Auto Layout Tool

March 2018

McMaster Centre for Software Certification (McSCert)

Contents

1 Introduction

The Auto Layout tool automatically formats a Simulink model to improve its visual layout. This tool is useful for arranging Simulink model elements, such as blocks and lines, in order to increase readability, and benefits the user by automating the tedious task of manually organizing the many elements contained in a model.

Disclaimer This tool will try its best to make messy models (containing many signal crossings, not aligned blocks, unclear data flow, etc.) easier to read, but you may find that models that are already well laid out, will benefit less than a model that is auto-generated and has no layout, for example.

More Information

For more information on the tool and how it can be used in model-based development with Simulink, please refer to the following papers:

Vera Pantelic, Steven Postma, Mark Lawford, Monika Jaskolka, Bennett Mackenzie, Alexandre Korobkine, Marc Bender, Jeff Ong, Gordon Marks, Alan Wassyng, "Software engineering practices and Simulink: bridging the gap," *International Journal on Software Tools for Technology Transfer (STTT)*, 2017, 1-23.

Vera Pantelic, Steven Postma, Mark Lawford, Alexandre Korobkine, Bennett Mackenzie, Jeff Ong, and Marc Bender, "A Toolset for Simulink: Improving Software Engineering Practices in Development with Simulink," *Proceedings of 3rd International Conference on Model-Driven Engineering and Software Development (MODELSWARD 2015)*, SCITEPRESS, 2015, 50–61.

2 How to Use the Tool

This section describes what must be done to setup the tool, as well as how to use the tool.

2.1 Prerequisites

Please ensure the following, before using the tool:

- Use MATLAB/Simulink 2011b or newer.
- The tool is present in your MATLAB path.
- Graphviz is installed if using a Matlab version earlier than 2015b (see Section 2.1.1).
- The model is open (or loaded, for command line use).

2.1.1 Graphing Methods

The Auto Layout tool supports two different ways of producing an *initial layout* for a model. The initial layout is the first placement of blocks according to their connections to other model elements. Subsequent operations of the Auto Layout tool transform the model layout further by making a series of adjustments to the initial layout.

The first method of initial layout is through the use of Graphviz[1], and the second is through Matlab's built-in graph plot[2] capabilities that exist as of 2015b. If you do not have Matlab 2015b+, or simply would like to use Graphviz instead, please follow the installation steps below. If you have Graphviz installed and also Matlab 2015b+, you can use the configuration parameters (Section 2.4) to switch between the two methods at any time (you may find that one produces better results for you).

Graphviz Installation

1. Install Graphviz: Download Graphviz files from the official website: http://www.graphviz.org/download/.
2. Change System Path:

   2a. For *Windows*, newer versions of the Graphviz software do not automatically put Graphviz's `dot` command on the system path. Therefore, for the tool to function the user must manually set the system path such that the `dot` command in the batch file works correctly. This means appending the Graphviz bin directory to the PATH environment variable. The path that needs to be added is `C:`

[1] https://www.graphviz.org
[2] https://www.mathworks.com/help/matlab/ref/graphplot.html

`\ProgramFiles(x86)\Graphviz2.xx\bin` where 2.xx is the Graphviz version that was installed. To learn how to set the system path appropriately, refer to: http://www.computerhope.com/issues/ch000549.htm.

2b. For *Linux* and *Mac OS X*, if after installation the dot command is not on the system path visible to MATLAB, the MATLAB system path must be changed to include the folder that contains the command. For detailed instructions on running external programs from MATLAB, see: http://www.mathworks.com/help/matlab/matlab_env/run-external-commands-scripts-and-programs.html.

2.2 Getting Started

The tool can be used via the Simulink Context Menu, which can be viewed by right-clicking in a model. The *Auto Layout* option is available, as shown in Figure 1.

2.3 Functionality

This section describes the tool functionality when being used from the Simulink Context Menu (Figure 1).

Right-clicking anywhere in the model and then selecting `Auto Layout` from the Context Menu will begin the auto layout of a model. This operation may take a few seconds.

Note: There is currently no support to undo an auto layout operation. You will be warned if you attempt to auto layout an unsaved model (Section 2.5).

2.4 Configuration Parameters

The configuration file `config.txt` is included in `AutoLayout\src`. The following configuration parameters are utilized by the tool, and can be modified by the user in order to tailor tool functionality:

- `graphing_method` – Customize which graph layout method to use.
- `show_names` – Customize how to show block names.
- `portless_rule` – Customize where to place blocks with no ports.
- `sort_portless` – Customize how to group blocks with no ports.
- `inport_rule` – Customize where to place inport blocks.
- `outport_rule` – Customize where to place outport blocks.
- `note_rule` – Customize where to place annotations.

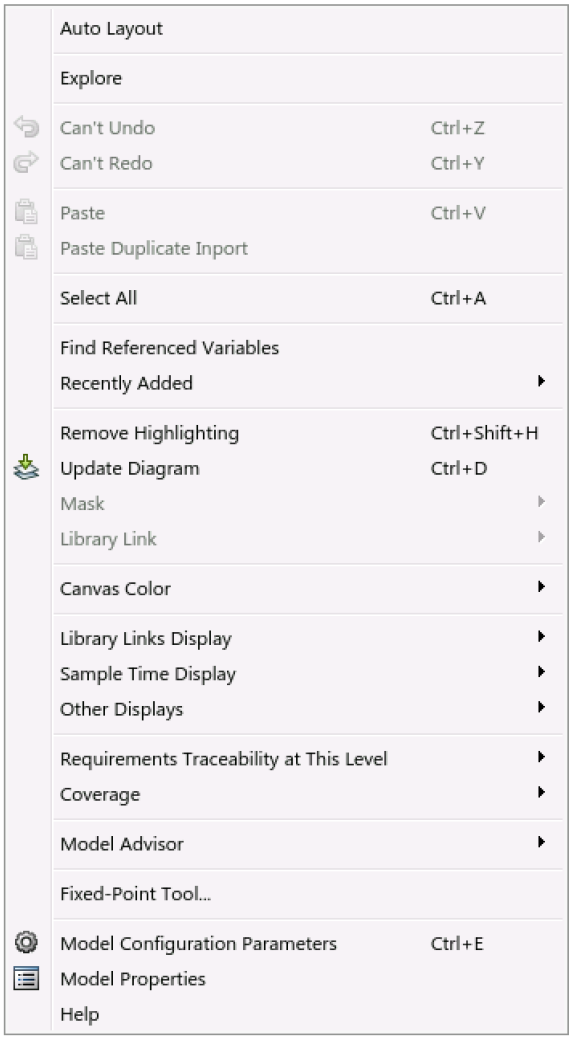


Figure 1: Simulink Context Menu with tool option visible.

Please see the configuration file for more details regarding parameter usage and accepted values. These parameters can be modified with MATLAB open, and do not require that MATLAB be restarted for the changes to take effect.

2.5 Errors and Warnings

Any errors or warnings during tool use will be visible in the MATLAB Command Window. Typically, errors will be shown when the model is locked or function parameters are incorrect.

A common error occurs when one tries to start the auto layout operation on

an unsaved model. As a result, the warning shown in Figure 2 will appear. The user is given three options:

1. Press *Yes* to save and continue with the auto layout of the model.
2. Press *No* to continue with the auto layout of the model without saving. You may lose changes if you decide you do not wish to save after the auto layout operation.
3. Press *Cancel* or the close window button to abort the operation.

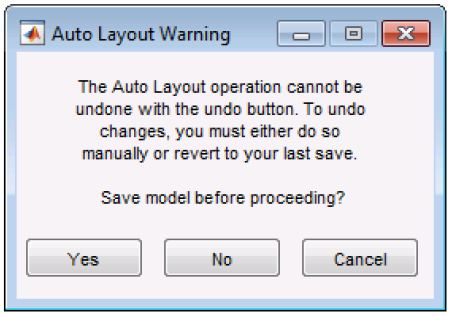


Figure 2: Unsaved model warning.

3 Example

Use the command `AutoLayoutDemo` in the Simulink command window to open the example model, shown in Figure 3. This example has many blocks that are not placed in an organized fashion, with unclear flow of data from left to right. Many signal lines are also crossing one another, making the data flow even more difficult to understand.

To auto layout this model, right-click anywhere in the model and select the `Auto Layout` option. The resulting model is shown in Figure 4. The results will vary depending on which graphing method is used.

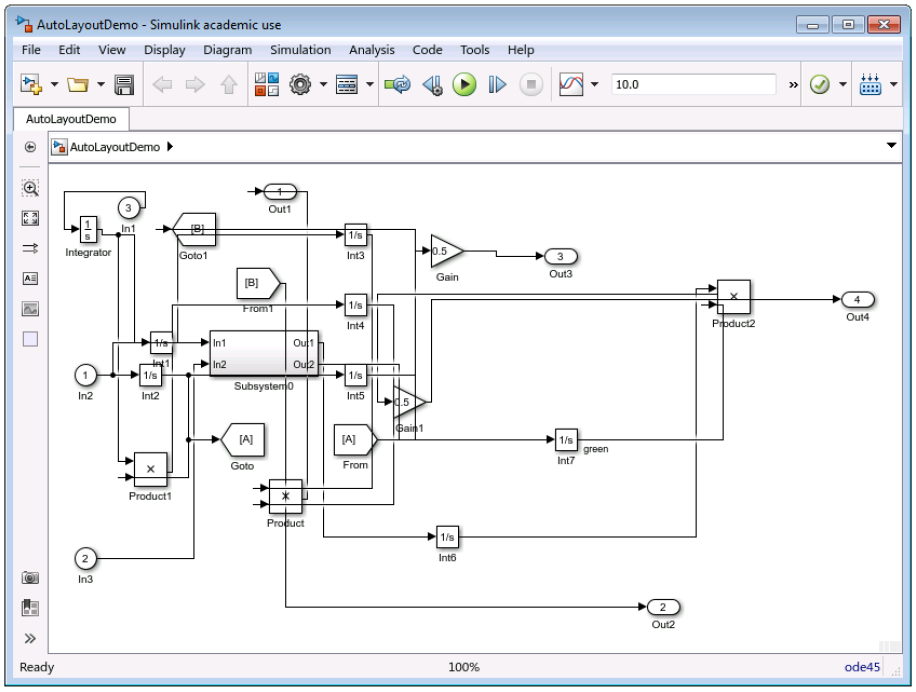
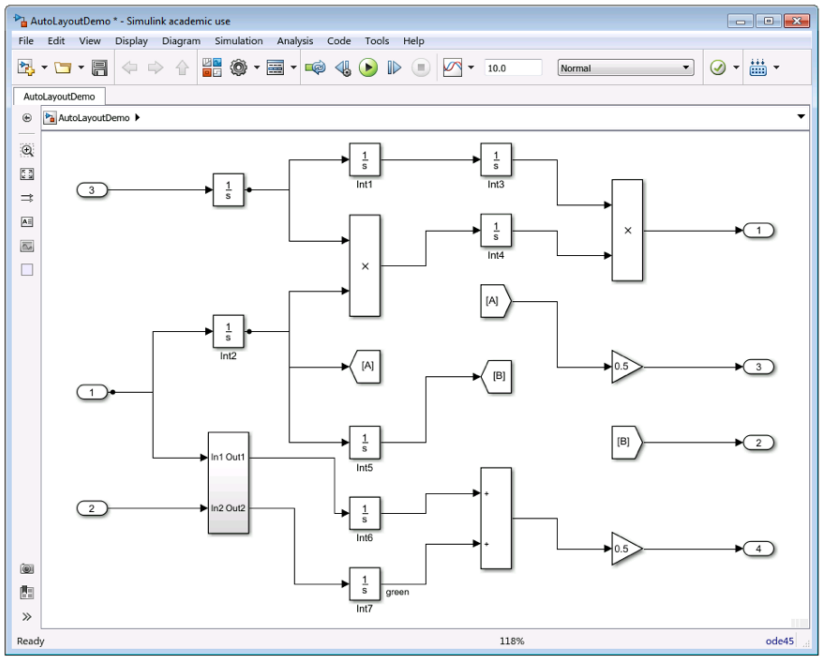
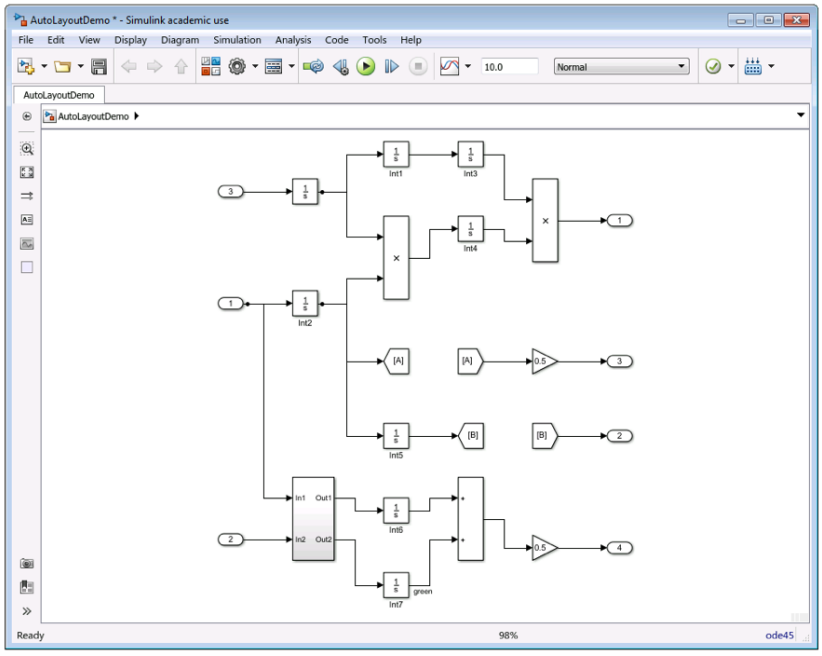


Figure 3: Auto Layout demo: The `AutoLayoutDemo` model before the auto layout operation.



(a) Using Graphviz



(b) Using Matlab graph plotting

Figure 4: Auto Layout demo: The `AutoLayoutDemo` model after the auto layout operation.

4 Matlab Commands

The tool can also be used via the MATLAB command line, with the following function.

Function	`AutoLayout`
Syntax	`AutoLayout`(*address*)
Description	Modifies the *system* model so it is laid out to be more visually organized.
Inputs	*address*: Simulink model name.
Outputs	N/A