Flatten Subsystem Tool

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McMaster Centre for Software Certification (McSCert)

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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.

1.1 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, 95–117.

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 Flatten Subsystem, use one of the following approaches:
   (a) **Download the `.zip` from GitHub**
      i. Unzip the contents into your desired location.
      ii. Add the unzipped folder and subfolders to your MATLAB search path.
      iii. Download the Simulink-Utility in the same manner. Add the folder and subfolders to your MATLAB search path also. This is a dependency for the tool to work correctly.
   (b) **Use the Git command line**
      i. Use the following command to download the tool and any necessary submodules.

      ```
      git clone --recursive https://github.com/McSCert/Flatten-Subsystem
      ```

      ii. Add the folder and subfolders to your MATLAB search path.
   (c) **If you already have the files**
      i. Add the tool folder and subfolders to your MATLAB search path.
4. Ensure your model is open (or loaded, for command line use) and unlocked.

Troubleshooting: 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.

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.

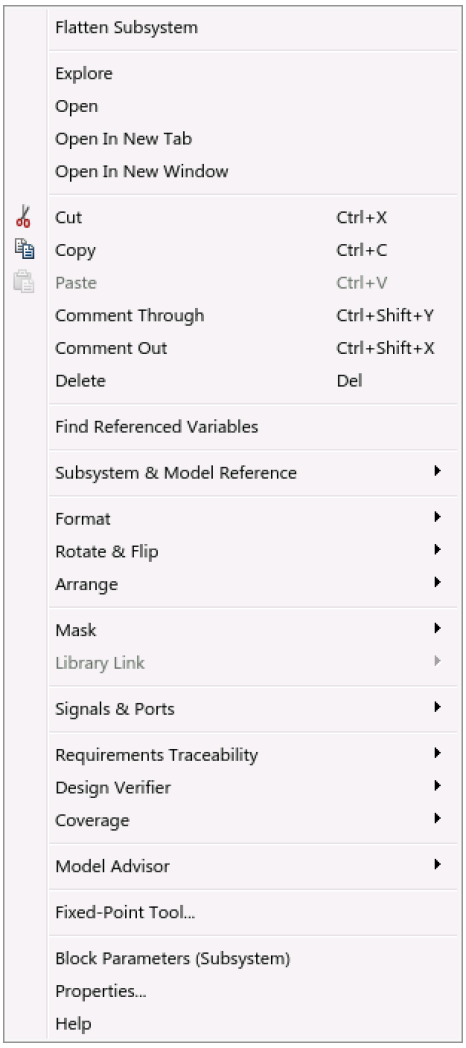

Figure 1: Simulink Context Menu with tool option visible.

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.

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.

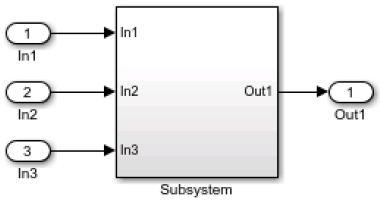

Figure 2: Flatten Subsystem demo: The `FlattenSubsystemtDemo` model before flattening the subsystem.

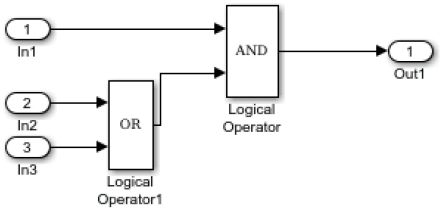

Figure 3: Flatten Subsystem demo: The subsystem from Figure 2 before flattening.

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.

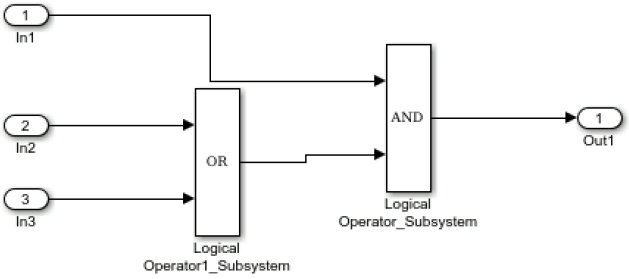

Figure 4: Flatten Subsystem demo: The `FlattenSubsystemtDemo` model after flattening.

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