

EENG307: Introduction to Root Locus¹

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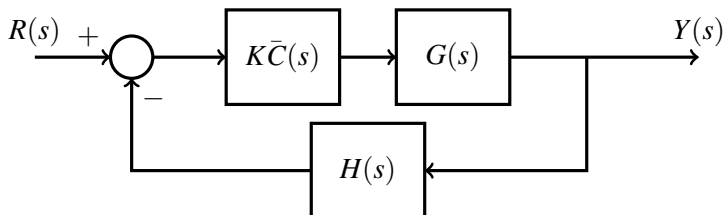
Lecture 18

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² 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 Kupilik, University of Alaska, Anchorage

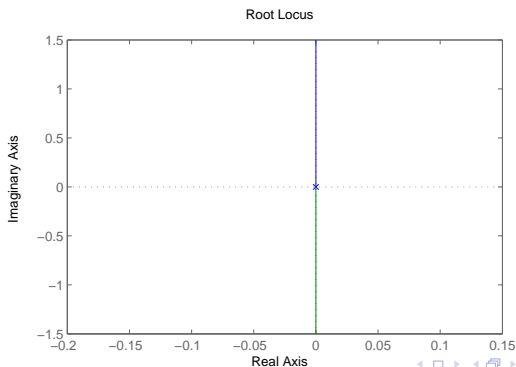
Design Question:

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 $\bar{C}(s)$?

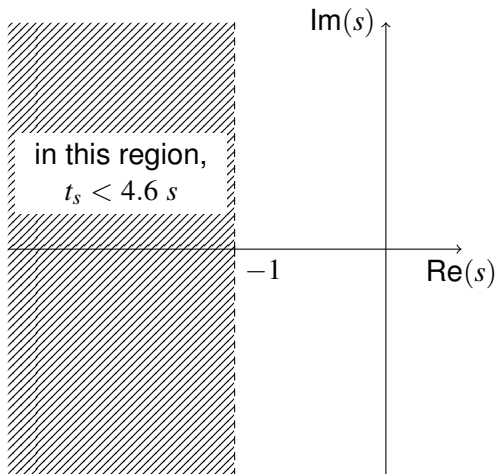


Plotting the root locus using MATLAB

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



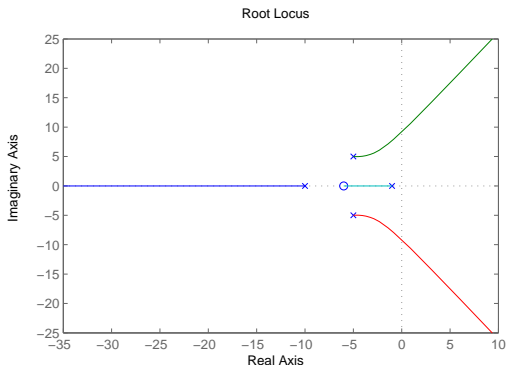
Settling Time Requirement for Example



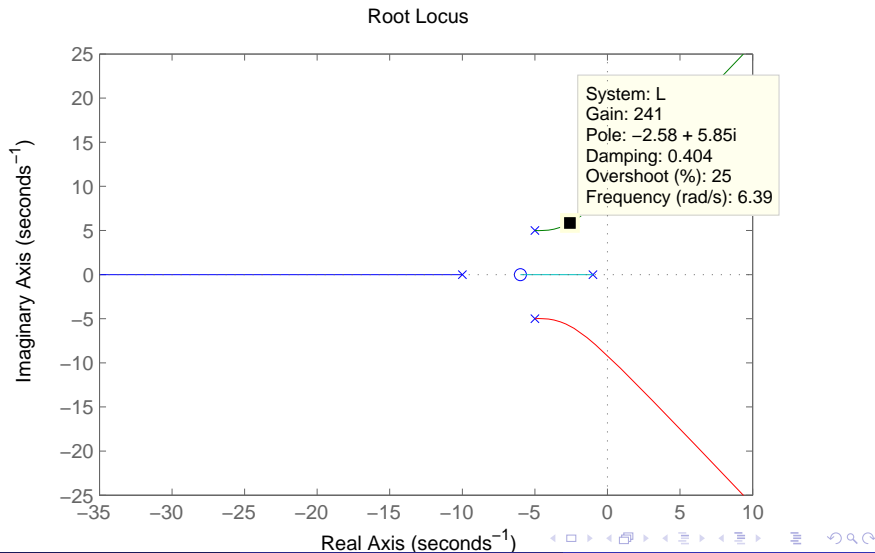
By comparing the root locus (closed-loop poles on the imaginary axis) from Example ?? to the allowable region for the closed-loop poles (real

Plotting the root locus using MATLAB

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



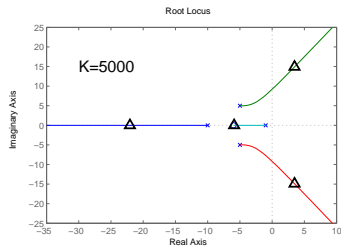
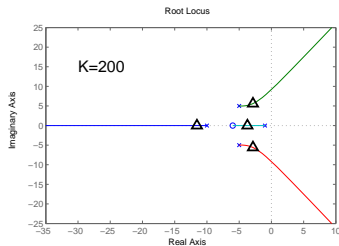
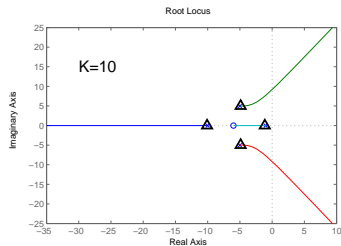
Pole Location Information



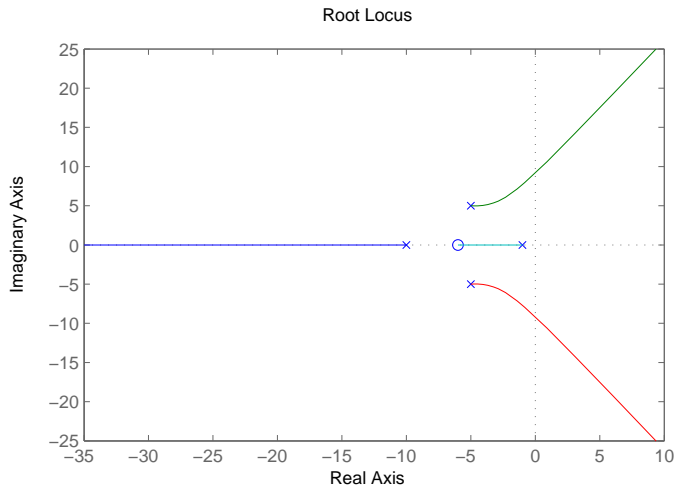
Four Questions for Root Locus Features

- 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 ∞ ? (Especially relevant to whether they enter the right half plane, meaning the closed loop system becomes unstable.)

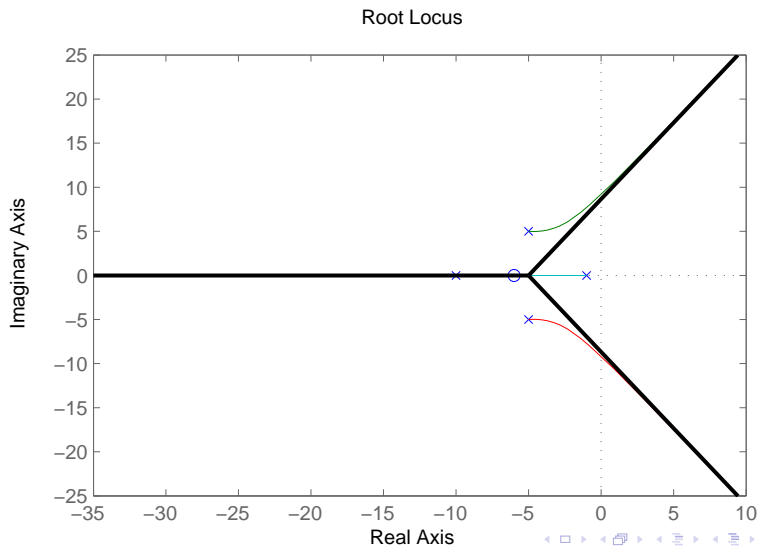
Root Locus with closed loop pole overlay



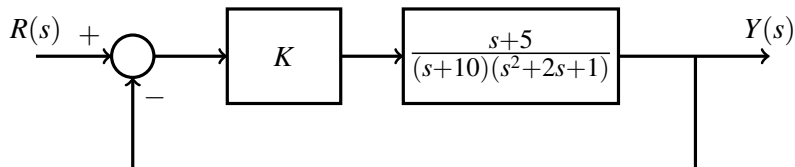
Root locus on the real axis



Root Locus Asymptotes



Root Locus Example Problem 1



- What closed loop poles are achievable using proportional control?

