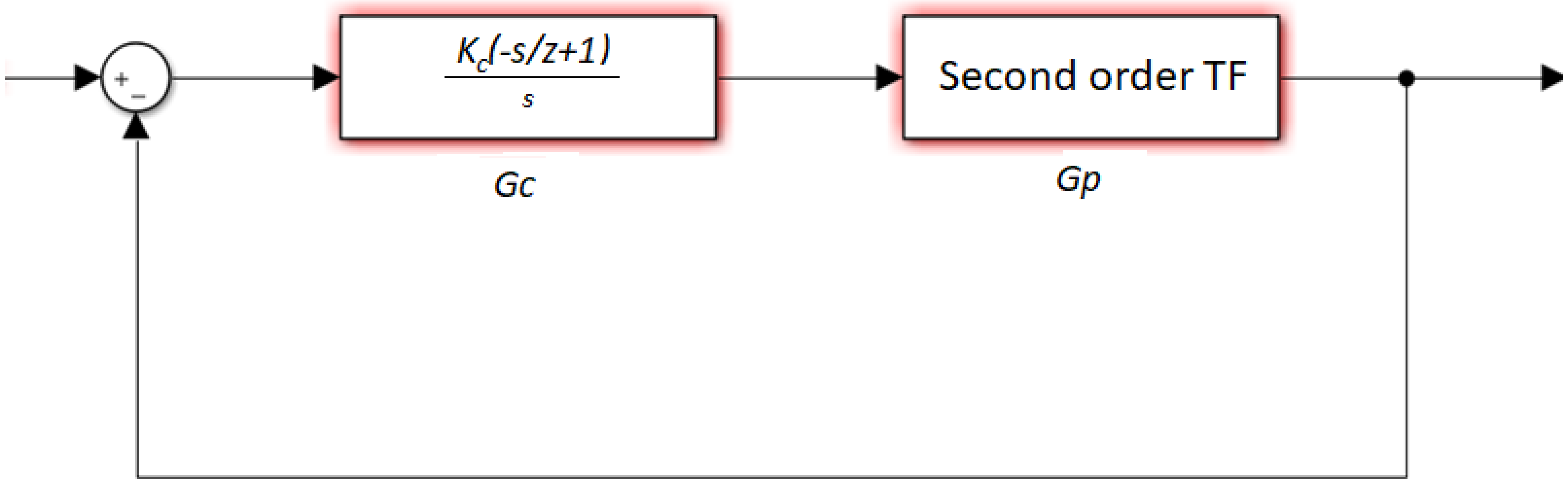
EEE-342

Lab-2 Preliminary Work Guide

Closed Velocity Loop



- The coefficient of plant is found by taking the average of prefound coefficients in first lab.

$$K = \frac{K_1 + K_2 + K_3}{3}, \qquad \tau = \frac{\tau_1 + \tau_2 + \tau_3}{3}$$

Update for Plant Definiton

- Since the plant has time delay, we will use first order pade approximation:

$$G_p(s) = \frac{K}{\tau s + 1} \times \frac{-\frac{hs}{2} + 1}{\frac{hs}{2} + 1}$$

where

$$h = 0.01 \text{ seconds}$$

Root Locus Analysis

- For 991 linearly separated samples of z in the specified range, obtain the closed loop pole locations with respect to K. Note that

  [r,k] = *rlocus(G)*

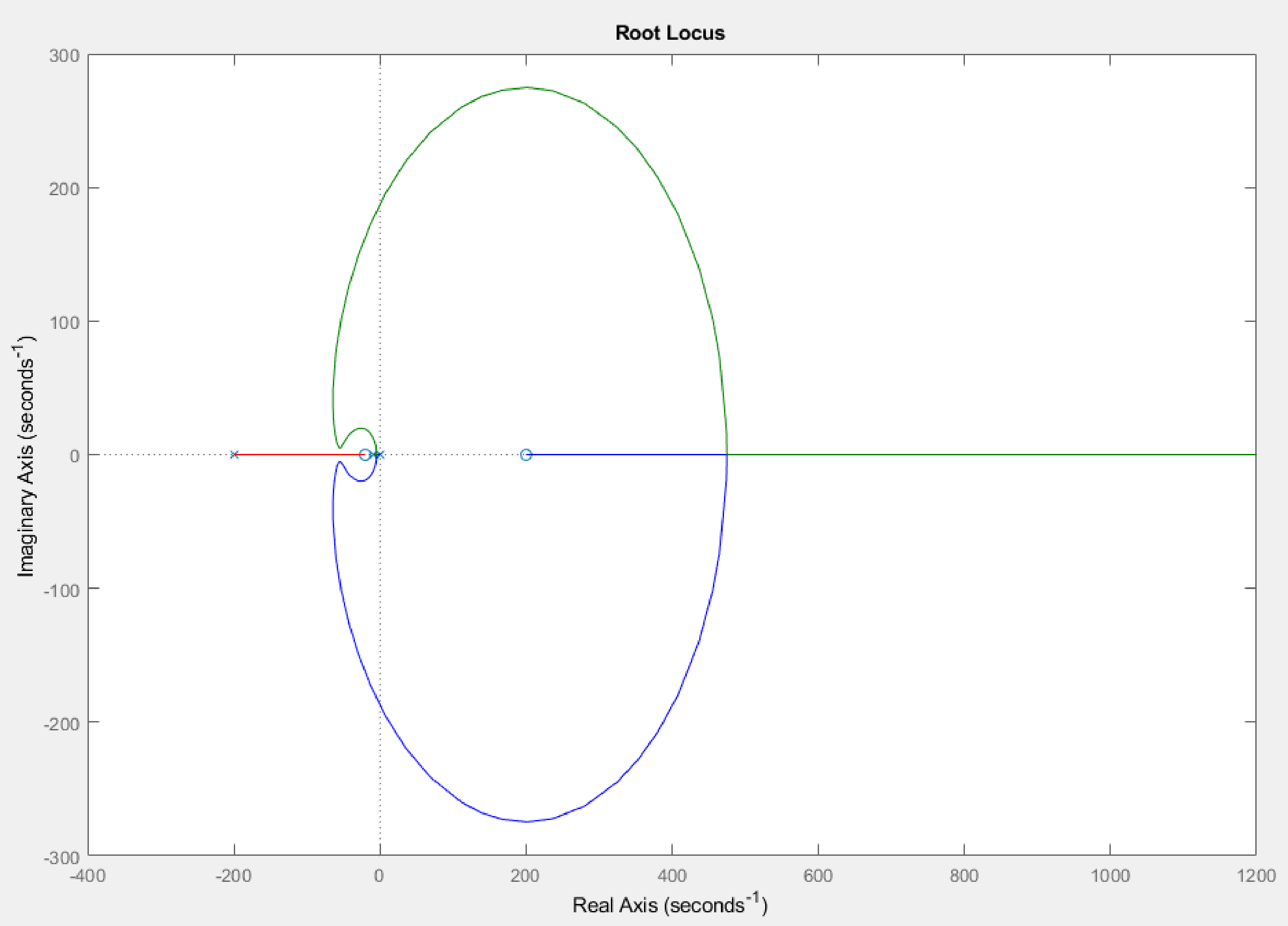
command returns CL pole locations (r) and the corresponding gain (K).

- Here, *G* is the open loop transfer function: $G = G_c \times G_p$

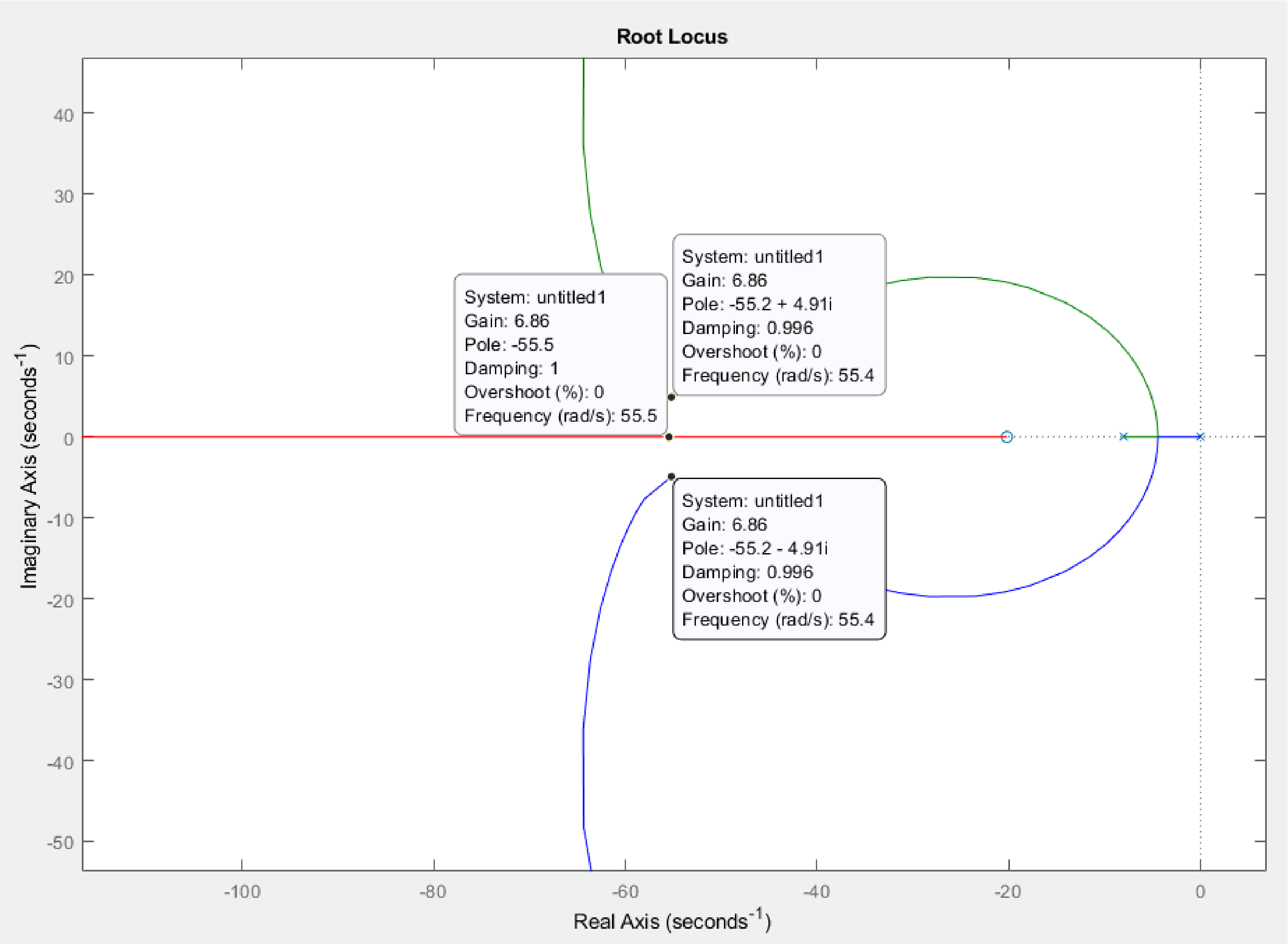
- Therefore, for each sample of *z*, you need to get pole locations, find the point where pole/s that are closest to imaginary axis are furthest and save the corresponding z value and real parts of closest pole/s (d).

- Then, you need to plot *d* vs *z* and select the global minimum from that plot. z_1 is the value at x-axis where global minimum is.

Root Locus Analysis (An example for z_1)



Root Locus Analysis (An example for z_1)



- The best scenario for the given system is for z_1

$$K = 6.86$$

$$Re\{poles\} < -55$$

- Naturally, your results will differ from these results

Final Task

- Design the closed velocity loop in Simulink.
- Implement step input with an amplitude of 10.
- Get outputs for each CL with the following 3 controllers

$$C_i = \frac{K_i\left(-\frac{s}{z_i} + 1\right)}{s}$$

where $z_2 = \frac{z_1}{2}, z_3 = \frac{z_1}{3}$, and K_i are the gains such that the distance between closed loop poles and imaginary axis are maximized for corresponding z_i values.

- Plot step responses on same figure and comment on your results.