3.3.2 Editors - Animation - Graph Editor

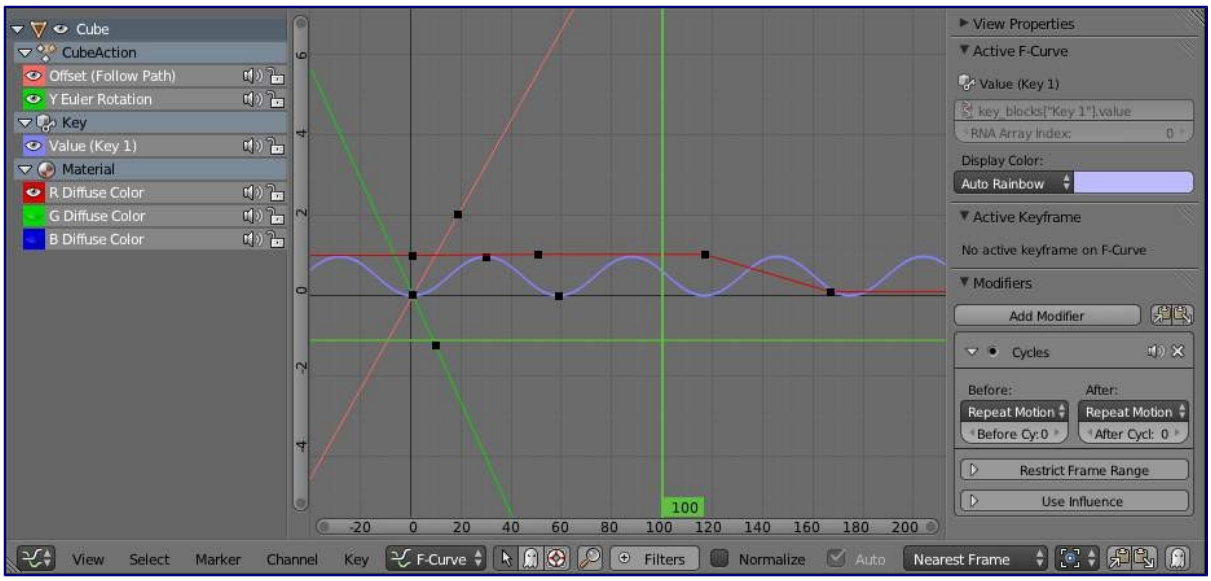
Graph Editor

- Graph Editor
  - Curve Editor Area
  - Header
  - Channels Region

Graph Editor

The graph editor is the main animation editor. It allows you to modify the animation for any properties using *F-Curves*.

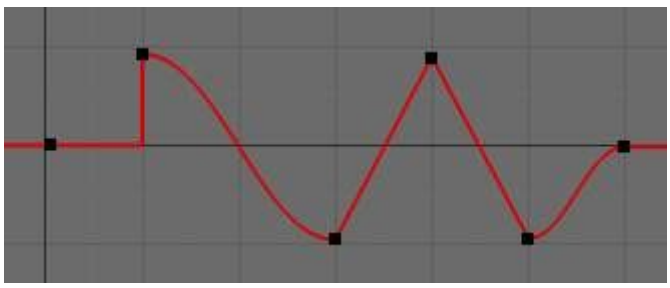
The graph editor has two modes, *F-Curve* for *Actions*, and *Drivers* for *Drivers*. Both are very similar in function.



The Graph Editor.

Curve Editor Area

Here you can see and edit the curves and keyframes.



A curve with different types of interpolation.

See *F-Curves* for more info.

Navigation

As with most windows, you can:

Pan `MMB`
: Pan the view vertically (values) or horizontally (time) with click and drag.

Zoom `Wheel`
: Zoom in and out with the mouse wheel.

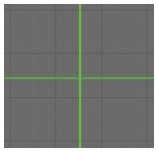
Scale View `Ctrl-MMB`
: Scale the view vertically or horizontally.

These are some other useful tools.

View All `Home`
: Reset viewable area to show all keyframes.

View Selected `NumpadPeriod`
: Reset viewable area to show selected keyframes.

2D Cursor



Graph Editor 2D Cursor.

The current frame is represented by a green vertical line called the *Time Cursor.*

As in the *Timeline*, you can change the current frame by pressing or holding `LMB`.

The green horizontal line is called the *Cursor.* This can be disabled via the *View Menu* or the *View Properties* panel.

The *Time Cursor* and the *Cursor* make the *2D Cursor.* The *2D Cursor* mostly used for editing tools.

View Axes

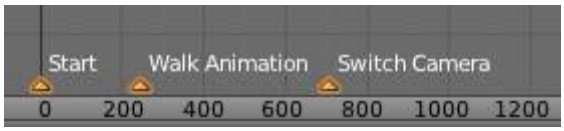
For *Actions* the X-axis represents time, the Y-axis represents the value to set the property.

For *Drivers* the X-axis represents the *Driver Value*, the Y-axis represents the value to set the property.

Depending on the selected curves, the values have different meaning: For example rotation properties are shown in degrees, location properties are shown in Blender Units. Note that *Drivers* use radians for rotation properties.

Markers

Like with most animation editors, markers are shown at the bottom of the editor.



Graph Editor Markers.

Markers can be modified in the *Graph Editor* though its usually best to use the *Timeline*.

See *Markers* for more info.

Header

Here you'll find.

- The menus.
- Graph Editor mode.
- View controls.
- Curve controls.

Header Controls

Graph Mode.

Mode
: F-Curve for *Actions*, and Drivers for *Drivers*.

View Controls.

View controls

Show Only Selected
: Only include curves related to the selected objects and data.

Show Hidden
: Include curves from objects/bones that are not visible.

Show Only Errors
: Only include curves that are disabled or have errors.

Search Filter
: Only include curves with keywords contained in the search text.

Type Filter
: Filter curves by property type.

Normalize
: Normalize curves so the maximum or minimum point equals 1.0 or -1.0.

Auto
: Automatically recalculate curve normalization on every curve edit.

Curve Controls.

Curve controls

Auto Snap

Auto snap the keyframes for transformations.

No Auto-Snap Time Step Nearest Frame Nearest Marker

Pivot Point

Pivot point for rotation.

Bounding Box Center
: Center of the select keyframes.

2D Cursor
: Center of the *2D Cursor. Time Cursor + Cursor.*

Individual Centers
: Rotate the selected keyframe *Bezier* handles.

Copy Keyframes **`Ctrl-C`**
: Copy the selected keyframes to memory.

Paste Keyframes **`Ctrl-V`**
: Paste keyframes from memory to the current frame for selected curves.

Create Snapshot
: Creates a picture with the current shape of the curves.

Channels Region

Channels Region.

The channels region is used to select and manage the curves for the graph editor.

Hide curve
Represented by the eye icon.
Deactivate/Mute curve
Represented by the speaker icon.
Lock curve from editing
Represented by the padlock icon.

Channel Editing

Select channel `LMB`

Multi Select/Deselect `Shift-LMB`

Toggle Select All `A`

Border Select (`LMB` drag) or `B` (`LMB` drag)

Border Deselect (`Shift-LMB` drag) or `B` (`Shift-LMB` drag)

Delete selected `X` or `Delete`

Lock selected `Tab`

Make only selected visible `V`

Enable Mute Lock selected `Shift-Ctrl-W`

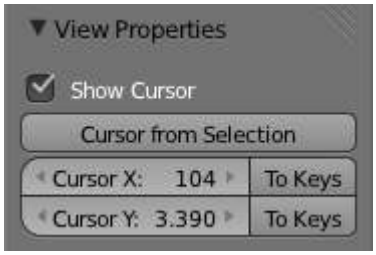
Disable Mute Lock selected `Alt-W`

Toggle Mute Lock selected `Shift-W`

Properties Region

The panels in the *Properties Region*.

View Properties Panel



View Properties Panel.

Show Cursor
Show the vertical *Cursor.*
Cursor from Selection
Set the *2D cursor* to the center of the selected keyframes.
Cursor X

Time Cursor X position.

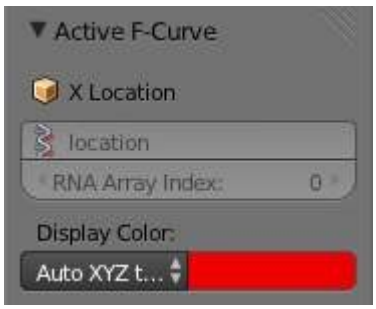
To Keys
Snap selected keyframes to the *Time Cursor.*

Cursor Y

Vertical *Cursor* Y position.

To Keys
Snap selected keyframes to the *Cursor.*

Active F-Curve Panel



Active F-Curve Panel.

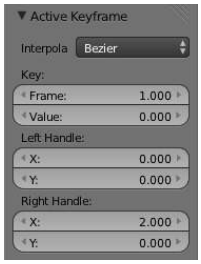
This panel displays properties for the active *F-Curve*.

***Channel Name* (X Location)**
ID Type + Channel name.
RNA Path
RNA Path to property + Array index.
Color Mode

Color Mode for the active *F-Curve*.

Auto Rainbow
Increment the *HUE* of the *F-Curve* color based on the channel index.
Auto XYZ to RGB
For property sets like location xyz, automatically set the set of colors to red, green, blue.
User Defined
Define a custom color for the active *F-Curve*.

Active Keyframe Panel



Active Keyframe Panel.

Interpolation

Set the forward interpolation for the active keyframe.

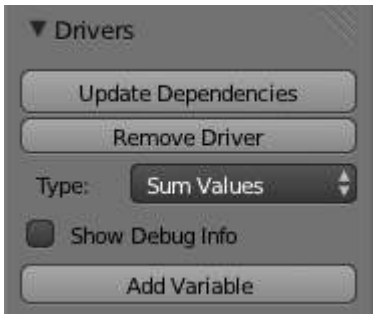
Constant
Keep the same value till the next keyframe.
Linear
The difference between the next keyframe.
Bezier
Bezier interpolation to the next keyframe.

Key
Frame
Set the frame for the active keyframe.
Value
Set the value for the active keyframe.

Left Handle
Set the position of the left interpolation handle for the active keyframe.

Right Handle
Set the position of the right interpolation handle for the active keyframe.

Drivers Panel



Drivers Panel.

See Drivers Panel for more info.

Modifiers Panel

Modifiers Panel.

See *F-Modifiers* for more info.

See also

- *Graph Editor - F-Curves*
- *Graph Editor - F-Modifiers*
- *Actions*
- *Drivers*

F-Curves

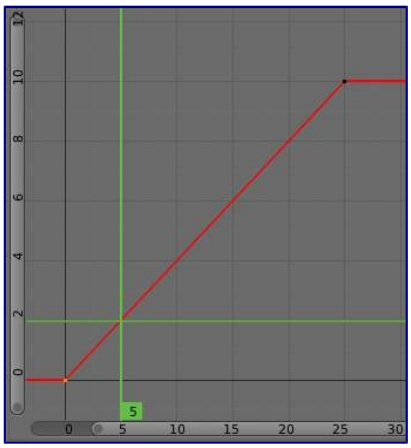
After animating some property in Blender using keyframes you can edit their corresponding curves. When something is “animated,” it changes over time. This curve in shown as something called an F-Curve. Basically what an F-Curve does is it a interpolates between two animated properties. In Blender, animating an object means changing one of its properties, such as an objects location, or its scale.

As mentioned, Blender’s fundamental unit of time is the “frame”, which usually lasts just a fraction of a second, depending on the *frame rate* of the scene. As animation is composed of incremental changes spanning multiple frames, usually these properties ARE NOT manually modified *frame by frame*, because:

- it would take ages!
- it would be very difficult to get smooth variations of the property (unless you compute mathematical functions and type a precise value for each frame, which would be crazy).

This is why nearly all direct animation is done using **interpolation**.

The idea is simple: you define a few Key Frames, which are multiple frames apart. Between these keyframes, the properties’ values are computed (interpolated) by Blender and filled in. Thus, the animators’ workload is significantly reduced.



Example of interpolation

For example, if you have:

- a control point of value `0` at frame `0`,
- another one of value `10` at frame `25`,
- and you use linear interpolation,

then, at frame `5` we get a value of `2`.

The same goes for all intermediate frames: with just two points, you get a smooth growth from `0` to `10` along the **25 frames**. Obviously, if you’d like the frame `15` to have a value of `9`, you’d have to add another control point (or keyframe)...

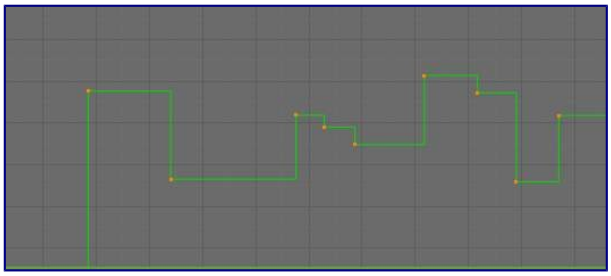
Settings

F-curves have three additional properties, which control the interpolation between points, extension behavior, and the type of handles.

Interpolation Mode

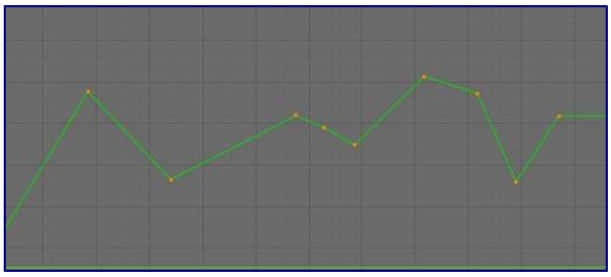
You have three choices (T, or Curve ‣ Interpolation Mode):

Constant
: There is no interpolation at all. The curve holds the value of its last keyframe, giving a discrete (stairway) “curve”. Usually only used during the initial “blocking” stage in pose-to-pose animation workflows.



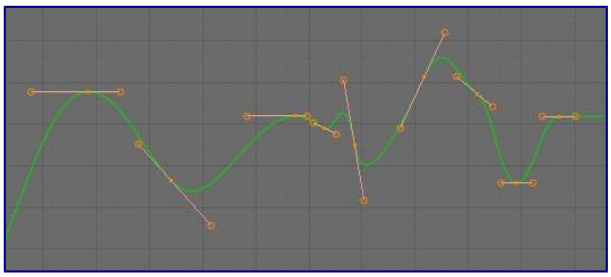
Constant.

Linear
: This simple interpolation creates a straight segment between each neighbor keyframes, giving a broken line. It can be useful when using only two keyframes and the *Extrapolation* extend mode, to easily get an infinite straight line (i.e. a linear curve).



Linear.

Bezier
: The more powerful and useful interpolation, and the default one. It gives nicely smoothed curves, i.e. smooth animations!



Bézier.

Remember that some FCurves can only take discrete values, in which case they are always shown as if constant interpolated, whatever option you chose.

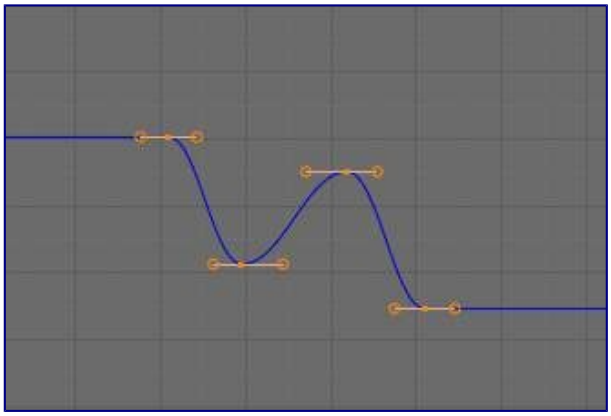
Extrapolation

(`Shift-E`, or Channel ‣ Extrapolation Mode)

Extrapolation defines the behavior of a curve before the first and after the last keyframes.

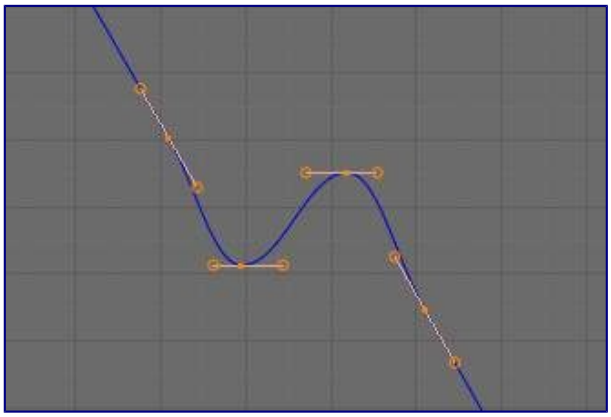
There are two basic extrapolation modes:

Constant
: The default one, curves before their first keyframe and after their last one have a constant value (the one of these first and last keyframes).



Constant extrapolation

Linear
: Curves ends are straight lines (linear), as defined by their first two keyframes (respectively their last two keyframes).



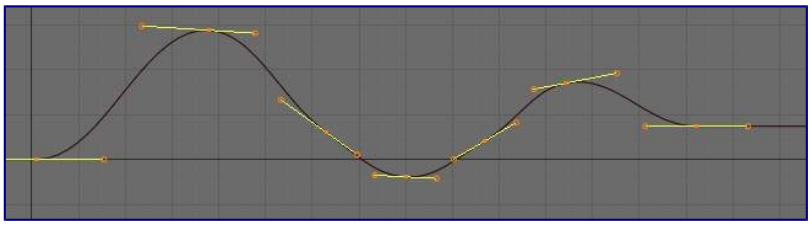
Linear extrapolation

Additional extrapolation tools (e.g. the “Cycles” F-Modifier) are located in the *F-Curve Modifiers*

Handle Types

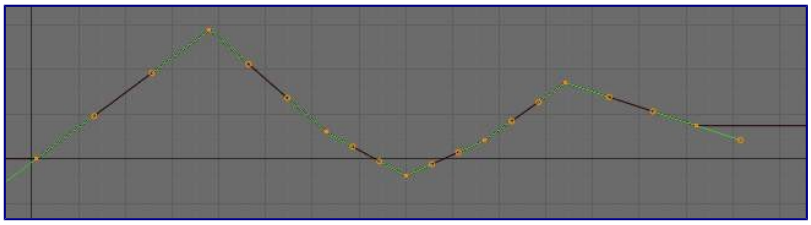
There is another curve option quite useful for Bézier-interpolated curves. You can set the type of handle to use for the curve points `V`

Automatic
: Keyframes are automatically interpolated



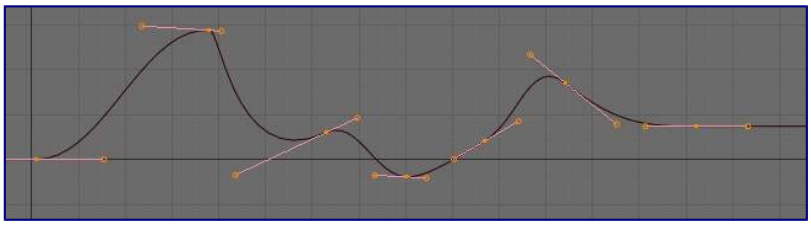
Auto handles

Vector
: Creates linear interpolation between keyframes. The linear segments remain if keyframe centers are moved. If handles are moved, the handle becomes Free.



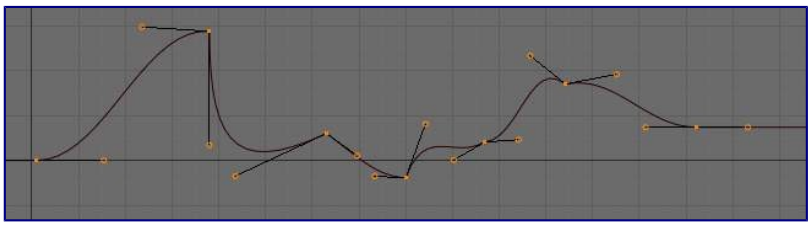
Vector handles

Aligned
: Handle maintain rotation when moved, and curve tangent is maintained



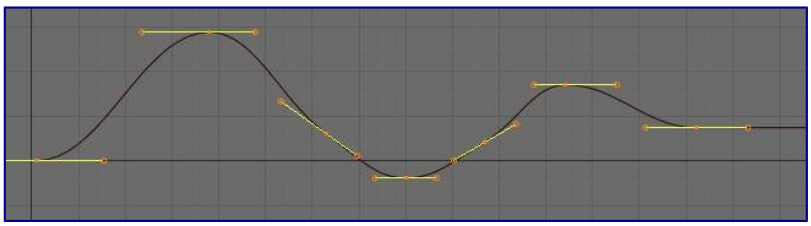
Aligned handles

Free
: Breaks handles tangents



Free handles

Auto Clamped
: Auto handles clamped to not overshoot



Auto clamped handles

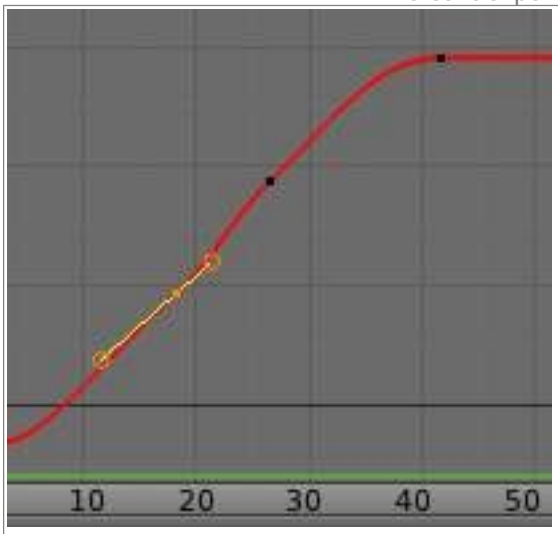
Direction of time

Although F-curves are very similar to Bezier Curves, there are some important differences.

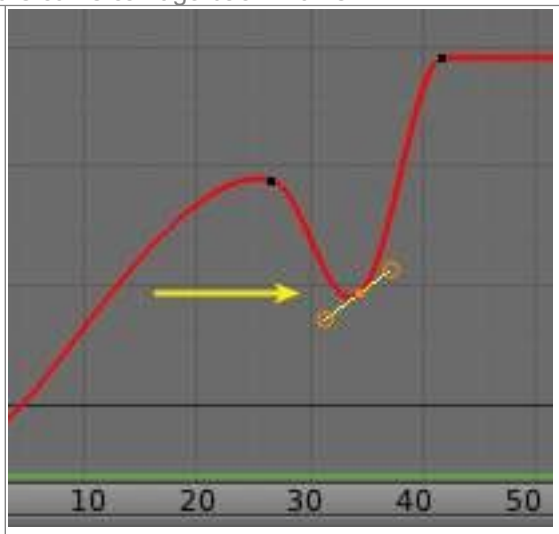
For obvious reasons, **a property represented by a Curve cannot have more than one value at a given time**, hence:

- when you move a control point ahead of a control point that was previously ahead of the point that you are moving, the two control points switch their order in the edited curve, to avoid that the curve goes back in time
- for the above reason, it's impossible to have a closed Ipo curve

Two control points switching: the curve can't go back in time!



Before moving the second keyframe



After moving the second keyframe

Editing Tools

By default, when new channels are added, the *Graph Editor* sets them to *Edit Mode*. Selected channels can be locked by pressing Tab.

Many of the hotkeys are the same as the viewport ones, for example:

- G to grab
- R to rotate
- S to scale
- B for border select/deselect

And of course you can lock the transformation along the X (time frame) or Y (value) axises by pressing X or Y during transformation.

For precise control of the keyframe position and value, you can set values in the *Active Keyframe* of the Properties Region.

Transform Snapping

When transforming keyframes with `G`, `R`, `S`, the transformation can be snapped to increments.

Snap Transformation to 1.0 `Ctrl`

Divide Transformation by 10.0 `Shift`

Keyframes can be snapped to different properties by using the *Snap Keys* tool.

Snap Keys `Shift-S`

Current Frame
: Snap the selected keyframes to the *Time Cursor.*

Cursor Value
: Snap the selected keyframes to the *Cursor.*

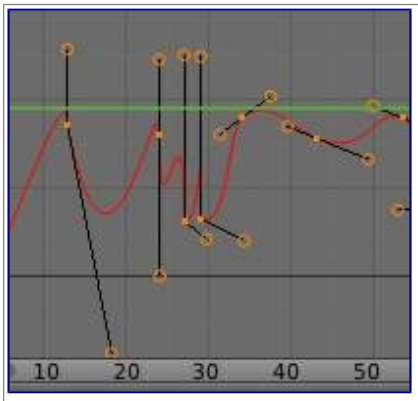
Nearest Frame
: Snap the selected keyframes to their nearest frame individually.

Nearest Second
: Snap the selected keyframes to their nearest second individually, based on the *FPS* of the scene.

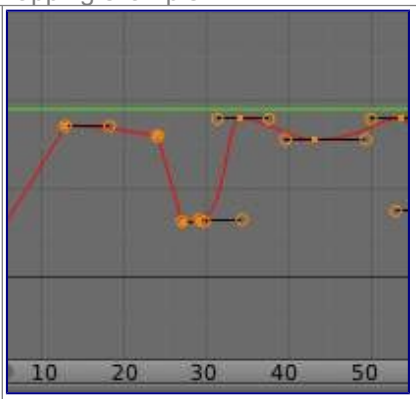
Nearest Marker
: Snap the selected keyframes to their nearest marker individually.

Flatten Handles
: Flatten the *Bezier* handles for the selected keyframes.

Flatten Handles snapping example.



Before Flatten Handles.



After Flatten Handles.

Mirror

Selected keyframes can be mirrored over different properties using the *Mirror Keys* tool.

Mirror Keys `Shift-M`

By Times Over Current Frame
: Mirror horizontally over the *Time Cursor.*

By Values over Cursor Value
: Mirror vertically over the *Cursor.*

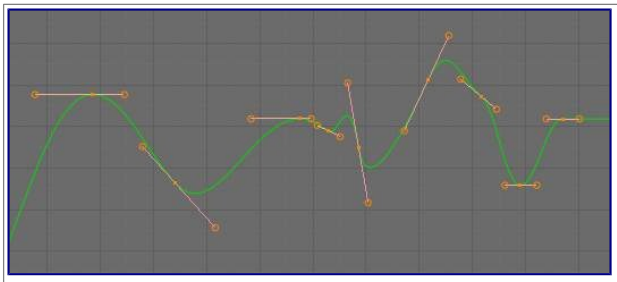
By Times over Time 0
: Mirror horizontally over frame 0.

By Values over Value 0
: Mirror vertically over value 0.

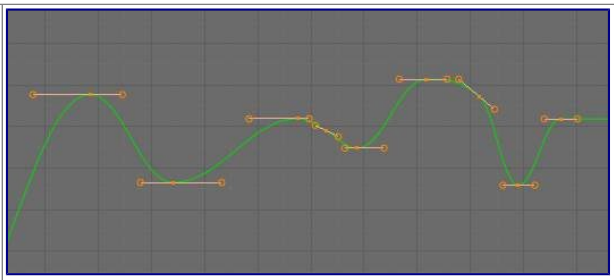
By Times over First Selected Marker
: Mirror horizontally the over the first selected *Marker.*

Clean Keyframes

Clean Keyframes resets the keyframe tangents to their auto-clamped shape, if they have been modified. *Clean Keyframes* `O`



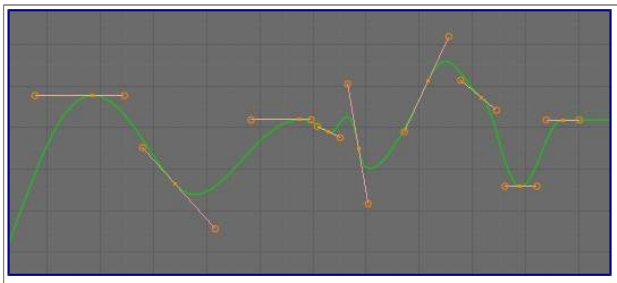
FCurve before cleaning



FCurve after cleaning

Smoothing

(`Alt-O` or Key ‣ Smooth Keys) There is also an option to smooth the selected curves , but beware: its algorithm seems to be to divide by two the distance between each keyframe and the average linear value of the curve, without any setting, which gives quite a strong smoothing! Note that the first and last keys seem to be never modified by this tool.



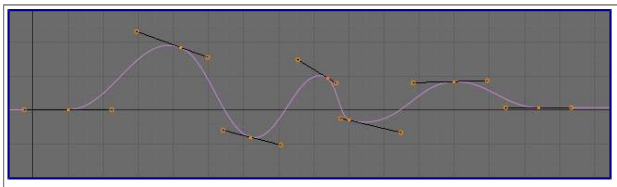
FCurve before smoothing

FCurve after smoothing

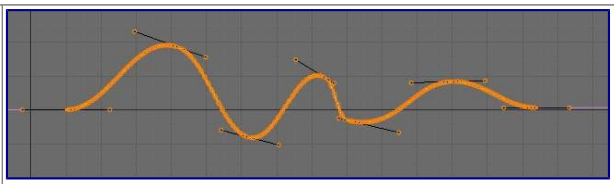
Sampling and Baking Keyframes

Sample Keyframes `Shift-O`

Sampling a set a keyframes replaces interpolated values with a new keyframe for each frame.



FCurve before sampling



FCurve after sampling

Bake Curves `Alt-C`

Baking a curve replaces it with a set of sampled points, and removes the ability to edit the curve.

F-Curve Modifiers

F-Curve modifiers are similar to object modifiers, in that they add non-destructive effects, that can be adjusted

at any time, and layered to create more complex effects.

Adding a Modifier

The F-curve modifier panel is located in the Properties panel. Select a curve by selecting one of its curve points, or by selecting the channel list. Click on the *Add Modifier* button and select a modifier.

To add spin to an object or group, select the object/group and add a keyframe to the axis of rotation (x,y, or z)

Go to the Graph Editor.....make sure the f-curves properties panel is visible (View > Properties)

>Add Modifier > (e.g.) Generator

Types of Modifiers

Generator

Generator creates a Factorized or Expanded Polynomial function. These are basic mathematical formulas that represent lines, parabolas, and other more complex curves, depending on the values used.

Additive
: This option causes the modifier to be added to the curve, instead of replacing it by default.

Poly Order
: Specify the order of the polynomial, or the highest power of ‘x’ for this polynomial. (number of coefficients - 1).

Change the Coefficient values to change the shape of the curve.

See also
The Wikipedia Page for more information on polynomials.

Built-in Function

These are additional formulas, each with the same options to control their shape. Consult mathematics reference for more detailed information on each function.

- Sine
- Cosine
- Tangent
- Square Root
- Natural Logarithm
- Normalized Sine (sin(x)/x)

Amplitude
: Adjusts the Y scaling

Phase Multiplier
: Adjusts the X scaling

Phase Offset
: Adjusts the X offset

Value Offset

Adjusts the Y offset

Envelope

Allows you to adjust the overall shape of a curve with control points.

Reference Value
Set the Y value the envelope is centered around.
Min
Lower distance from Reference Value for `1:1` default influence.
Max
Upper distance from Reference Value for `1:1` default influence.
Add Point
Add a set of control points. They will be created at the current frame.
Fra:
Set the frame number for the control point.
Min
Specifies the lower control point's position.
Max
specifies the upper control point's position.

Cycles

Cycles allows you add cyclic motion to a curve that has 2 or more control points. The options can be set for before and after the curve.

Cycle Mode
Repeat Motion
Repeats the curve data, while maintaining their values each cycle.
Repeat with Offset
Repeats the curve data, but offsets the value of the first point to the value of the last point each cycle.
Repeat Mirrored
Each cycle the curve data is flipped across the X-axis.
Before/After Cycles
Set the number of times to cycle the data. A value of 0 cycles the data infinitely.

Noise

Modifies the curve with a noise formula. This is useful for creating subtle or extreme randomness to animated movements, like camera shake.

Blend Type
Replace
Adds a -.5 to .5 range noise function to the curve.
Add
Adds a 0 to 1 range noise function to the curve.
Subtract
Subtracts a 0 to 1 range noise function to the curve.
Multiply
Multiplies a 0 to 1 range noise function to the curve.
Scale

Adjust the overall size of the noise. Values further from 0 give less frequent noise.

Strength
Adjusts the Y scaling of the noise function.

Phase
Adjusts the random seed of the noise.

Depth
Adjusts how detailed the noise function is.

Python

Limits

Limit curve values to specified X and Y ranges.

Minimum/Maximum X
Cuts a curve off at these frames ranges, and sets their minimum value at those points.

Minimum/Maximum Y
Truncates the curve values to a range.

Stepped

Gives the curve a stepped appearance by rounding values down within a certain range of frames.

Step Size
Specify the number of frames to hold each frame

Offset
Reference number of frames before frames get held. Use to get hold for ‘1-3’ vs ‘5-7’ holding patterns.

Use Start Frame
Restrict modifier to only act before its ‘end’ frame

Use End Frame
Restrict modifier to only act after its ‘start’ frame