Name: _____ Roll No: _____

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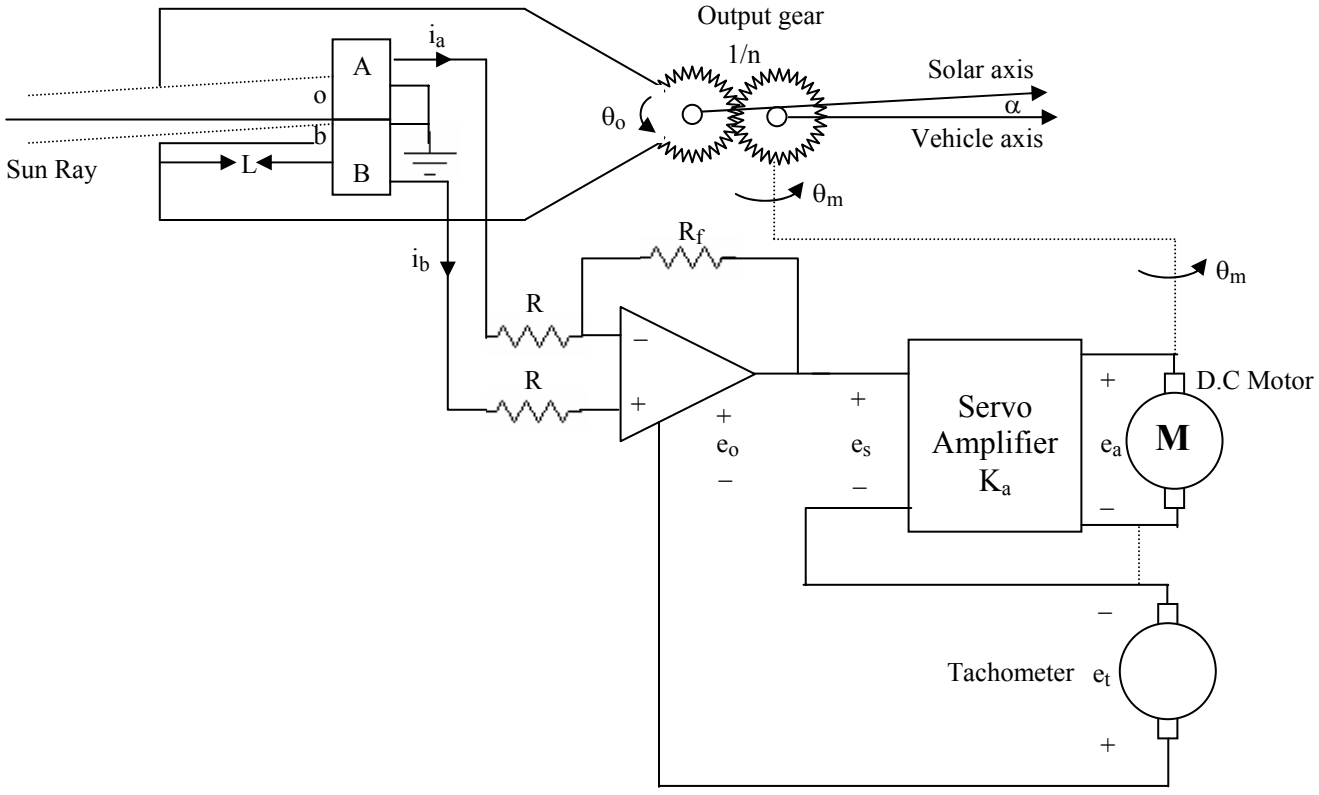
DEPARTMENT OF ELECTRONIC & TELECOMMUNICATION ENGINEERING
MEHRAN UNIVERSITY OF ENGINEERING & TECHNOLOGY, JAMSHORO
Feedback Control Systems (1st Term, Third Year, 03TL)
Lab Practice # 09

Block Diagram Representation of Sun Seeker System

1. Introduction

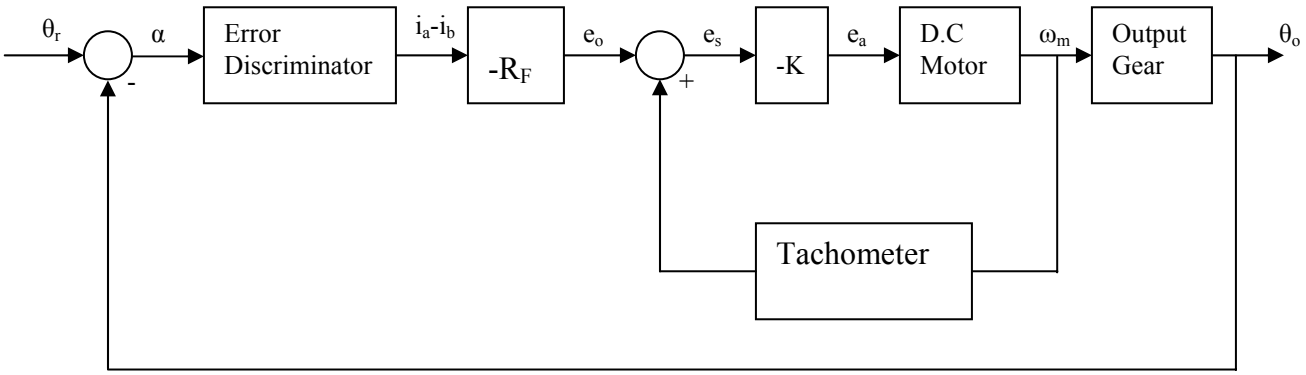
In the previous lab we modeled this system mathematically. In this lab we are required to model this system in block diagram format. In block diagram representation each part of the system is shown with its necessary feed-forward and feedback connections. As shown in the following figure there are six main parts of the system. In block diagram all the six parts are shown with respective input and output variables.



2. System Variables

The purpose of the system is to sense the solar axes and produce the desired output variation in the vehicle axes depending upon the magnitude of the error. Here solar axes is represented by θ_r and vehicle axes is represented by θ_o. The difference between two is the error α. After comparing the solar axes and the vehicle axes the produced error is

given to the error discriminator which produces the output in the form of currents i_a and i_b. The operational amplifier then produces the error voltage e_o. The magnitude of the output voltage depends upon the difference in input currents. This error voltage is given to the input of the servo-amplifier. Where the error signal is inverted and amplified again to drive the D.C motor. D.C motor then rotates back or forward depending upon the nature of error. Thus the rotation of the D.C motor causes the gears to derive the system back into the alignment. Tachometer is used to provide the feedback to servo amplifier. The block diagram of the system is shown in the following figure.



3. Error Discriminator

The mathematical representation of the error discriminator is shown in the following equation

$$\mathbf{i_a(t) = W/2 + L \tan \alpha(t)}$$

$$\mathbf{i_b(t) = W/2 - L \tan \alpha(t)}$$

Input of the error discriminator is α and output is i_a-i_b. then

$$\mathbf{(i_a-i_b)/\alpha = 2L}$$

4. Operational Amplifier

The difference of two currents is given to the input of op-amp. That causes to produce e_o at the output.

$$\mathbf{e_o = -R_F\,(i_a-i_b)}$$
$$\mathbf{e_o/(i_a-i_b) = -R_F}$$

5. Servo Amplifier

$$\mathbf{e_s = -K\,e_a}$$
$$\mathbf{e_s / e_a = -K}$$

6. D.C Motor

Transfer function of the D.C motor is given by:

$$\theta_m / e_a = K_i /(S^2 R_a J + S R_a B + K_i K_b)$$

7. Output Gear

Finally the output produced by D.C motor (i-e angular displacement θ_m) is given to the output gear that drives the system back into the desired position θ_o.

$$\theta_o = 1/n\ \theta_m$$

or

$$\theta_o/\theta_m = 1/n$$

8. Tachometer

The function of the tachometer is to provide the feedback to servo-amplifier. It converts the angular (θ_m) into voltage e_t through the tachometer constant K_t.

$$e_t = S\ k_t\ \theta_m$$

or

$$e_t/\theta_m = S\ k_t$$

Exercise#1:

(a) Determine the overall transfer function of the system.

(b) Replace all constants by value 1 and plot the pole zero map of the system.

(c) Find the step response of the function.

(d) Change the system parameters to improve the response of the system.