AAE 364 Control Systems Analysis
Problem Set 7

Professor Inseok Hwang
School of Aeronautics and Astronautics, Purdue University
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Reading Assignment:

- Sections 1-4 in Chapter 6.

Problem 1

Solve B-6-7 and B-6-12 in Chapter 6.

Problem 2

Consider the unity feedback system shown in Figure 1:

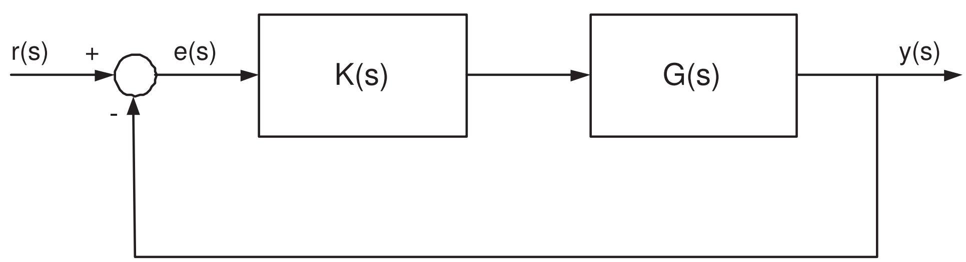

Figure 1: A unity feedback system.

Plot the root loci for the system ($k > 0$) with

1. $$K(s) = k,\ \ G(s) = \frac{-(s+2)}{s^2}$$
2. $$K(s) = k,\ \ G(s) = \frac{(s+9)}{s(s^2+4s+11)}$$
3. $$K(s) = k,\ \ G(s) = \frac{(1-s)}{s^3+s^2+1}$$

Problem 3: Spacecraft

Consider the unity-feedback system in Figure 1 with the plant $G(s)$ representing the spacecraft attitude dynamics shown in Figure 2:

$$\frac{\theta(s)}{T_c(s)} = \frac{0.036(s+25)}{s^2(s^2+0.04s+1)} \tag{1}$$

Sketch the root loci of the unity-feedback system, with $K(s) = K$, as K varies from 0 to $+\infty$ (as accurately as you can)

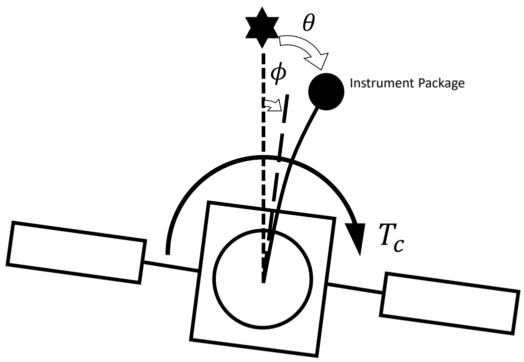

Figure 2: Two-body Model of Satellite

Problem 4: Aircraft

The following figure shows the coordinate axes and forces acting on the aircraft in the longitudinal plane of motion. Assuming that the aircraft is cruising at constant velocity and altitude.

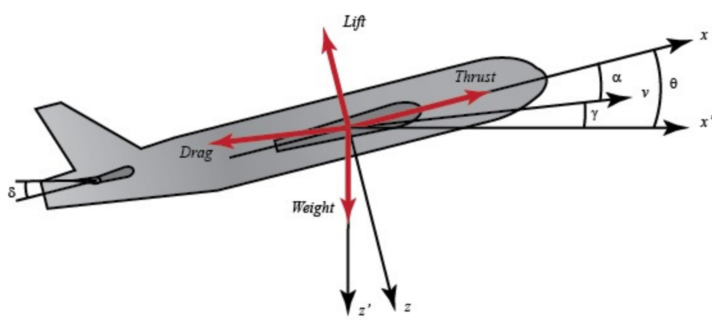

Figure 3: Forces acting on an aircraft in the Longitudinal plane.

Consider the unity-feedback system in Figure 1 with the plant $G(s)$ representing the aircraft shown in Figure 3. Sketch the root loci of the unity-feedback system, with $K(s) = K$, as K varies from 0 to ∞ (as accurately as you can) with the following $G(s)$:

1. $G(s)$ representing the aircraft pitch angle response output to the elevator deflection input:

$$G(s) = \frac{\Theta(s)}{\Delta(s)} = \frac{1.1057s + 0.1900}{s^3 + 0.7385s^2 + 0.8008s}$$

2. $G(s)$ representing the aircraft altitude response output to the elevator deflection input:

$$G(s) = \frac{H(s)}{\Delta(s)} = \frac{1.1057s - 0.1900}{s^5 + 17.95s^4 + 123.3s^3 + 366.3s^2 + 112.2s}$$

Remarks: First, draw the root loci by hand and then use MATLAB. When you presents results obtained with MATLAB as your solutions, you should explain your results clearly to get full credits. (Just giving figures and numbers is not enough for answers)