

# EENG307: Introduction to Root Locus<sup>1</sup>

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## Lecture 18

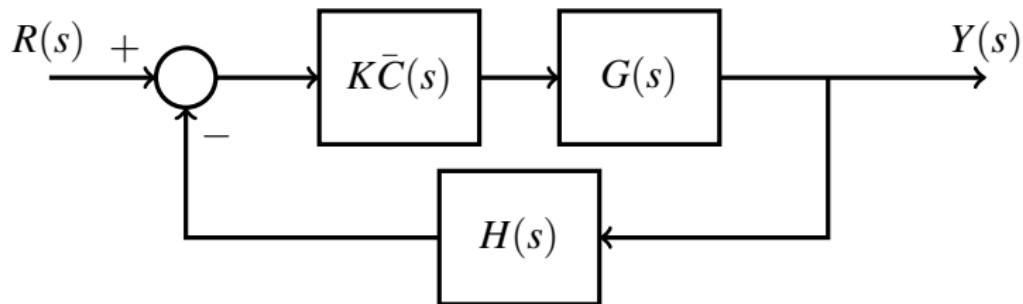
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<sup>2</sup>Developed and edited by Tyrone Vincent and Kathryn Johnson, Colorado School of Mines, with contributions from Salman Mohagheghi, Chris Coulston, Kevin Moore, CSM and Matt Kuplik, University of Alaska, Anchorage <

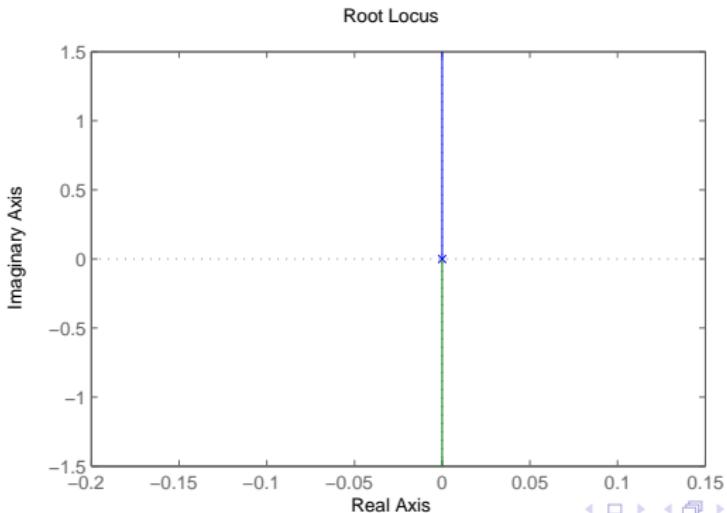
# Design Question:

What closed loop poles are achievable by varying the gain  $K$  in the feedback system below for a given plant  $G(s)$ , sensor  $H(s)$ , and basic controller structure  $\bar{C}(s)$ ?

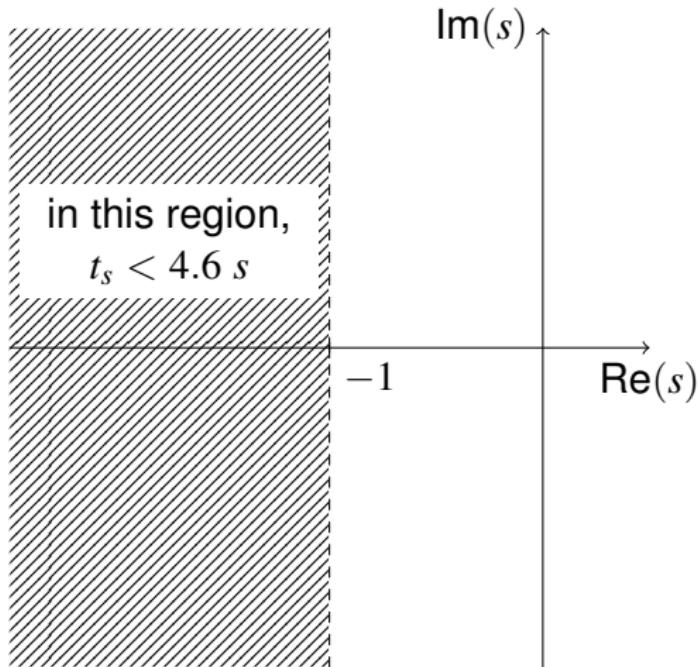


# Plotting the root locus using MATLAB

```
» s = tf('s'); % note: another way to define a TF  
using s as a variable  
» L = 1/s^2  
» rlocus(L)
```



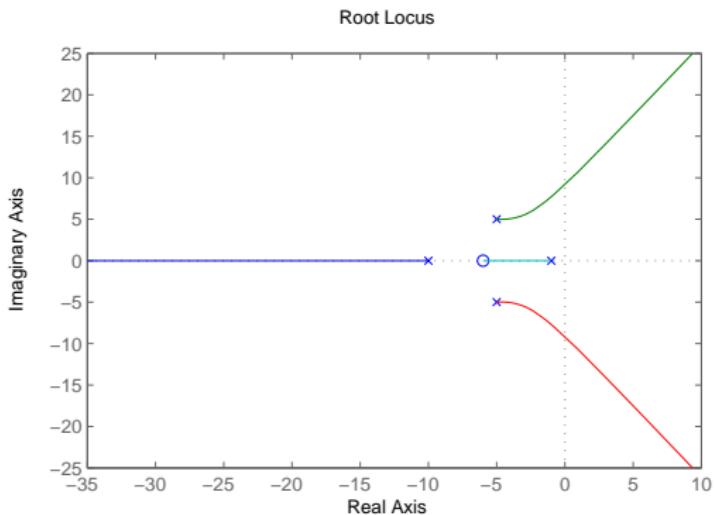
# Settling Time Requirement for Example



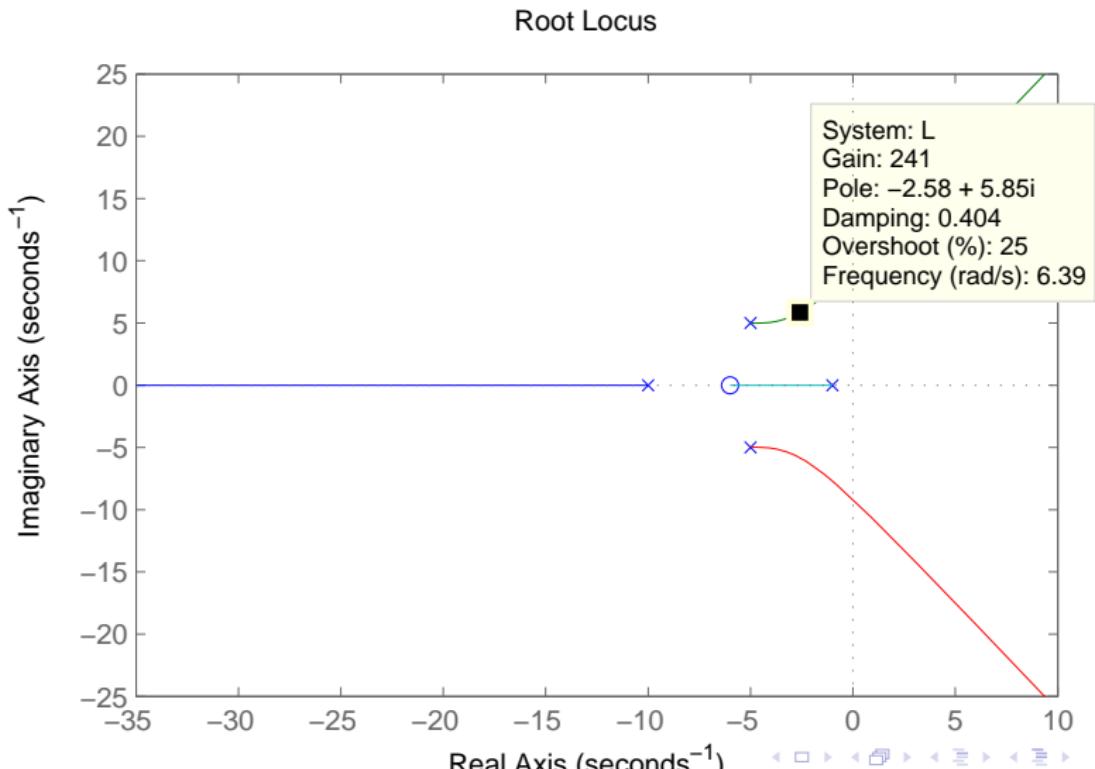
By comparing the root locus (closed-loop poles on the imaginary axis) from Example ?? to the allowable region for the closed-loop poles (real

# Plotting the root locus using MATLAB

```
» s = tf('s');  
» G = (s+6)/((s+1)*(s+10)*(s^2+10*s+50))  
» rlocus(G)
```



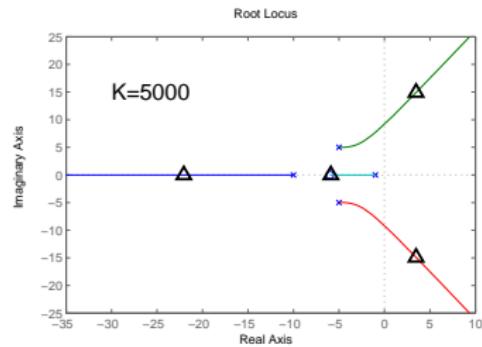
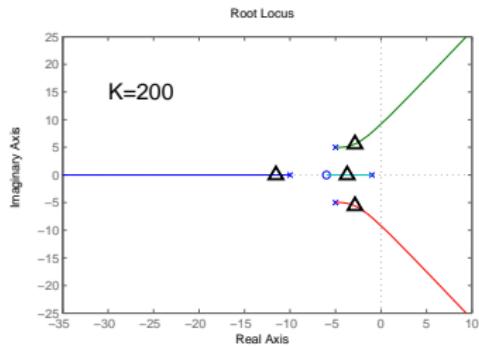
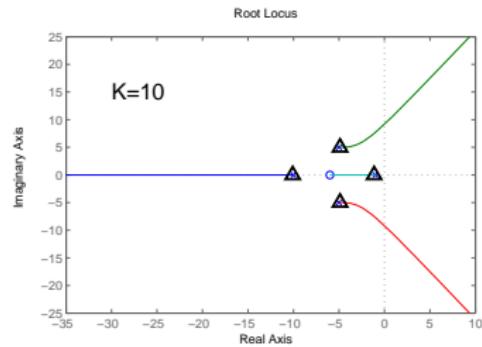
# Pole Location Information



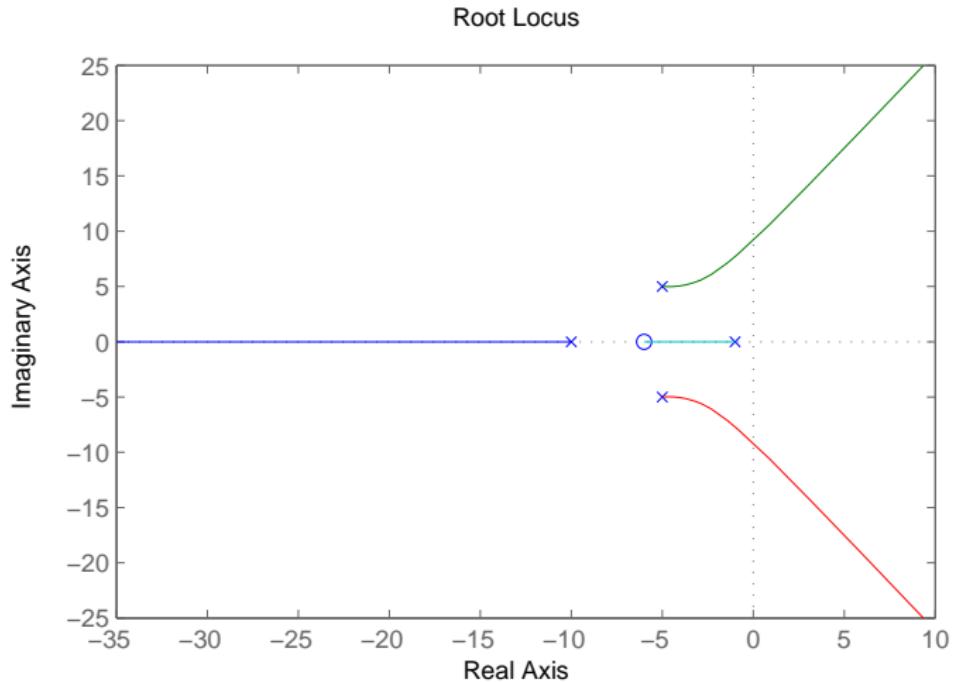
# Four Questions for Root Locus Features

- How many loci will we have?
- Where do the loci begin ( $K = 0$ ) and end ( $K = \infty$ )?
- When do we have loci on the real axis?
- At what angles do the loci approach magnitude  $\infty$ ? (Especially relevant to whether they enter the right half plane, meaning the closed loop system becomes unstable.)

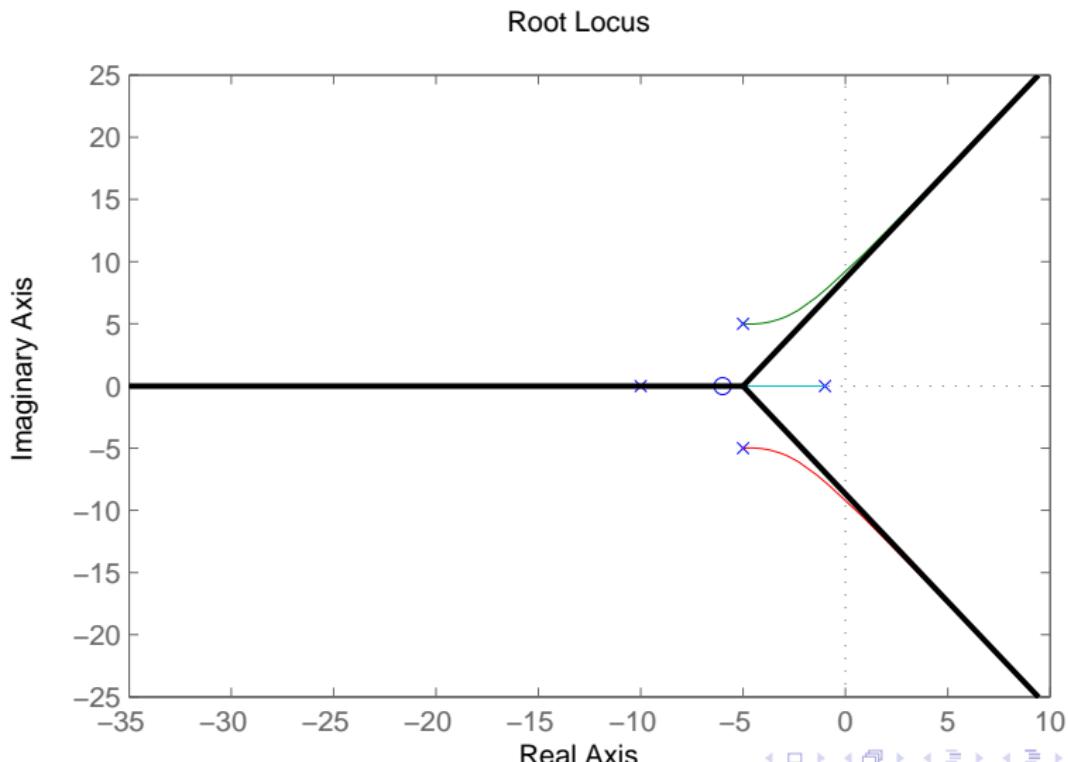
# Root Locus with closed loop pole overlay



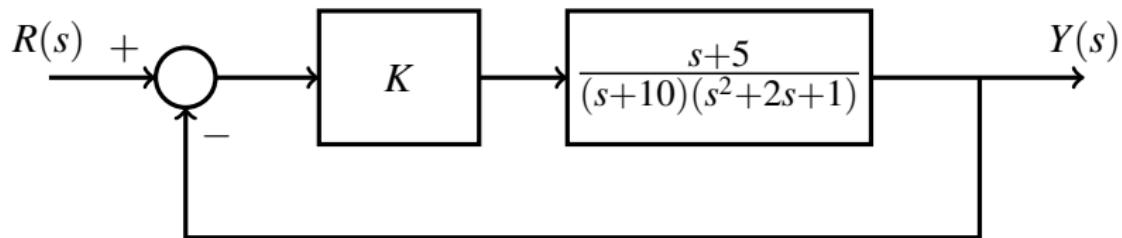
# Root locus on the real axis



# Root Locus Asymptotes



# Root Locus Example Problem 1



- What closed loop poles are achievable using proportional control?

