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Guidelines for MATLAB's SISO Design Tool GUI

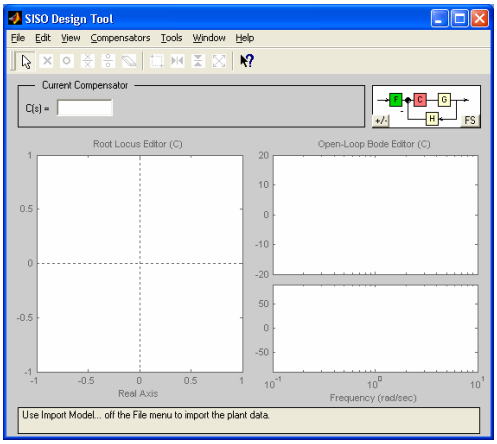
The **SISO Design Tool** is a graphical user interface (GUI) that facilitates the design of compensators for single-input, single-output feedback loops. The SISO Design Tool allows you to iterate rapidly on your designs and perform the following tasks:

- Manipulate closed-loop dynamics using root locus techniques.
- Shape open-loop Bode responses.
- Add compensator poles and zeros.
- Add and tune lead/lag networks and notch filters.
- Inspect closed-loop responses (using the LTI Viewer).
- Adjust phase and gain margins.
- Convert models between discrete and continuous time.

The **sisotool** command opens the SISO Design Tool and sets it up for controller design.

Here are the steps for launching the SISO Design Tool:

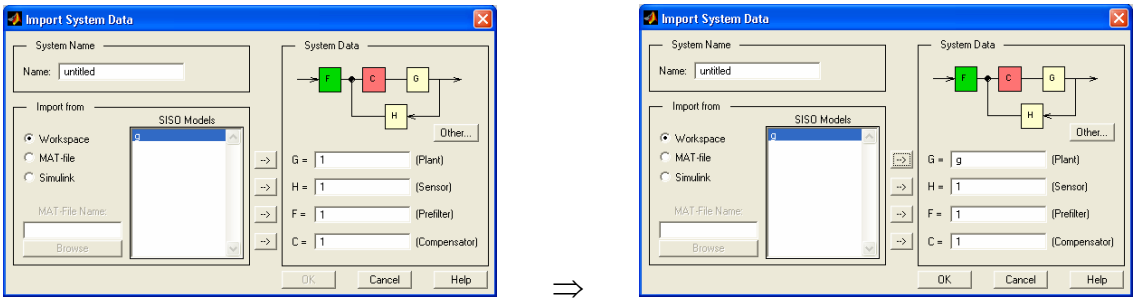
1. Enter the **plant model** (transfer function, etc.) into MATLAB workspace
   Ex: $G(s)=\frac{10}{s(s+2)}$
2. Type **sisotool** and press return
   The SISO Design Tool window opens as shown.



NOTE:

- To change the Control System toolbox preferences, choose **Toolbox Preferences…** from **File** menu and make necessary modification in **Units**, **Style**, **Characteristics** and **SISO Tool** options.

3. Select **Import …** from File menu and import the plant model **G(s)** into sisotool GUI.



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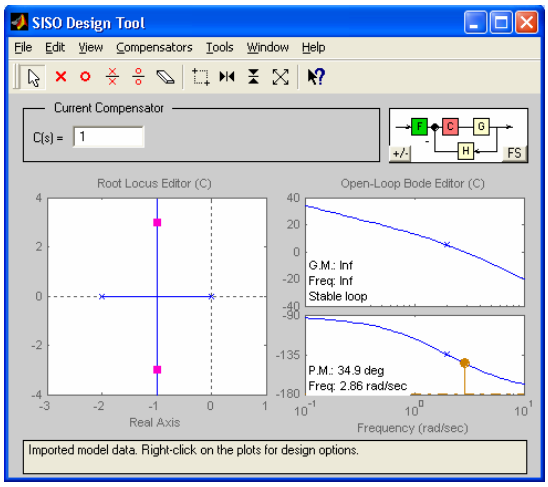
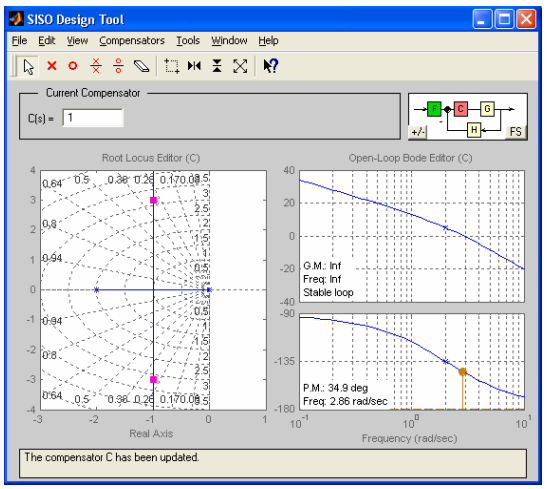
The **root locus** and **Bode plot** of the plant **G(s)** with the default control C(s)=1 will then be shown in the SISO Design Tool window.

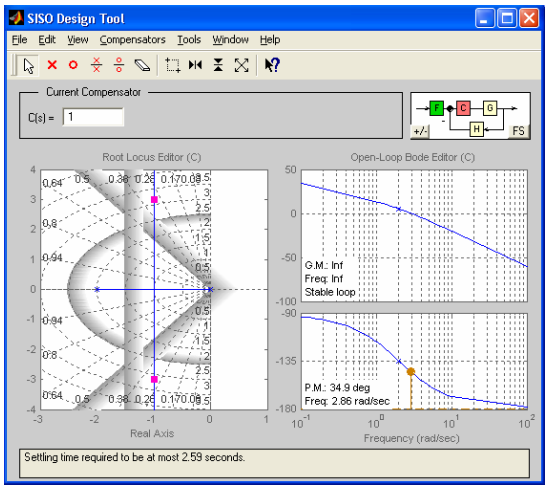


NOTE:

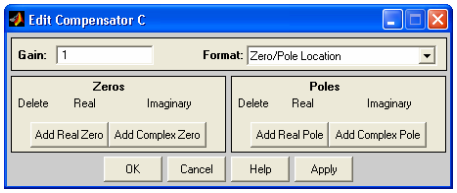
- To change the units of the Bode magnitude plot from dB to absolute value, choose **magnitude in "absolute" – "log scale"** from **Edit / SISO Tool Preferences / Units** menu.
- To change the compensator format from default to $C(s) = K\,\frac{\frac{s}{z}+1}{\frac{s}{p}+1}$, choose **Natural frequency** from **Edit / SISO Tool Preferences / Options** menu.

4. To add/remove **grids** you **right click** on the corresponding **plot windows** (root-locus, Bode, or both) and select the grid option. To show the **design constraint boundaries**, you **right click** on the appropriate **plot window** and choose design constraint option and specify your **new** constraint. To modify these constraints, **click and drag** the appropriate constraint boundary to a new location.





5. To design or modify the control, **right-click** on the Current Compensator box. The compensator window opens where you can add/delete zeros and poles and change the control gain.



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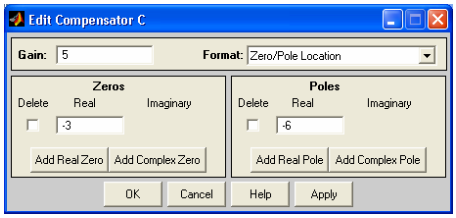

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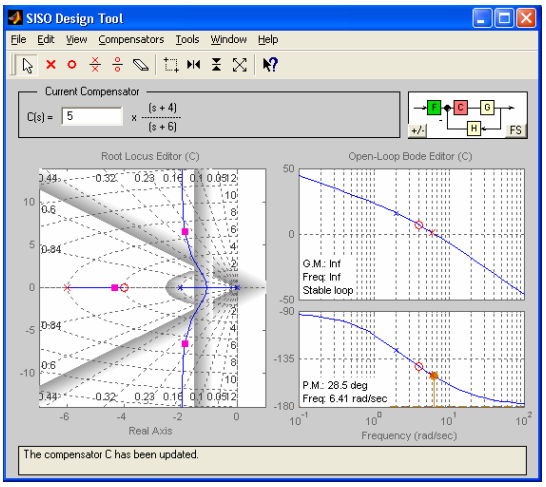
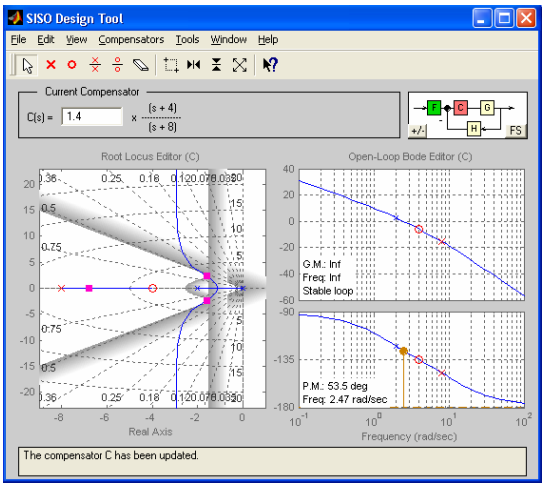
The **root locus** and **Bode plot** of the open-loop system **C(s)G(s)**, with the new control C(s), will be shown in the SISO Design Tool window.



You can now interactively **modify** the current **compensator** until the design constraints are satisfied.

6. To change the compensator's pole and zero, **click and drag** them to new locations. Instantly, you will see the systems **root-locus** and **Bode plot** will also change.



NOTE:

- To save the results and plots at different stages of your design, choose **Save Session** from **File** menu. It saves everything.
- To retrieve the results and plots that were saved at different stages of design, choose **Retrieve Session** from **File** menu.

You can also **click and drag** the **closed-loop poles** (the **red squares** on the root-locus) to new locations. This, instantly changes the corresponding control gain.

To change the control gain, you may also **click and drag** the **Bode plot magnitude** up or down. The cross-over frequency, phase-margin and gain-margin, shown in the Bode plot, will then change instantly.

Now, the current controller is: $C(s) = 1.4\,\frac{s+4}{s+8}$

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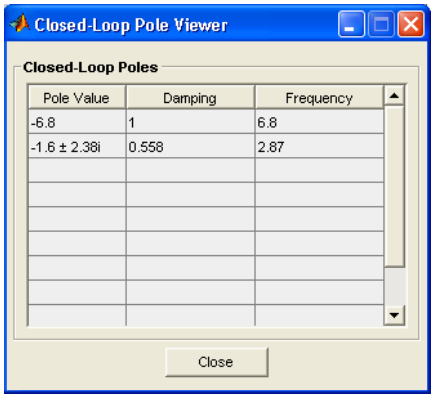
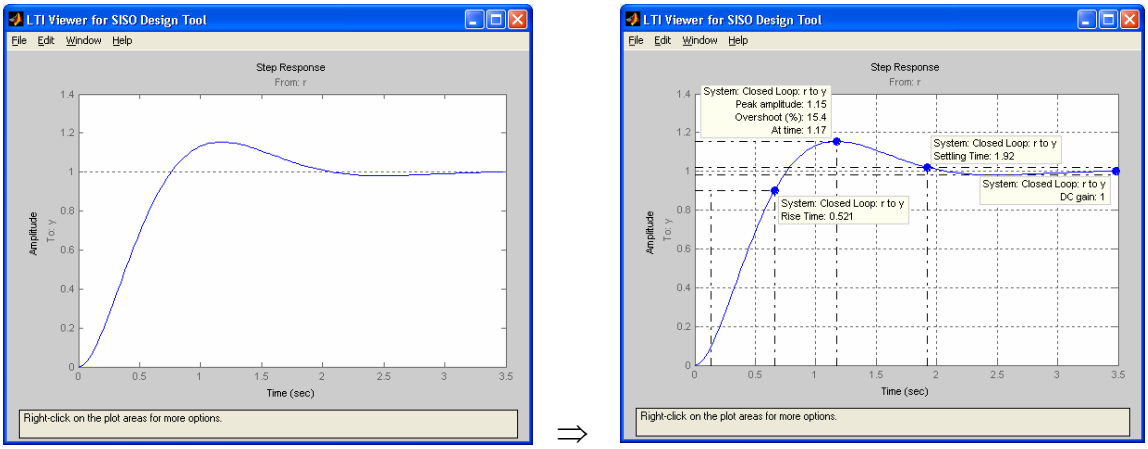
7. You can now check the characteristics of the closed-loop system.

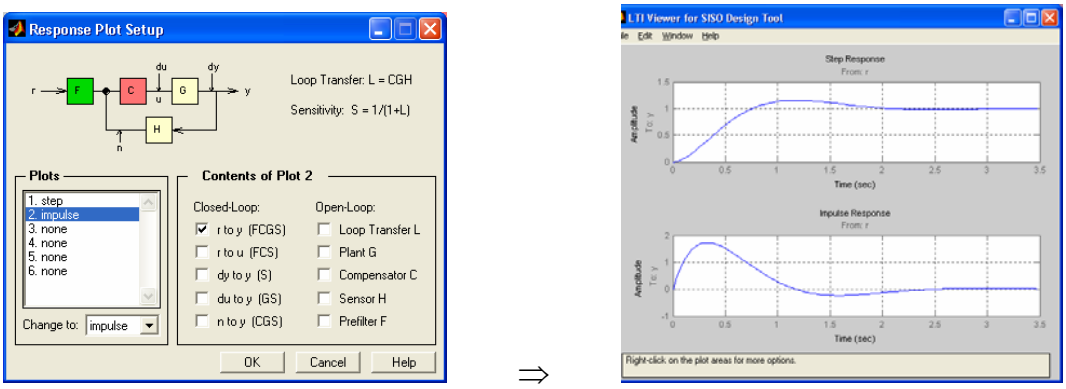
   To see **closed-loop poles**, choose closed-loop poles from **View** menu.



   To see **closed-loop step-response**, choose **Loop Responses → Closed-Loop Step** from **Tools** menu. You can **right click** on the plot in the **LTI Viewer** window to add/remove grid, as well as add/remove closed-loop characteristics (Peak Response, Settling Time, Rise Time, Steady State).



   For **other system responses**, select **Loop Responses → Other …** from **Tools** menu.



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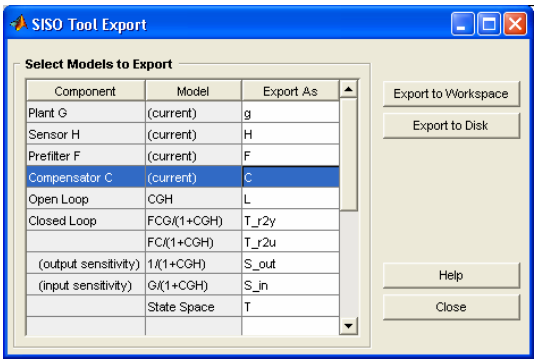
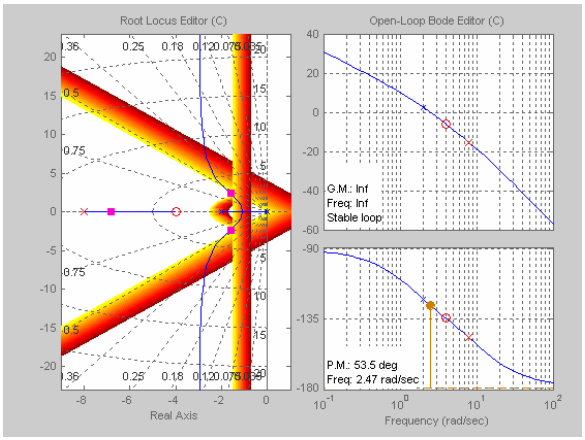
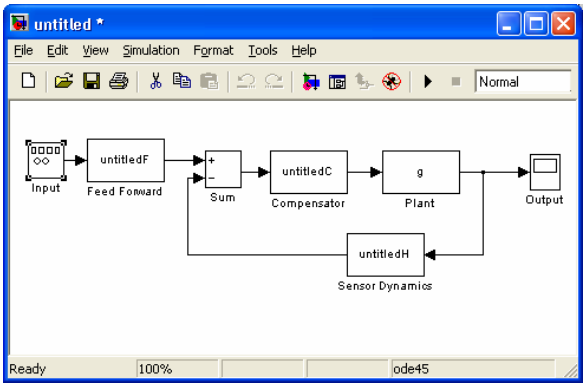
8. To export the designed controller to MATLAB workspace, choose **Export …** from the **File** menu. The exported data will overwrite the existing data in the workspace.

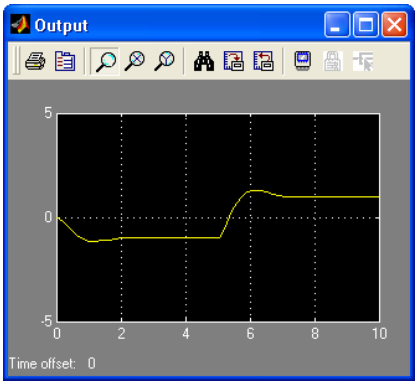


9. To **transfer the plots to** another application such as **WORD**, choose **Print to Figure** from **File** menu. This, transfers the selected figure to a **MATLAB Figure** window. Now, in this Figure window, choose **Copy Figure** from the **Edit** menu and then **Paste** it into your **WORD** file.



10. To transfer the data to SIMULINK, choose **Draw Simulink Diagram** from the **Tools** menu. This can be done only after the plant and compensator data have already been exported to MATLAB workspace.





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