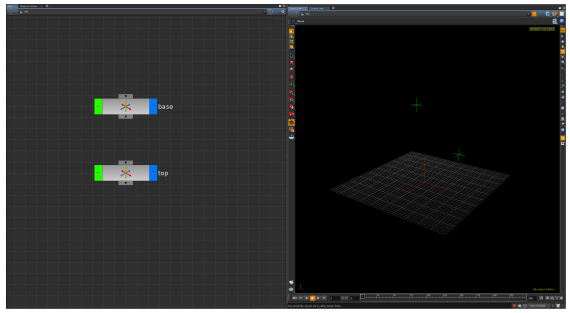
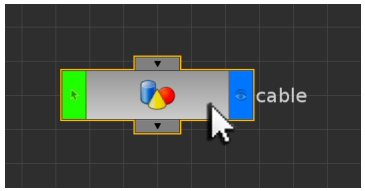
Open the scene **wire_cable_begin.hipnc**. This scene contains **two Object Level Nulls**, both of which are procedurally animated using simple expressions. When **PLAY** is pressed, both of these Null Objects bounce around the scene. This example will look at creating a spiral cable between these two animated Null Objects.



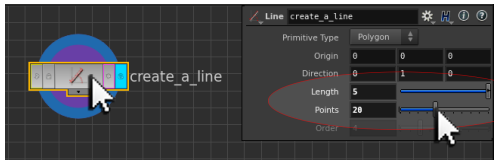
NOTE: Expression based animation will be covered in an upcoming lecture. The animation assigned to these Null Objects is simply for testing purposes, and therefore keyframes could have been used instead.

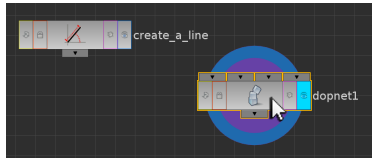


Alongside the Null Objects, create a new **Geometry Object**, and rename it to **cable**. Inside it, **delete** the **default File SOP** and in its place create a **Line SOP**.

Rename the node to **create a line**, and in its **parameters** specify:

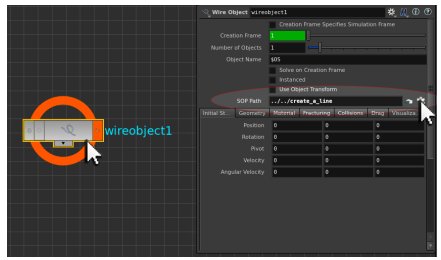
Length	**5**
Points	**20**





This will create a vertical line that some simple dynamics can be added to.

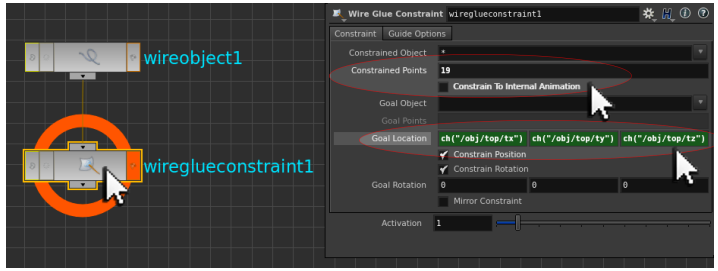
Alongside the Line SOP create a **DOP Network**. **Double LMB** on the **DOP Network** to go inside it, and create a **Wire Object DOP**. This node can be used to read in the **Line SOP geometry**.



In the **parameters** of the **Wire Object DOP** specify:

SOP Path	**../../create_a_line**

Append to the Wire Object DOP a **Wire Glue Constraint DOP**. This can be used to fix one end of the line onto one of the animated Null Objects.



In the **parameters** for the **Wire Glue Constraint DOP** specify:

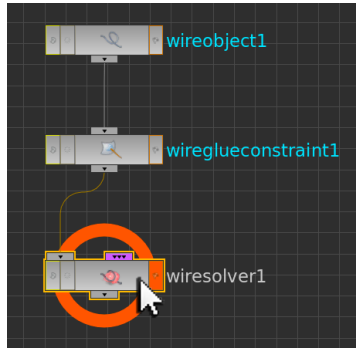
Constrained Points **19**

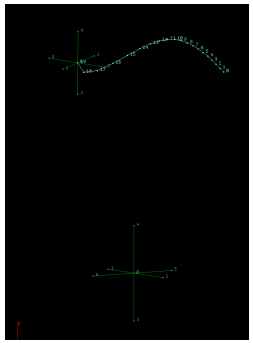
☐ **Constrain to Animation**

Goal Location **ch("/obj/top/tx")** **ch("/obj/top/ty")** **ch("/obj/top/tz")**

This will fix the top point of the line geometry onto the **top Null Object**.

NOTE: Channel referencing of the top Null Object's translate position parameters can be copied and pasted into the Goal Location parameter; or this channel reference can simply be typed directly into this parameter instead.

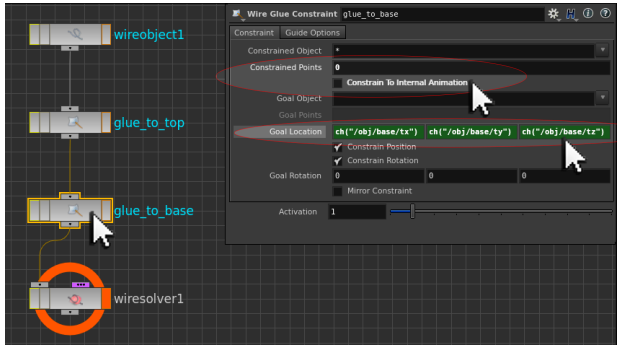




Append to the network a **Wire Solver DOP**. This will activate the dynamics of the line geometry as a dynamic wire. When **PLAY** is pressed, the line is instantly glued to the top Null object as it animates.

FIXING THE BASE OF THE LINE

Rename the Wire Glue Constraint DOP to glue_to_top, and use CTRL + c and CTRL + v to Copy and Paste a second version of this node. Rename this copy to glue_to_base.



In the **parameters** for the **glue_to_base** node specify:

Constrained Points **0**

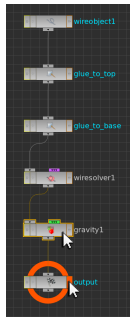
■ **Constrain to Animation**

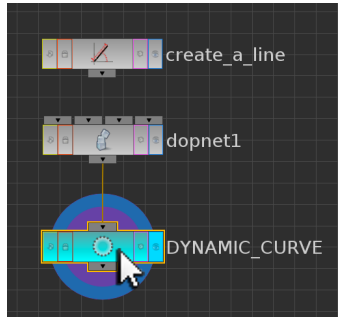
Goal Location **ch("/obj/base/tx")** **ch("/obj/base/ty")** **ch("/obj/base/tz")**

This will procedurally fix the base point of the line geometry onto the animated base Null Object.

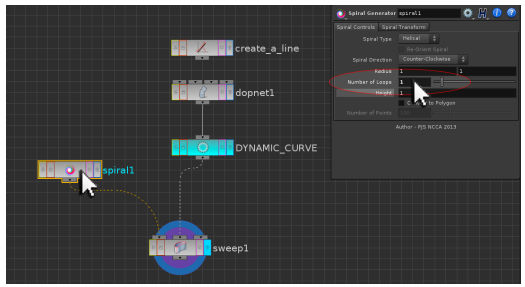
NOTE: Channel referencing of the base Null Object's translate position parameters can be copied and pasted into the Goal Location parameter; or this channel reference can simply be typed directly into this parameter instead.

As a final step, append a **Gravity Force DOP** to this dynamics network, and **wire** it **into** the standard **Output DOP**. Back at **SOP Level** append a **Null SOP** to the DOP Network.





Alongside this network chain, **create** a **Spiral Generator** and append to it a **Sweep SOP**. Wire the output from the DYNAMIC_CURVE Null SOP as its second input.



In the **parameters** for the **Spiral Generator** specify:

Spiral Controls >

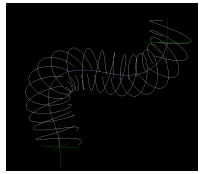
Radius **0.5** **0.5**

Number of Loops **1**

Spiral Transform >

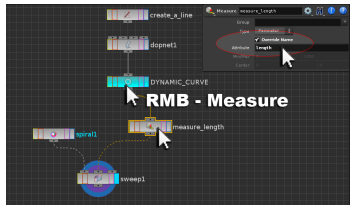
Rotate **90** **0** **0**

This will create a single loop of the spiral that when it is swept along the dynamic curve helps create the spiral cable effect.



When **PLAY** is pressed, the Height value of the Spiral Generator does not change relative to animated line. Each swept spiral therefore does not align properly to the one above or below it.

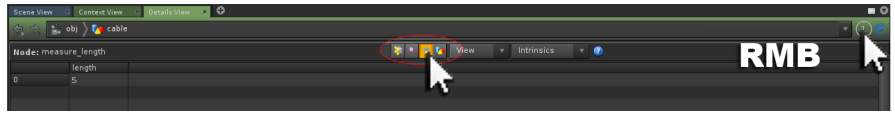
RMB on the output of the **DYNAMIC_CURVE Null SOP** to **insert** a **Measure SOP** and **rename** it to **measure_length**. This can be used to procedurally calculate the length of the length of the line at each frame.



In the **parameters** for the **Measure SOP** specify:

☑	**Override Name**
Attribute	**length**

This will create a primitive attribute called length storing the length of the line. The value for this attribute can be seen by activating a **Geometry Spreadsheet** as a new **Pane Tab Type** over the **Viewer**, and setting a **Pane Number** value of **1**.



When the **Primitive Attribute display button** is **activated**, the **length value** can be seen. This value will also adjust with each new frame in accordance to the new length value being created. As all the points along the curve are equidistant, this overall length value can be divided to create a suitable value for controlling the Height parameter of the Spiral Generator SOP.

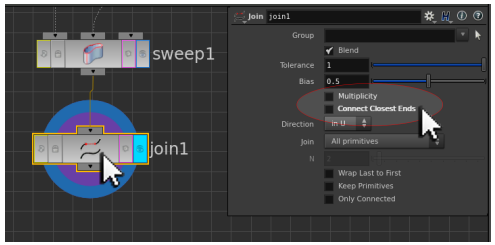
To the **Height** parameter of the **Spiral Generator SOP**, add the following expression:

Height	**prim("../measure_length",0,"length",0) / npoints("../create_a_line")**

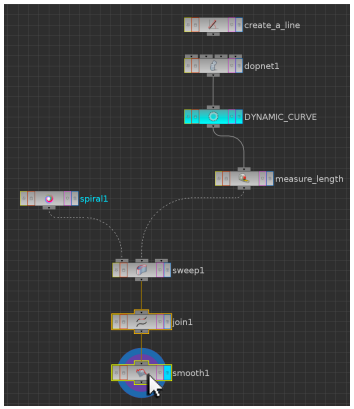
The **prim() expression** will **retrieve** the **length attribute** created by the Measure SOP. The npoints() expression will return the number of points created by the Line SOP.

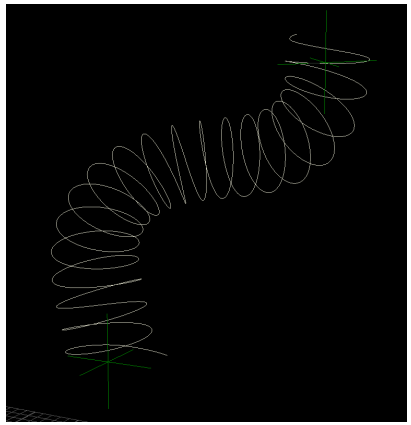
When **PLAY** is pressed again, the alignment of the swept spirals along each curve is much better for creating a consistent spiral coil around the dynamic curve.

A **Join SOP** can then be appended to link all the separate spirals together. In the **parameters** of the **Join SOP**, **deactivate** the **Connect Closest Ends option**. This will prevent the Join SOP from automatically guessing incorrectly which ends of the separate spirals should connect to each other.



A **Smooth SOP** can be used to complete the illusion of the spiral coil; smoothing out the resulting curve to create a natural coil shape.





As a final step, a NURBS circle can be swept onto this coil curve to create the final cable geometry. **See file wire_cable_complete.hipnc**