UC Berkeley

EE128 Homework #1

Due on 9/15/04 (before the Wednesday lab session)

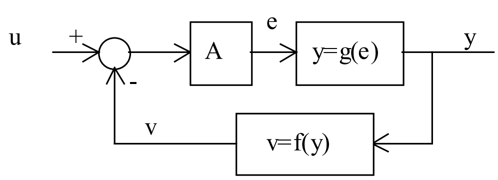
Consider the following feedback system where u is the input and y is the output.

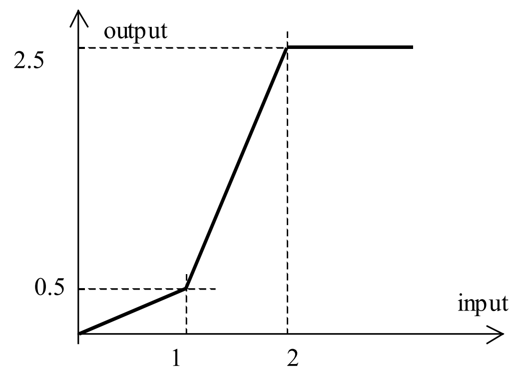
(1) Assume v=y (i.e., f(.) is the identity function), A=20, and the graph of the function g is shown below. Sketchy the y vs. u graph. The y variable in your graph must cover the interval [0 3] and you must specify the coordinate of any 'break point' of the graph.

(2) Assume y=e (i.e., g(.) is the identity function), A=20, and the graph of the function f is shown below. Sketchy the y vs. u graph. The y variable in your graph must cover the interval [0 3] and you must specify the coordinate of any 'break point' of the graph.

(3) Repeat the (1) and (2) but assume A-> infinite.

(4) The function g() can be thought of as the 'plant' and g() as the sensor. Draw some conclusions from the above analysis on the magnitude of A and the effect of f() on the transfer function (i.e., graph) of y vs. u.

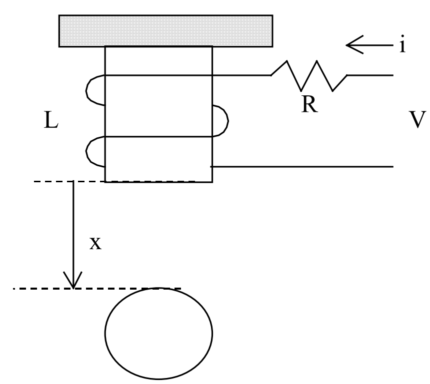




(2) The figure on the right shows a ball suspension system. The steel ball is suspended in the air by the electromagnetic force generated by the electromagnet.

The magnetic force acting on the ball is $F=(k*i^2)/x^2$, the mass of the ball is m. Gravitational constant is g. The inductance of the magnet is L and the resistance of the magnet winding is R (as represented by a resistor in the figure). Using the state vector x defined below, write a nonlinear state equation (V is the input and x is the output variable).

X=[i , x, v] where v is the speed of ball.



(3) Problem 2.23 in the textbook.
(4) Draw a block diagram of the motor system in Problem 2.23.
(5) If the armature circuit of a DC motor is driven by a controlled current source, the effects of armature winding resistance (Ra), armature inductance (La), and the back emf (Ke) are completely nullified. In such a case, the armature current i_a should be considered as the input variable. Assume the motor in Problem 2.23 is driven by a controlled current source (i_a). Find the transfer function between i_a and θ2. (Hint: This is a 4^{th} order transfer function.)