Using Matlab SISOTOOL 2016 part 4

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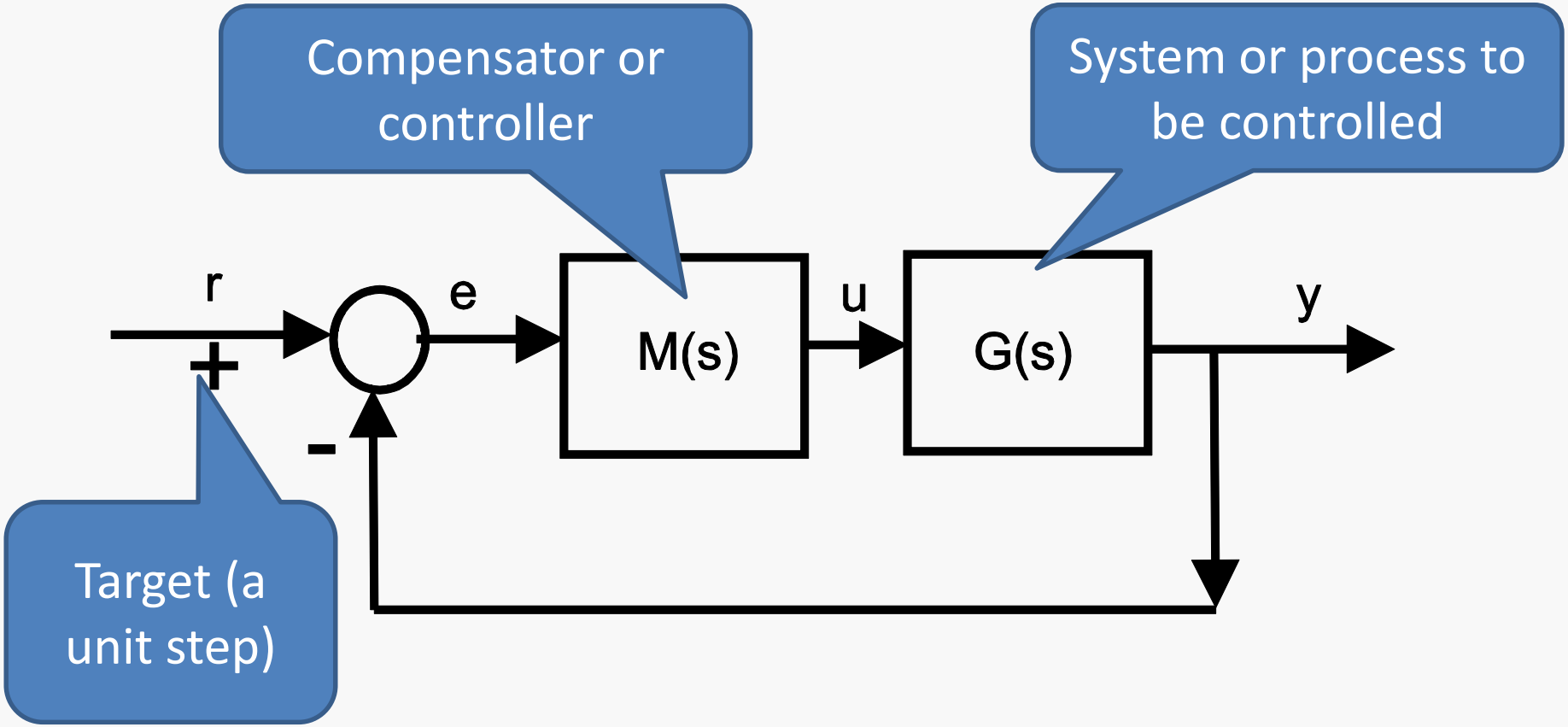
http://controleducation.group.shef.ac.uk/indexwebbook.html

Introduction

- There has been a relatively major change in the presentation and functionality of sisotool in MATLAB 2016.
- This resource gives a quick overview of how to do lead and lag compensator design.
- Principally, it demonstrates the graphical placement tools for poles and zeros, but also the ease with which fine tuning can be done via the compensator editor.
- Real time demonstrations are given at the end of the video.

Assumptions

This resource assumes a simple feedback structure as follows (although sisotool will deal with more complicated structures).

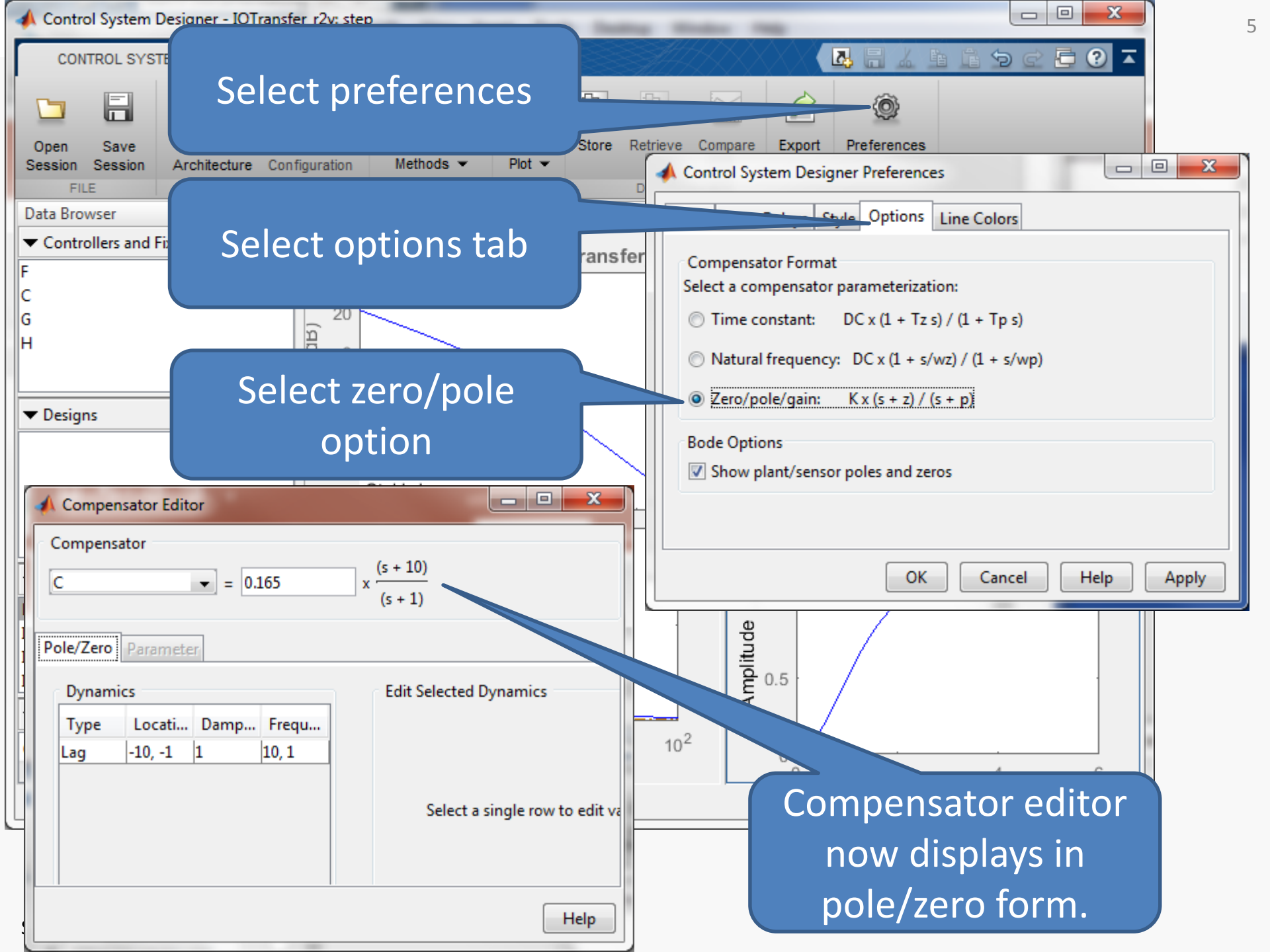


WARNING on preferences

Sisotool can display compensators in various standard forms.

1. It may, change the underlying proportional gain when you enter a pole and zero.
2. Ensure you always display the implied compensator and check that it has the numeric values you intended.

For this resource, we use pole/zero format which must FIRST be selected via preferences.


Select preferences
Select options tab
Select zero/pole option
Compensator editor now displays in pole/zero form.
Control System Designer - IOTransfer_r2y: step
Open Session
Save Session
Architecture
Configuration
Methods
Plot
Store
Retrieve
Compare
Export
Preferences
Data Browser
Controllers and Fi
Designs
Control System Designer Preferences
Options
Line Colors
Compensator Format
Select a compensator parameterization:
Time constant: DC x (1 + Tz s) / (1 + Tp s)
Natural frequency: DC x (1 + s/wz) / (1 + s/wp)
Zero/pole/gain: K x (s + z) / (s + p)
Bode Options
Show plant/sensor poles and zeros
OK
Cancel
Help
Apply
Compensator Editor
Compensator
C
= 0.165 x (s + 10) / (s + 1)
Pole/Zero
Parameter
Dynamics
Type
Locati...
Damp...
Frequ...
Lag
-10, -1
1
10, 1
Edit Selected Dynamics
Select a single row to edit va
Help
Amplitude

LAG COMPENSATOR DESIGN

Lag compensator design

For the sake of simplicity, as the focus is sisotool, this video uses the following design procedure (increase low freq. gain by a factor of 5).

1. Find gain K to set the PM to be 60 degrees.
2. Determine the gain cross-over frequency w_g.
3. Set the zero to be $w_g/10$.
4. Set the pole to be $w_g/50$.

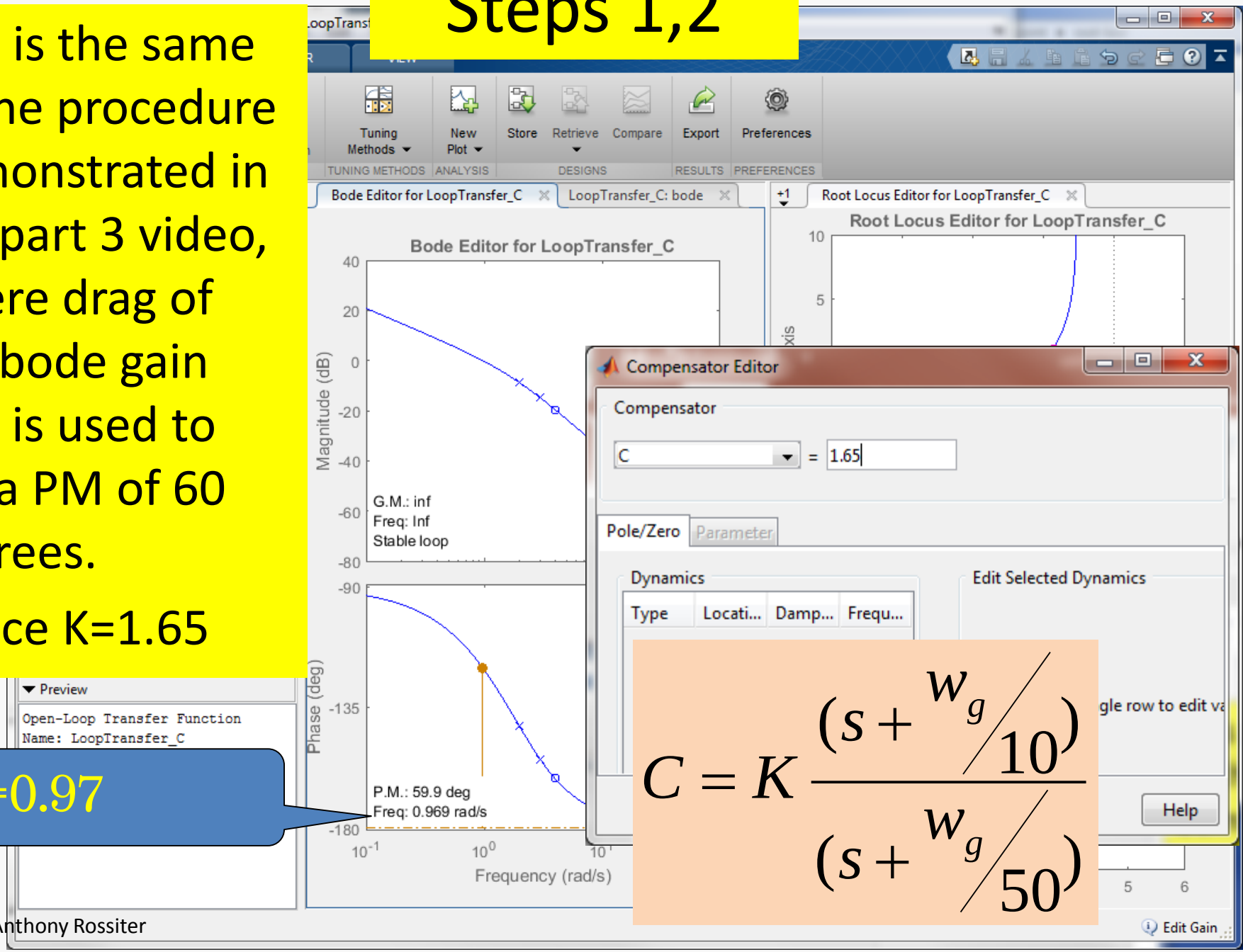
$$C = K\frac{(s + w_g/10)}{(s + w_g/50)}$$

The use of sisotool to support this design method is demonstrated.

Steps 1,2

This is the same as the procedure demonstrated in the part 3 video, where drag of the bode gain plot is used to get a PM of 60 degrees.

Hence K=1.65



w_g=0.97

$$C = K \frac{(s + w_g/10)}{(s + w_g/50)}$$

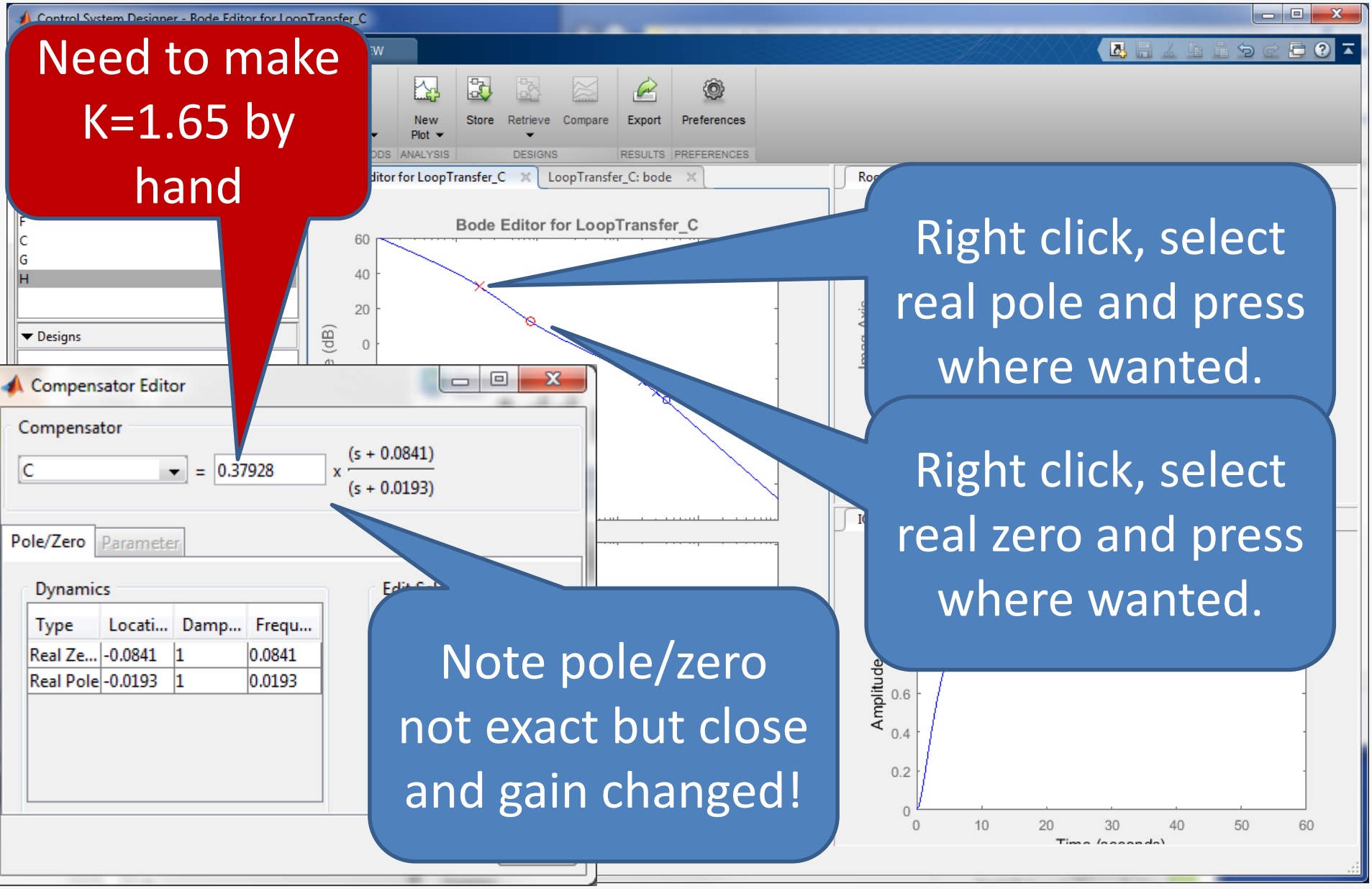
Steps 3,4

$$K = 1.65, \quad w_g = 0.97, \quad C = K \frac{(s + w_g/10)}{(s + w_g/50)}$$

$$C \approx 1.65 \frac{(s + 0.1)}{(s + 0.02)}$$

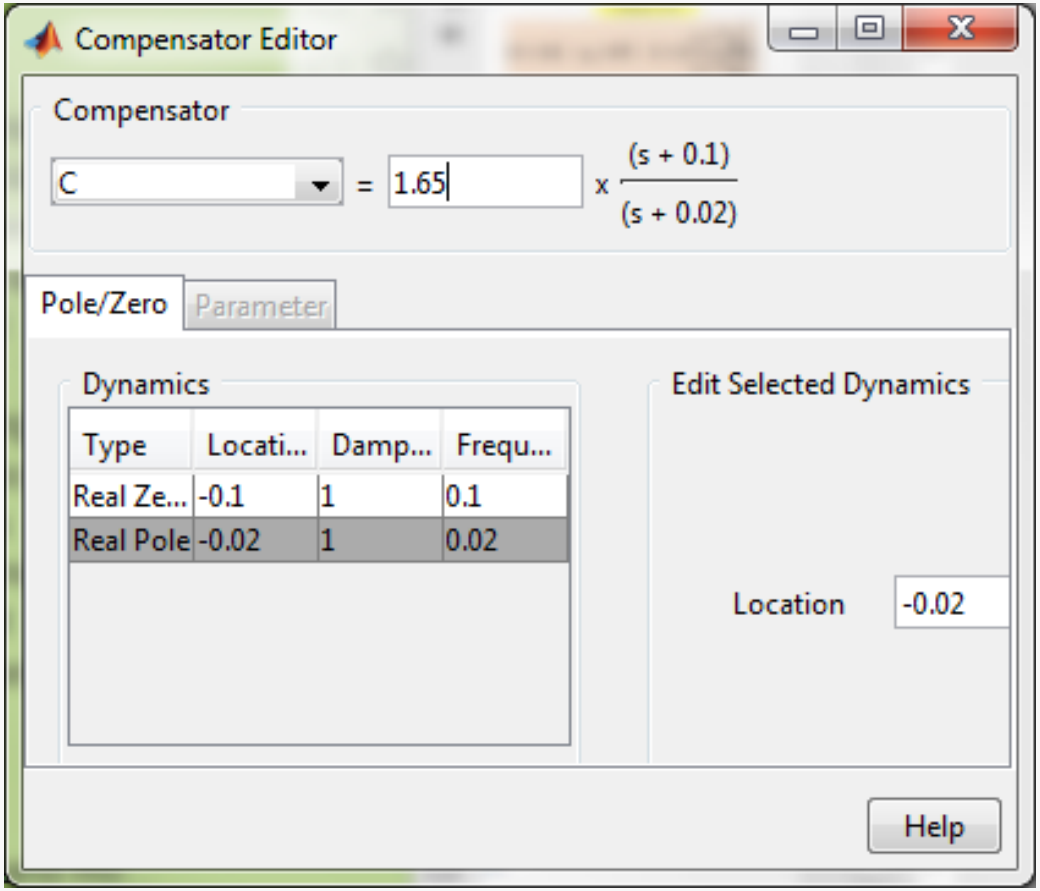
Next, use the graphical placement tool in the root-loci plot to place poles and zeros at approximately the correct places.

Add poles and zeros direct onto graph



For an exact design

Enter desired values directly into the compensator editor



DESIGN WITHOUT EXPLICITLY COMPUTING VALUES OF K AND WG

Advantages of sisotool design

This is best done with a live demonstration.

The basic method is the same, but no explicit computations are made so quick and allows intuitive tuning.

1. Use drag of Bode to get desired PM (approx.).
2. Add a zero at a decade below the gain cross over frequency, which is clearly marked.
3. Add a pole to left of zero, with ratio the desired gain uplift.
4. Modify gain plot to regain phase margin.

Actual C(s) available from compensator editor if needed.

LIVE DEMONSTRATION

Remark

- Poles and zeros can also be dropped directly into the root-loci plot if desired.
- A live demonstration will be used to show this.

Conclusion

This video has demonstrated the basic use of the drag and drop facilities in sisotool in MATLAB 2016 for doing lag compensator design.

Drag (in Bode gain plot) allows the user to quickly get the desired phase margin.

Drop (in bode gain plot or root loci) allows poles and zeros to be placed with the mouse.

The edit compensator window can be used for fine tuning if desired.

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