

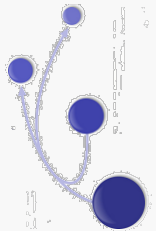
Herbert Sauro

Bioengineering, UW
Seattle
2016

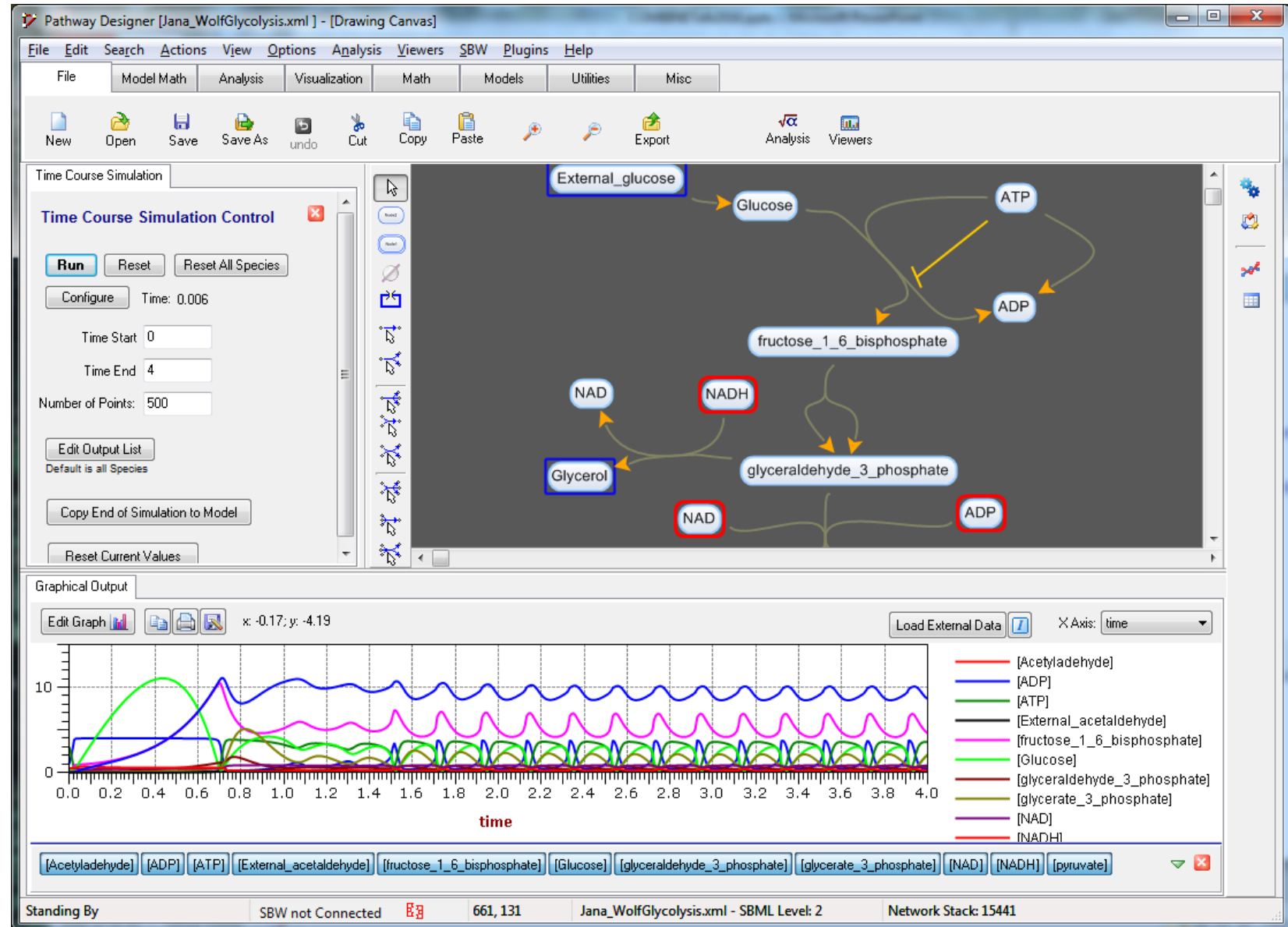


pathwayDesigner.org

Bosley LLC and Rosa and Co, LLC



pathwayDesigner



pathwayDesigner

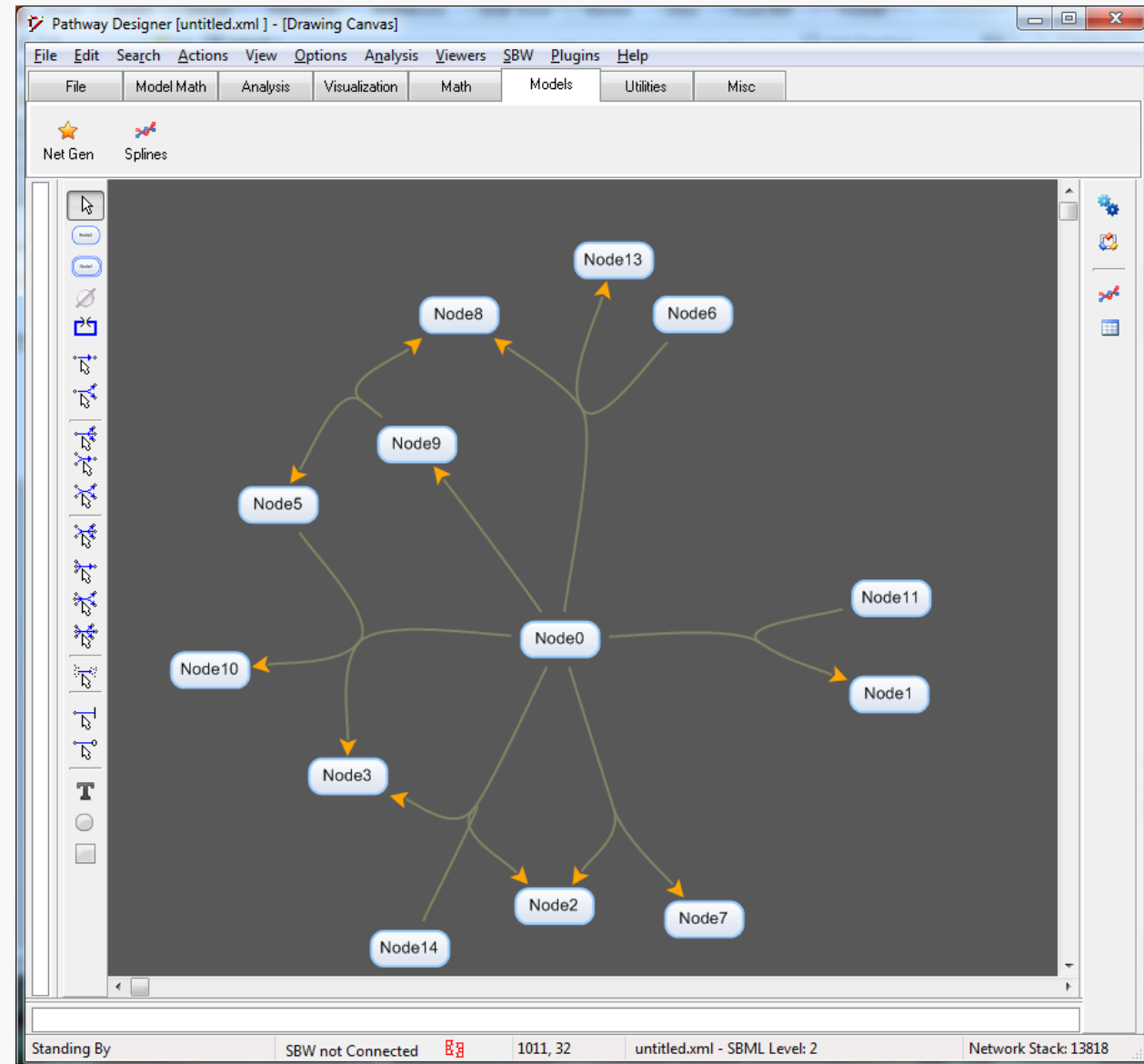
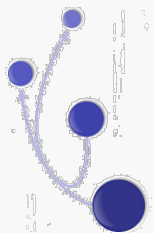
Derived from the JDesigner
Codebase

Visible

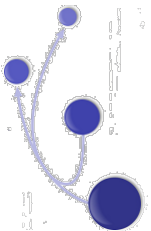
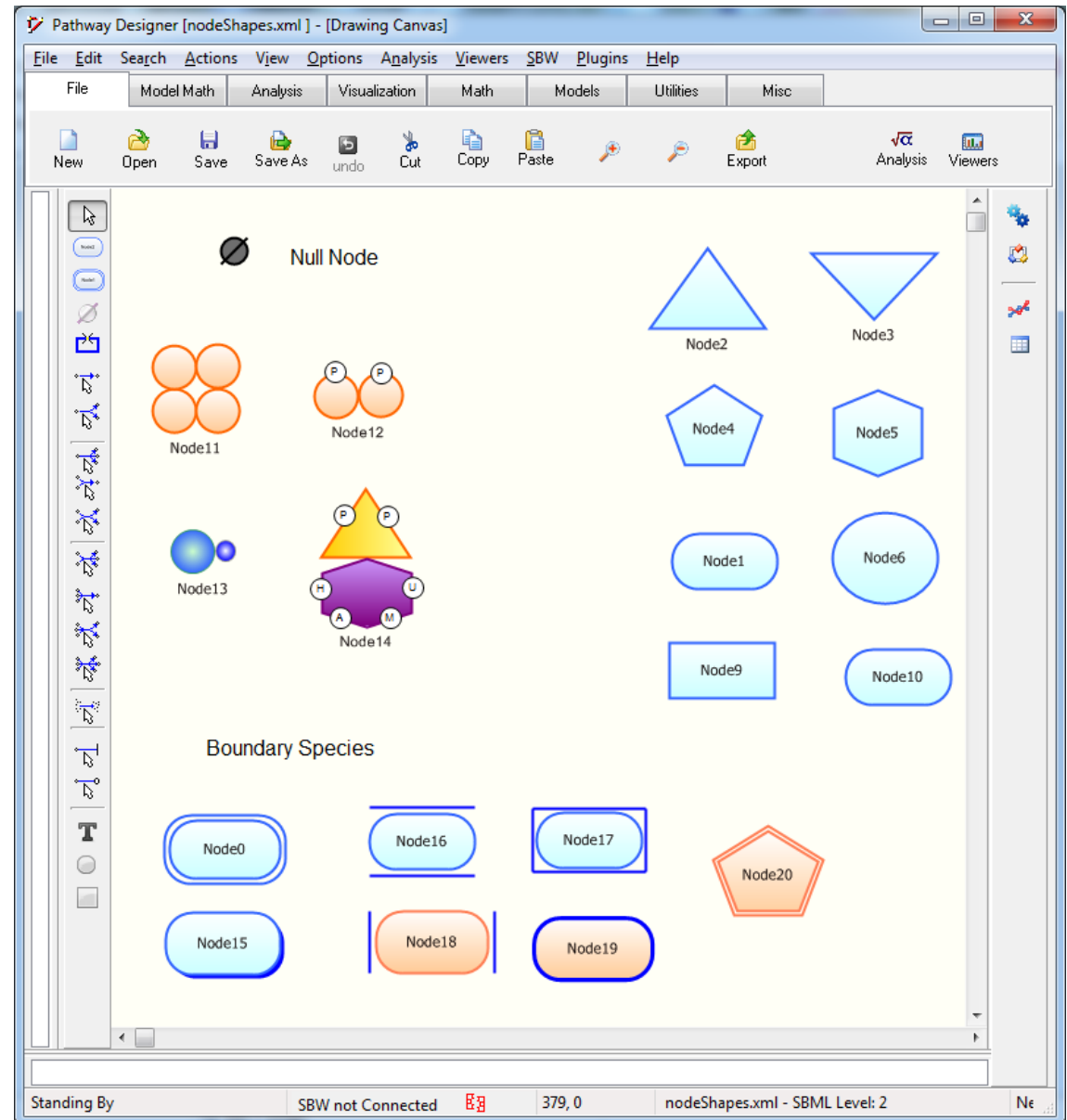
- New toolbar
- Range of Plugins
- New range of species shapes
- Styles
- SBML Events
- Misc

Under the Hood

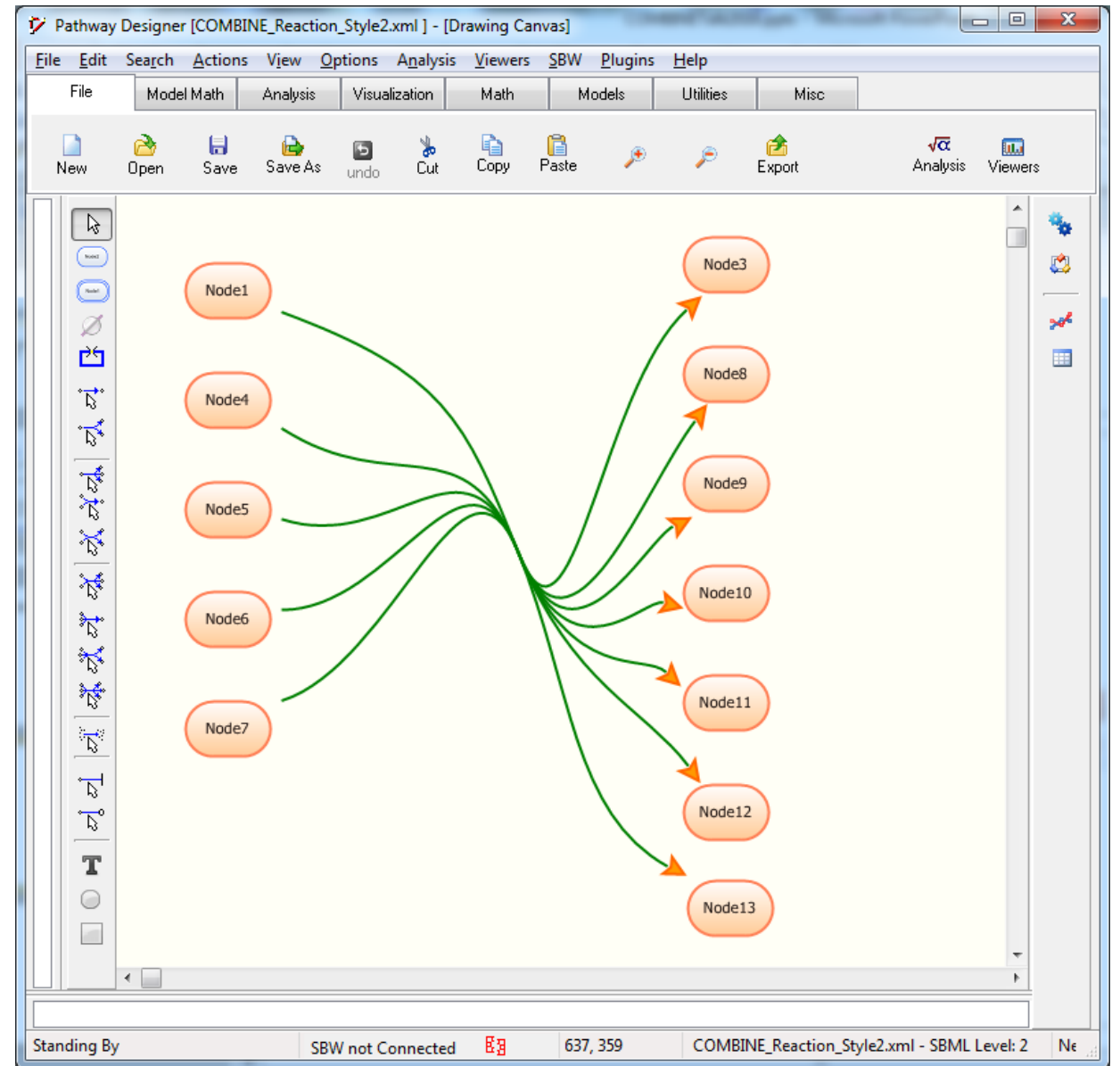
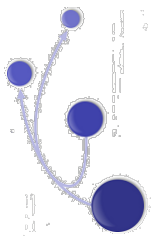
- New Plugin Interface
- Uses libSBML to parse SBML
- Uses libRoadRunner directly
- SBW interface



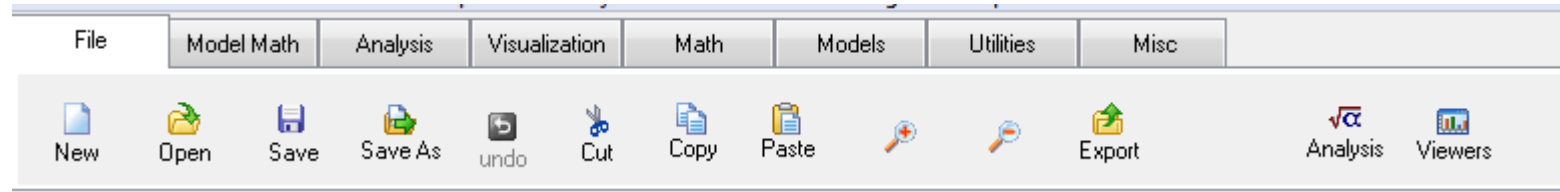
New Node Styles



n by m reactions

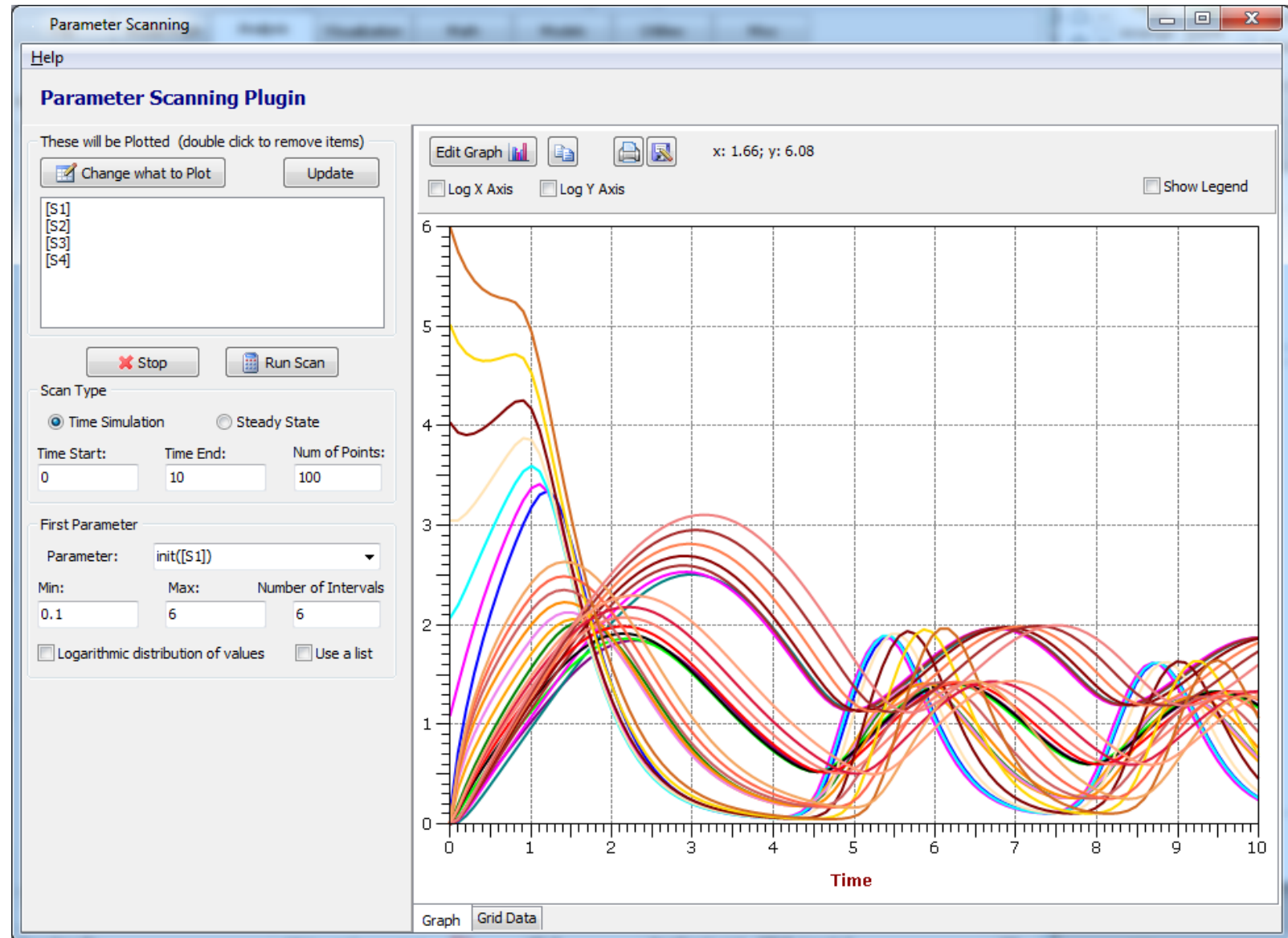


Toolbar



Place holder for plugins

Plugins: Parameter Scanning



Plugins: MCA (sensitivity) Plugin

The screenshot shows the 'MCA Plugin' window. On the left, under 'Compute the Steady State', there are 'Solve' and 'Select Output' buttons. Below them, the 'Closeness to Steady State' is $7.7564189070413E-6$. A table lists the steady state values for variables [S1], [S2], [S3], and [S4]. On the right, there are tabs for 'Jacobian', 'Flux Control', 'Concentration Control', and 'Elasticities'. The 'Jacobian' tab is active, displaying a 4x4 matrix of sensitivity coefficients and a table of eigenvalues. At the bottom, there are 'Copy to Clipboard' buttons and settings for 'Width' (8), 'Decimal Places' (4), and a 'Scientific Notation' checkbox.

Metabolic Control Analysis Plugin

Compute the Steady State

Solve Select Output

Closeness to Steady State: $7.7564189070413E-6$

Variable	Value
[S1]	0.5431
[S2]	0.6635
[S3]	0.9175
[S4]	1.4530

Jacobian Flux Control Concentration Control Elasticities

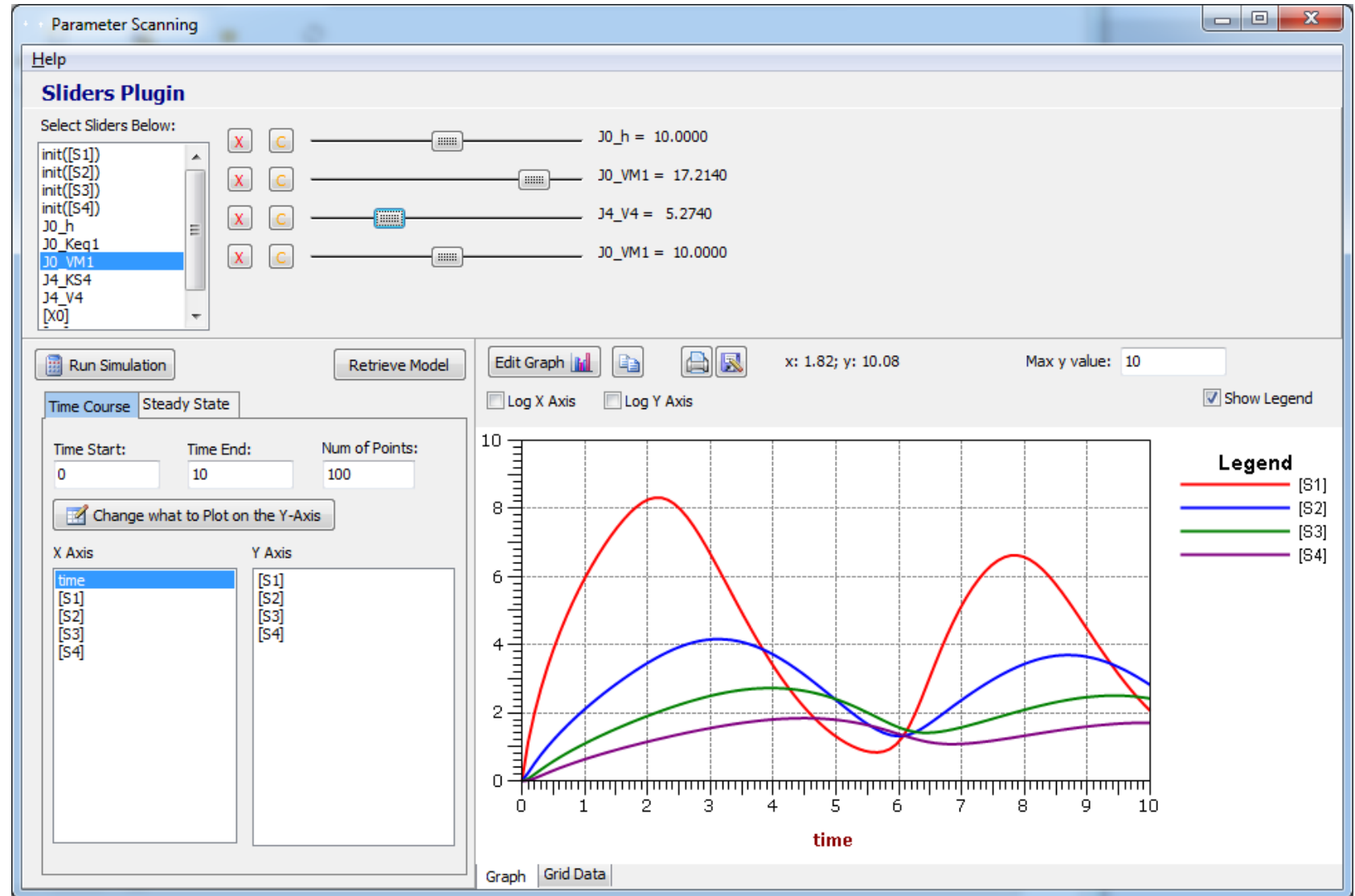
	[S1]	[S2]	[S3]	[S4]
[S1]	-3.7423	1.7492	0.0000	-10.0608
[S2]	3.6888	-4.9030	1.4955	0.0000
[S3]	0.0000	3.1538	-3.9107	1.1452
[S4]	0.0000	0.0000	2.4151	-1.4730

Eigenvalues

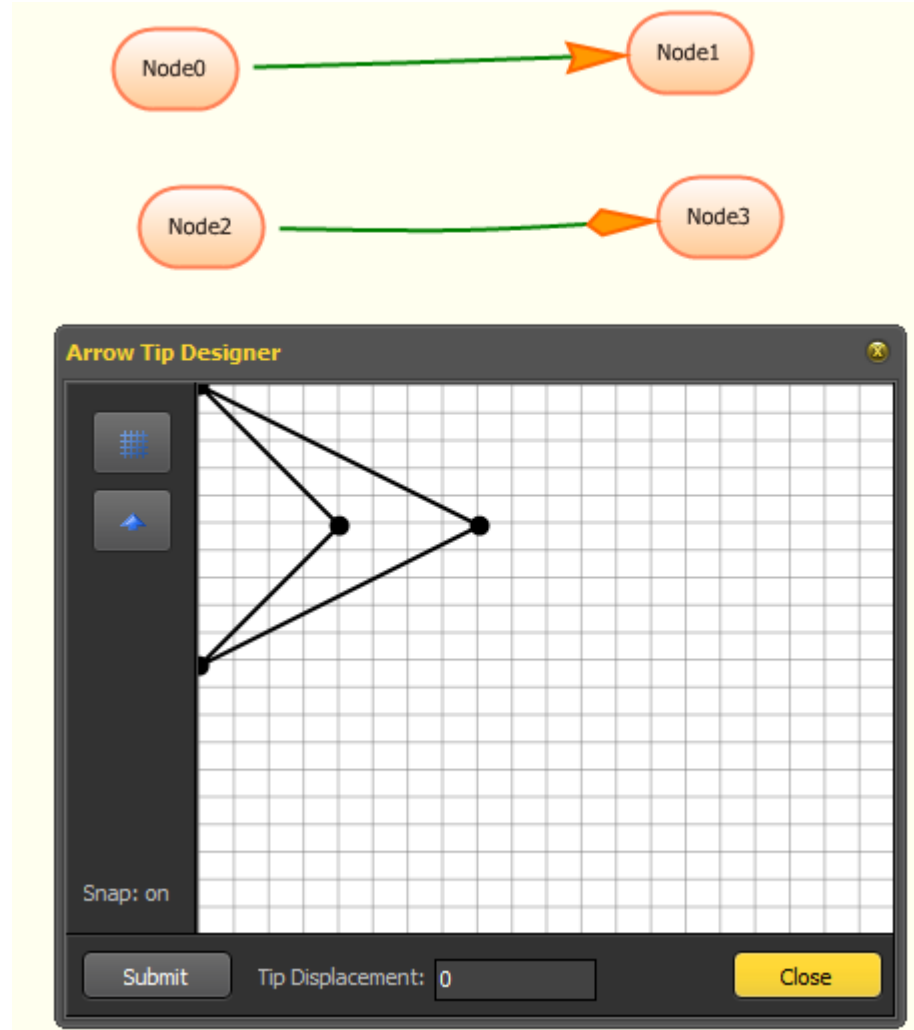
Eigen: 0	0.1041, 2.3178i
Eigen: 1	0.1041, -2.3178i
Eigen: 2	-7.1186, 1.9038i
Eigen: 3	-7.1186, -1.9038i

Copy to Clipboard Copy to Clipboard Width: 8 Decimal Places: 4 Scientific Notation

Plugins: Sliders



Plugins: Arrow Designer



AutoLayout Library

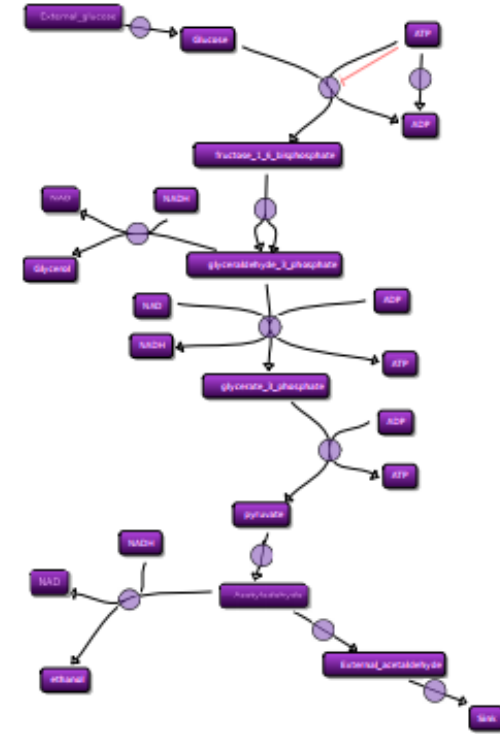
libSBNW, a portable C/C++ library that supports the SBML **layout extension** and can automatically generate layouts for SBML models. Supports layout of species, reactions, compartments and modifiers. Also includes support for alias nodes and locking of nodes in place. Python bindings are available, see Tellurium.

A portable library to support the SBML Layout Extension

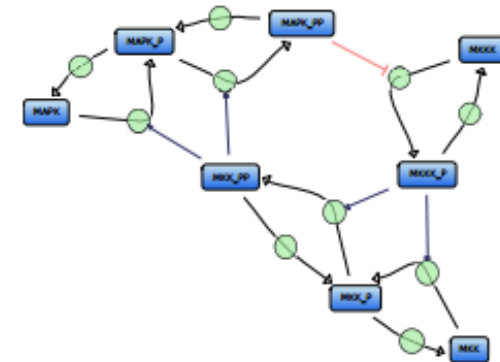
<http://biorxiv.org/content/early/2016/01/05/035725>

<https://github.com/sys-bio/sbnw>

Kyle Medley



(b) A rendered version of the model displayed above



Plugins: AutoLayout

The screenshot displays the Pathway Designer application interface. The main window shows a network diagram with nodes (Node0, Node1, Node4, Node8, Node9, Node10, Node12, Node13) and directed edges. The 'Visualization' tab is active in the top menu. Two plugin windows are open on the right side of the interface.

Autolayout Plugin

Autolayout Version: 1.3.23
Number of compartments: 0
Number of nodes: 13
Number of reactions: 10

Stiffness: 23.00 [Set Stiffness]
Gravity: 15.00 [Set Gravity]

[Create Tikz] [Save as SBML Layout] [Layout] [Close]

Random Network Designer

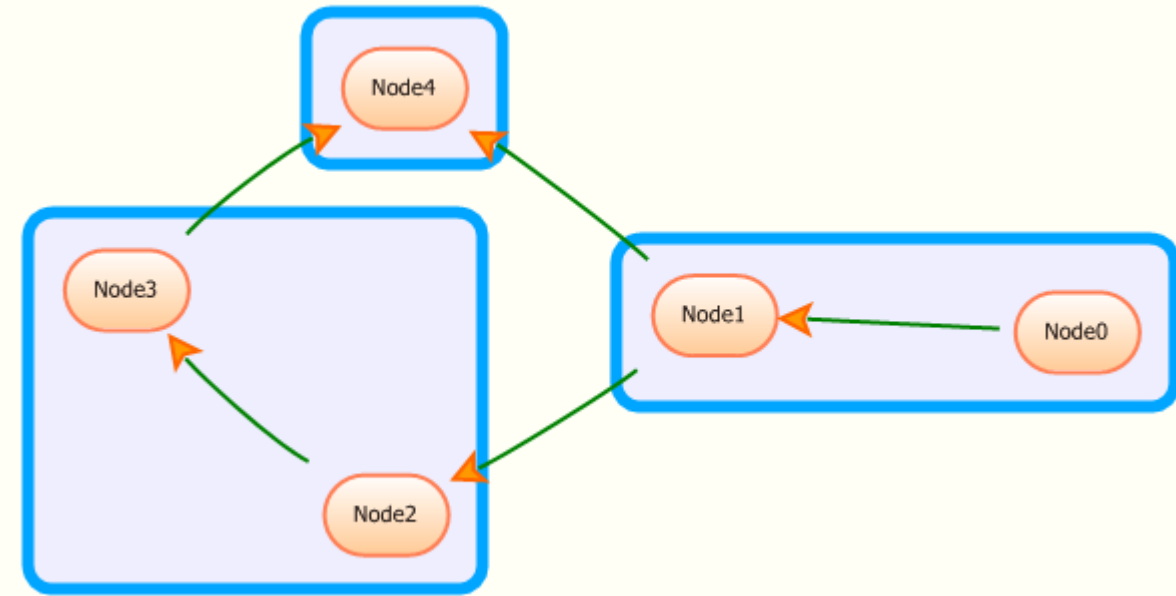
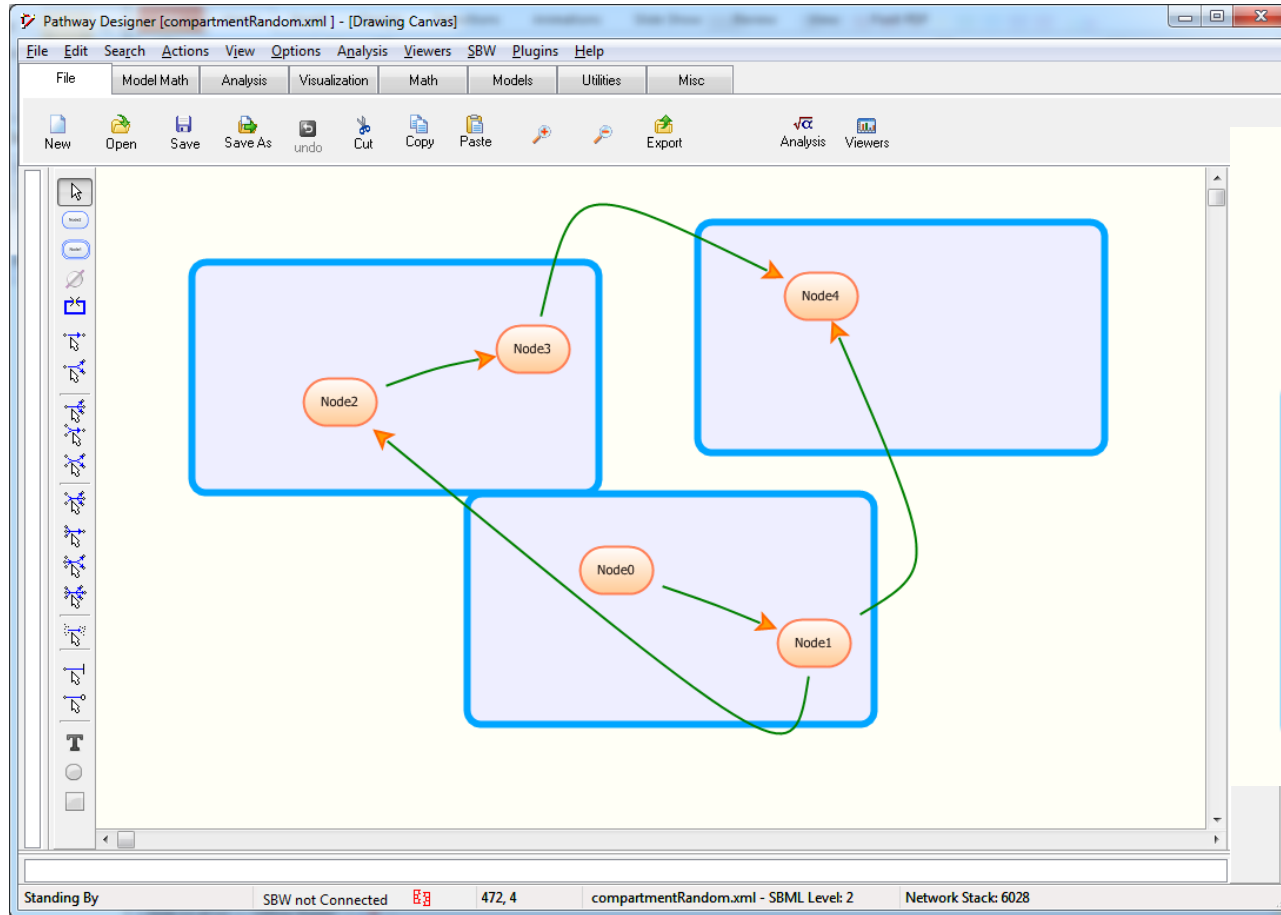
Number of Species: 15
Number of Reactions: 10

Probability of UniUni: 0.25
Probability of BiUni: 0.25
Probability of UniBi: 0.25
Probability of BiBi: 0.25

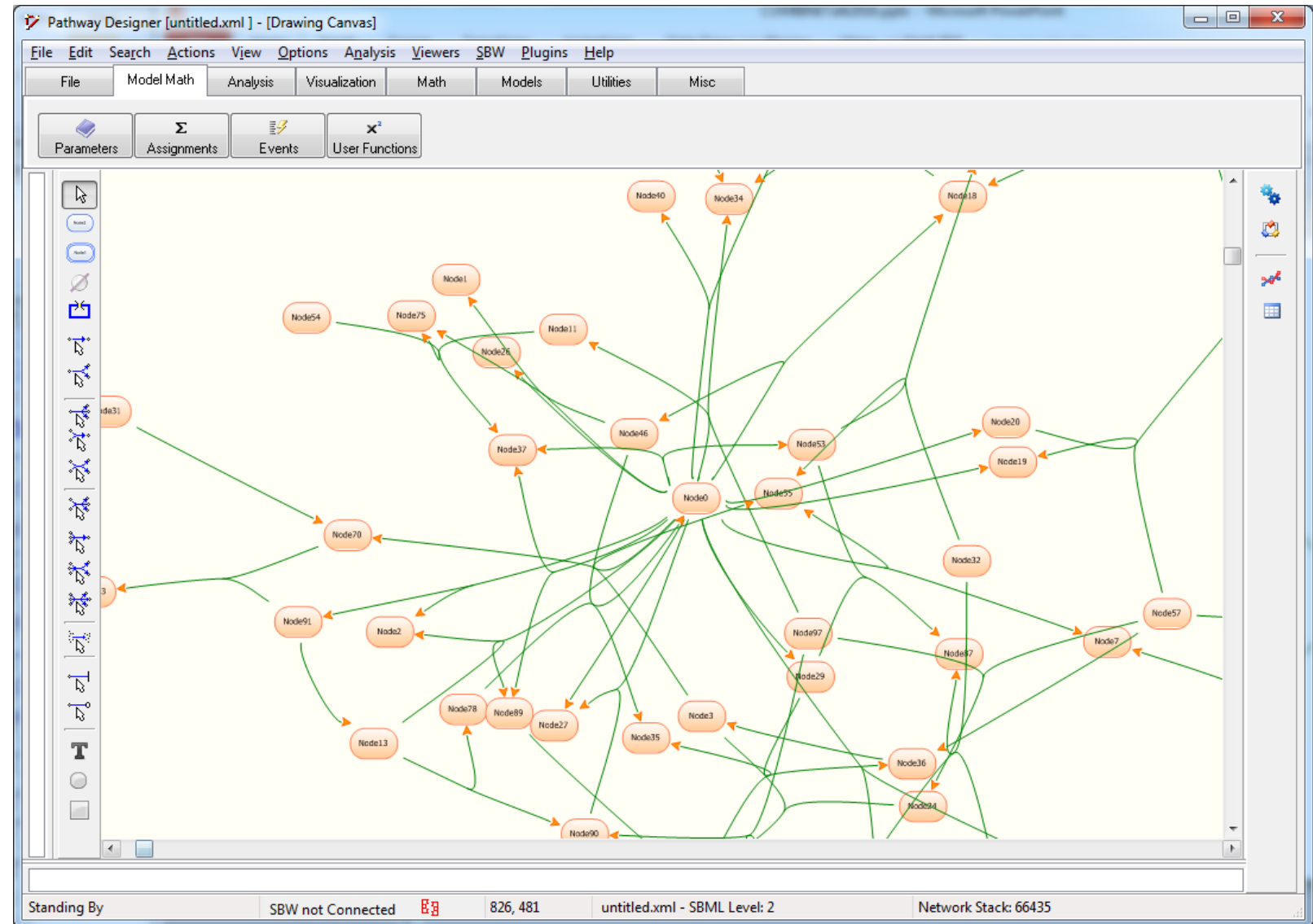
☒ Remove any orphan species

Bezier Curves [v]
[Clear]

Plugins: AutoLayout, Compartments

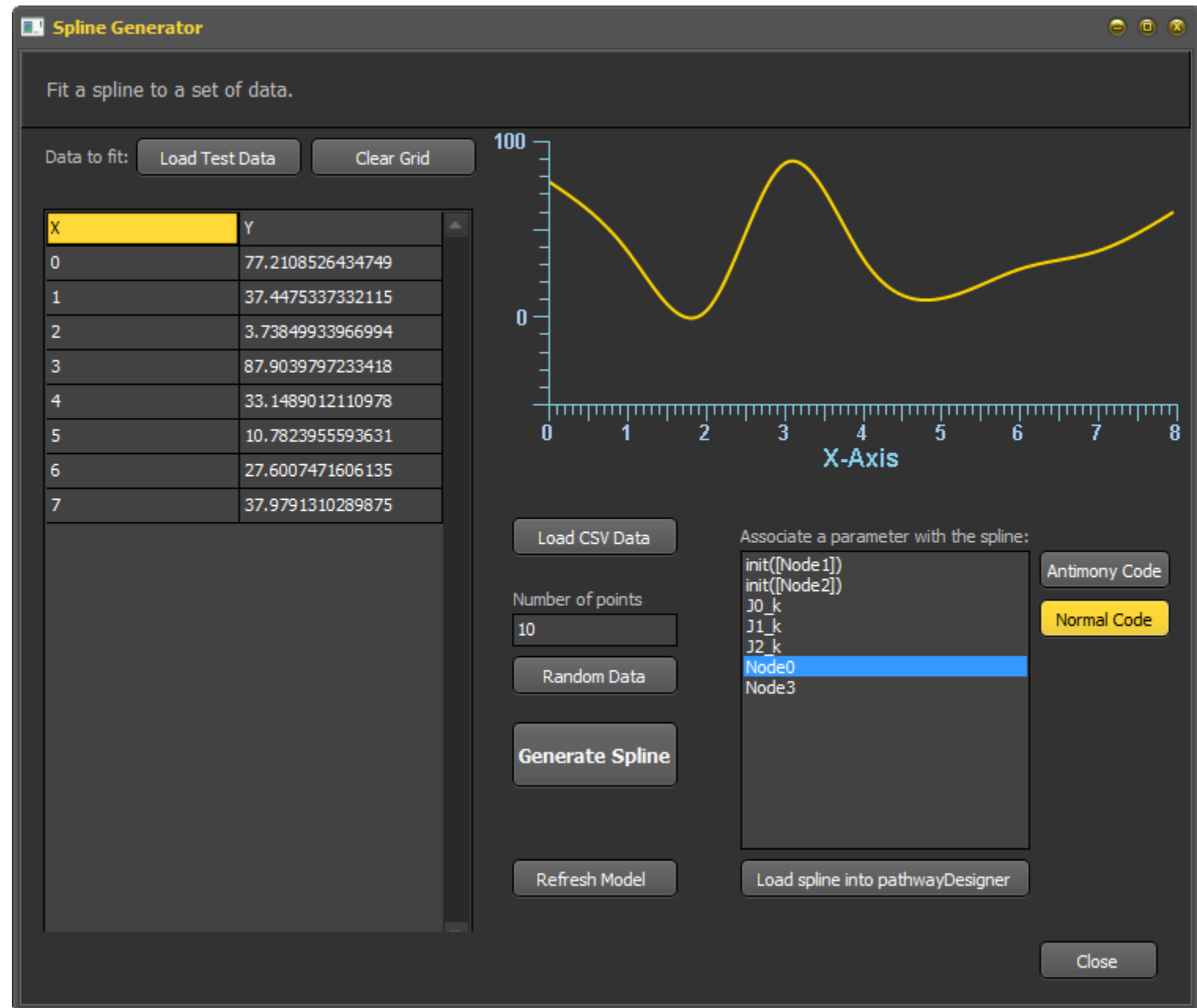


Alias Nodes/Autolayout



Cubic Spline Input

Thanks to Felix Winter

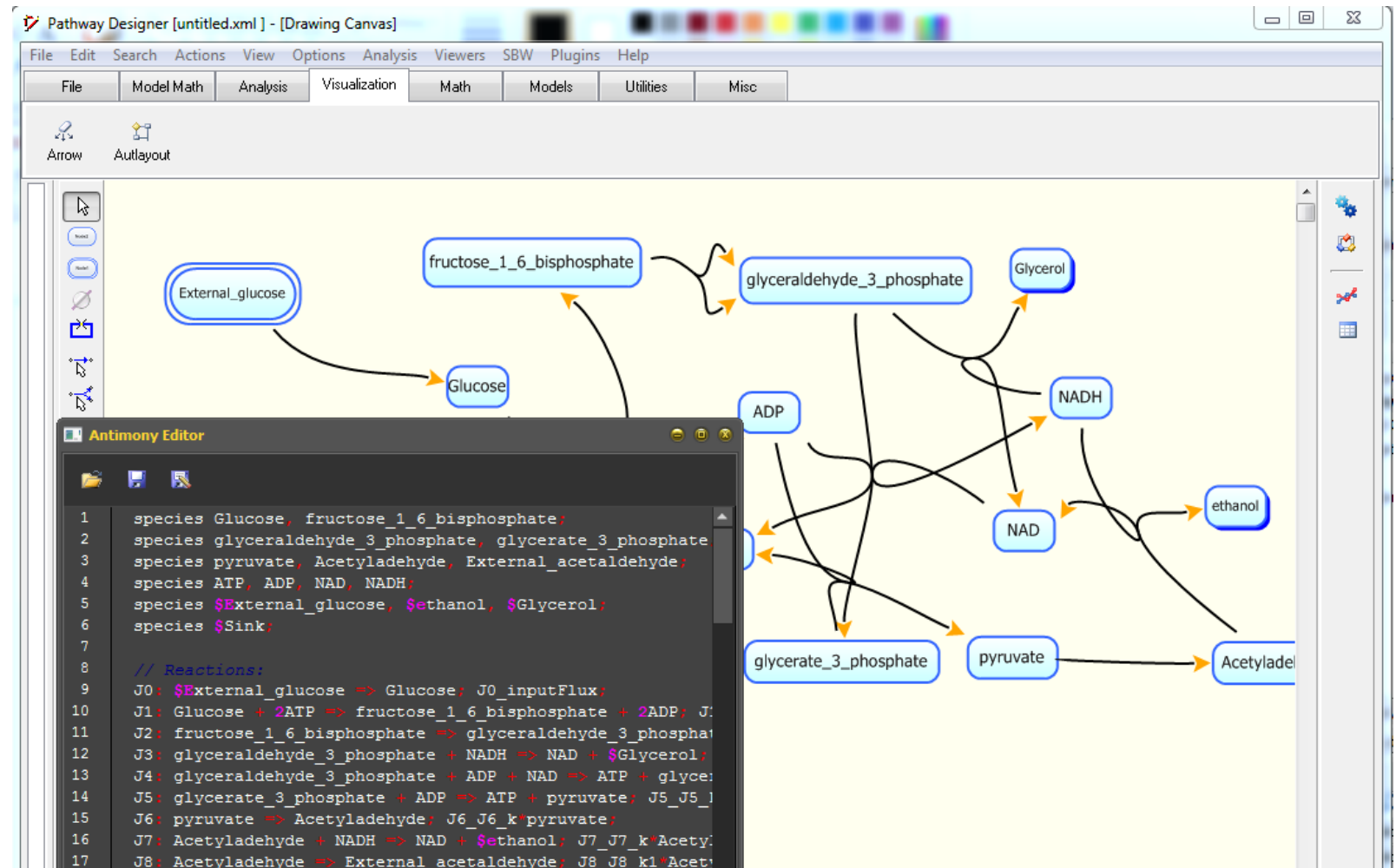


Spline as a piecewise function

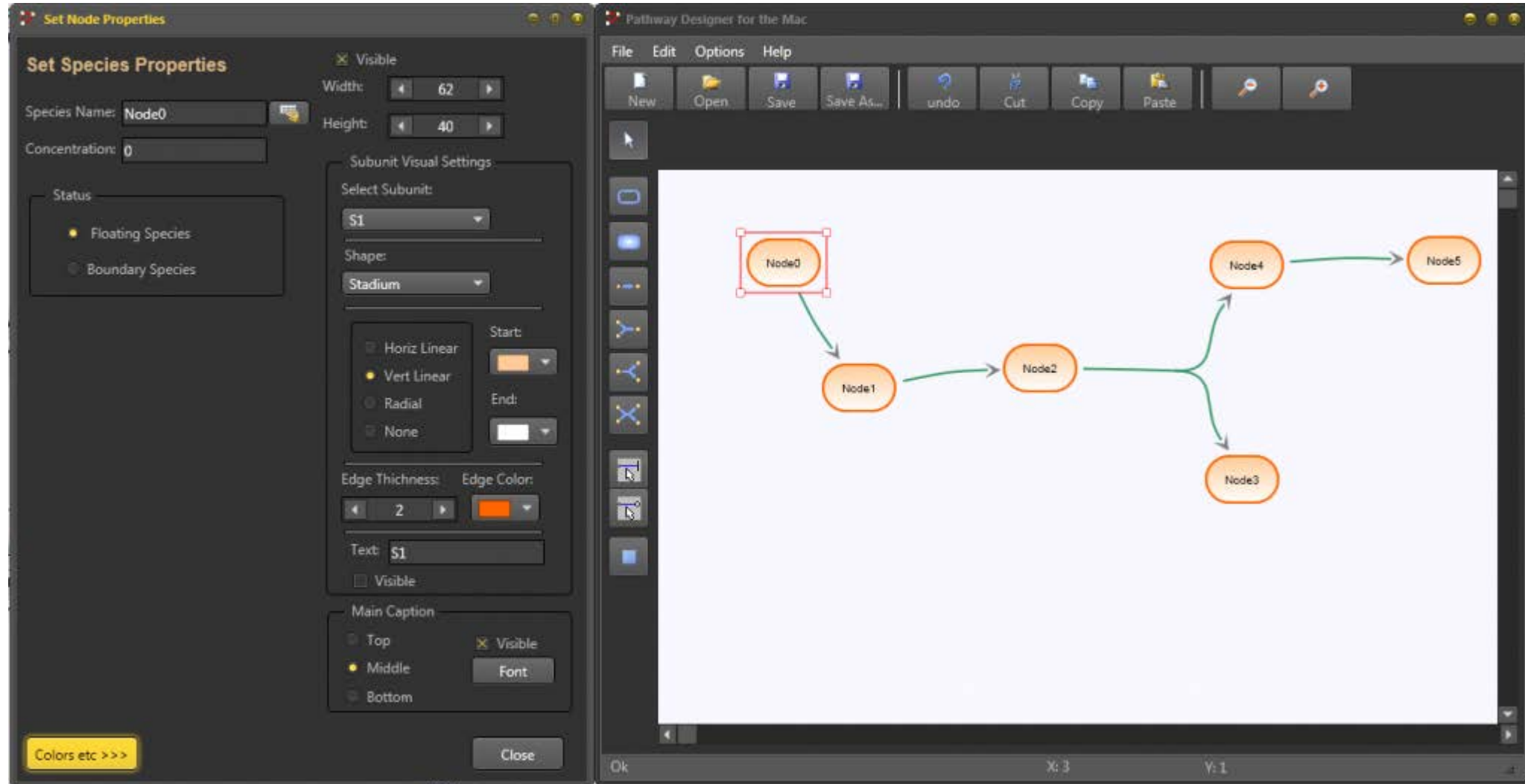
```
Node0 = piecewise (((-9.622571*(time-0) + 0.000000)*(time-0) -  
30.140748)*(time-0) + 77.210853, (time >=0.000000) && (time <=  
1.000000), ((54.167142*(time-1) - 28.867714)*(time-1) - 59.008462)*(time-  
1) + 37.447534, (time >=1.000000) && (time <= 2.000000), ((-  
95.225764*(time-2) + 133.633710)*(time-2) + 45.757534)*(time-2) +  
3.738499, (time >=2.000000) && (time <= 3.000000), ((69.940842*(time-3) -  
152.043583)*(time-3) + 27.347662)*(time-3) + 87.903980, (time  
>=3.000000) && (time <= 4.000000), ((-13.228473*(time-4) +  
57.778944)*(time-4) - 66.916977)*(time-4) + 33.148901, (time >=4.000000)  
&& (time <= 5.000000), ((-10.230666*(time-5) + 18.093525)*(time-5) +  
8.955493)*(time-5) + 10.782396, (time >=5.000000) && (time <= 6.000000),  
((8.526313*(time-6) - 12.598474)*(time-6) + 14.450544)*(time-6) +  
27.600747, (time >=6.000000) && (time <= 7.000000), ((-4.326822*(time-7)  
+ 12.980467)*(time-7) + 14.832537)*(time-7) + 37.979131, (time  
>=7.000000) && (time <= 8.000000))
```

Pretty!

Plugin: Antimony

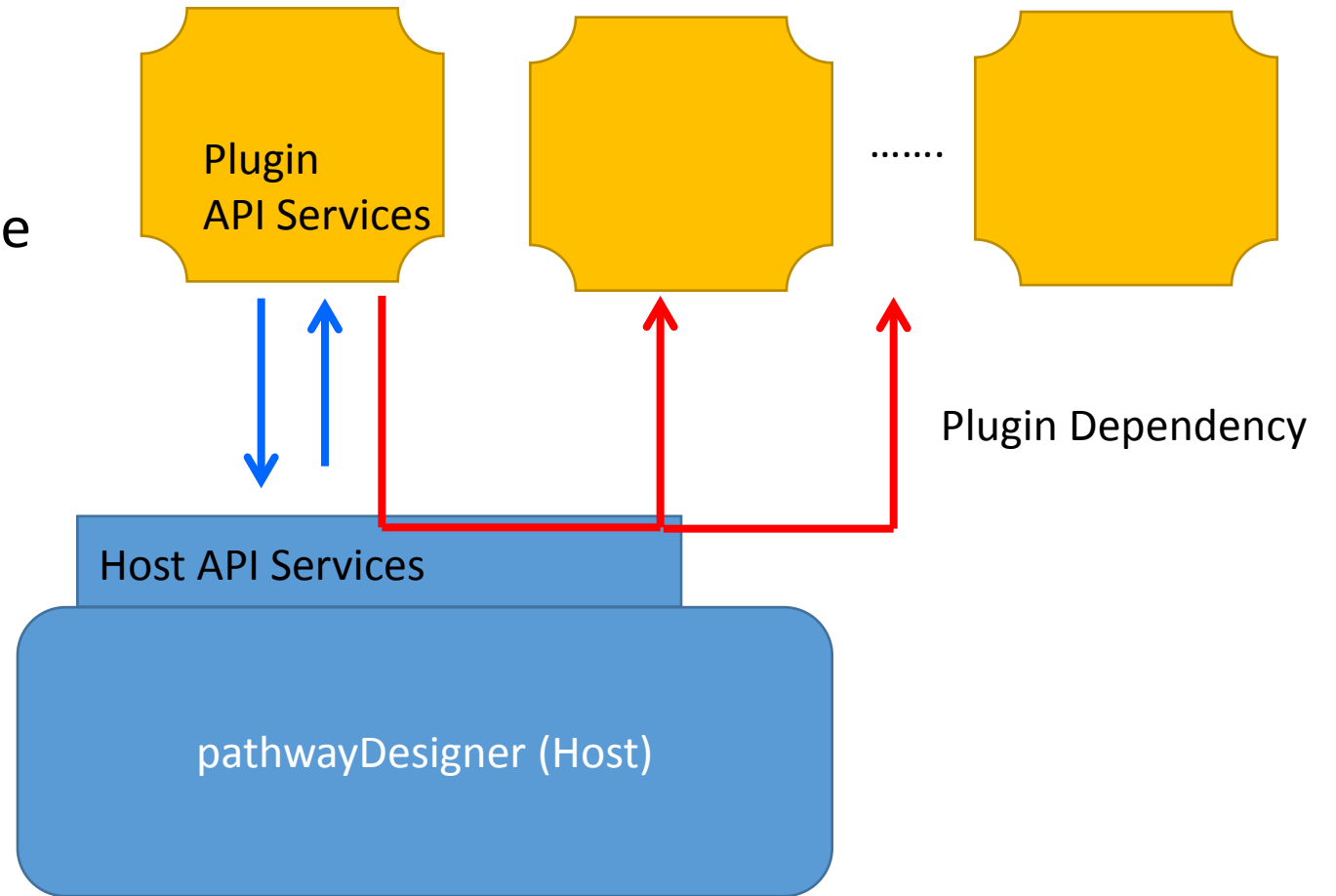


Mac Version – alpha



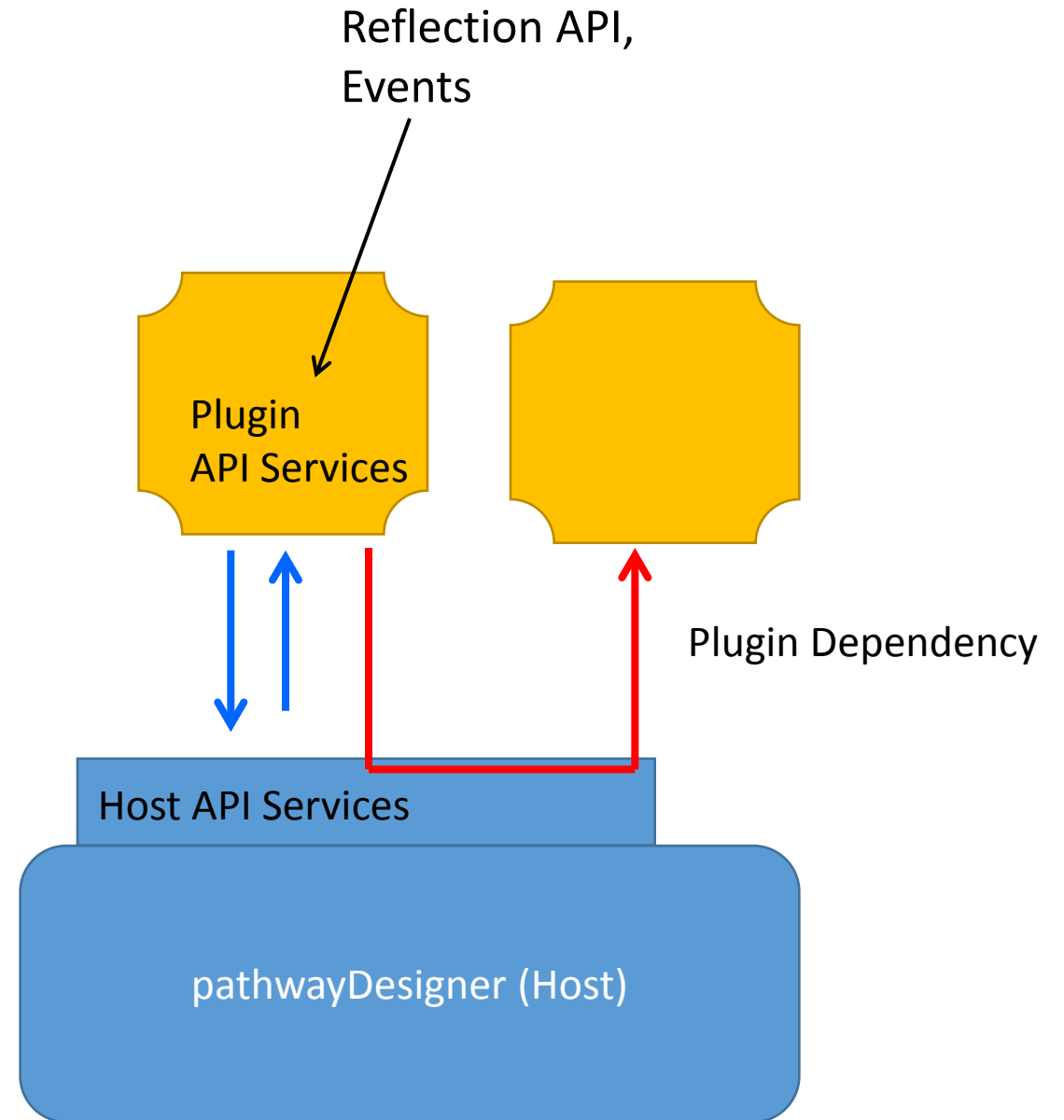
Plugin Architecture

The design is based on the idea that plugins can be written in any language that supports C type calls.



HOST API Services

Utilities
IntegerArray
DoubleArray
StrArray
Matrix – labeled array
List
Network – visual aspects of network
Forms – create GUI components
simulationService – SBW or libRoadRunner
Antimony



Plugin Viewer

The screenshot shows the 'Plugin Viewer' application window. The title bar includes a green gear icon and the text 'Plugin Viewer'. The window is divided into several sections:

- Loaded Plugins:** A list of plugins with 'www.sys-bio.org/Autolayout' selected and highlighted in blue.
- Exports an API:** A checkbox labeled 'YES'.
- Available Methods:** A list of methods including 'loadSBMLStr', 'getNumberReactions', 'getNodeCentroid', 'getNodeWidth', 'getNodeHeight', 'getReactionCurves', and 'setStiffness'.
- Information:** A section containing metadata such as 'Id: 10', 'Id Name: www.sys-bio.org/Autolayout', 'Name: Autolayout', 'Display Name: Autolayout plugin', 'Author: Herbert M Sauro', 'Address: Seattle UW, 98125 USA', 'Email: hsauro@gmail.com', 'Home Page: www.sys-bio.org', 'Licence: Public Domain', 'Plugin Version: 1.0', 'Date: 20 May 2015', 'Category/Type: Visualization', and 'Host API: 0.20'.
- Description:** A text area containing the description 'Plugin that provides autolayout capability'.
- Disable plugin:** A checkbox at the bottom right of the information section.
- Buttons:** A row of buttons including 'Unload Plugin', 'View API Docs' (which is highlighted), 'Get Pascal Bindings', 'Get Python Interface', and 'Copy'.
- Exports API:** A section showing 'Yes' and 'API Version: Major: 1 Minor: 0 Build: 0'.
- API GUID:** A text field containing '{A0A606EC-3C4B-48FA-B288-FBD6FEE88599}'.
- TAutolayoutAPI = record:** A code block showing the plugin's API signature with various functions and procedures.
- This plugin depends on:** An empty text area for listing dependencies.
- Close:** A button at the bottom right of the window.

Self Documenting

Reflection API

hasPluginAPI

getAPIGUID

getNumberOfMethodsInAPI

getNameOfMethodInAPI

getNumberOfArgumentsInAPI

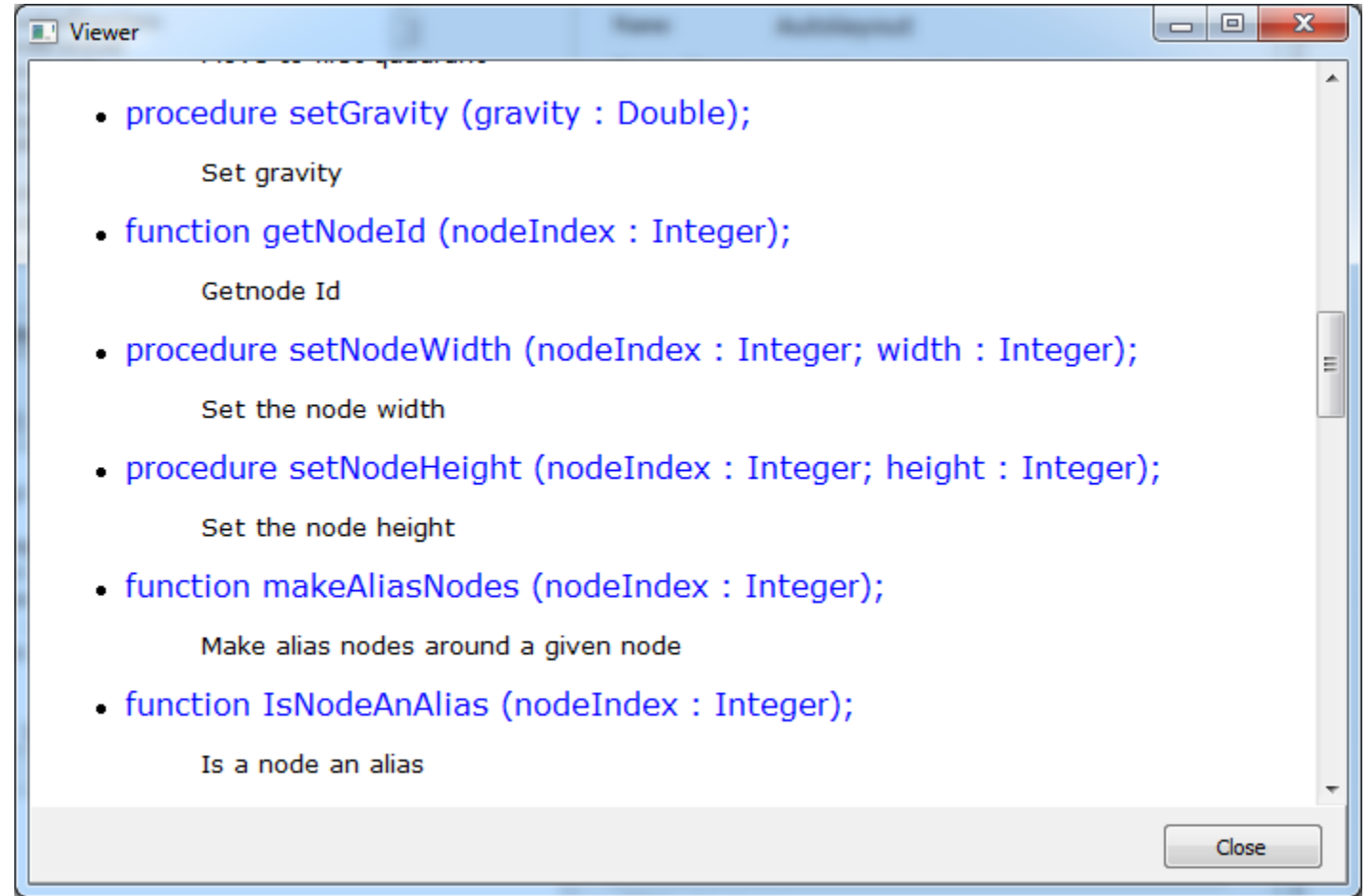
getArgumentTypeInAPI

getReturnTypeInAPI

getDocsInAPI

getMethodDispatchIdInAPI

callMethodInAPI



Future

Short Term (within 1 year)

1. Finish the Mac version (single code base for Windows and Mac)
2. Finish support for alias nodes
3. Finish Python plugin
4. Finish saving layouts using layout extension
5. Support render extension?

Long term

Real-time Interactive simulation

Acknowledgments

Kyle Medley for libSBNW

Bosley and Rosa for testing and suggestions

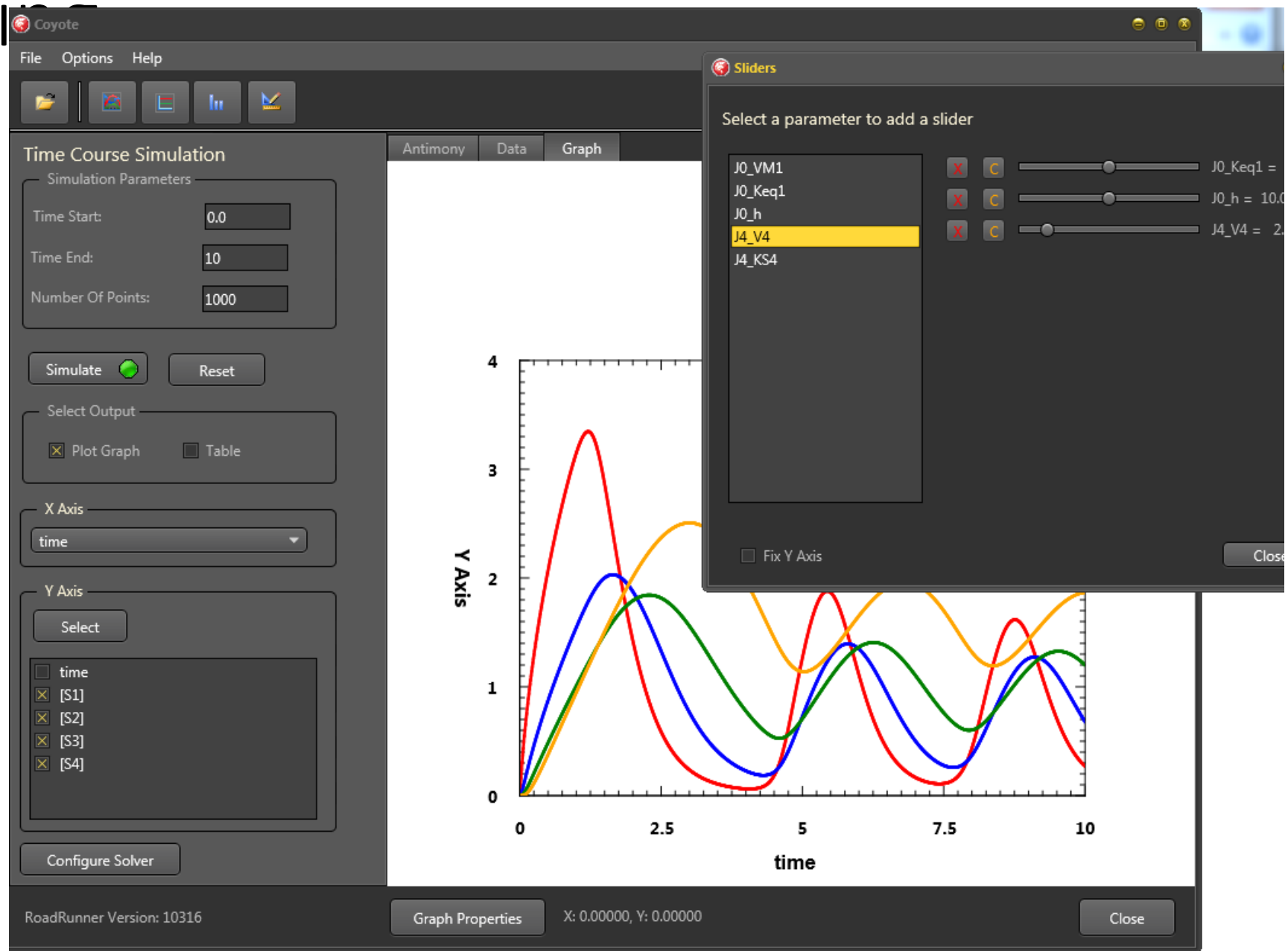
Felix Winter for Cubic Spline ideas

Stackoverflow on how to add borders around triangles



pathwayDesigner.org

Self Documenting



Host Events and Dispatch

OnDestroy

OnBroadcastMessage – message from a plugin to all plugins

OnLoadingComplete

OnModelChange

OnNodeValueChangeByIndex

OnValueChangeById