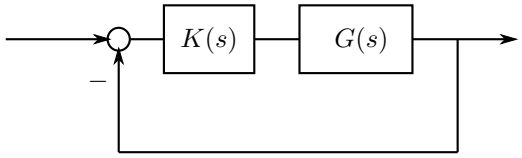
EE363 Automatic Control: Homework #8

1) *Nyquist stability criterion.* Consider the following double integrator system

$$G(s) = \frac{1}{s^2}$$

with a PID control

$$K(s) = 2(1 + \frac{1}{s} + s)$$



a) What is the magnitude and the phase of $K(s)G(s)$ at $\omega = 1$ ($s = j$)?

b) Carefully draw the Bode diagrams. You may check your results with the MATLAB `bode()` function.

c) What is the gain margin and the phase margin of your control system? You may check your results with the MATLAB `margin()` function. Your answer may look unfamiliar. What does that mean?

d) Carefully draw the Nyquist diagram with extra caution at around $\omega \to 0$ (the infinite radius parts in your diagram). Unfortunately, using the MATLAB `nyquist()` function won't help in this specific problem.

e) Check the closed loop stability from the diagram you obtained in d). What is N (the number of the clockwise encirclements around -1), and Z (the number of unstable poles in your closed loop system)? Is the closed loop system stable?

f) Check the stability result that you've obtained in e) by using MATLAB. You may use the `rlocus()` function or whatever (*e.g.*, `pole()`, `eig()`, *et cetera*), to check your closed loop pole locations.

g) Your answer in f) should correspond to what you've got in d)-e). If so, you are good. If not, go back and think about it, or discuss with your friends.