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Control Systems

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		his manual is an introduction to cont		

systems based on GATE problems.Links to sample Python codes are available in the text.

Download python codes using

svn co https://github.com/gadepall/school/trunk/ control/codes

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1 Mason's Gain Formula

2 Bode Plot

- 2.1 Introduction
- 2.2 Example

3 Second order System

- 3.1 Damping
- 3.1. The open-loop transfer function of a plant in a unity feedback configuration is given as

$$G(s) = \frac{K(s+4)}{(s+8)(s^2-9)}$$
(3.1.1)

The value of the gain K(>0) for which -1+12lies on the root locus is

Solution: The closed loop transfer function for a negative feed back system is:

$$F(s) = \frac{G(s)}{1 + G(s)H(s)}$$
 (3.1.2)

Since it is a unity feed back system, H(s) = 1, and now using the characteristic equation at $s_1 = -1 + 12$

$$1 + G(s_1)H(s_1) = 0 (3.1.3)$$

$$G(s_1) = -1$$
 (3.1.4)

$$|G(s_1)| = 1 (3.1.5)$$

$$G(s_1) = \frac{K(s_1 + 4)}{(s_1 + 8)(s_1^2 - 9)}$$
(3.1.6)

$$G(s_1) = \frac{K(s_1 + 4)}{(s_1 + 8)(s_1 + 3)(s_1 - 3)}$$
(3.1.7)

$$G(s_1) = \frac{K(3+j2)}{(7+j2)(2+j2)(-4+j2)}$$
 (3.1.8)

$$|G(s_1)| = \frac{K\sqrt{13}}{\sqrt{51}\sqrt{8}\sqrt{20}} = 1$$
 (3.1.9)

$$K = 25.05 \tag{3.1.10}$$

$$F(s) = \frac{25.05(s+4)}{s^3 + 8s^2 + 16.05s + 28.2}$$
 (3.1.11)

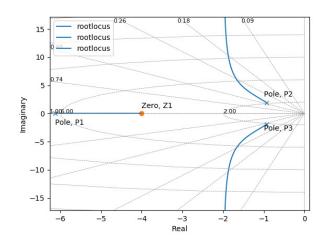


Fig. 3.1: Root locus plot for verification

$$Z_1 = -4, P_1 = -6.13, P_2 = -0.93 + \text{j}1.93, P_3 = -0.93 - \text{j}1.93$$

codes/ee18btech11052.py

3.2 Example

4 ROUTH HURWITZ CRITERION

- 4.1 Routh Array
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- 4.3 Stability
- 5 STATE-SPACE MODEL
- 5.1 Controllability and Observability
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 - 6 Nyquist Plot
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