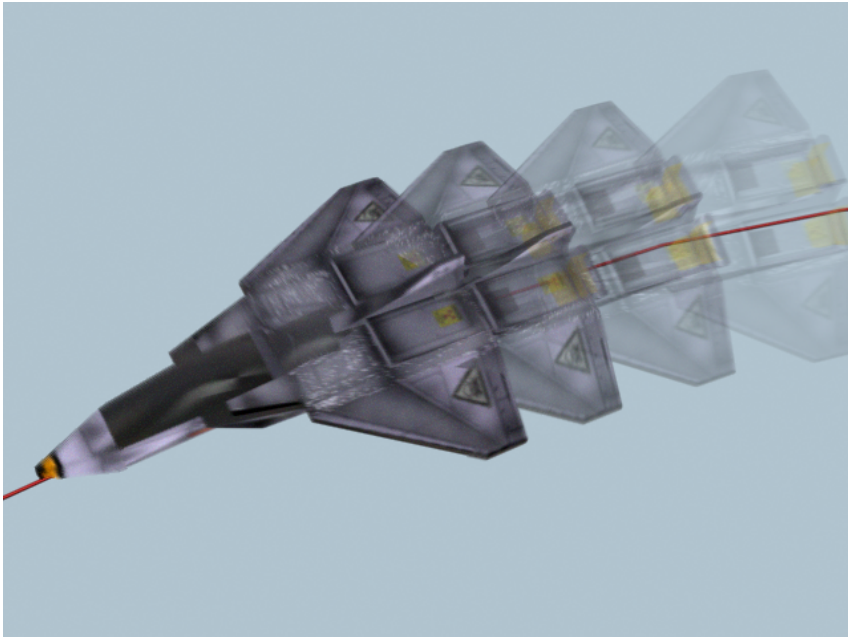


Flying a Spacefighter



In this tutorial, you'll animate a spacefighter to make it fly along a simple path by using the path constraint. You'll also be shown how to blend paths.

In this tutorial, you will learn how to:

- Animate with Path constraints.
- Use dummy objects for animation.
- Use weighted list controllers to add turbulence.
- Set keys using the Set Keys button.
- Control Euler controller rotations.
- Substitute high-resolution objects for low-resolution objects by using XRefs.


Skill level: Beginner to Intermediate

Time to complete: 1 hour

Adding and Adjusting Flight Paths

In this first exercise, you'll assign a path constraint to the spacefighter and have it fly along a path. You'll also set a few path parameters to improve the flight dynamics of the spacefighter.

Set up the lesson:

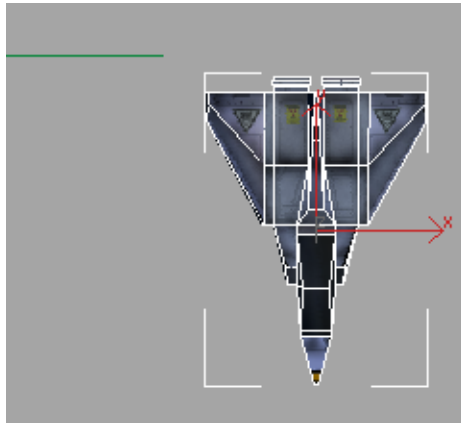
-  On the Quick Access toolbar, click the Open File button, navigate to the *animation\spacefighter* folder, and open *flyingspacefighter.max*.

This scene includes the following:

- A spaceship named *SpaceFighter*.
- A path, *Path01*.
- A (hidden) camera named *SpaceCam*.

Assign a path constraint:

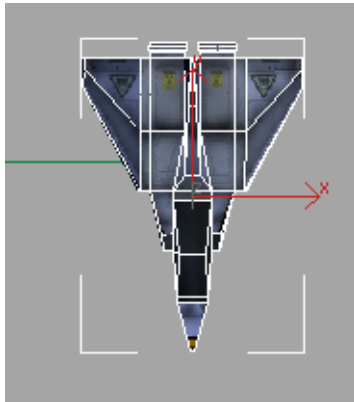
- 1 In the Top viewport, select the *SpaceFighter* object.



- 2 Open the Animation menu and choose Constraints > Path Constraint. A dotted line now links the spacefighter and the mouse cursor.
- 3 Click the green line, *Path01*.

Once you pick the path, the spacefighter jumps to the start point of the path.

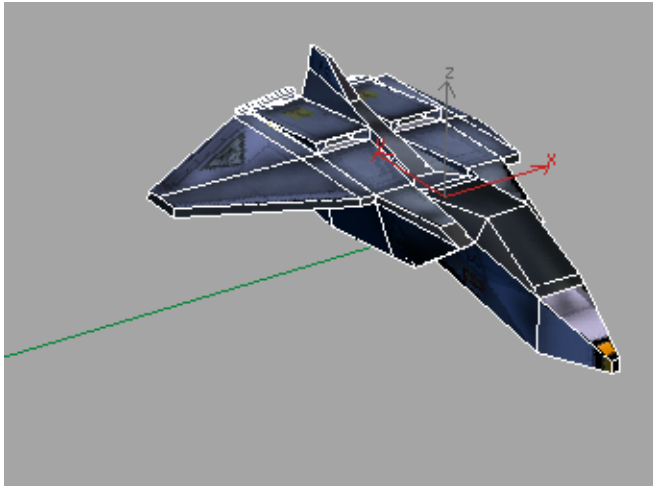
(Any spline can become an animation path.)



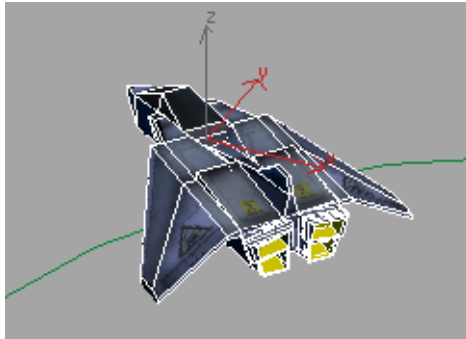
Also, the command panel automatically switches to the Motion panel.



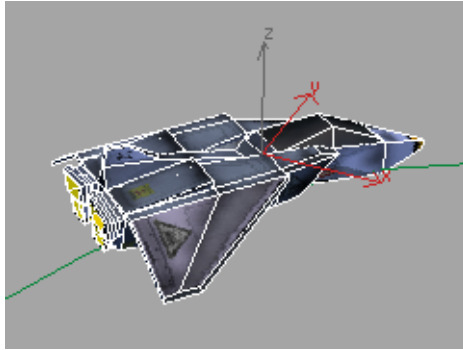
- 4 From the Motion panel, slide the rollouts up until you can see all of the Path Parameters rollout, if necessary. You'll see that *Path01* has been added to the path list.
- 5 Activate the SpaceCam viewport and play the animation. The spacefighter moves along the path, but it doesn't point in the correct direction.



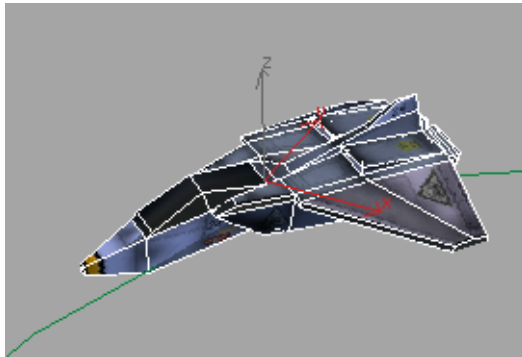
- 6 In the Path Options group of the Path Parameters rollout, set the following:
- Turn on Follow: the spacefighter follows the path and turns as the path curves, but it's perpendicular to the motion path.



- In the Axis group, change the axis to Y: the spacefighter is reoriented and faces along the path, but it's flying backwards.



- Turn on Flip: the spacefighter now faces the direction it moves along the path.



NOTE You can change settings while the animation is playing.

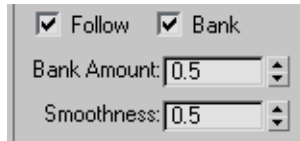
- 7 Play the animation again.
Now the spacefighter is moving along the path properly, but its flight dynamics don't look realistic.

Improving the Flight Characteristics

In this section, you'll improve the flight characteristics of the spacefighter. You'll make it move more realistically as it enters and exits turns.

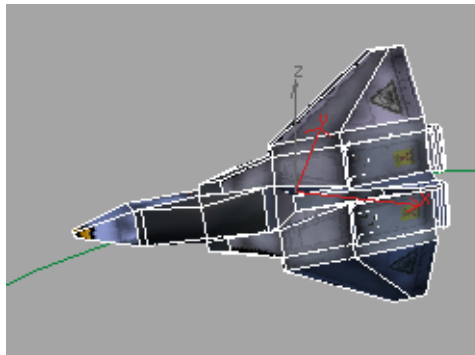
Make the flight more realistic:

- 1 Turn on Bank and play the animation again, if it isn't still playing.



The spacefighter now banks as it goes through the turns. However, the motion is subtle; it needs to be more pronounced. You'll use the Bank Amount and Smoothness settings to make the spacefighter look as though it's banking sharply into the curves of the path.

- 2 Set Bank Amount to **7.0**.



Bank Amount controls how far an object rolls to either side of the path it travels along.

If you were sitting in the cockpit, positive values roll the starfighter to the left and negative values roll to the right. Be careful how high you set Bank Amount. If too high, the spacefighter will roll all the way over. Experiment with different settings and put it back to 7.0 before continuing.

- 3 Set Smoothness to **1.0**.

Smoothness controls how rapidly the roll changes as the starfighter moves through bends in the path. Smaller values make the object more responsive to changes in the curve while larger values smooth out jerkiness.

The motion of the spacefighter as it rights itself coming out of the turns is more even. Try increasing and decreasing the Smoothness value to see what happens.

- 4 Save your scene as **MySpaceFighter01.max**.

Animating the Path of the Spacefighter

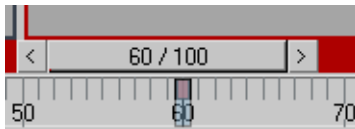
You can animate the Path Parameters settings for more dynamic-looking animation. In this section, you'll add a bit of drama to the action by animating some settings changes.

Animate path parameters:

- 1 Move the time slider to frame 60.



- 2 Turn on Auto Key and set Bank Amount to **6.0**.



You'll see a new key added to the timeline at frame 60.

- 3 Slide the time slider to 75 and set Bank Amount to **12.0**.
- 4 Turn off Auto Key and play the animation.
As the spacefighter enters the second curve, it makes a drastic rolling turn, as if evading a missile or dodging a laser.
- 5 Save your scene as **MySpaceFighter02.max**.


Blending Paths

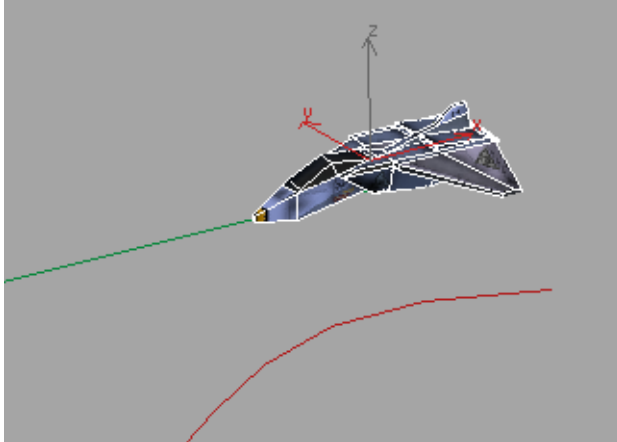
So far, you've worked with a single path. 3ds Max allows you to combine motion along multiple paths, which can result in some interesting effects.

Set up the lesson:

- Open the file *flyingspacefighter02.max*.
Files for this lesson are in the `\scenes\animation\spacefighter` folder.
This scene includes the following:
 - A spaceship named *SpaceFighter*.
 - Two paths, *Path01* (green) and *Path02* (red).
 - A camera (hidden) named *SpaceCam*.

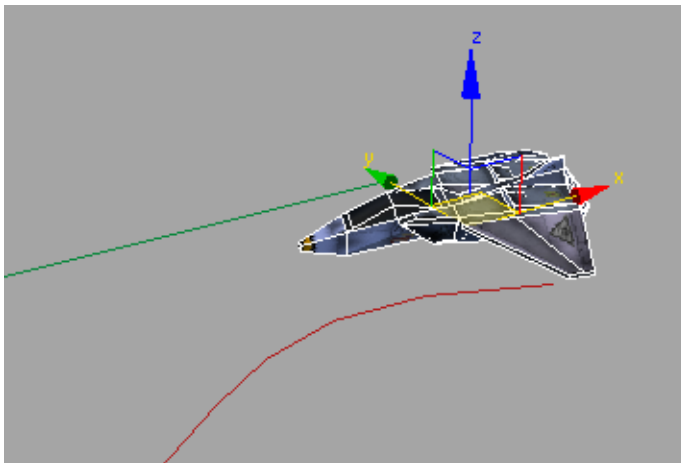
Fly the spacefighter along blended paths:

- 1  Select *SpaceFighter* and open the Motion panel.



The spacefighter is already constrained to *Path01*.

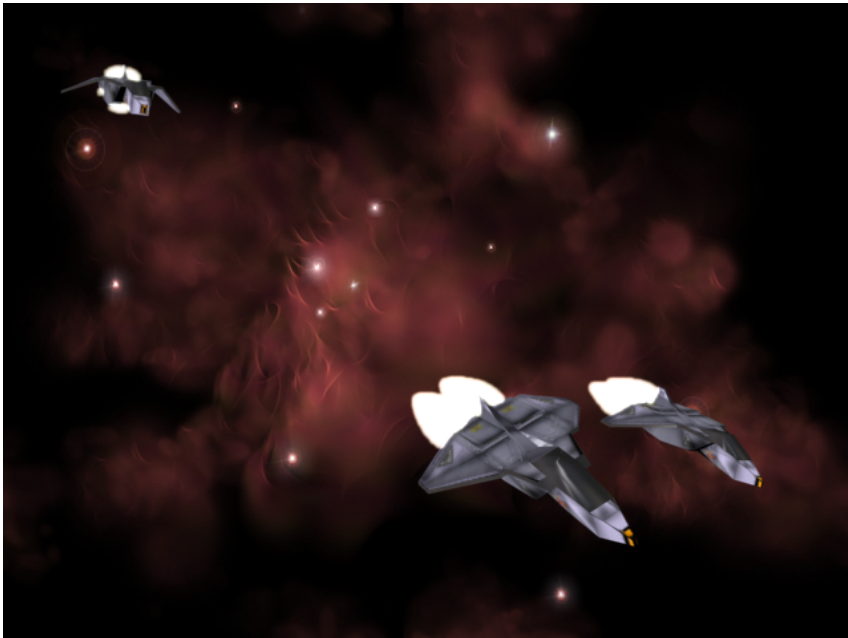
- 2 On the Path Parameters rollout, click the Add Path button.
- 3 Select *Path02*, the red path.



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

- 4 Click the Add Path button again to turn it off.
- 5 Activate the SpaceCam viewport, if it's not already active, and play the animation.
The Weight setting controls how much the spacefighter is affected by each path.
- 6 In the path list on the Path Parameters dialog, highlight the *Path01* entry and set its Weight value (immediately below the list) to **25.0**.
- 7 Play the animation again.
The spacefighter follows *Path02* more closely because it has a greater weight than *Path01*. Experiment with different Weight settings for each path and see what happens.
- 8 Save your scene as **MySpaceFighter03.max**.

Animating the Spacefighter with Constraints and Controllers



In this lesson, you'll use an assortment of constraints and controllers with a flight of spacefighter on a mission.

Set up the lesson:

- Open the file *flyingspacefighter03.max*.
Files for this lesson are in the `\animation\spacefighter` folder.
The scene already contains the following:
 - A flight of three spacefighters, *FlightLeader*, *Wingman01*, and *Wingman02*.
 - A dummy object, *SpaceshipControl*.
 - Two motion paths, *flightpath* (visible) & *wingmanpath* (hidden).
 - A camera (hidden), *SpaceCam*.

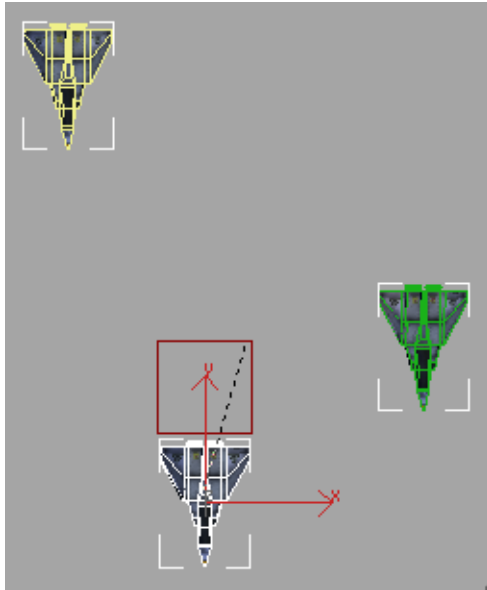
Using a Dummy Object to Control the Flight

Dummy objects are helper objects. You can create them from the Helpers button on the Create panel. They can be useful when setting up an animation. By animating a dummy, you can focus on getting your motion set up using a simple object that doesn't slow down your system. Once the dummy animation is complete you link objects to the dummy. Now wherever the dummy moves, the object goes with it.

Link the spacefighters to the dummy:



- 1 Activate the Top viewport, if it's not already active, and click the Select And Link button from the Main toolbar.
- 2 Select *FlightLeader* and drag the cursor over the dummy, *SpaceshipControl*. Release the mouse button.
FlightLeader is now linked to the *SpaceshipControl*. Wherever you move *SpaceshipControl*, *FlightLeader* will follow.



3 Link both *Wingman01* and *Wingman02* to *SpaceshipControl*.

Add a path constraint to the dummy:



1 In the Top viewport, use Zoom Extents to view the scene.

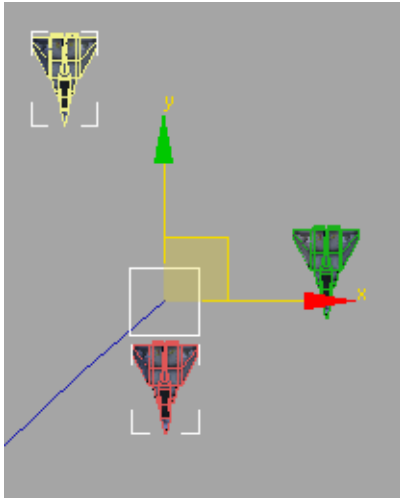


2 Click Select Object to turn it on and turn off Select And Link.

3 Select *SpaceshipControl*.

4 From the Animation menu, choose Constraints > Path Constraint. Drag the cursor and click the *flightpath*.

SpaceshipControl jumps to the beginning of the path. The spacefighters follow along since they're linked to the dummy.



- 5 In the Path Parameters rollout, make the following settings.
 - Turn on Follow, Bank, and Constant Velocity.
 - In the Axis group, turn on Y and Flip.
 - Set the Bank Amount to **7.0** and the Smoothness to **1.0**.
- 6 Activate the SpaceCam viewport and play the animation. All three spacefighters move along the flightpath.
- 7 Save the scene as **MyFlight01.max**.

Making the Camera Follow the Action

In this exercise, you'll use the Link Constraint to make the camera follow the flight as it passes by. Continue from the last lesson or open *flyingspacefighter04.max*

Add link constraint to the camera:

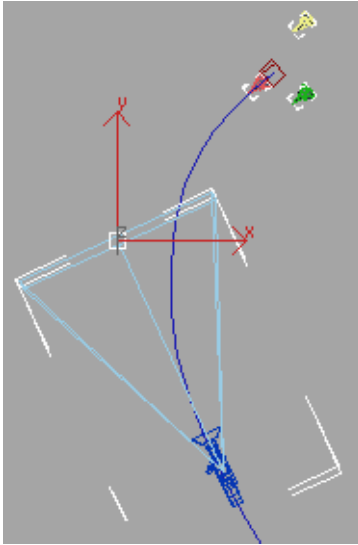


- 1 Open the Display panel and turn off Cameras in the Hide By Category rollout. The camera, *SpaceCam*, will appear.



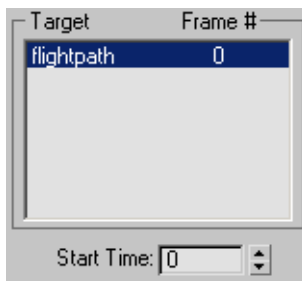
- 2 In the Top viewport, use Zoom Extents to view the scene. Select the camera target.

Also make sure the time slider is set to frame 0 (zero).



- 3 From the Main menu, choose Animation > Constraints > Link Constraint. Click the *flightpath* to set the first Link Parameter at frame 0 (zero).

NOTE For this step and the one that follows, Auto Key doesn't need to be turned on, because the Link constraint is active.



- 4 Move the time slider to frame 80 and click the Add Link button in the Link Params rollout. Click *SpaceshipControl*.



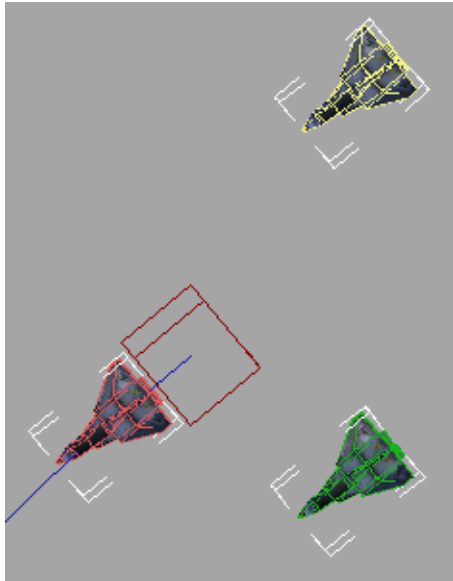
- 5 Click Add Link to turn it off.
- 6 Activate the SpaceCam viewport and play the animation.
The camera target is linked to the *flightpath* from frames 0 to 79. At frame 80, the camera target begins to specifically track the SpaceshipControl object.
- 7 Save the scene as **MyFlight02.max**.


Your Flight Leader Gets Cocky

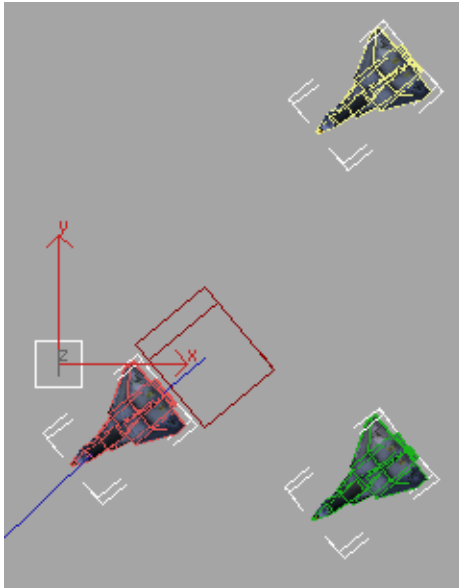
Your flight leader is a pretty bold character. He or she feels a victory roll is in order as the flight passes by your vantage point from *SpaceCam*. In this exercise, you'll use the Orientation Constraint to control the rotation of the flight leader's spacefighter as it performs a barrel roll. Continue from the last lesson or open *flyingspacefighter05.max*.



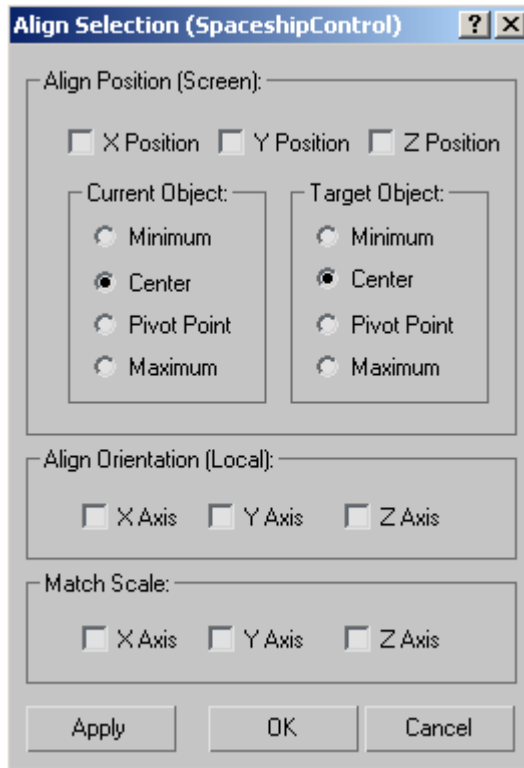
- 1 In the Top viewport, use Region Zoom to view the three spacefighters.



-  On the Create panel, click Helpers, then Dummy. Create a new dummy object near the *FlightLeader* and name it **barrelroll**.

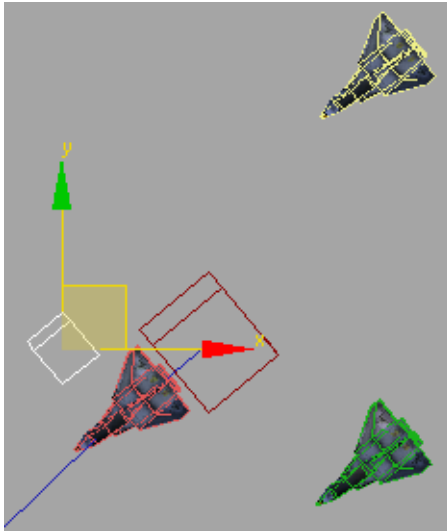



- 3 Click Select And Link and link *barrelroll* to *SpaceshipControl*.
- 4 From the Tools menu, choose Align > Align, and click *SpaceshipControl*. The Align Selection (*SpaceshipControl*) dialog appears.



- 5 In the Align Position (Screen) group, turn off the X, Y, and Z Positions.
- 6 In the Align Orientation (Local) group, turn on the X, Y, and Z Axis controls and click OK.

The *barrelroll* dummy now has the same orientation as the *SpaceshipControl*.



- 7  On the Motion panel, open the Assign Controller rollout, if it's not open, and select the Rotation: Euler XYZ controller.

- 8  Click the Assign Controller button and choose TCB Rotation from the Assign Rotation Controller dialog.


NOTE Do not miss this step. It allows you to rotate the *barrelroll* dummy about its local Y axis.


Animate the victory roll:

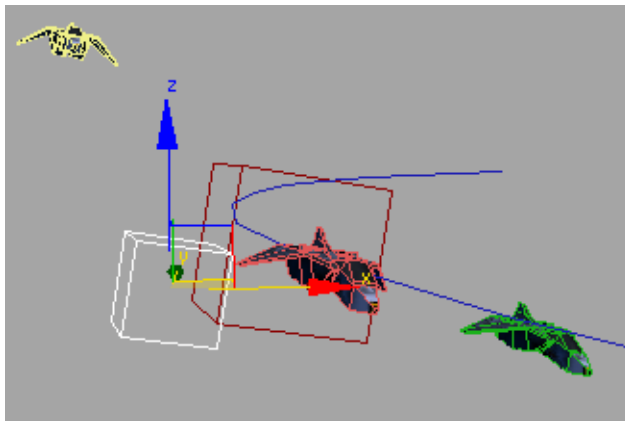
- 1 Select the *FlightLeader* in the Top viewport.
- 2 Open the Animation menu and choose Constraints > Orientation Constraint. Move the cursor over the *barrelroll* dummy and select it. You'll see *barrelroll* added to the Orientation Constraint Target list on the Motion panel.




- 3 Select *barrelroll* and make sure that the time slider is at frame 0 (zero).

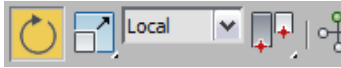
- 4  Turn on the Set Key toggle and click the Set Keys button.

- 5  Move the time slider to frame 110 and click Set Keys again. You've added two keys that will keep the *FlightLeader* flying normally from frames 0 to 110.



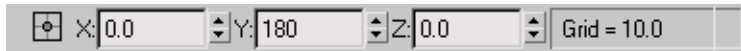
- 6 Activate the SpaceCam viewport and move the time slider to frame 130.

- 7  Click Select And Rotate and change the Reference Coordinate System to Local.



- 8 Click the *barrelroll* dummy and rotate it around the Y axis to about **180** degrees and click the Set Keys button.

NOTE If you'd like to be precise, you can enter the rotation in the Y axis type-in field on the status bar.




- 9 Move the time slider to frame 150 and rotate the *barrelroll* dummy around the Y axis another **180** degrees and click the Set Keys button. Turn off the Set Key Toggle when you've finished.
- 10 Save the scene as **MyFlight03.max** and play the animation.

A Wingman in Trouble

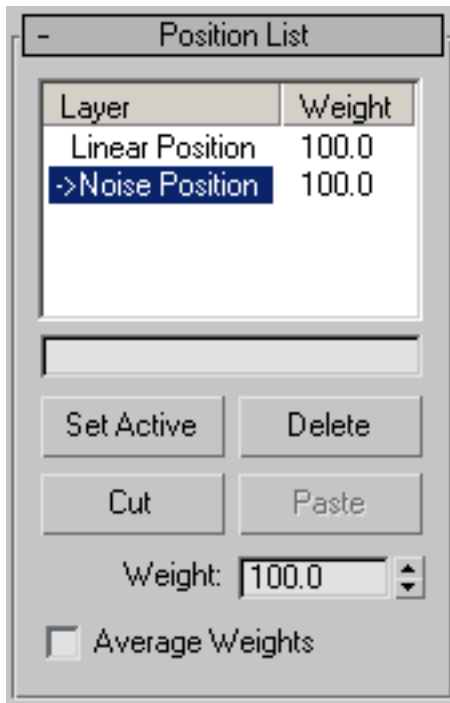
While the *FlightLeader* is performing stunts, *Wingman01* seems to be having some trouble. He doesn't seem to be flying as smoothly as the others. In this exercise, you'll use the Noise Controller to add some turbulence to *Wingman01* flight dynamics. Continue from the last lesson or open *flyingspacefighter06.max*.

NOTE If you continue from the last lesson, make sure that the time slider is back on frame 0 (zero).

Add turbulence:

- 1  In the Top viewport, use Region Zoom to view the three spacefighters, if you haven't done so already.
You might have to do a Zoom Extents first, then a Region Zoom to see the three fighters.
- 2 Select *Wingman01*.
- 3 On the Animation menu, choose Position Controllers > Noise.

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.



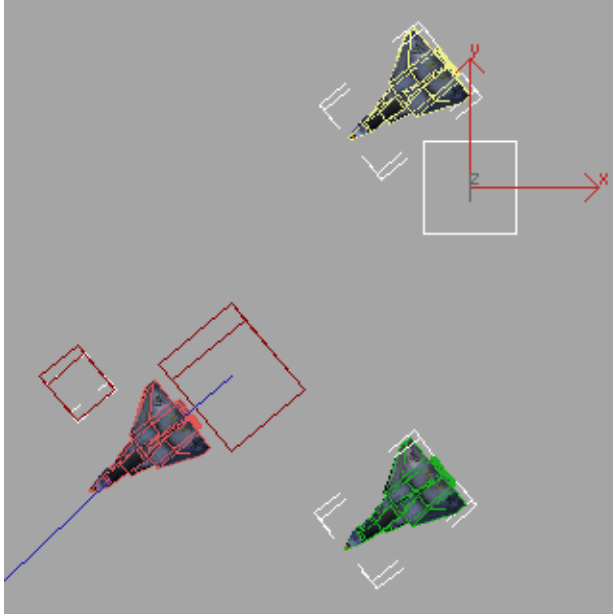
- 4 Play the animation and note the erratic flying of *Wingman01*.
- 5 Stop the playback and change the Weight of the Noise Position controller to **25.0** percent.
Now the flight path of the *Wingman01* spacefighter is affected by slight battle damage.
- 6 Save the scene as **MyFlight04.max**.

A Wingman Is Called Away

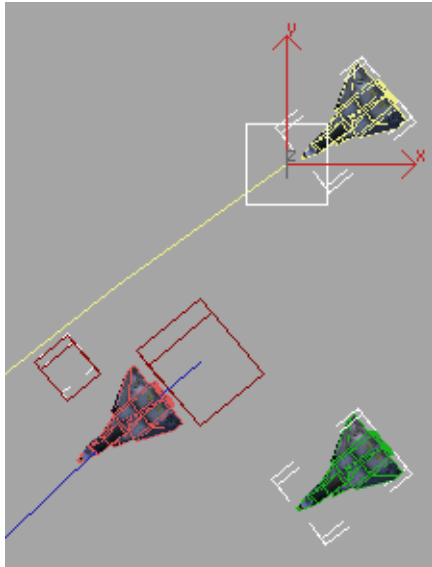
Now it looks like *Wingman02* has received a transmission and is being ordered to peel off and fly somewhere else. You'll revisit the Link Constraint to make *Wingman02* follow the *FlightLeader* for a little while then take off on another path. Continue from the last lesson, or open *flyingspacefighter07.max*.

Alter course for Wingman02:

- 1 Reset your time slider to frame 0 (zero) and zoom to the trio of spacefighters in the Top viewport.
- 2 Create a dummy near *Wingman02* and call it *WingmanControl*.



- 3 Right-click any viewport and choose Unhide By Name from the quad menu. Select *wingmanpath* and click Unhide.
A yellow path appears in front of *Wingman02*.
- 4 Make sure the new dummy, *WingmanControl*, is still selected and choose Animation > Constraints > Path Constraint. Drag the cursor over and pick *wingmanpath*.
The *WingmanControl* jumps to the beginning of *wingmanpath*.



- 5 In the Path Parameters rollout duplicate the previous settings.
 - Turn on Follow, Bank, and Constant Velocity.
 - In the Axis group, turn on Y and Flip.
 - Set the Bank Amount to **7.0** and the Smoothness to **1.0**.
If you play the animation, you'll see *WingmanControl* on its own path.



TIP To better see *Wingman02* fly away, before you play the animation go to frame 0, activate the SpaceCam viewport, turn on the Field-of-View navigation button, and drag downward in the SpaceCam viewport until in frame 0 you can see the entire loop of *wingmanpath*, and a bit of *FlightLeader*, at the right-hand side of the viewport.



SpaceCam viewport with a larger Field-of-View

Make Wingman02 change paths:



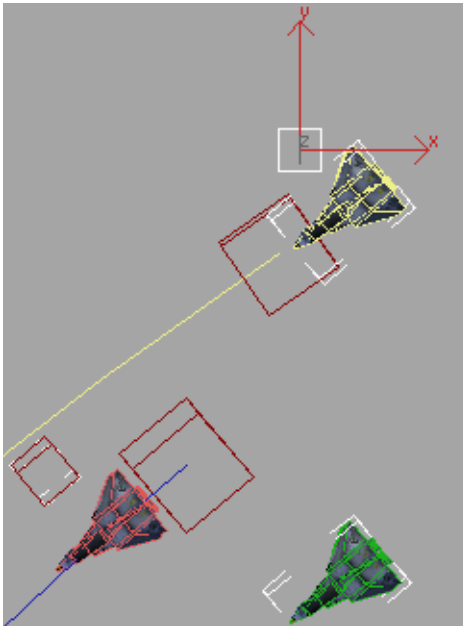
- 1 In the Top viewport, select *Wingman02* and click the Select And Unlink button.
Wingman02 is no longer linked to the *SpaceshipControl* dummy object.
- 2 From the Animation menu, choose Constraint > Link Constraint and select *SpaceshipControl*.
Wingman02 will work as it did before, but the link constraint will give you the flexibility to have it follow a different path.
- 3 Move the time slider to frame 45 and click the Add Link button in the Link Params rollout on the Motion panel.
- 4 Click the *WingmanControl* dummy.
You will see *WingmanControl* is added to the Target list, and when *Wingman02* gets to frame 45, the spacefighter begins to follow the *WingmanControl* dummy on the other path.

- 5 Save the scene as **MyFlight05.max** and play the animation.

Make Wingman02 roll out of formation:

To make *Wingman02* roll out of formation, you'll use the Orientation Constraint again.

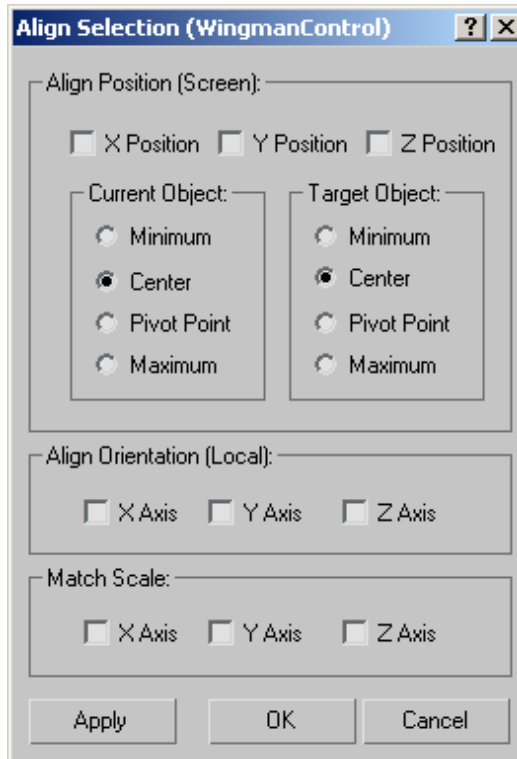
- 1 Move the time slider back to frame 0 (zero), if it's not there already.
- 2 Create another dummy object in the Top viewport near *Wingman02* and name it *wingmanroll*.



- 3 Use Select And Move to position *wingmanroll* next to *Wingman02*. Watch the Front and Right viewports to help you position it. This will help you keep the objects in your scene organized.



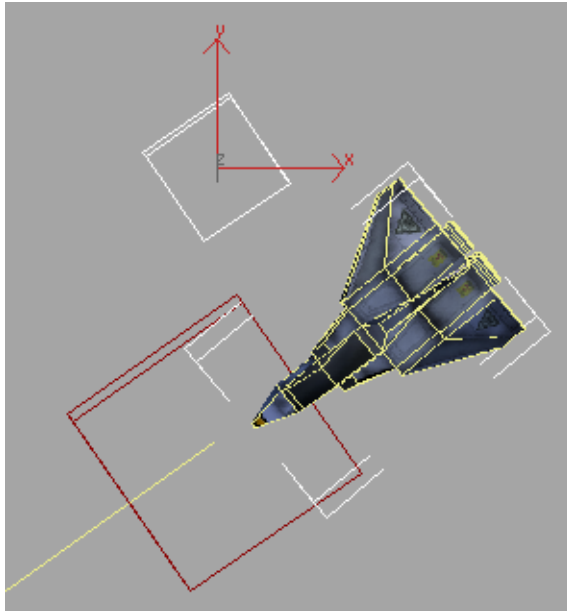
- 4 Click Select And Link and link *wingmanroll* to *WingmanControl*.
- 5 From the Tools menu, choose Align > Align, and click *WingmanControl*. The Align Selection (WingmanControl) dialog appears.



- 6 In the Align Position (Screen) group, make sure the X, Y, and Z Position controls are turned off.
- 7 In the Align Orientation (Local) group, turn on the X, Y, and Z axis controls and click OK.

The *wingmanroll* dummy aligns to *WingmanControl*.

NOTE This is important because you want to make sure that rotation values you give *wingmanroll*, later on, will be based on the initial orientation of *WingmanControl*. Otherwise, any rotation you give *wingmanroll* will result in the spaceship tumbling out of control.



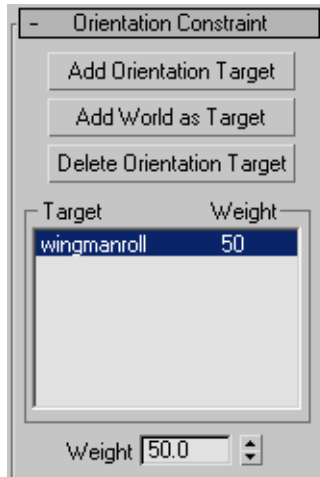
- 8 On the Motion panel, open the Assign Controller rollout, and select the Rotation: Euler XYZ controller.




- 9 Click the Assign Controller button and choose TCB Rotation from the Assign Rotation Controller dialog.


NOTE If you don't assign the TCB Rotation controller, you will not be able to rotate *wingmanroll* about a local axis.

- 10 Select *Wingman02* in the Top viewport.
- 11 Open the Animation menu and choose Constraints > Orientation Constraint. Move the cursor over *wingmanroll* and select it.
You'll see *wingmanroll* added to the Orientation Constraint target list in the Orientation Constraint rollout on the Motion panel.




12 Select *wingmanroll* in the Top viewport.

13  Turn on the Set Key toggle and click the Set Keys button.

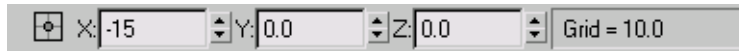
14  Move the time slider to frame 60 and click Set Keys again. You've added two keys that will keep *Wingman02* flying normally from frames 0 to 60.

15 Activate the SpaceCam viewport and move the time slider to frame 85.

16  Click Select And Rotate and change the Reference Coordinate System to Local.

17 You'll make two rotations during this step:

- Enter **-15** in the X axis Coordinate Display Type-in field and click the Set Keys button.



- Enter **90** in the Y axis Coordinate Display Type-in field and click the Set Keys button.



- 18** Move the time slider to frame 100 to make the next two rotations:
 - Rotate **5** degrees around the Z axis and click the Set Keys button.
 - Rotate **90** degrees around the Y axis and click the Set Keys button again.
- 19** Move the time slider to frame 115 to make the next two rotations:
 - Rotate **10** degrees around the Z axis and click the Set Keys button.
 - Rotate **90** degrees around the Y axis and click the Set Keys button again.
- 20** Turn off the Set Key toggle when you've finished. Save the scene as **MyFlight06.max** and play the animation.