Flatten Subsystem Tool

September 2019

McMaster Centre for Software Certification (McSCert)

1   Introduction

The Flatten Subsystem tool automatically flattens a Simulink subsystem, that is, it moves the subsystem contents up one level, reconnects the signals, and removes the subsystem block. This tool is useful for making quick transformations to a model by automating the tedious task of manually copying and connecting the many elements contained in a subsystem.

Note: This functionality has been since included in Matlab*/Simulink 2014a as the "Expand Subsystem" operation*[1]*. This tool is still beneficial for earlier versions of* Matlab*/Simulink, as well as handling more types of subsystems*

More Information

For more information on the tool and how it can be used in a 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.

---

[1] https://www.mathworks.com/help/simulink/ug/expand-subsystem-contents.html

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 and Installation

1. Use MATLAB/Simulink 2011b or newer.

2. Install the Auto Layout Tool.

3. To install the tool,

   (a) from a `.zip` file — unzip the contents into your desired location. Ensure the unzipped folder and subfolders are present in your MATLAB search path, or add them if they are not present. Run sl_refresh_customizations to refresh the Context Menu.

   (b) from a `.mltbx` file — simply open MATLAB and double-click on the file. Your MATLAB search path should be automatically configured.

   (c) from the files only — add the folders and subfolders to your MATLAB search path. Run sl_refresh_customizations to refresh the Context Menu.

   - *Note:* If running the command "`which FlattenSubsystem`" indicates that the script is not found, then the tool needs to be added to the MATLAB search path. For information on adding files to the MATLAB search path, please see the MathWorks documentation.

4. Ensure your model is open (or loaded, for command line use) and unlocked.

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 *Flatten Subsystem* option is available, as shown in Figure 1.

2.3 Functionality

Right-clicking on a subsystem in the model and then selecting `Flatten Subsystem` from the Context Menu will flatten those subsystems. Any blocks that are considered subsystems can be flattened, including atomic subsystems, code reused subsystems, etc. These types of subsystems are not supported with Simulink's built-in `Expand Subsystem` function.
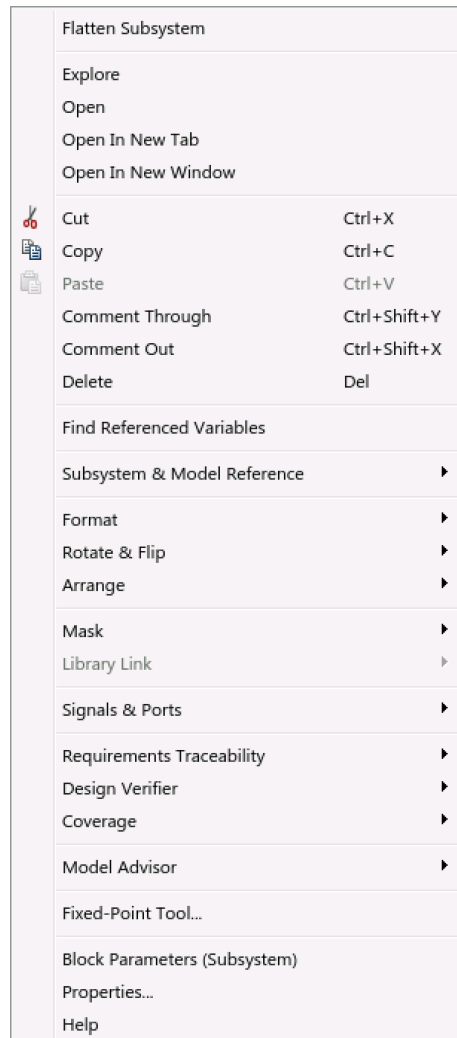
Figure 1: Simulink Context Menu with tool option visible.

2.4   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.

3 Example

Use the command `FlattenSubsystemtDemo` in the Simulink command window to open the example model, shown in Figure 2 and 3. This simple example has a single subsystem, which contains a few blocks.
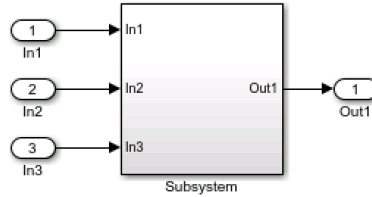

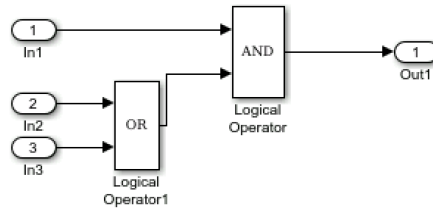Figure 2: Flatten Subsystem demo: The `FlattenSubsystemtDemo` model before flattening the subsystem.

Figure 3: Flatten Subsystem demo: The subsystem from Figure 2 before flattening.

To flatten this subsystem, right-click on the subsystem in Figure 2 and select the `Flatten Subsystem` option. The resulting model is shown in Figure 4.
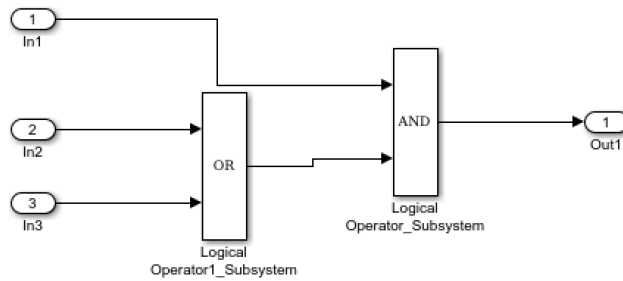

Figure 4: Flatten Subsystem demo: The `FlattenSubsystemtDemo` model after flattening.

4   Matlab Commands

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

Function	`FlattenSybsystem`
Syntax	`FlattenSybsystem`(*address*, *subToFlatten*)
Description	Takes all blocks in *subToFlatten* and moves them to up one level, while also removing the subsystem.
Inputs	*address*: Simulink model name. *subToFlatten*: Cell array of subsystems to flatten.
Outputs	N/A