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## Library Tutorial

### Introduction

This document is designed to act as a tutorial for an individual who has had some prior experience with Simulink. It is assumed that the reader has already read through the Beginner and Intermediate MATLAB Tutorials and the Simulink Tutorial. For any questions or concerns, please contact

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### Creating the Library

A library is a collection of blocks which can be used by other Simulink models. When a block is updated in the library, all the corresponding blocks in all referenced models will be updated as well.

In this example, we will create a block which will compute the coefficient of lift using the equation

$$C_L = \frac{L}{qS_{ref}}$$

Where  $q = \frac{1}{2}\rho V^2$

1. Start Simulink.
2. Select File > New > Library as shown in Figure 1

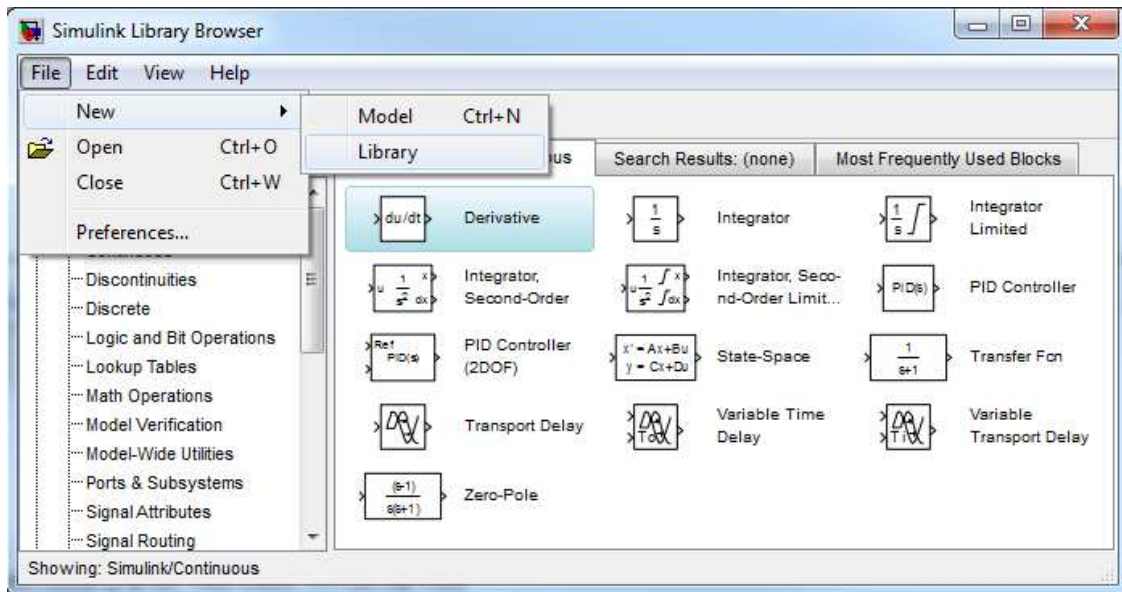


Figure 1: Creating a new library in Simulink

3. Drag a Simulink block (for example, a 'Derivative' block) into the resulting workspace (Figure 2).

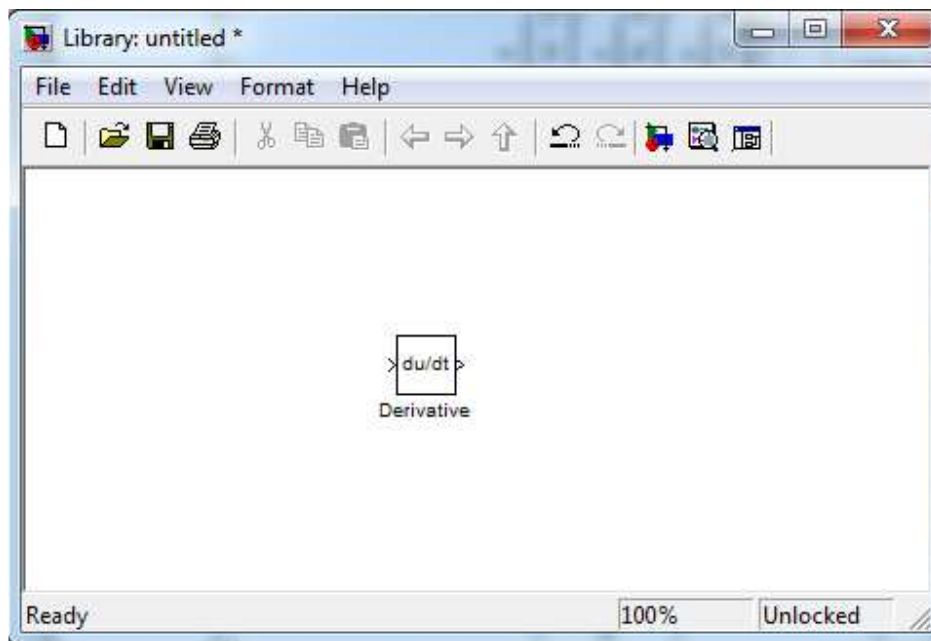


Figure 2: After dragging 'Derivative' block into library. Note that upper left windows says 'Library:'

4. Click on this block to select it and then select 'Edit > Create Subsystem' (Figure 3)

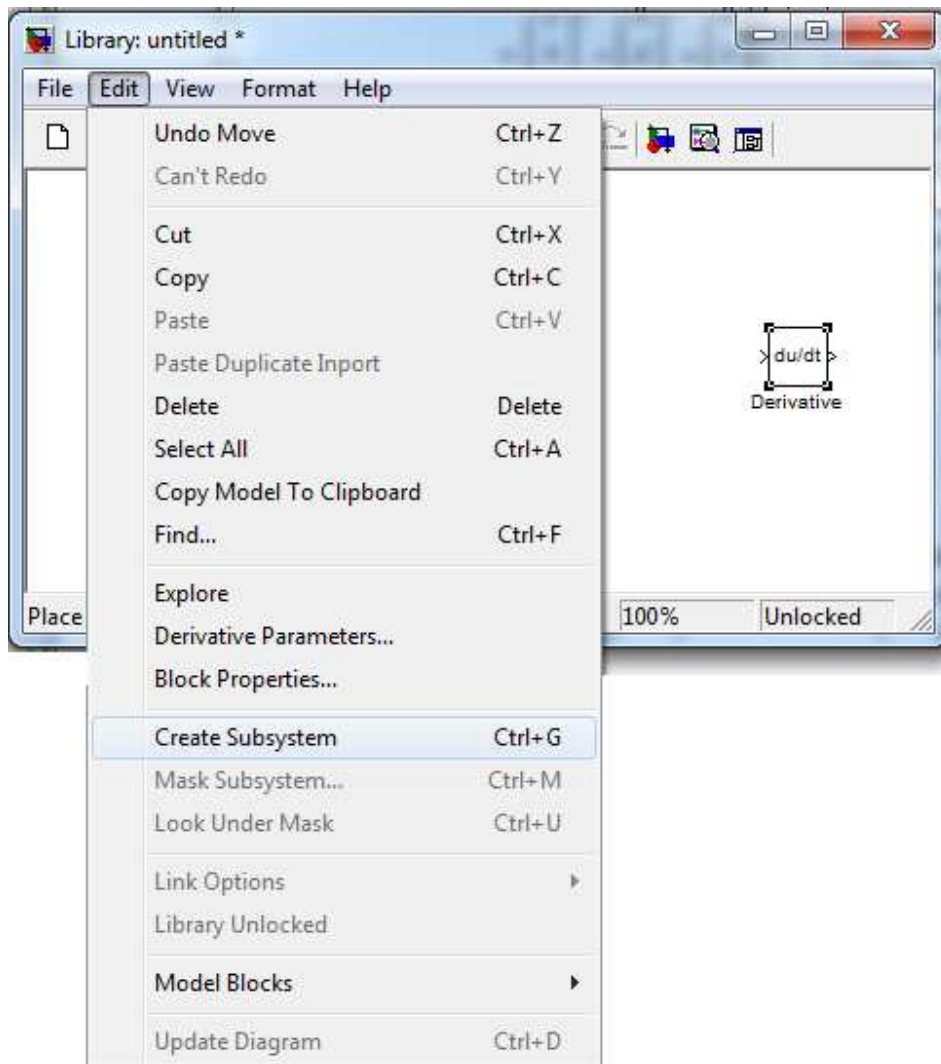


Figure 3: Creating a subsystem of the block

5. Rename the block 'calculate\_CL'
6. Double click on the block and modify the input/output to be as shown in Figure 4.  
Note that the constants blocks are set to a variable values of 'S\_ref' and 'rho'

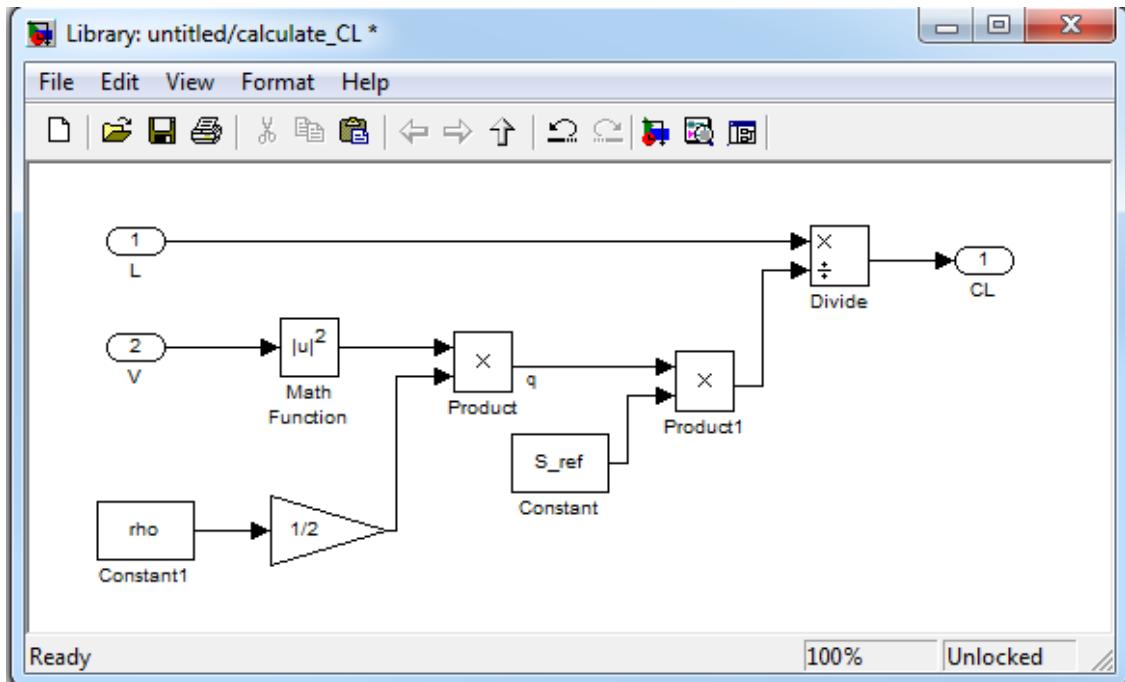



Figure 4: Implementing the equation for CL. Note that the constants blocks are set to 'S\_ref' and 'rho'

7. Close the subsystem.
8. Right click on the block and select 'Mask Subsystem...'. This will effectively close the block to users of this block and allow you to define an interface and documentation for the block.
9. On the resulting dialog box, click on the 'Parameters' tab then click on the  button twice. Modify the parameters to look like Figure 5. This is how the values of 'rho' and 'S\_ref' will be passed into the block.

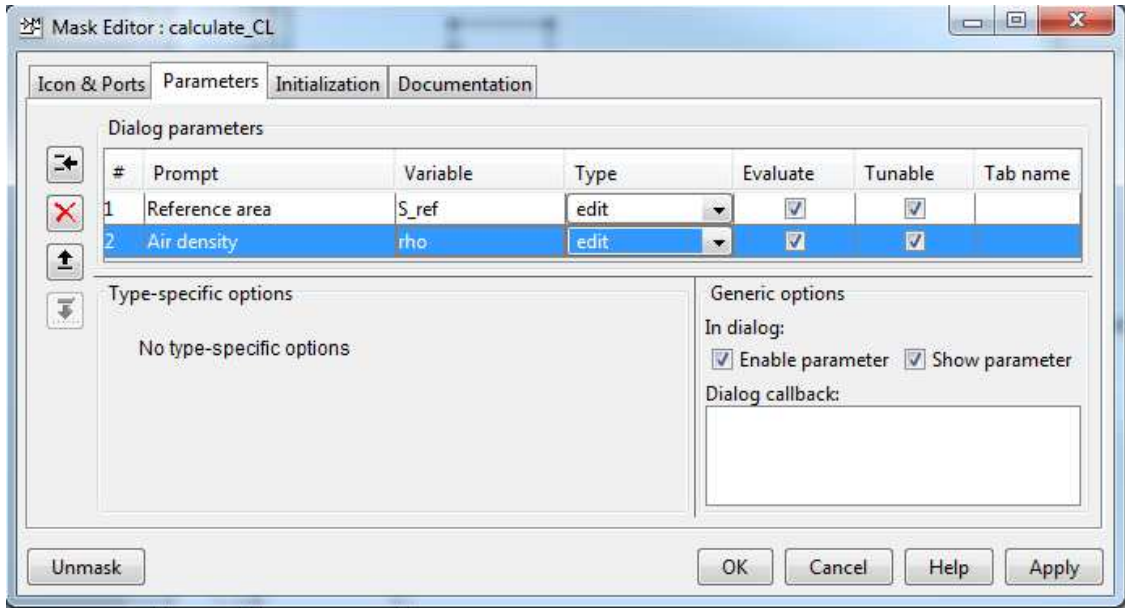


Figure 5: Modifying mask input parameters

10. Click on the Documentation tab and modify the parameters to be similar to Figure 6.

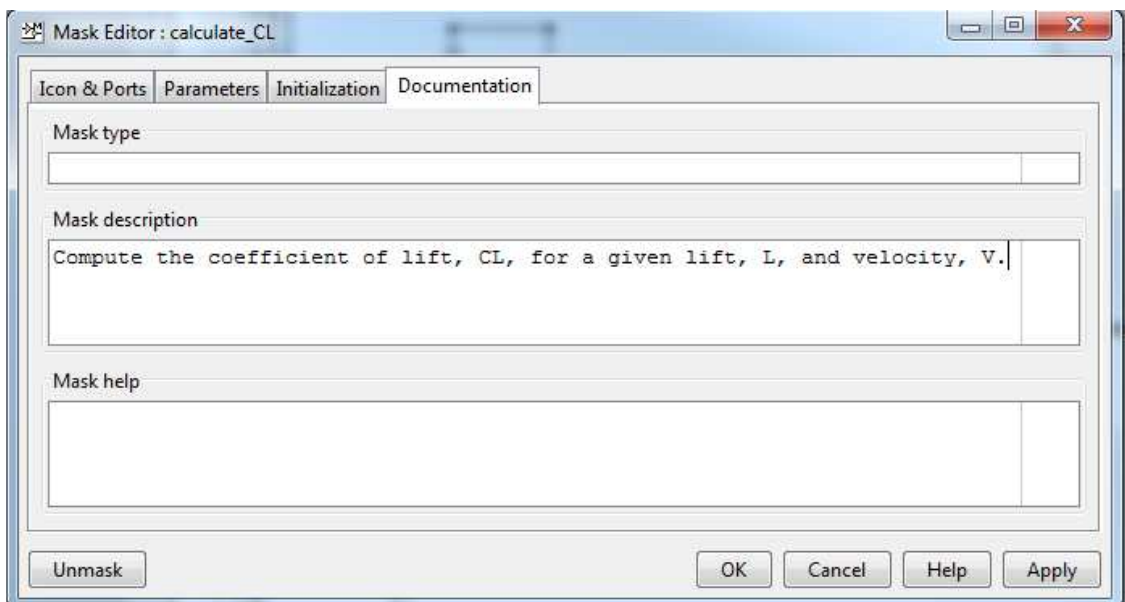


Figure 6: Modifying mask documentation

11. Click on 'OK' to close the window.

12. Double click on the block and notice that you can no longer access the interior of the block. Instead, the interface that you just defined is presented to the user (Figure 7).

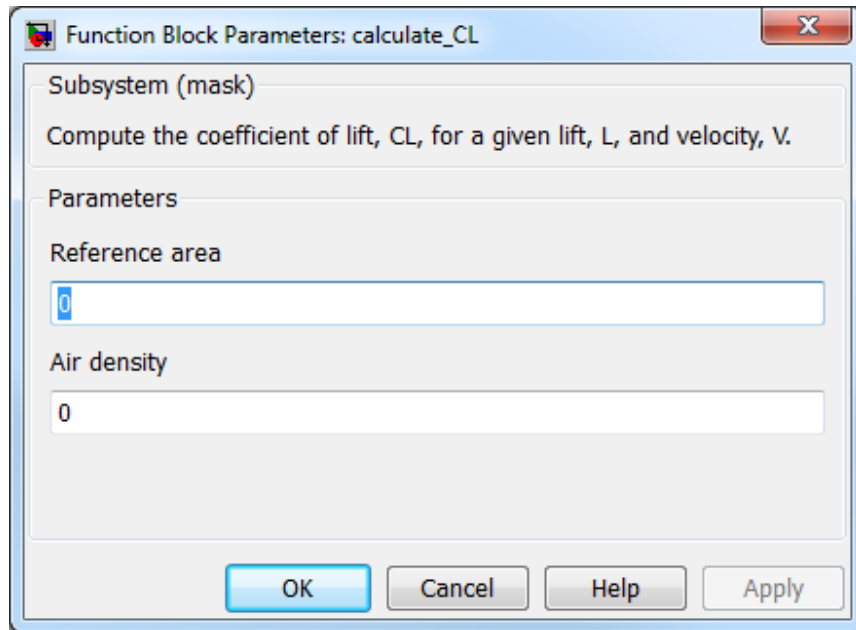


Figure 7: Mask interface

13. Save your library (for the remainder of the tutorial, we will assume you have saved the library as 'myLibrary.mdl').

## Using the Library

The blocks from the library can now be used in other Simulink models.

1. Start a new Simulink model by opening the Simulink Library Browser and selecting 'File > New > Model'
2. Turn on Library Link Display by selecting 'Format > Library Link Display > User' (Figure 8)

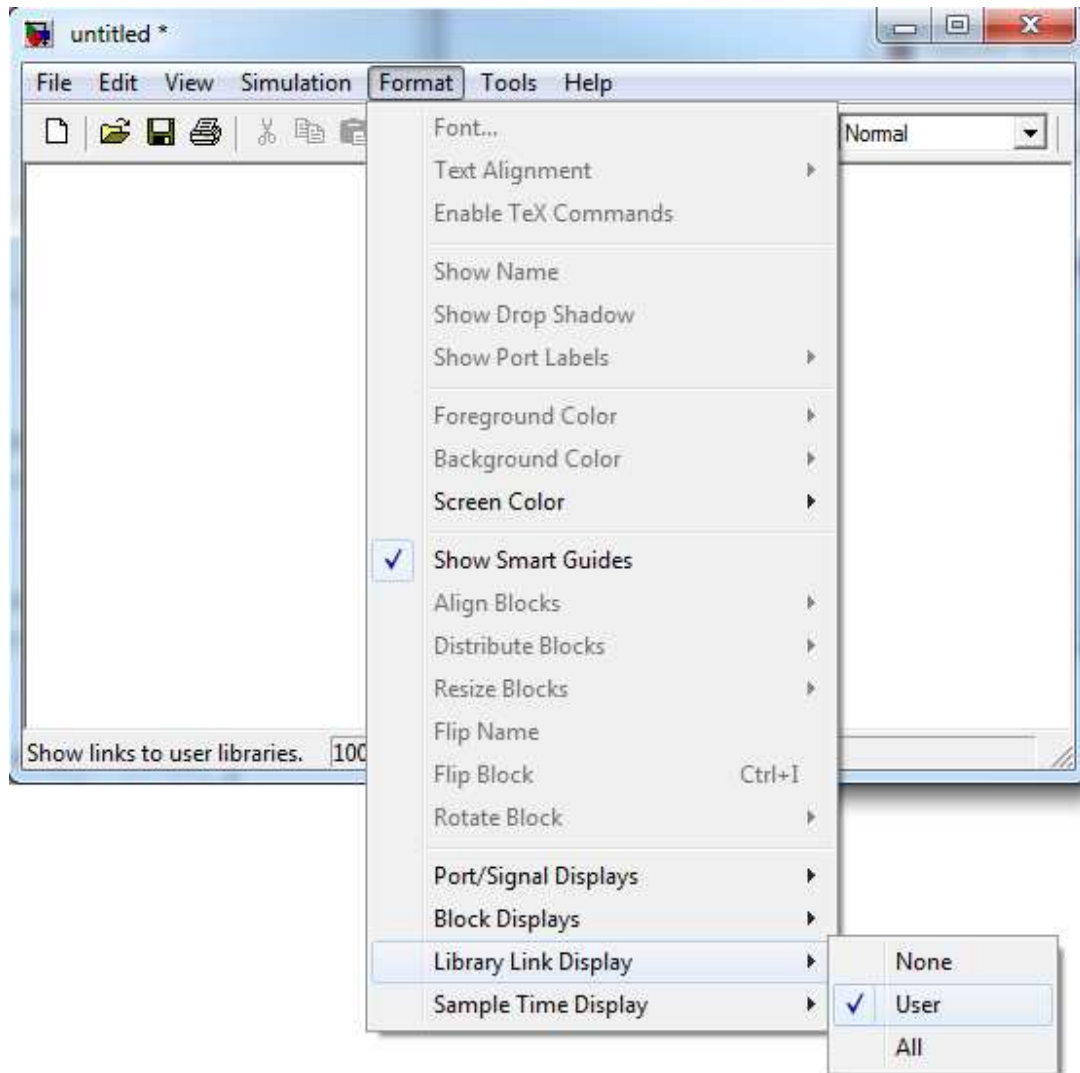
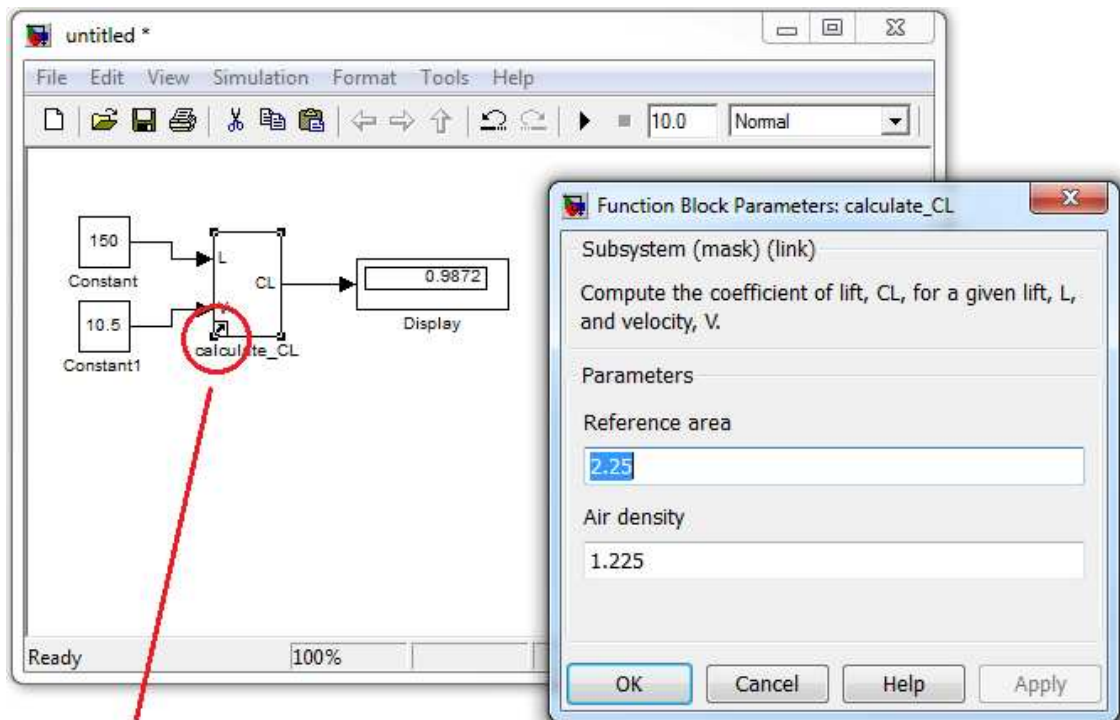


Figure 8: Turning on Library Link Display in your Simulink model.

3. Drag your 'calculate\_CL' block from your library into this model. Notice that there is an arrow in the lower left corner showing that this block is linked to a user defined library.
4. At this point, you can close the library (close the 'myLibrary.mdl' file).
5. Add blocks and parameters to your Simulink model to simulate a condition of  $L = 150$ ,  $V = 10.5$ ,  $S_{ref} = 2.25$ , and  $\rho = 1.225$  (Figure 9)



Arrow shows that this block is linked to a user defined library

Figure 9: Adding blocks and parameters to simulate condition

6. Run the model and verify that the block calculates the appropriate value.
7. Save this Simulink model (for the remainder of the tutorial, we will assume that you have saved this model as 'mySimulinkModel.mdl')

## Modifying the Library

The blocks in the library can be modified and these changes will then propagate the all models which make use of the blocks.

1. Open the library (myLibrary.mdl).
2. By default, when you re-open a library, it is locked. This means that you are unable to modify it. Unlock the library by selecting 'Edit > Unlock Library' (Figure 10).



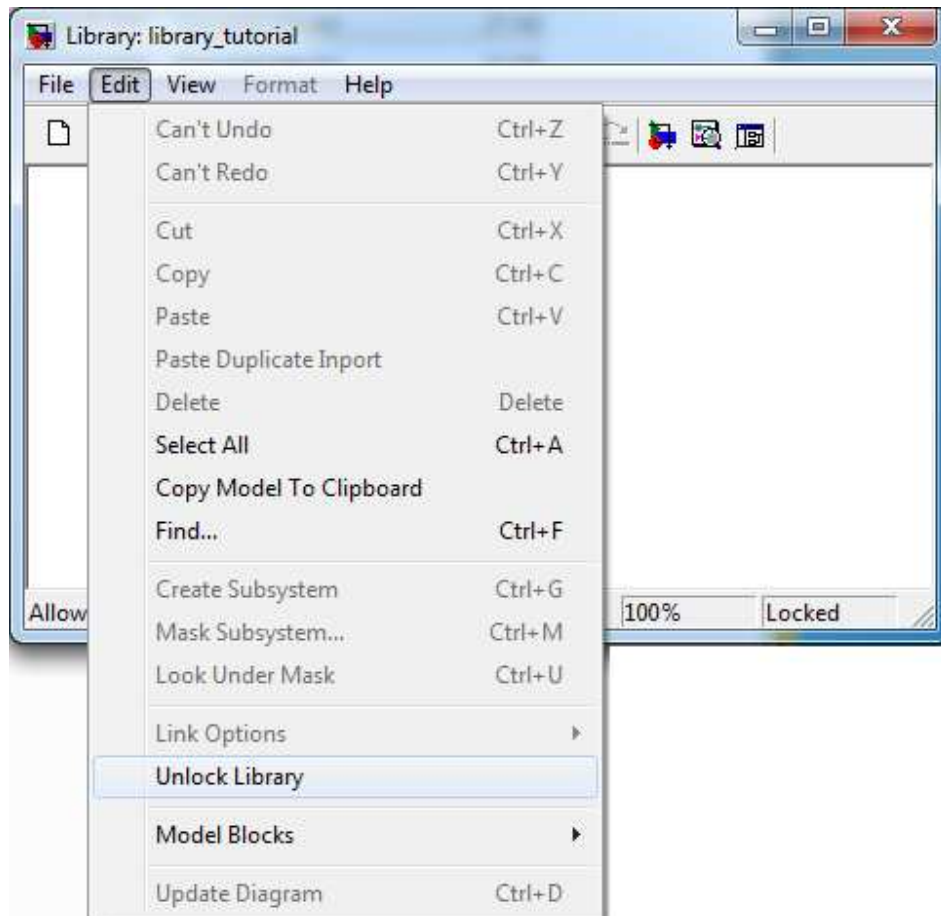


Figure 10: Unlocking the library so that we can modify blocks in the library.

3. We would now like to modify the 'calculate\_CL' block so that the air density ( $\rho$ ) is an input signal instead of a constant input parameter. To do this, right click on the 'calculate\_CL' block and select 'Look Under Mask'. You should now see the internal workings of the block (similar to Figure 4).
4. Modify the block so that ' $\rho$ ' is an input signal as shown in

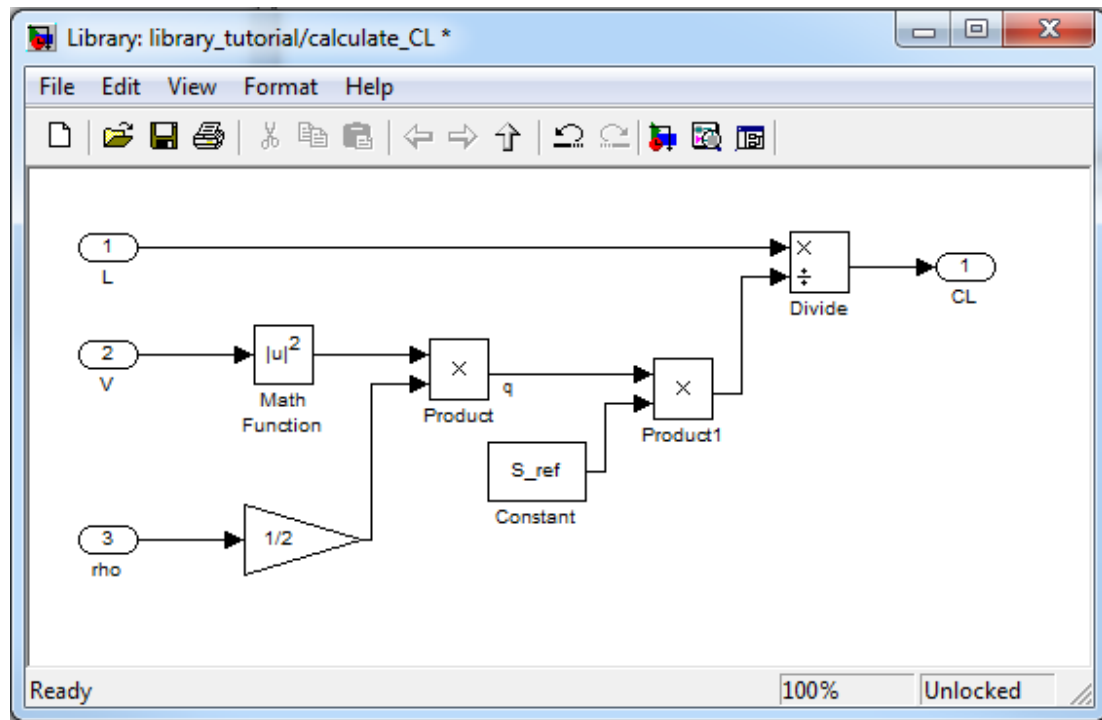


Figure 11: Modifying the 'calculate\_CL' block so 'rho' is an input signal instead of an input parameter.

5. Close the window to return to the library. Notice that the 'calculate\_CL' block has updated to reflect the fact that 'rho' is an input signal now.
6. We now need to modify the interface of the block so that 'rho' is no longer an input parameter. Do this by right clicking on the 'calculate\_CL' block and select 'Edit Mask'.
7. Click on the 'Parameters' tab and click anywhere on the line which defines 'rho' as an input parameter.

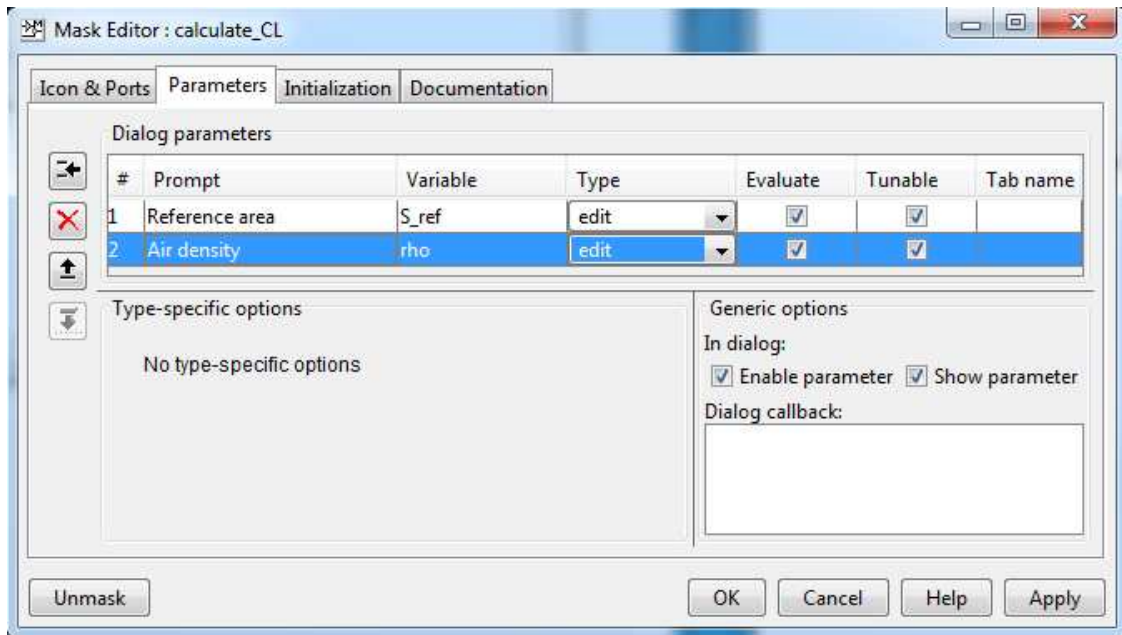



Figure 12: Selecting the line which defines 'rho' as an input parameter.

8. Delete this line by clicking on the  button. Close the window by clicking on 'OK'.
9. Save the library.
10. We can now see how these changes propagate to models which reference this library block. Open the previously generated Simulink model (mySimulinkModel.mdl).
11. You may need to update the model in order to reflect the changes you have made in the library. Do this by selecting 'Edit > Update Diagram'

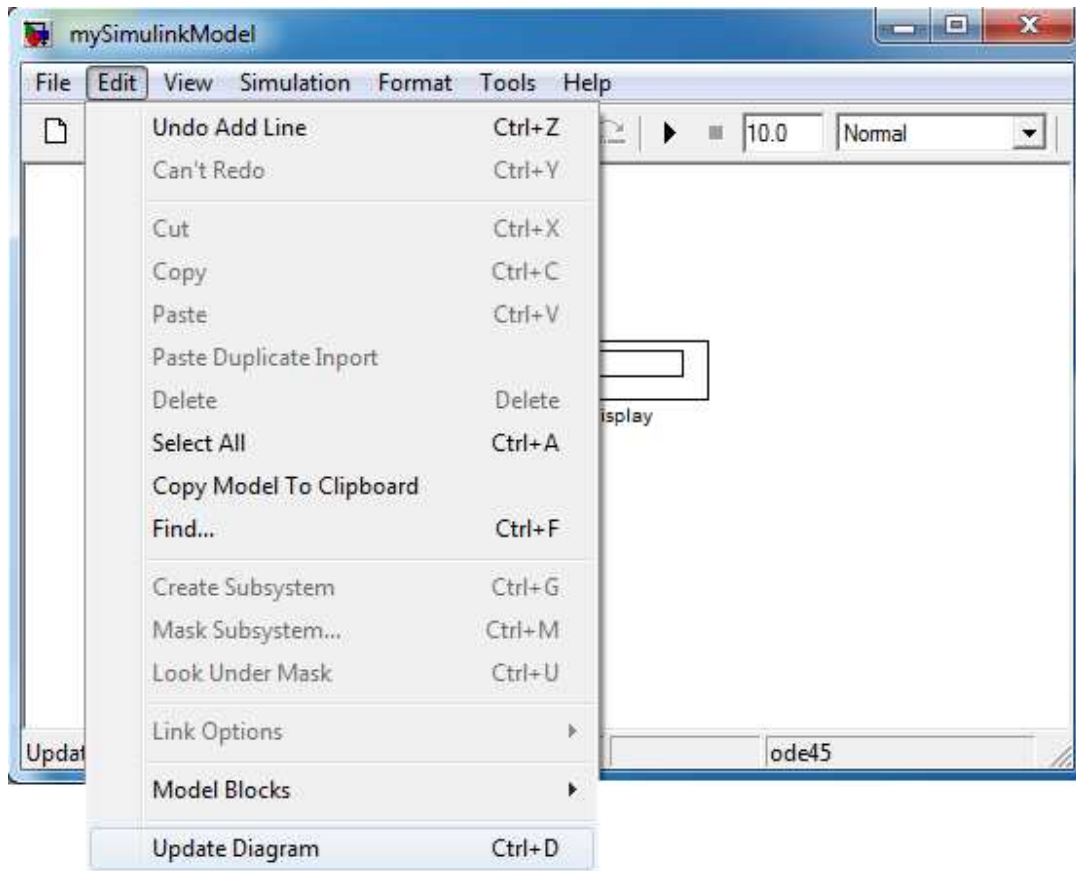


Figure 13: Updating the diagram to ensure that all library block references are current.

12. At this point, you should see that the 'calculate\_CL' block reflects the most recent changes that were made in the library (double click on the block to see the changes to the mask interface) as shown in Figure 14.

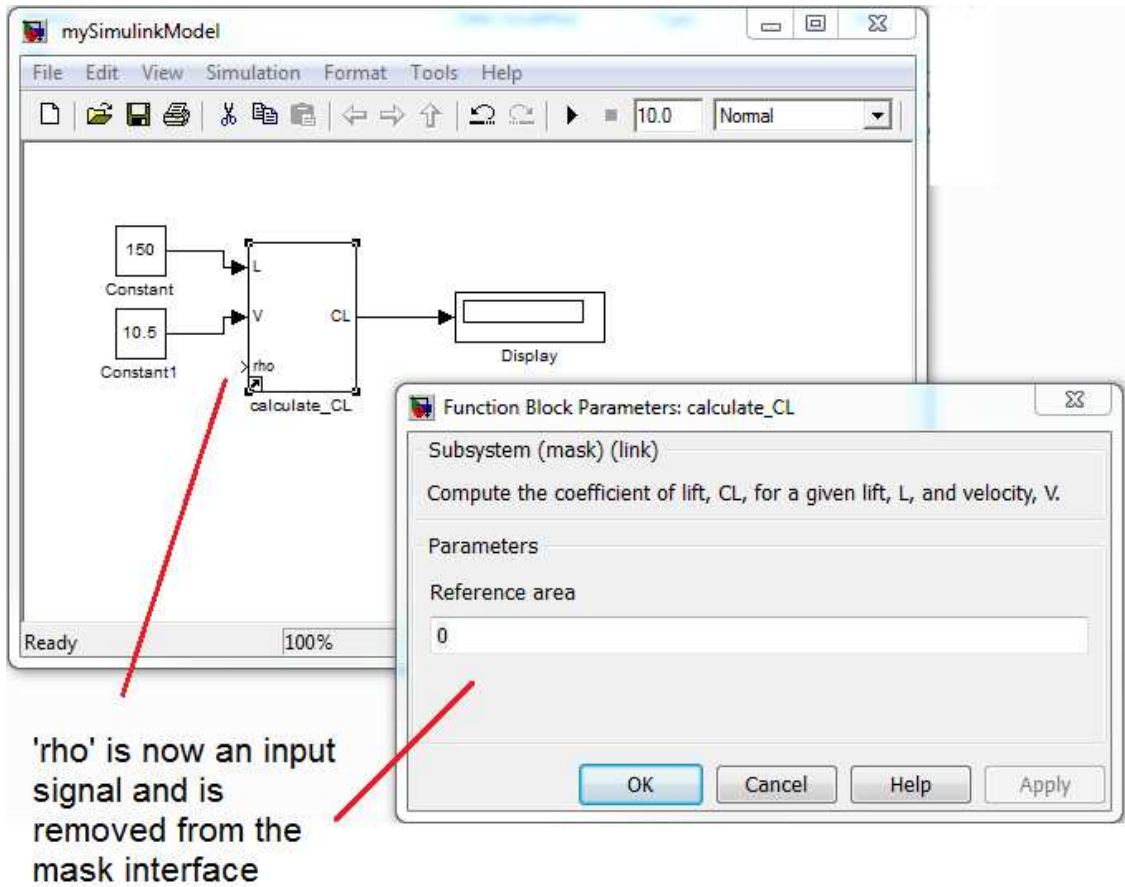


Figure 14: Changes to the library propagate to all models which make use of its blocks.

13. Modify your Simulink model to reflect these changes and verify that the 'calculate\_CL' block still functions as desired (Figure 15).

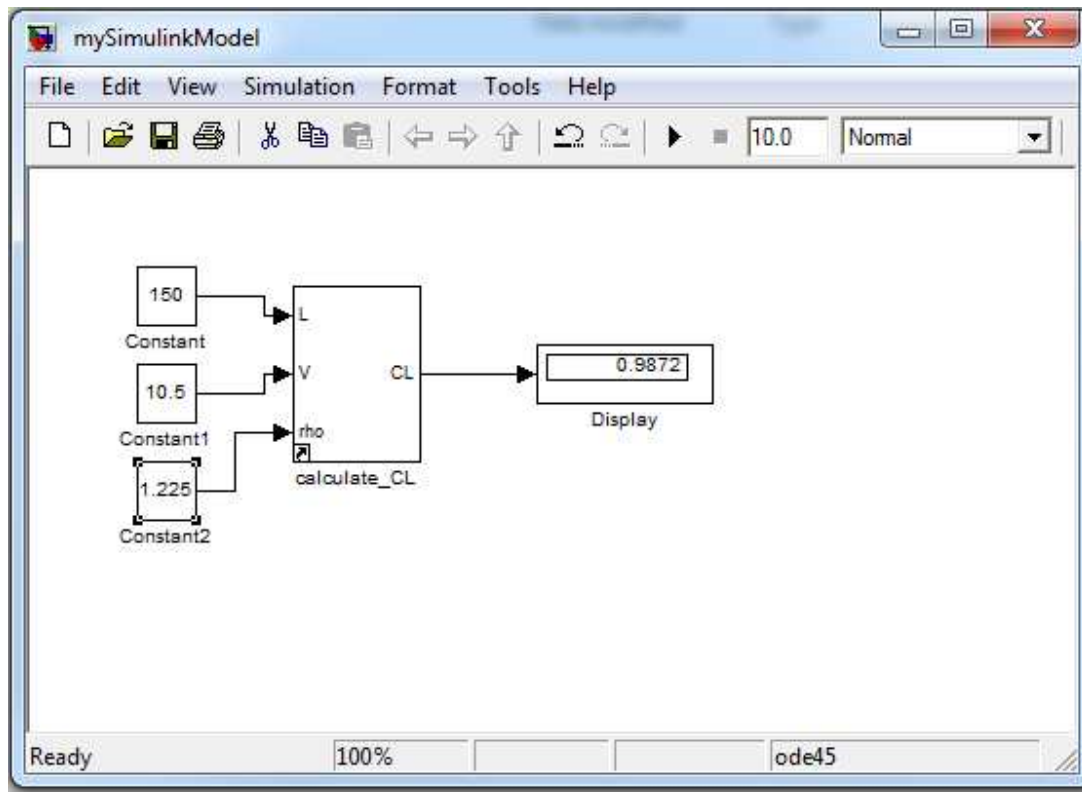


Figure 15: Modifying the Simulink model to interface with the new 'calculate\_CL' block.

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Version History: 10/20/11: Created  
10/21/11: Modified: Updated documentation and fixed some bugs.