

7.2.4 Rigging - Constraints - Transform

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Copy Location Constraint

Description

The *Copy Location* constraint forces its owner to have the same location as its target.

Warning

Note that if you use such a constraint on a *connected* bone, it will have no effect, as it is the parent's tip which controls the position of your owner bone's root.

Options



Copy Location panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If *Target* is an *Armature*, a new field is displayed offering the optional choice to set an individual bone as *Target*.

Head/Tail

If a *Bone* is set as *Target*, a new field is displayed offering the optional choice of where along this bone the target point lies.

Vertex Group

If *Target* is a *Mesh*, a new field is displayed offering the optional choice to set a *Vertex Group* as target.

X, Y, Z

These buttons control which axes (i.e. coordinates) are constrained - by default, all three ones are.

Invert

The *Invert* buttons invert their respective preceding coordinates.

Offset

When enabled, this control allows the owner to be translated (using its current transform properties), relative to its target's position.

Space

This constraint allows you to choose in which space to evaluate its owner's and target's transform properties.

Copy Rotation Constraint

The *Copy Rotation* constraint forces its owner to match the rotation of its target.

Options



Copy Rotation panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If *Target* is an *Armature*, a new field is displayed offering the optional choice to set an individual bone as *Target*.

Head/Tail

If a *Bone* is set as *Target*, a new field is displayed offering the optional choice of where along this bone the target point lies.

Vertex Group

If *Target* is a *Mesh*, a new field is displayed offering the optional choice to set a *Vertex Group* as target.

X, Y, Z

These buttons control which axes are constrained - by default, all three are on.

Invert

The *Invert* buttons invert their respective rotation values.

Offset

When enabled, this control allows the owner to be rotated (using its current transform properties), relative to its target's orientation.

Space

This constraint allows you to choose in which space to evaluate its owner's and target's transform properties.

Copy Scale Constraint

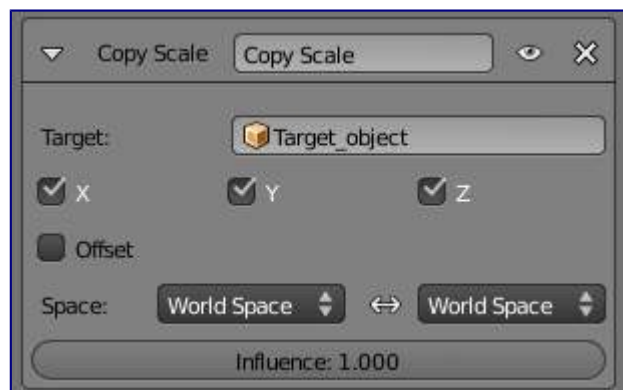
Description

The *Copy Scale* constraint forces its owner to have the same scale as its target.

Warning

Here we talk of **scale**, not of **size**! Indeed, you can have two objects, one much bigger than the other, and yet both of them have the same scale. This is also true with bones: in *Pose* mode, they all have a unitary scale when they are in rest position, represented by their visible length.

Options



Copy Scale panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If *Target* is an *Armature*, a new field is displayed offering the optional choice to set an individual bone as *Target*.

Head/Tail

If a *Bone* is set as *Target*, a new field is displayed offering the optional choice of where along this bone the target point lies.

Vertex Group

If *Target* is a *Mesh*, a new field is displayed offering the optional choice to set a *Vertex Group* as target.

X, Y, Z

These buttons control along which axes the scale is constrained - by default, it is enabled along all three.

Offset

When enabled, this control allows the owner to be scaled (using its current transform properties), relatively to its target's scale.

Space

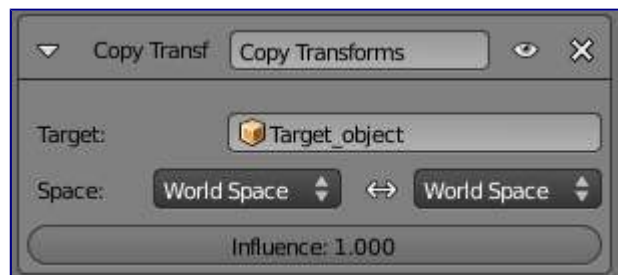
This constraint allows you to choose in which space to evaluate its owner's and target's transform properties.

Copy Transforms Constraint

Description

The *Copy Transforms* constraint forces its owner to have the same transforms as its target.

Options



Copy Transforms panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If *Target* is an *Armature*, a new field is displayed offering the optional choice to set an individual bone as *Target*.

Head/Tail

If a *Bone* is set as *Target*, a new field is displayed offering the optional choice of where along this bone the target point lies.

Vertex Group

If *Target* is a *Mesh*, a new field is displayed offering the optional choice to set a *Vertex Group* as target.

Space

This constraint allows you to choose in which space to evaluate its owner's and target's transform properties.

Limit Distance Constraint

Description

The *Limit Distance* constraint forces its owner to stay either further from, nearer to, or exactly at a given distance from its target. In other words, the owner's location is constrained either outside, inside, or at the surface of a sphere centered on its target.

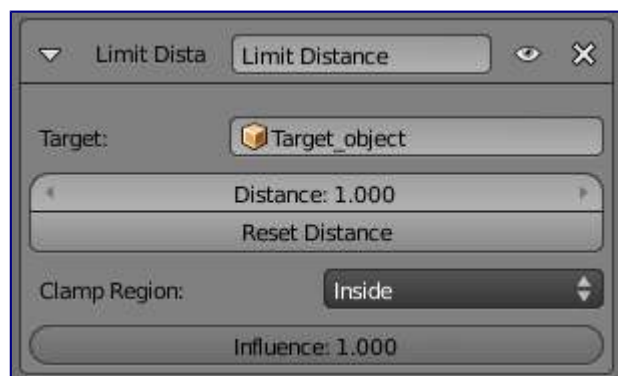
When you specify a (new) target, the *Distance* value is automatically set to correspond to the distance between the owner and this target.

Warning

Note that if you use such a constraint on a *connected* bone, it will have no effect, as it is the

parent's tip which controls the position of your owner bone's root.

Options



Limit Distance panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If *Target* is an *Armature*, a new field is displayed offering the optional choice to set an individual bone as *Target*.

Head/Tail

If a *Bone* is set as *Target*, a new field is displayed offering the optional choice of where along this bone the target point lies.

Vertex Group

If *Target* is a *Mesh*, a new field is displayed offering the optional choice to set a *Vertex Group* as target.

Distance

This numeric field sets the limit distance, i.e. the radius of the constraining sphere.

Reset Distance

When clicked, this small button will reset the *Distance* value, so that it corresponds to the actual distance between the owner and its target (i.e. the distance before this constraint is applied).

Clamp Region

The *Limit Mode* drop-down menu allows you to choose how to use the sphere defined by the *Distance* setting and target's center:

Inside (default)

The owner is constrained *inside* the sphere.

Outside

The owner is constrained *outside* the sphere.

Surface

The owner is constrained *on the surface* of the sphere.

Limit Location Constraint

Description

An object or *unconnected* bone can be moved around the scene along the X, Y and Z axes. This constraint restricts the amount of allowed translations along each axis, through lower and upper bounds.

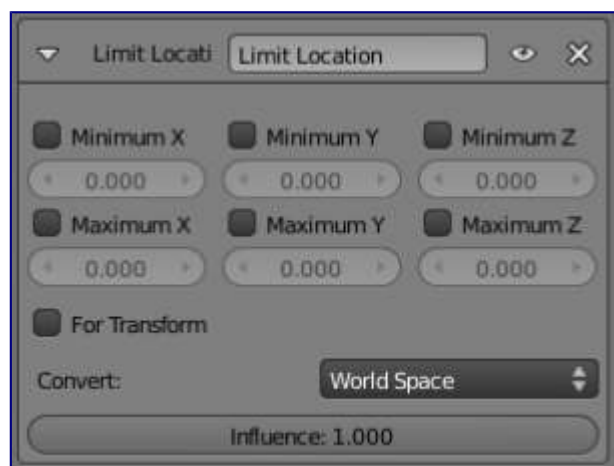
The limits for an object are calculated from its center, and the limits of a bone, from its root.

It is interesting to note that even though the constraint limits the visual and rendered location of its owner, its owner's data block still allows (by default) the object or bone to have coordinates outside the minimum and maximum ranges. This can be seen in its *Transform Properties* panel (N). When an owner is grabbed and attempted to be moved outside the limit boundaries, it will be constrained to those boundaries visually and when rendered, but internally, its coordinates will still be changed beyond the limits. If the constraint is removed, its ex-owner will seem to jump to its internally specified location.

Similarly, if its owner has an internal location that is beyond the limits, dragging it back into the limit area will appear to do nothing until the internal coordinates are back within the limit threshold (unless you enabled the *For Transform* option, see below).

Setting equal the min and max values of an axis, locks the owner's movement along that axis... Although this is possible, using the *Transformation Properties* axis locking feature is probably easier!

Options



Limit Location panel

Minimum X, Minimum Y, Minimum Z

These buttons enable the lower boundary for the location of the owner's center along, respectively, the X, Y and Z axes of the chosen *Space*. The numeric field below them controls the value of their limit. Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

Maximum X, Maximum Y, Maximum Z

These buttons enable the upper boundary for the location of the owner's center along, respectively, the X, Y and Z axes of the chosen *Space*. Same options as above.

For Transform

We saw that by default, even though visually constrained, the owner can still have coordinates out of

bounds (as shown by the *Transform Properties* panel). Well, when you enable this button, this is no longer possible - the owner's transform properties are also limited by the constraint. Note however that the constraint does not directly modify the coordinates: you have to grab its owner one way or another for this to take effect...

Convert

This constraint allows you to choose in which space to evaluate its owner's transform properties.

Limit Rotation Constraint

Description

An object or bone can be rotated around the X, Y and Z axes. This constraint restricts the amount of allowed rotations around each axis, through lower and upper bounds.

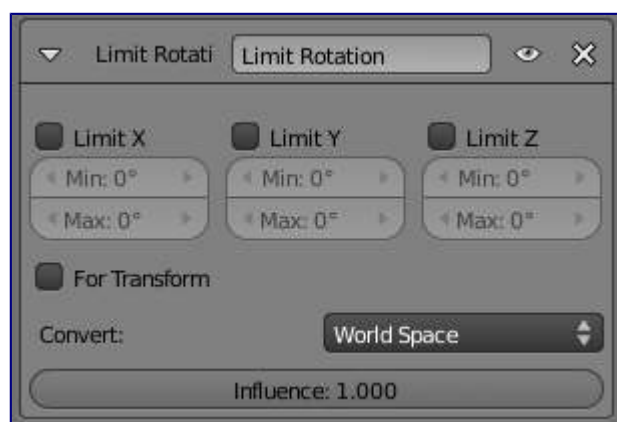
It is interesting to note that even though the constraint limits the visual and rendered rotations of its owner, its owner's data block still allows (by default) the object or bone to have rotation values outside the minimum and maximum ranges. This can be seen in the *Transform Properties* panel (N). When an owner is rotated and attempted to be rotated outside the limit boundaries, it will be constrained to those boundaries visually and when rendered, but internally, its rotation values will still be changed beyond the limits. If the constraint is removed, its ex-owner will seem to jump to its internally specified rotation.

Similarly, if its owner has an internal rotation that is beyond the limit, rotating it back into the limit area will appear to do nothing until the internal rotation values are back within the limit threshold (unless you enabled the *For Transform* option, see below).

Setting equal the min and max values of an axis, locks the owner's rotation around that axis... Although this is possible, using the *Transformation Properties* axis locking feature is probably easier.

This transform does not constrain the bone if it is manipulated by the IK solver. For constraining the rotation of a bone for IK purposes, see the "Inverse Kinematics" section of Bone properties.

Options



Limit Rotation panel

Limit X, LimitY, LimitZ

These buttons enable the rotation limit around respectively the X, Y and Z axes of the owner, in the chosen *Space*. The *Min* and *Max* numeric fields to their right control the value of their lower and upper boundaries, respectively.

Note that:

- If a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.
- Unlike the *Limit Location constraint*, you cannot enable separately lower or upper limits...

For Transform

We saw that by default, even though visually constrained, the owner can still have rotations out of bounds (as shown by the *Transform Properties* panel). Well, when you enable this button, this is no more possible - the owner transform properties are also limited by the constraint. Note however that the constraint does not directly modifies the rotation values: you have to rotate one way or the other its owner, for this to take effect...

Convert

This constraint allows you to chose in which space evaluate its owner's transform properties.

Limit Scale Constraint

Description

An object or bone can be scaled along the X, Y and Z axes. This constraint restricts the amount of allowed scalings along each axis, through lower and upper bounds.

Warning

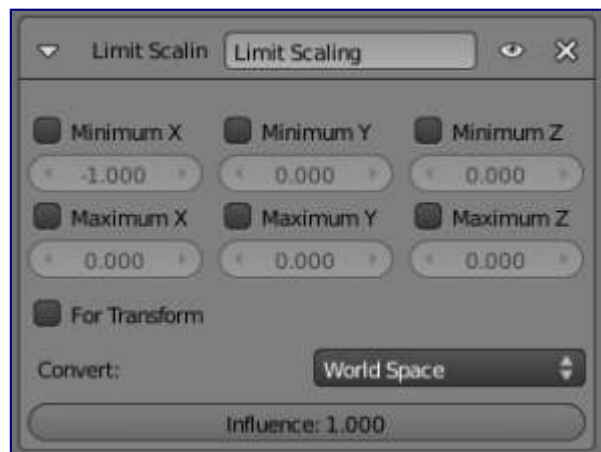
This constraint does not tolerate negative scale values (those you might use to mirror an object...): when you add it to an object or bone, even if no axis limit is enabled, nor the *For Transform* button, as soon as you scale your object, all negative scale values are instantaneously inverted to positive ones... And the boundary settings can only take strictly positive values.

It is interesting to note that even though the constraint limits the visual and rendered scale of its owner, its owner's data block still allows (by default) the object or bone to have scale values outside the minimum and maximum ranges (as long as they remain positive!). This can be seen in its *Transform Properties* panel (N). When an owner is scaled and attempted to be moved outside the limit boundaries, it will be constrained to those boundaries visually and when rendered, but internally, its coordinates will still be changed beyond the limits. If the constraint is removed, its ex-owner will seem to jump to its internally-specified scale.

Similarly, if its owner has an internal scale that is beyond the limits, scaling it back into the limit area will appear to do nothing until the internal scale values are back within the limit threshold (unless you enabled the *For Transform* option, see below - or your owner has some negative scale values).

Setting equal the min and max values of an axis locks the owner's scaling along that axis. Although this is possible, using the *Transformation Properties* axis locking feature is probably easier.

Options



Limit Scale panel

Minimum / Maximum X, Y, Z

These buttons enable the lower boundary for the scale of the owner along respectively the X, Y and Z axes of the chosen *Space*. The *Min* and *Max* numeric fields to their right control the value of their lower and upper boundaries, respectively. Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

For Transform

We saw that by default, even though visually constrained, and except for the negative values, the owner can still have scales out of bounds (as shown by the *Transform Properties* panel). Well, when you enable this button, this is no longer possible - the owner transform properties are also limited by the constraint. Note however that the constraint does not directly modify the scale values: you have to scale its owner one way or another for this to take effect.

Convert

This constraint allows you to choose in which space to evaluate its owner's transform properties.

Maintain Volume Constraint

Description

The *Maintain Volume* constraint limits the volume of a mesh or a bone to a given ratio of its original volume.

Option



Maintain Volume panel

Free X / Y / Z

The free-scaling axis of the object.

Volume

The bone's rest volume. Default is **1.0**.

Space

This constraint allows you to choose in which space to evaluate its owner's transform properties.

See also

- Harkyman on the development of the Maintain Volume constraint, March 2010

Transformation Constraint

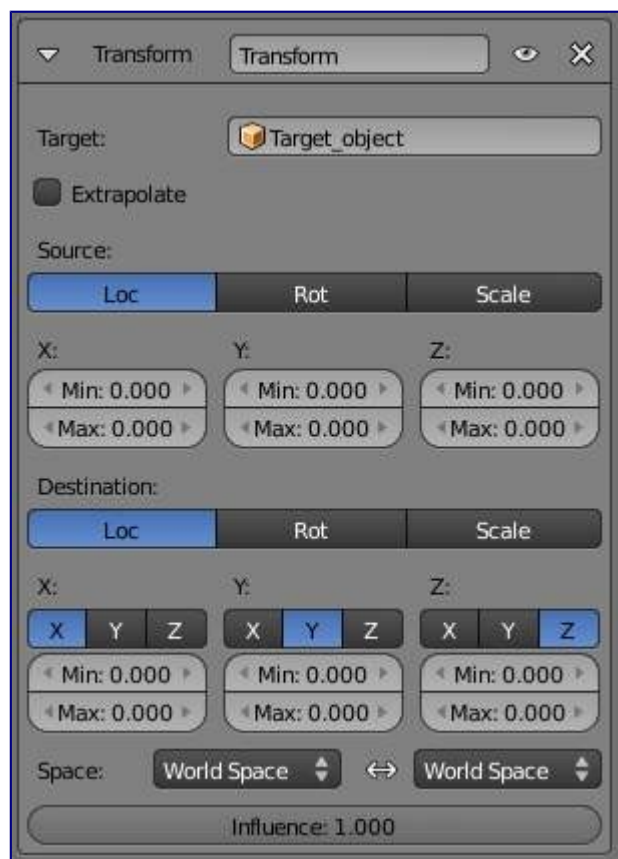
This constraint is more complex and versatile than the other “transform” constraints. It allows you to map one type of transform properties (i.e. location, rotation or scale) of the target, to the same or another type of transform properties of the owner, within a given range of values (which might be different for each target and owner property). You can also switch between axes, and use the range values not as limits, but rather as “markers” to define a mapping between input (target) and output (owner) values.

So, e.g. you can use the position of the target along the X axis to control the rotation of the owner around the Z axis, stating that **1 BU** along the target X axis corresponds to

10 around the owner Z axis. Typical uses for this include gears (see note below),

and rotation based on location setups.

Options



Transformation panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If *Target* is an *Armature*, a new field is displayed offering the optional choice to set an individual bone as *Target*.

Head/Tail

If a *Bone* is set as *Target*, a new field is displayed offering the optional choice of where along this bone the target point lies.

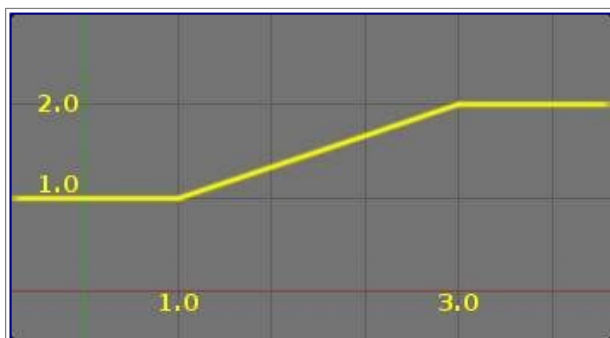
Vertex Group

If *Target* is a *Mesh*, a new field is displayed offering the optional choice to set a *Vertex Group* as target.

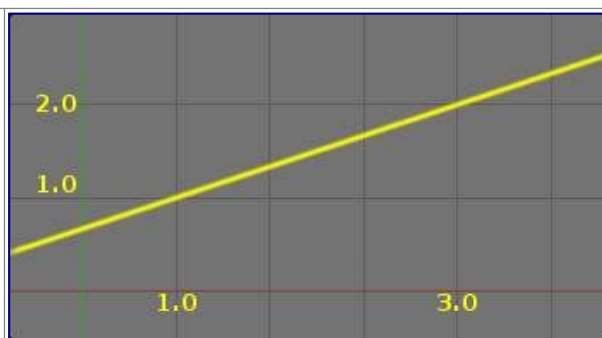
Extrapolate

By default, the *min* and *max* values bound the input and output values; all values outside these ranges are clipped to them. When you enable this button, the *min* and *max* values are no longer strict limits, but rather “markers” defining a proportional (linear) mapping between input and corresponding output values. Let’s illustrate that with two graphs (*The Extrapolate principles*). In these pictures, the input range (in abscissa) is set to $[1.0, 4.0]$, and its corresponding output range (in ordinate), to $[1.0, 2.0]$. The yellow curve represents the mapping between input and output.

The Extrapolate principles.



Extrapolate disabled: the output values are bounded inside the [1.0, 2.0] range.



Extrapolate enabled: the output values are “free” to proportionally follow the input ones.

Warning

Note that:

- When mapping transform properties to location (i.e. *Loc*, *Destination* button is enabled), the owner’s existing location is added to the result of evaluating this constraint (exactly like when the *Offset* button of the *Copy Location* constraint is enabled...).
- Conversely, when mapping transform properties to rotation or scale, the owner’s existing rotation or scale is overridden by the result of evaluating this constraint.
- When using the rotation transform properties of the target as input, whatever the real values are, the constraint will always “take them back” into the $-180, 180$ range (e.g. if the target has a rotation of 420 around its X axis, the values used as X input by the constraint will be $((420 + 180) \bmod 360) - 180 = 60 - \dots$). This is why this constraint is not really suited for gears!
- Similarly, when using the scale transform properties of the target as input, whatever the real values are, the constraint will always take their absolute values (i.e. invert negative ones).
- When a *min* value is higher than its corresponding *max* one, both are considered equal to the *max* one. This implies you cannot create “reversed” mappings...

Source

It contains the input (from target) settings. The three *Loc*, *Rot* and *Scale* toggle buttons, mutually exclusive, allow you to select which type of property to use. The X:, Y: and Z: *min* and *max* numeric fields control the lower and upper bounds of the input value range, independently for each axis. Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

Destination

It contains the output (to owner) settings.

- The three *Loc*, *Rot* and *Scale* toggle buttons, mutually exclusive, allow you to select which type of property to control.
- The three *Axis Mapping* drop-down lists allow you to select which input axis to map to, respectively (from top to bottom), the X, Y and Z output (owner) axes.
- The *min* and *max* numeric fields control the lower and upper bounds of the output value range, independently for each mapped axis. Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

Space

This constraint allows you to choose in which space to evaluate its owner's and target's transform properties.