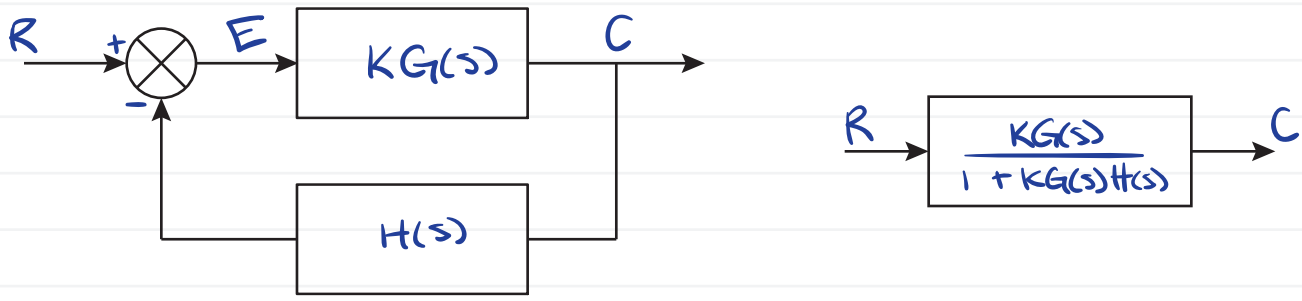
The Control System Problem

The control system problem is the problem of determining the closed-loop poles -- which govern the stability and transient response of a system -- of a system. These poles depend on parameters in the controller, often the gain K. Refer to the figure below for the following developments.



The forward transfer function is what we call KG(s). The feedback transfer function is what we call H(s). The open-loop transfer function is defined as the product of the two: KG(s)H(s).

If we break down G(s) and H(s) into numerators and denominators:

we can see how these affect the closed loop transfer function T(s):

Observations:
(1) The closed-loop zeros are equal to the zeros of G(s) and the poles of H(s).
(2) The closed-loop poles depend on K, and are difficult to find in general.

The root locus will give us a graphical depiction of the closed-loop poles for varying K.