5.3.3 Modeling - Curves - Extrude

Editing

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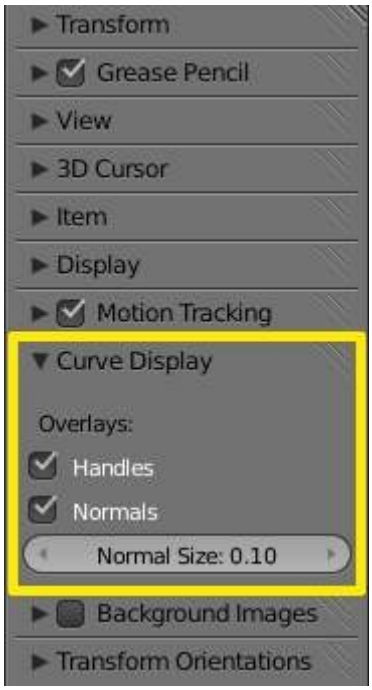
Curve Editing

This page covers the basics of curve editing. Curve basics, selecting and advanced editing are covered in the following pages:

- *Curve basics*
- *Curve Selecting*

Curve Display

Display Options



Curve Display panel

When in Edit mode, the Properties Shelf (`N`) contains options in the *Curve Display* panel for how curves are displayed in the 3D viewport.

Handles
: Toggles the display of Bezier handles while in edit mode. This does not affect the appearance of the curve itself.

Normals
: Toggles the display of Curve Normals.

Normal Size
: Sets the display scale of curve normals.

Hiding Elements

When in *Edit* mode, you can hide and reveal elements from the display. This can be useful in complex models with many elements on the Screen.

Hide Selected elements
: Use `H`, or the Curve ‣ Show/Hide ‣ Hide Selected menu option from the 3D window header.

Show Hidden elements
: Use `Alt-H`, or the Curve ‣ Show/Hide ‣ Show Hidden menu option from the 3D window header.

Hide Unselected elements
: Use `Shift-H`, or the Curve ‣ Show/Hide ‣ Hide Unselected menu option from the 3D window header.

Basic Curve Editing (translation, rotation, scale)

Reference
Mode: *Edit* mode Menu: Curve ‣ Transform ‣ Grab/Move, Rotate, Scale, ... Hotkey: G / R / S

Like other elements in Blender, Curve control points can be grabbed/moved (G), rotated (R) or scaled (S) as described in the *Basic Transformations* section. When in *Edit* mode, *proportional editing* is also available for transformation actions.

Snapping

Reference
Mode: *Edit* mode Panel: *Curve Tools* (*Editing* context)

Mesh snapping also works with curve components. Both control points and their handles will be affected by snapping, except for within itself (other components of the active curve). Snapping works with 2D curves but points will be constrained to the local XY axes.

Deforming Tools

Reference
Mode: *Edit* mode Menu: Curve ‣ Transform

The *To Sphere*, *Shear*, *Wrap* and *Push/Pull* transform tools are described in the *Transformations* sections. The two other tools, *Tilt* and *Shrink/Fatten Radius* are related to *Curve Extrusion*.

Smoothing

Reference
Mode: *Edit* mode Hotkey: [W][] ‣ smooth

Curve smoothing is available through the specials menu. For Bézier curves, this smoothing operation currently only smooths the positions of control points and not their tangents. End points are also constrained when smoothing.

Mirror

Reference

Mode: *Edit* mode
Menu: Curve ‣ Mirror
Hotkey: `Ctrl-M`

The *Mirror* tool is also available, behaving exactly as with *mesh vertices*,

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Set Bézier Handle Type

Reference
Mode: *Edit* mode Panel: Curve Tools ‣ Handles Menu: Curve ‣ Control Points ‣ Set Handle Type Hotkey: `V`

Handle types are a property of *Bézier curves.* and can be used to alter features of the curve. For example, switching to *Vector handles* can be used to create curves with sharp corners. Read the *Bézier curves* page for more details.

Extending Curves

Reference
Mode: *Edit* mode Menu: Curve ‣ Extrude Hotkey: `Ctrl-LMB` or `E`

Once a curve is created you can add new segments (in fact, new control points defining new segments), either by extruding, or placing new handles with `Ctrl-LMB` clicks. Each new segment is added to one end of the curve. A new segment will only be added if a single vertex, or handle, at one end of the curve is selected. If two or more control points are selected, a new Bézier closed curve is started.

Subdivision

Reference
Mode: *Edit* mode Panel: *Curve Tools* (*Editing* context) Menu: Curve ‣ Segments ‣ Subdivide Hotkey: `W`

Curve subdivision simply subdivides all selected segments by adding one or more control points between the selected segments. To control the number of cuts, press `W` to make a single subdivision. Then press `F6` to bring up the *Number of Cuts* menu.

Duplication

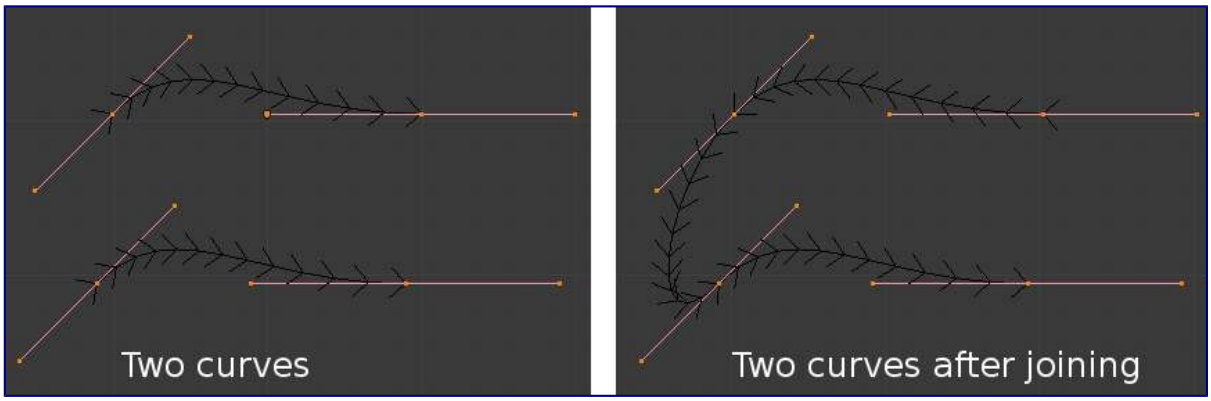
Reference
Mode: *Edit* mode Menu: Curve ‣ Duplicate Hotkey: `Shift-D`

This command duplicates the selected control points, along with the curve segments implicitly selected (if any). The copy is selected and placed in *Grab* mode, so you can move it to another place.

Joining Curve Segments

Reference
Mode: *Edit* mode Menu: Curve ‣ Make Segment Hotkey: F

Two open curves can be combined into one by creating a segment between the two curves. To join two separated curves, select one end control point from each curve then press F. The two curves are joined by a segment to become a single curve.



Curves before and after joining

Additionally, you can close a curve by joining the endpoints but note that you can only join curves of the same type (i.e. Bézier with Bézier, NURBS with NURBS)

Separating Curves

Reference
Mode: *Edit* mode Menu: Curve ‣ Separate Hotkey: P

Curve objects that are made of multiple distinct curves can be separated into their own objects by selecting the desired segments and pressing P. Note, if there is only one curve in a Curve object, pressing P will create a new

Curve object with no control points.

Deleting Elements

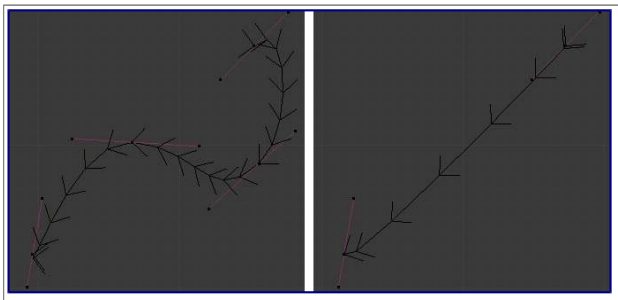
Reference
Mode: *Edit* mode Menu: Curve ‣ Delete... Hotkey: `X` or `Delete`

The *Erase* pop-up menu of curves offers you three options:

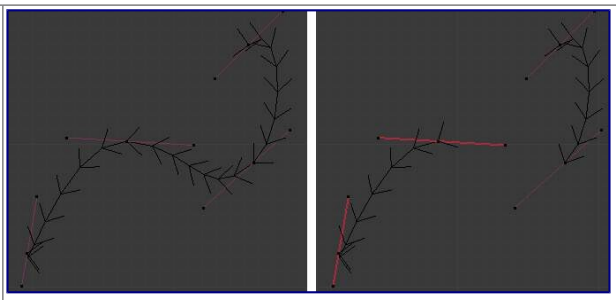
Selected
: This will delete the selected control points, *without* breaking the curve (i.e. the adjacent points will be directly linked, joined, once the intermediary ones are deleted). Remember that NURBS order cannot be higher than its number of control points, so it might decrease when you delete some control point. Of course, when only one point remains, there is no more visible curve, and when all points are deleted, the curve itself is deleted.

Segment
: This option is somewhat the opposite to the preceding one, as it will cut the curve, without removing any control points, by erasing one selected segment. This option always removes *only one segment* (the last "selected" one), even when several are in the selection. So to delete all segments in your selection, you'll have to repetitively use the same erase option...

All
: As with meshes, this deletes everything in the object!



Deleting Curve Selected



Deleting Curve segments

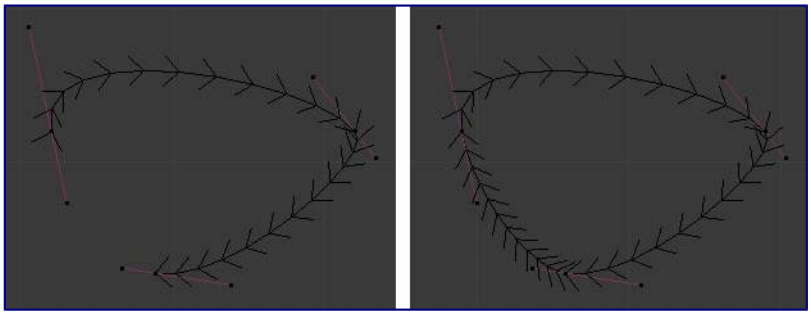
Opening and Closing a Curve

Reference
Mode: *Edit* mode Menu: Curve ‣ Toggle Cyclic Hotkey: `Alt-C`

This toggles between an open curve and closed curve (Cyclic). Only curves with at least one selected control point will be closed/open. The shape of the closing segment is based on the start and end handles for Bézier curves, and as usual on adjacent control points for NURBS. The only time a handle is adjusted after closing is if the handle is an *Auto* one. (*Open curve*) and (*Closed curve*) is the same Bézier curve open and closed.

This action only works on the original starting control-point or the last control-point added. Deleting a

segment(s) doesn't change how the action applies; it still operates only on the starting and last control-points. This means that `Alt-C` may actually join two curves instead of closing a single curve! Remember that when a 2D curve is closed, it creates a renderable flat face.



Open and Closed curves.

Switch Direction

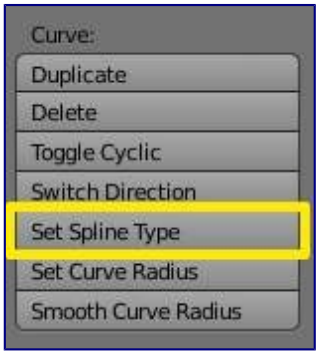
Reference
Mode: *Edit* mode Menu: Curve ‣ Segments ‣ Switch Direction, Specials ‣ Switch Direction Hotkey: [W] ‣ [pad2]

This command will "reverse" the direction of any curve with at least one selected element (i. e. the start point will become the end one, and *vice versa*). This is mainly useful when using a curve as path, or using the bevel and taper options.

Converting Tools

Converting Curve Type

Reference
Panel: Curve Tools –> Set Spline type Mode: *Edit* mode



Set Spline Type button

You can convert splines in a curve object between Bézier, NURBS, and Poly curves. Press `T` to bring up the Toolshelf. Clicking on the *Set Spline Type* button will allow you to select the Spline type (Poly, Bézier or NURBS).

Note, this is not a “smart” conversion, i.e. Blender does not try to keep the same shape, nor the same number of control points. For example, when converting a NURBS to a Bézier, each group of three NURBS control points become a unique Bézier one (center point and two handles).

Convert Curve to Mesh

Reference
Mode: *Object* mode Menu: Object ‣ Convert to Hotkey: `Alt-C`

There is also an “external” conversion, from curve to mesh, that only works in *Object* mode. It transforms a *Curve* object in a *Mesh* one, using the curve resolution to create edges and vertices. Note that it also keeps the faces and volumes created by closed and extruded curves.

Convert Mesh to Curve

Reference
Mode: *Object* mode Menu: Object ‣ Convert to Hotkey: `Alt-C`

Mesh objects that consist of a series of connected vertices can be converted into curve objects. The resulting curve will be a Poly curve type, but can be converted to have smooth segments as described above.

Curve Parenting

Reference
Mode: *Edit* mode Hotkey: `Ctrl-P`

You can make other selected objects children of one or three control points `Ctrl-P`, as with mesh objects.

Select either 1 or 3 control points, then `Ctrl-RMB` another object and use `Ctrl-P` to make a vertex parent.

Hooks

Reference
Mode: *Edit* mode Menu: Curve ‣ control points ‣ hooks

Hotkey: `Ctrl-H`

Hooks can be added to control one or more points with other objects.

Set Goal Weight

Reference

Mode: *Edit* mode
Menu: W ‣ Set Goal Weight

Set Goal Weight
This sets the “goal weight” of selected control points, which is used when a curve has Soft Body physics, forcing the curve to “stick” to their original positions, based on the weight.

Curve Deform

Curve Deform provides a simple but efficient method of defining a deformation on a mesh. By parenting a mesh object to a curve, you can deform the mesh up or down the curve by moving the mesh along, or orthogonal to, the dominant axis. This is a most useful tool to make an object follow a complex path, like e.g. a sheet of paper inside a printer, a film inside a camera, the water of a canal...

The *Curve Deform* works on a (global) dominant axis, X, Y, or Z. This means that when you move your mesh in the dominant direction, the mesh will traverse along the curve. Moving the mesh in an orthogonal direction will move the mesh object closer or further away from the curve. The default settings in Blender map the Y axis to the dominant axis. When you move the object beyond the curve endings the object will continue to deform based on the direction vector of the curve endings.

If the “curve path” is *3D*, the *Tilt* value of its control points will be used (see the *Extrusion* section above) to twist the “curved” object around it. Unfortunately, the other *Radius* property is not used (it would have been possible, for example, to make it control the size of the “curved” object...).

Tip

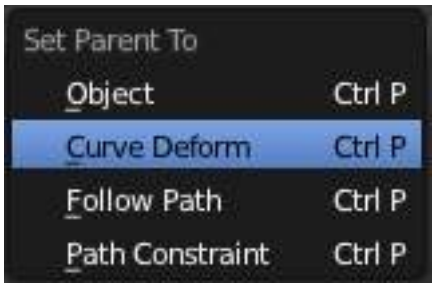
Try to position your object over the curve immediately after you have added it, before adding the curve deform. This gives the best control over how the deformation works.

Note

Use modifiers!

The *Curve Deform* relationship is now also a modifier, called *Curve*. The *Curve* modifier function acts the same as its counterpart, except that when the modifier is used, the “dominant axis” is set inside its properties - and the *Track X* / *Y* / *Z* buttons no longer have an effect on it. And you have some goodies, like the possibility, if “curving” a mesh, to only curve one of its vertex groups...

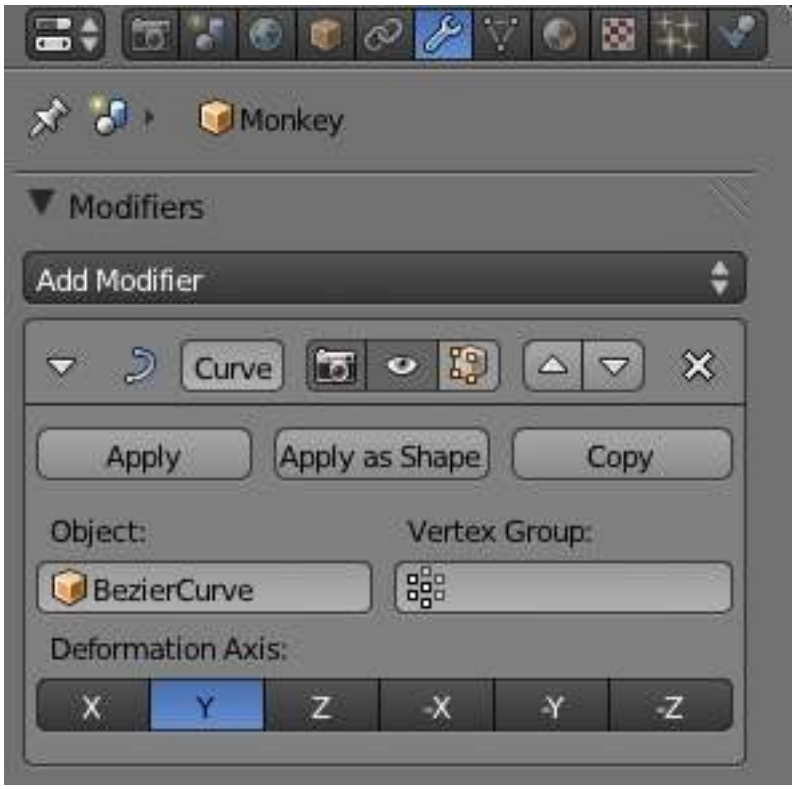
Interface



Make Parent menu.

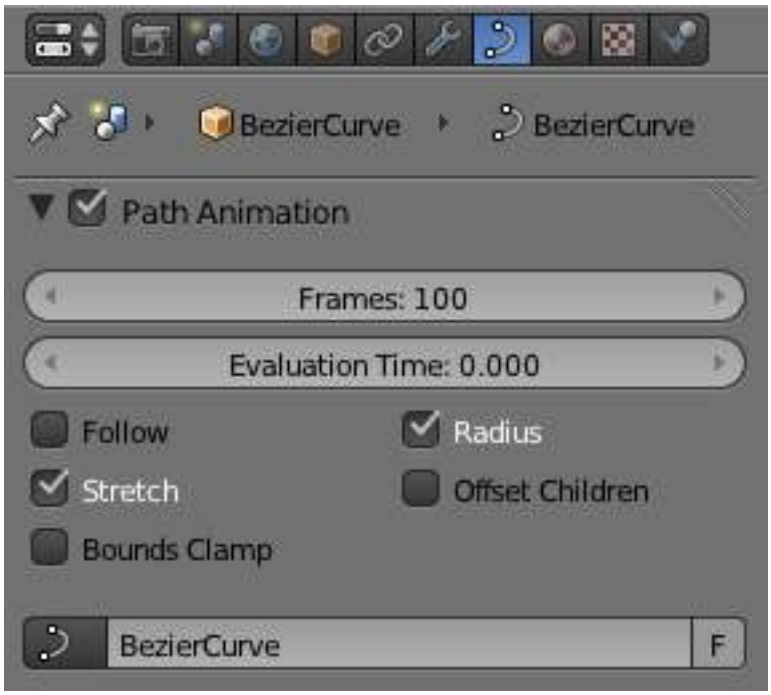
When parenting an object (mesh, curve, meta, ...) to a curve (`Ctrl-P`), you will be presented with a menu (*Make Parent menu*).

By selecting *Curve Deform*, you enable the curve deform function on the mesh object.



Anim settings panel.

The dominant axis setting is set on the mesh object. By default the dominant axis in Blender is *Y*. This can be changed by selecting one of the *Track X*, *Y* or *Z* buttons in the *Anim* Panel, (*Anim settings panel*), in *Object* context.



Curve and Surface panel.

Cyclic (or closed) curves work as expected where the object deformations traverse along the path in cycles. Note however that when you have more than one curve in the “parent” object, its “children” will only follow the first one.

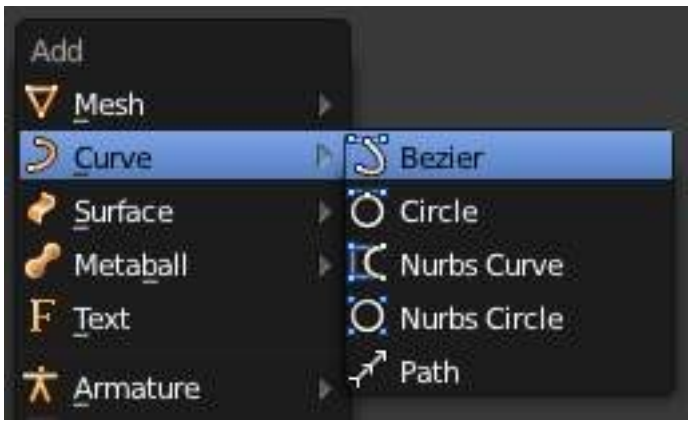
The *Stretch* curve option allows you to let the mesh object stretch, or squeeze, over the entire curve. This option is in *Object Data* properties, for the “parent” curve. See (*Curve and Surface panel*).

Example

Let’s make a simple example:

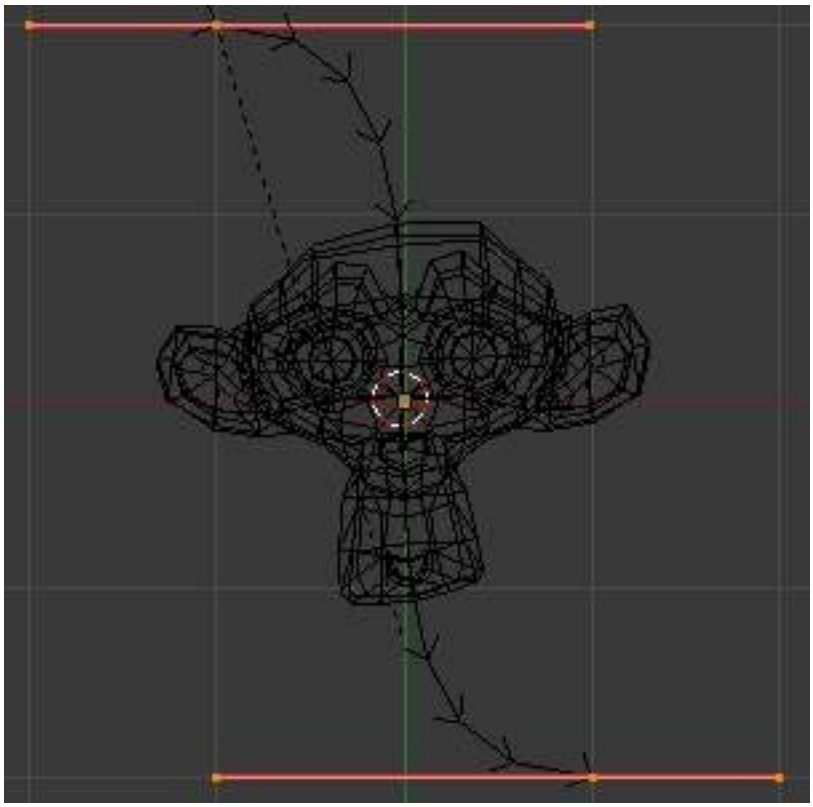
Add a Monkey!

- Remove default cube object from scene and add a Monkey (Add ‣ Mesh ‣ Monkey, *Add a Monkey!*)!
- Press `Tab` to exit *Edit* mode.



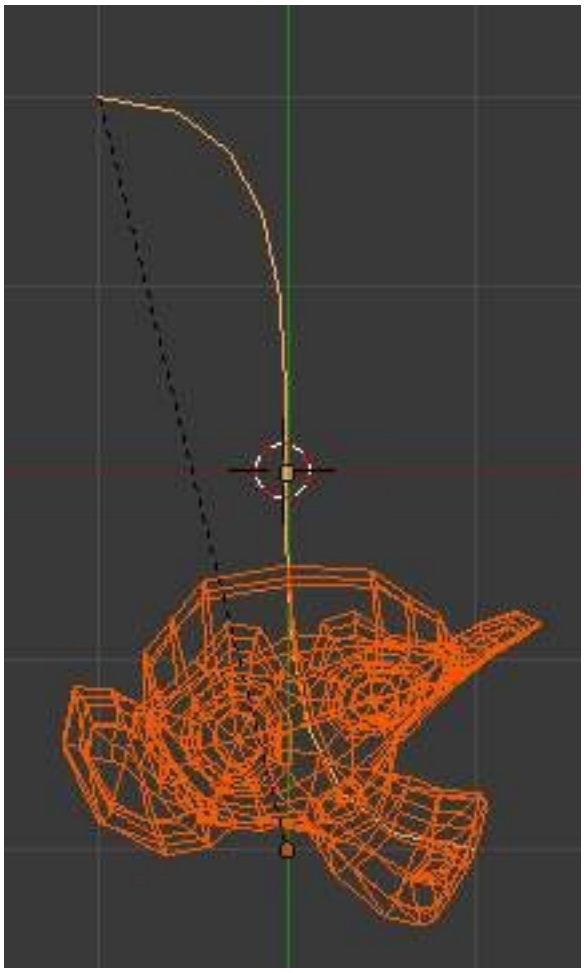
Add a Curve.

- Now add a curve (Add ‣ Curve ‣ Bezier Curve, *Add a Curve*).



Edit Curve.

- While in *Edit* mode, move the control points of the curve as shown in (*Edit Curve*), then exit *Edit* mode (Tab).



Monkey on a Curve.

- Now, you can use the new, modern, modifier way of “curving” the Monkey:
  - Select the Monkey (RMB).
  - In the *Object Modifiers* properties, *Modifiers* panel, add a *Curve* modifier.
  - Type the name of the curve (should be Curve) in the *Ob* field of the modifier, and optionally change the dominant axis to *Y*.
- Or you can choose the old, deprecated method (note that it creates a “virtual” modifier...):
  - Select the Monkey (RMB), and then shift select the curve (Shift-RMB).
  - Press Ctrl-P to open up the *Make Parent* menu.
  - Select *Curve Deform* (*Make Parent menu*).
- The Monkey should be positioned on the curve, as in (*Monkey on a Curve*).
- Now if you select the Monkey (RMB), and move it (G), in the Y-direction (the dominant axis by default), the monkey will deform nicely along the curve.

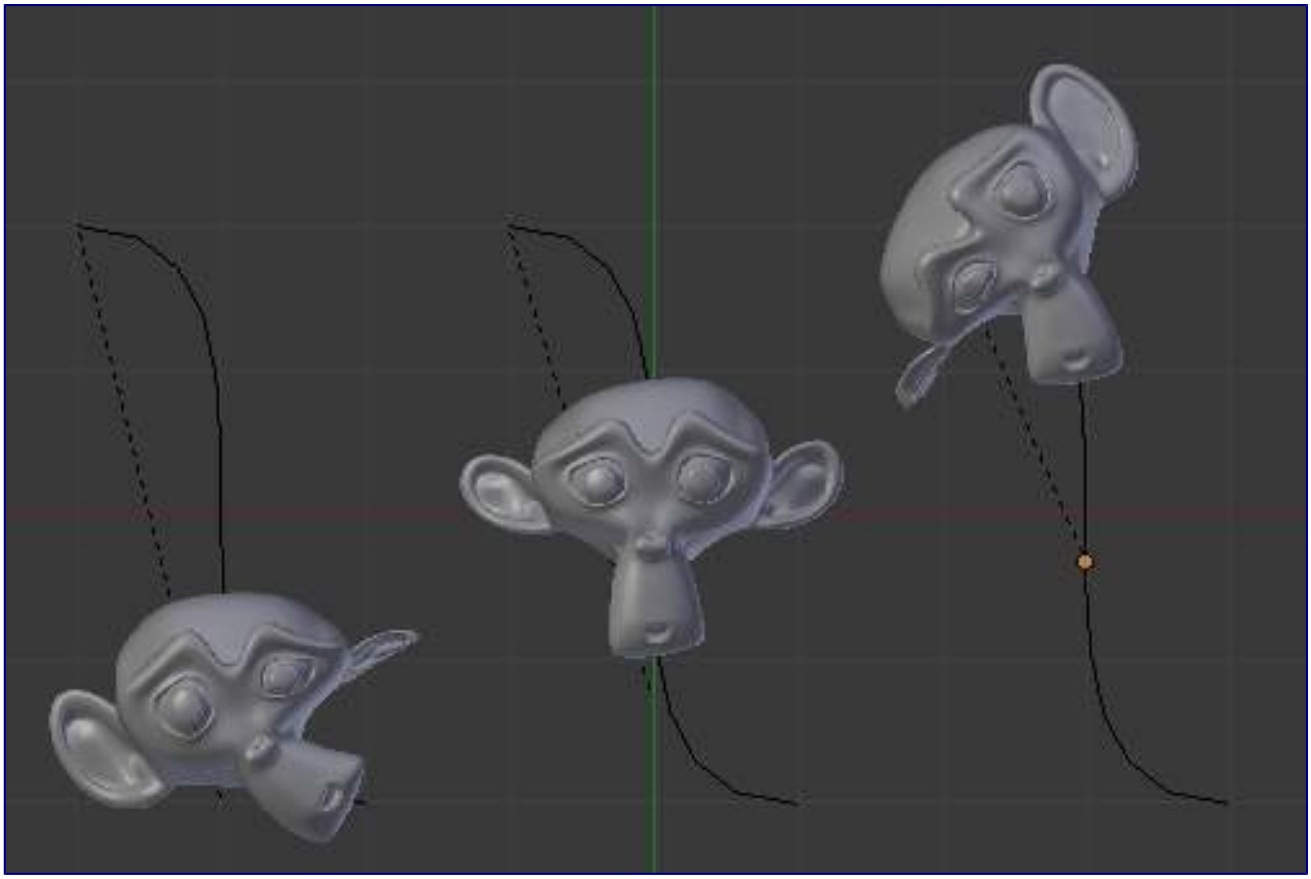
Tip

If you press MMB (or one of the X / Y / Z keys) while moving the Monkey you will constrain the movement to one axis only.

- In (*Monkey deformations*), you can see the Monkey at different positions along the curve. To get a cleaner view over the deformation I have activated *SubSurf* with *Subdiv* to **2**, and *Set Smooth* on the Monkey mesh.

Tip

Moving the Monkey in directions other than the dominant axis will create some odd deformations. Sometimes this is what you want to achieve, so you'll need to experiment and try it out!



Monkey deformations.

Curve Extrusion

This section covers methods for extruding curves, or giving them thickness, and how to control the thickness along the path.

Extrusion

Reference

Mode: *Object* or *Edit* mode
Panel: *Curve and Surface*

Extrusion can be especially with the bevel/taper/Tilt/Radius options. Note that this isn't related to *Extrude* used in mesh edit-mode.

We will see the different settings, depending on their scope of action:

Width

This controls the position of the extruded “border” of the curve, relative to the curve itself. With closed 2D curves (see below), it is quite simple to understand - with a *Width* greater than **1.0**, the extruded volume is wider, with a *Width* of **1.0**, the border tightly follows the curve, and with a *Width* lower than **1.0**, the volume is narrower? The same principle remains for open 2D and 3D curves, but the way the “outside” and “inside” of the curve is determined seems a bit odd?

It has the same effect with extruded “bevel” objects...

Tilt
This setting - unfortunately, you can never see its value anywhere in Blender - controls the “twisting angle” around the curve for each point - so it is only relevant with 3D curves! You set it using the *Tilt* transform tool (`T`, or Curve ‣ Transform ‣ Tilt), and you can reset it to its default value (i.e. perpendicular to the original curve plane) with `Alt-T` (or Curve ‣ Control Points ‣ Clear Tilt). With NURBS, the tilt is always smoothly interpolated. However, with Bézier, you can choose the interpolation algorithm to use in the *Tilt Interpolation* drop-down list of the *Curve Tools* panel (you will find the classical *Linear*, *Cardinal*, *B Spline* and *Ease* options...).

Simple Extrusion

Let’s first see the “simple” extrusion of curves, without additional bevel/taper objects.

Extrude

This controls the width (or height) of the extrusion. The real size is of course dependent on the scale of the underlying object, but with a scale of one, an *Extrusion* of **1.0** will extrude the curve one BU in both directions, along the axis perpendicular to the curve’s plane (see below for specifics of 3D curves?).

If set to **0.0**, there is no “simple” extrusion!

Bevel Depth
This will add a bevel to the extrusion. See below for its effects... Note that the bevel makes the extrusion wider and higher. If set to **0.0**, there is no bevel (max value: **2.0**).

Bev Resol
Controls the resolution of the bevel created by a *Bevel Depth* higher than zero. If set the **0** (the default), the bevel is a simple “flat” surface. Higher values will smooth, round off the bevel, similar to the resolution settings of the curve itself...

We have three sub-classes of results, depending on whether the curve is open or closed or 3D:

Open 2D Curve

The extrusion will create a “wall” or “ribbon” following the curve shape. If using a *Bevel Depth*, the wall becomes a sort of slide or gutter. Note the direction of this bevel is sometimes strange and unpredictable, often the reverse of what you would get with the same curve closed? You can inverse this direction by switching the direction of the curve.

This allows you, e.g., to quickly simulate a marble rolling down a complex slide, by combining an extruded beveled curve, and a sphere with a *Follow Path* constraint set against this curve?

Closed 2D Curve

This is probably the most useful situation, as it will quickly create a volume, with (by default) two flat and parallel surfaces filling the two sides of the extruded “wall”. You can remove one or both of these faces by disabling the *Back* and/or *Front* toggle buttons next to the *3D* one.

The optional bevel will always be “right-oriented” here, allowing you to smooth out the “edges” of the volume.

3D Curve

Here the fact that the curve is closed or not has no importance - you will never get a volume with an extruded 3D curve, only a wall or ribbon, like with open 2D curves.

However, there is one more feature with 3D curves: the *Tilt* of the control points (see above). It will make the ribbon twist around the curve ? to create a M?bius strip, for example!

Advanced Extrusion

These extrusions use one or two additional curve objects, to create very complex organic shapes.

To enable this type of extrusion, you have to type a valid curve object name in the *BevOb* field of the curve you are going to use as the “spinal column” of your extrusion. The “bevel” curve will control the cross section of the extruded object. Whether the *BevOb* curve is 2D or 3D has no importance, but if it is closed, it will create a “tube-like” extrusion; otherwise you will get a sort of gutter or slide object...

The object is extruded along the whole length of all internal curves. By default, the width of the extrusion is constant, but you have two ways to control it, the *Radius* property of control points, and the “taper” object.

The *Radius* of the points is set using the *Shrink/Fatten Radius* transform tool (`Alt-S`, or Curve ‣ Transform ‣ Shrink/Fatten Radius), or with the *Set Radius* entry in the *Specials* menu (`W`). Here again, you unfortunately cannot visualize anywhere the *Radius* of a given control point...

The *Radius* allows you to directly control the width of the extrusion along the “spinal” curve. As for *Tilt* (see above), you can choose the interpolation algorithm used for Bézier curves, in the *Radius Interpolation* drop-down list of the *Curve Tools* panel.

But you have another, more precise option: the “taper” object. As for the “bevel” one, you set its name in the *TaperOb* field of the main curve - it must be an *open curve*. The taper curve is evaluated along *the local X axis*, using *the local Y axis* for width control. Note also that:

- The taper is applied independently to all curves of the extruded object.
- Only the first curve in a *TaperOb* is evaluated, even if you have several separated segments.
- The scaling starts at the first control-point on the left and moves along the curve to the last control-point on the right.
- Negative scaling, (negative local Y on the taper curve) is possible as well. However, rendering artifacts may appear.
- It scales the width of normal extrusions based on evaluating the taper curve, which means sharp corners on the taper curve will not be easily visible. You’ll have to heavily level up the resolution (*DefResolU*) of the base curve.

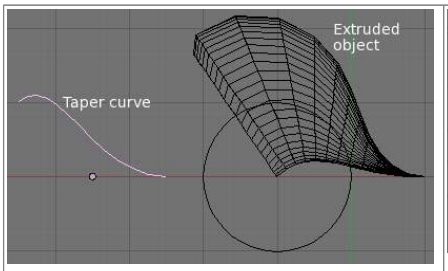
- With closed curves, the taper curve in *TaperOb* acts along the whole curve (perimeter of the object), not just the length of the object, and varies the extrusion depth. In these cases, you want the relative height of the *TaperOb* Taper curve at both ends to be the same, so that the cyclic point (the place where the endpoint of the curve connects to the beginning) is a smooth transition.

Last but not least, with 3D “spinal” curves, the *Tilt* of the control points can control the twisting of the extruded “bevel” along the curve!

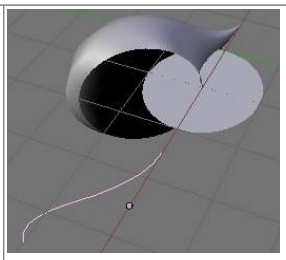
Examples

Let’s taper a simple curve circle extruded object using a taper curve. Add a curve, then exit *Edit* mode. Add another one (a closed one, like a circle); call it `BevelCurve`, and enter its name in the *BevOb* field of the first curve (*Editing* context *Curve and Surface* panel). We now have a pipe. Add a third curve while in *Object* mode and call it `TaperCurve`. Adjust the left control-point by raising it up about 5 units.

Now return to the *Editing* context, and edit the first curve’s *TaperOb* field in the Curve and Surface panel to reference the new taper curve which we called *TaperCurve*. When you hit enter the taper curve is applied immediately, with the results shown in (*Taper extruded curve*).

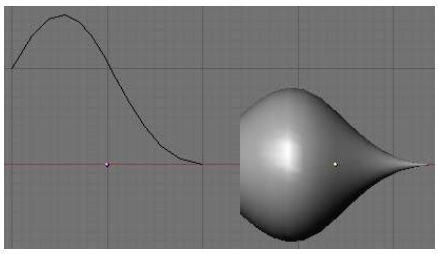


Taper extruded curve.



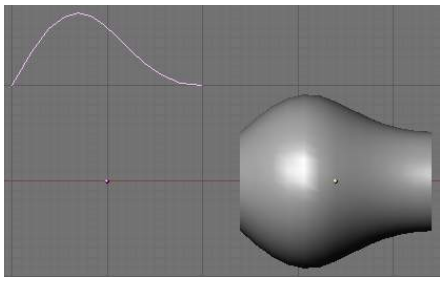
Taper solid mode.

You can see the **taper curve** being applied to the **extruded object**. Notice how the pipe’s volume shrinks to nothing as the taper curve goes from left to right. If the taper curve went below the local Y axis the pipe’s inside would become the outside, which would lead to rendering artifacts. Of course as an artist that may be what you are looking for!



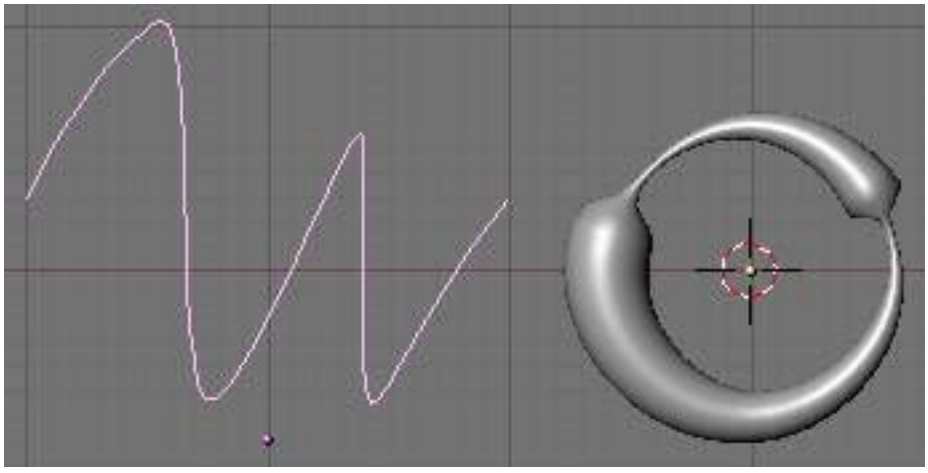
Taper example 1.

In (*Taper example 1*) you can clearly see the effect the left taper curve has on the right curve object. Here the left taper curve is closer to the object center and that results in a smaller curve object to the right.



Taper example 2.

In (*Taper example 2*) a control point in the taper curve to the left is moved away from the center and that gives a wider result to the curve object on the right.



Taper example 3.

In (*Taper example 3*), we see the use of a more irregular taper curve applied to a curve circle.

TODO: add some “bevel” extrusion with *Tilt* examples.