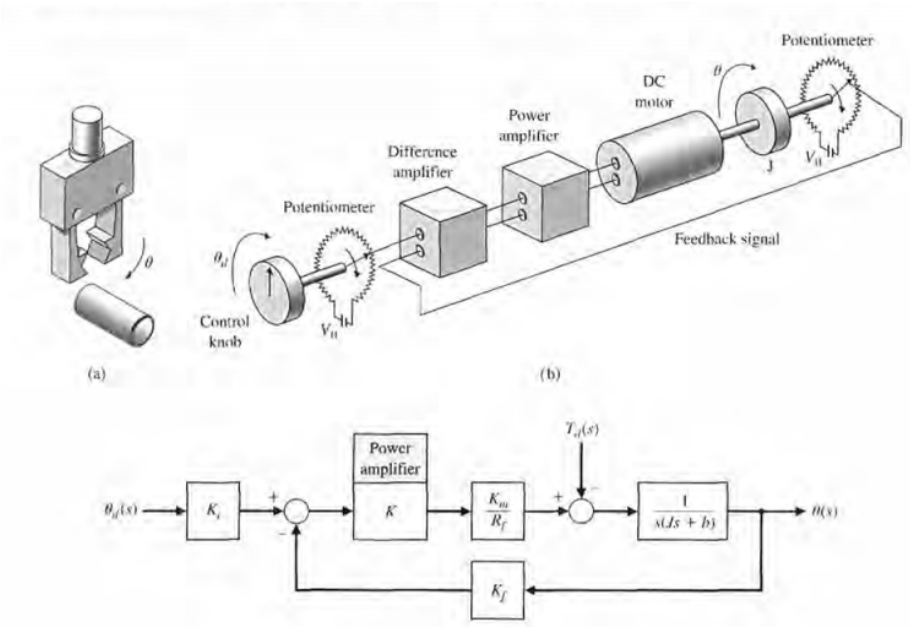
Real World Problems for Control System Studies

August 10, 2022

Analyse the system and add appropriate controller in the system.

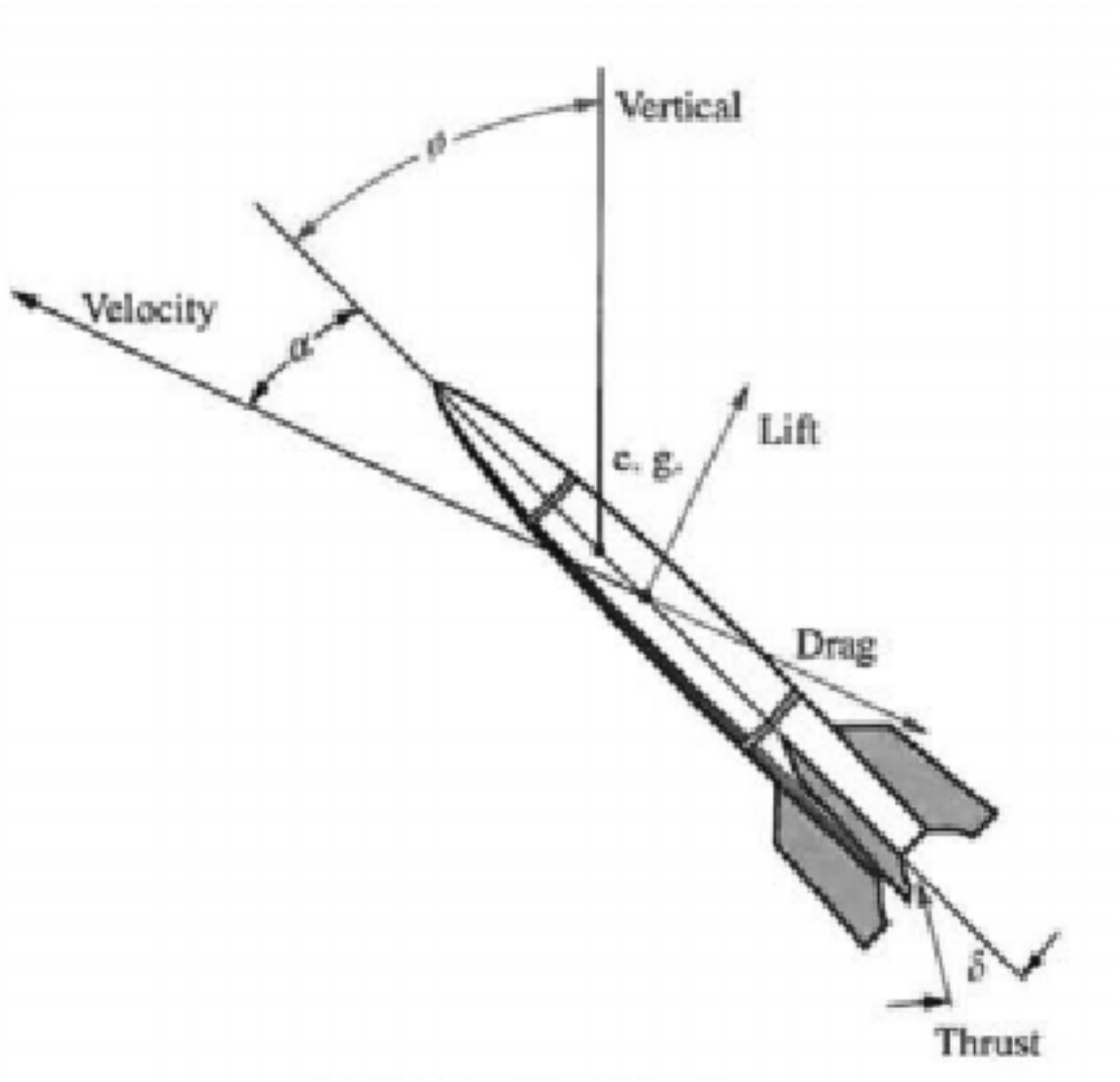
0.1 DC Motor



0.2 Missile System

A missile in flisht as shown in figure below is subject ot several forces: thrust, lift, drag and gravity. The missile flies at an angle of attack, α from its longitudinal axis, creating lift. For steering, the body angle from vertical, ϕ is controlled by rotating the engine at the tail. The transfer function relating the body angle, ϕ to the anglular displacement δ of the engine is of the form:

$$\frac{\phi(s)}{\delta(s)} = \frac{K_a s + K_b}{K_3 s^3 + K_2 s^2 + K_1 s + K_0} \tag{1}$$



0.3 Satellite Control

The space satellite shown in figure below uses a control system to readjust its orientation as shown in block diagram.

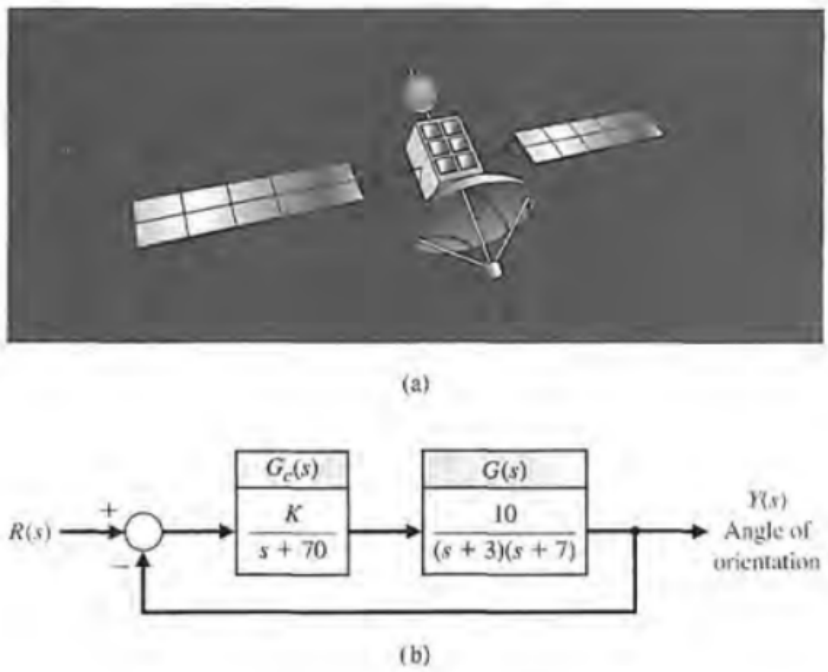
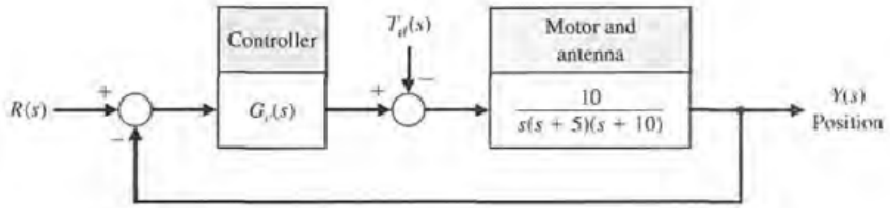


Figure 1: Caption

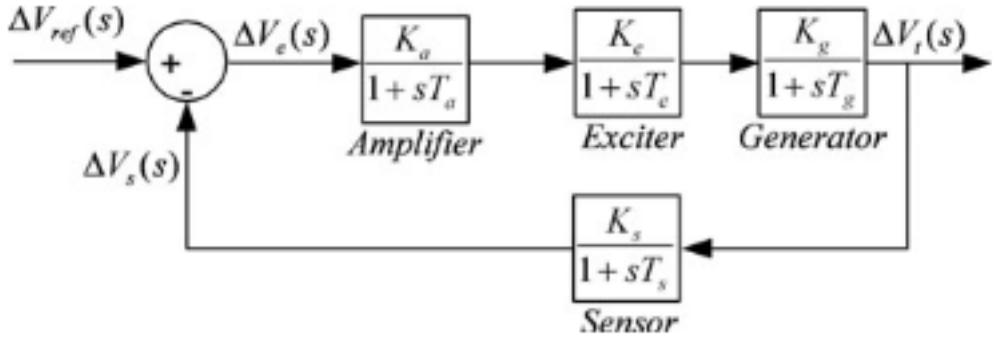
0.4 Antenna Position Control

(a)



(b)

0.5 Automatic Voltage Regulator



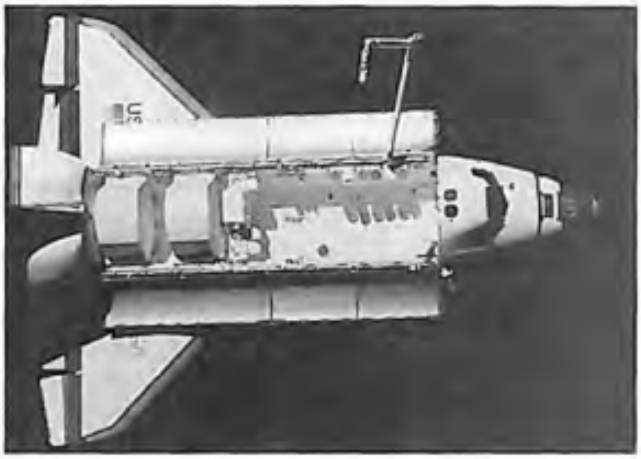
Elements	Transfer function	Gain	Time constants
Amplifier	$TF_A = \frac{K_a}{1+sT_a}$	$K_a = 10.0$	$T_a = 0.1$
Excitor	$TF_e = \frac{K_e}{1+sT_e}$	$K_e = 1.0$	$T_e = 0.4$
Generator	$TF_g = \frac{K_g}{1+sT_g}$	$K_g = 1.0$	$T_g = 1.0$
Sensor	$TF_s = \frac{K_s}{1+sT_s}$	$K_s = 1.0$	$T_s = 0.01$

0.6 Space Shuttle

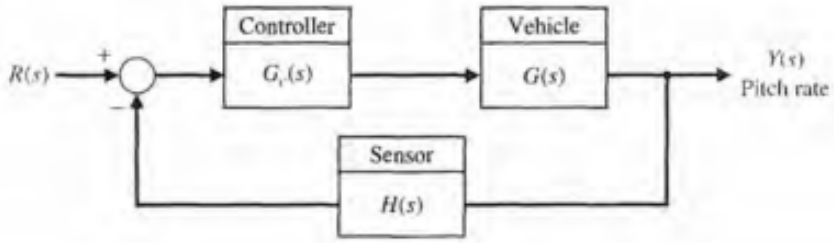
The space shuttle, shown in figure below, carries large payloads into space and returns them to earth for reuse. the shuttle uses elevons at the trailing edge of the wing and a brake on the tail to control the flight during entry. The block diagram of a pitch rate control system is shown in figure. the sensor is represented by a gain H(s) = 0.5 and the vehicle by the transfer function:

$$G(s) = \frac{0.30(s + 0.05)(s^2 + 1600)}{(s^2 + 0.05s + 16)(s + 70)} \tag{2}$$

The controller $G_c(s)$ can be gain or any suitable transfer function.



(a)



(b)

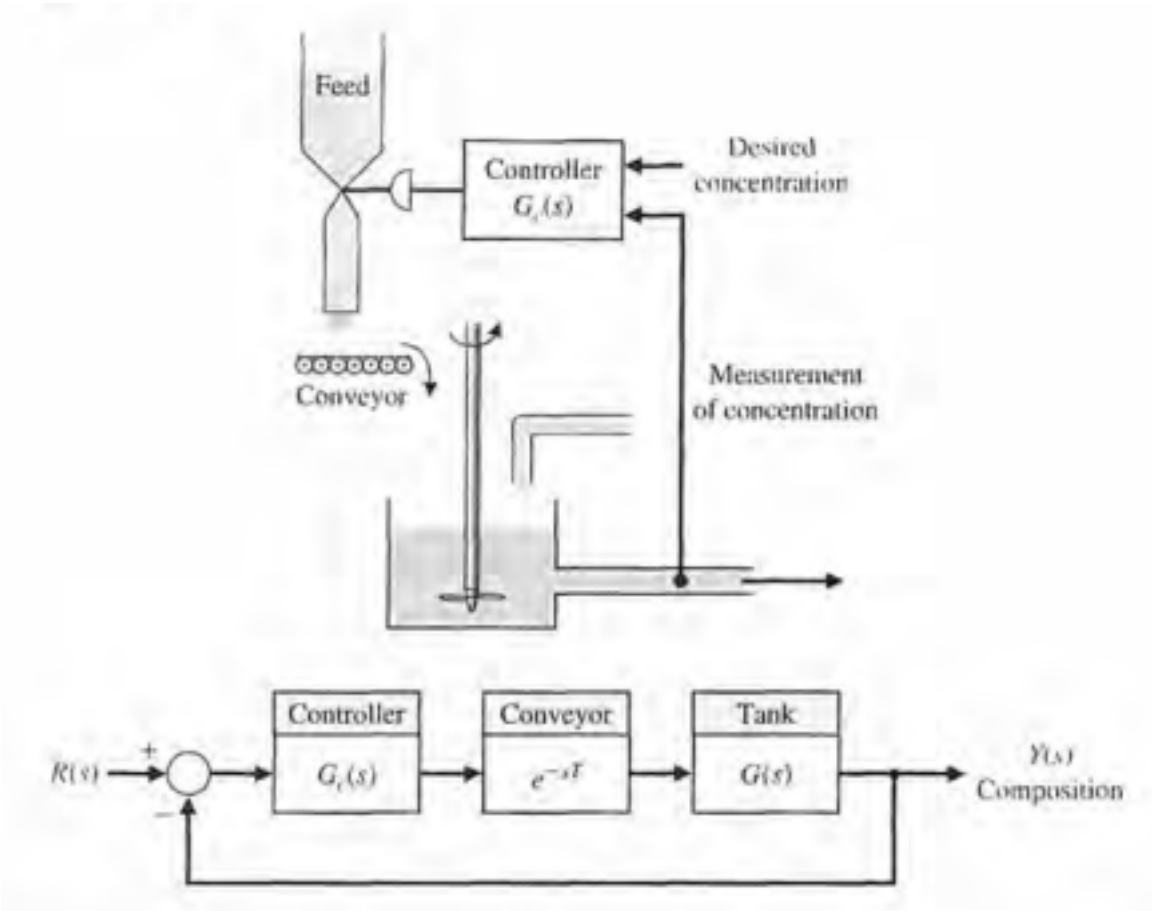
0.7 Chemical Concentration Control System:

A control system for a chemical concentration control system is shown in figure below. The system receives a granual feed of varying composition, and we want to maintain a contant composition of the otupt mixture by adjusting the feed flow valve. the transfer function of the tank and output valve is

$$G(s) = \frac{5}{5s+1} \tag{3}$$

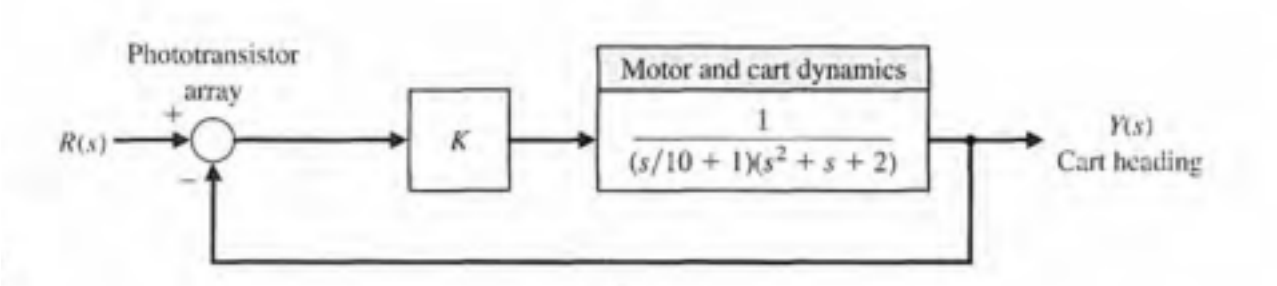
and that of controller is

$$G_c(s) = K_1 + \frac{K_2}{s} \tag{4}$$



0.8 Electric Carrier

An electric carrier that automaticall follows a tape track laid out on a factory floor. Closed loop feedback systems are used to control the guidance and speed of the vehicle. The cart senses tha tape path by means of an array of 16 phototransistors. The block diagra of the steering system is shown in figure below.



Note: Complete at least two system. Analyse the results for uncompensated and compenstated. Use your own parameters.

The problems has been taken from book entitled: ""Modern control systems". APA (6th ed.) Dorf, R. C., & Bishop, R. H. (2001)."No Copyright Infringement Intended