Modelling and control summaries

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Nyquist 7: Self-study tutorial sheet

This is primarily for students to practise. Attempt questions by hand and only after completion, use MATLAB to test your solutions.

QUESTION 1. Sketch Nyquist of the following

$$G=\frac{4}{s(s+5)};\quad H=\frac{10(s+2)}{(s+5)^2};\qquad N=\frac{0.0005(s+0.02)}{(0.008-s)(0.06+s)}$$

$$M=\frac{2(s+10)}{s(s+1)(s+4)};\quad P=\frac{3}{(s-1)(s+6)}\qquad L=\frac{s+2}{s^2(s+4)}$$

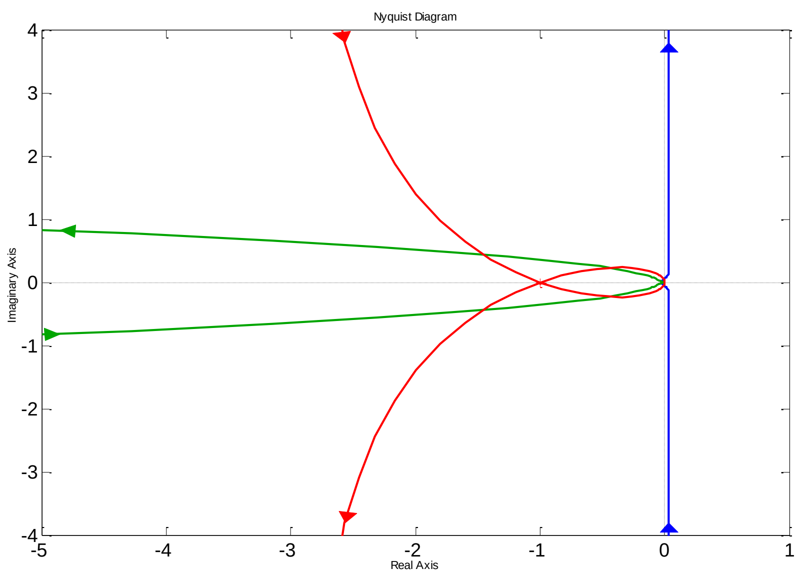
G=tf(4,[1 5 0]); **H=tf([10 20],[1 10 25])** **M=tf([2 20],poly([0 -1 -4]))**	**P=tf(3,poly([1 -6]))** **N=tf(0.0005*[1 0.02],poly([0.008,-0.06])*(-1))** **L=tf([1 2],[1 4 0 0])**

QUESTION 2. Match systems to the Nyquist plots

$$G1=\frac{s+1}{s(s+4)(s+3)}$$

$$G2=\frac{s+1}{s^2(s+4)}$$

$$G3=\frac{s+2}{s(s-1)}$$



Sketch the Bode/Nyquist diagrams with and without compensation

$$G(s)=\frac{0.3(s+10)}{s(s+1)(s+2)};\quad K_1(s)=2\frac{s+0.5}{s+2};$$

$$G(s)=\frac{0.4(s+5)}{s(s+0.5)(s+2)};\qquad K_1(s)=0.5;$$
$$K_2(s)=\frac{2(s+0.05)}{(s+0.2)};\quad K_3(s)=\frac{2(s+0.5)}{(s+2)}$$

$$G(s)=\frac{6(s+1)}{s(s-1)(s+3)};\quad K_1=\frac{4(s+2)}{s+5};\quad K_2=\frac{4(s+0.1)}{(s+0.04)}$$

$$G(s)=\frac{0.001(s+4)}{s(s+0.1)^2(s+2)};\quad K_1(s)=2\frac{s+0.06}{s+0.18};\quad K_2=\frac{1}{3}(\frac{s+0.18}{s+0.006})$$

$$G(s)=\frac{10(s+1)}{s(s+4)(s-2)};\quad K=4;\quad K_1(s)=8\frac{s+3}{s+12};\quad K_2=\frac{s+12}{s+3}$$

$$G(s)=\frac{4-4s}{s(s+2)(s+3)};\qquad K_1(s)=1;\quad K_2(s)=0.5;\quad K_3(s)=0.25\frac{(s+0.1)}{(s+0.05)}$$

You can overlay Bode/Nyquist plots on MATLAB as follows

```
>> nyquist(G,G*K1,G*K2);legend('G','GK1','GK2')
```

By computing the initial quadrant carefully, sketch Nyquist diagrams of the following.

$$G_1(s)=\frac{4.5s+3}{s^2(s+1)(s+2)};\quad G_2(s)=\frac{6s+3}{s^2(s+1)(s+2)};\quad G_3(s)=\frac{2s+3}{s^2(s+1)(s+2)}$$

$$G(s)=\frac{s+10}{(s+1)(s+2)}$$

Give an explanation of how dead-time affects Bode and Nyquist diagrams. Illustrate with several examples.