

Modelling and control summaries



by Anthony Rossiter

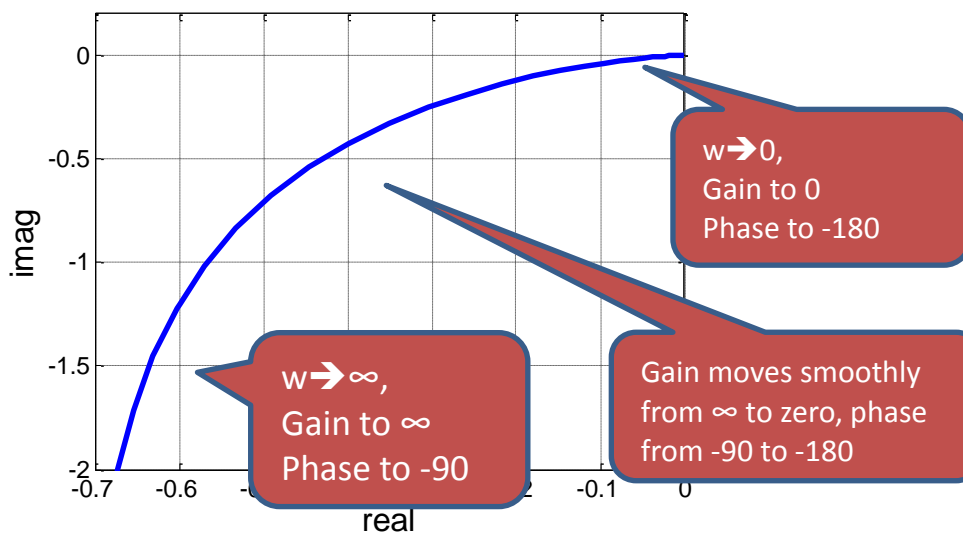
Nyquist 4: Sketching with integrators

<p>Asymptotic methods give a rough Bode plot using simple trends: i) as w tends to zero; ii) as w tends to infinity; iii) how do gain and phase change in between.</p>	<p>A simple Nyquist sketch is acquired by transcribing this information into an Argand diagram. NOTE: Accuracy is important near to -1 (0dB and -180 degrees).</p>
<p>Some key points should be noted when an integrator is present.</p>	<p>$\frac{1}{jw}$</p> <ul style="list-style-type: none"> As $w \rightarrow 0$, gain tends to infinity (typically phase tends to -90°) As $w \rightarrow$ infinity, gain tends to zero.

SKETCHING NYQUIST OF DIFFERENT $G(s)$ USING TRENDS

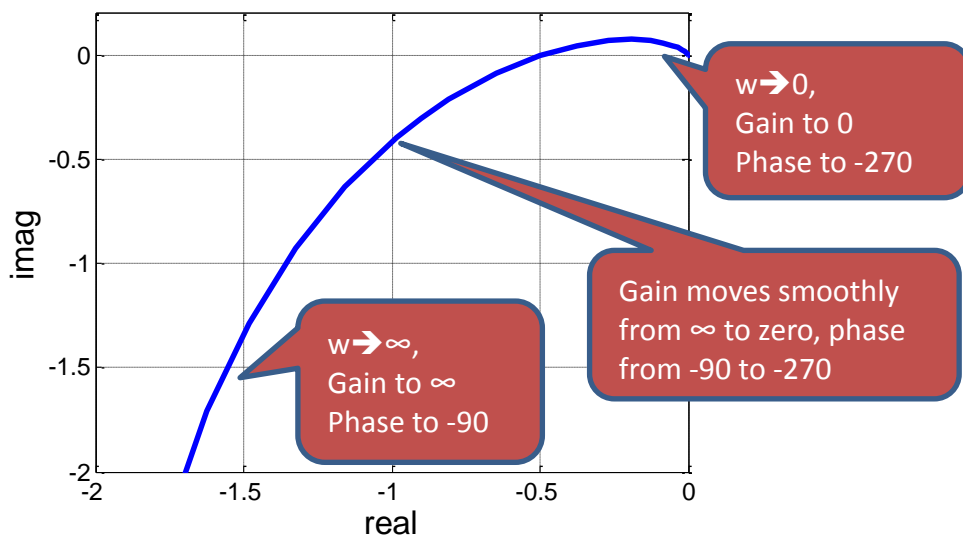
Note how initial/final values and trends can be used to form a reasonable sketch.

$$\frac{3}{s(s+2)}$$



2nd example

$$\frac{3}{s(s+1)(s+2)}$$

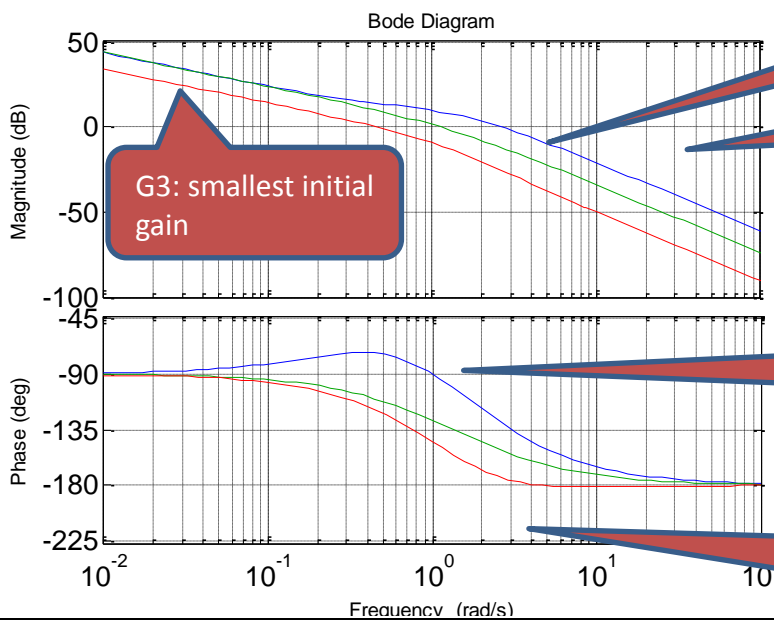


REMARKS:

1. Trends can be very useful for seeing the impact of different pole/zero positions on the resulting shapes of the Nyquist diagram.
2. This insight is invaluable later!
3. Always a good idea to use MATLAB to check your answers

NOTE HOW CHANGING ZERO CHANGES TREND HUGELY

$$G1 = \frac{9s+3}{s(s+1)(s+2)}; \quad G2 = \frac{2s+3}{s(s+1)(s+2)}; \quad G3 = \frac{0.3s+3}{s(s+1)(s+2)}$$



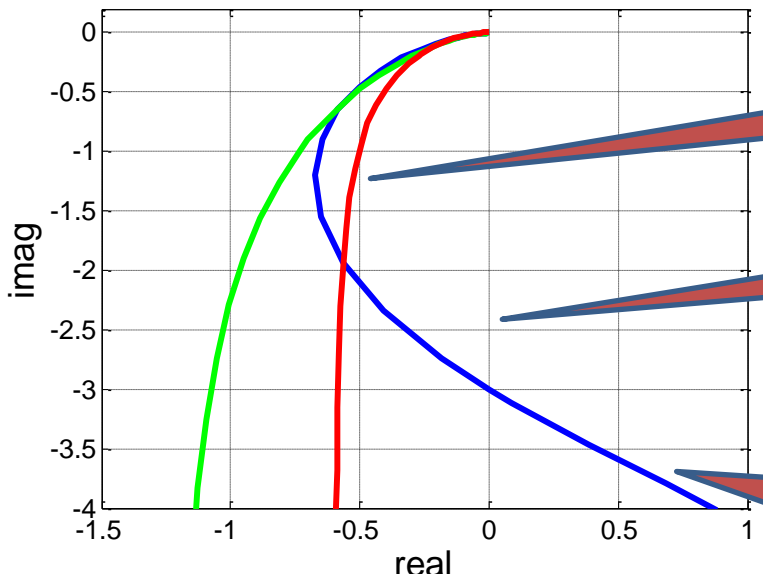
G1: gain largest but always decreases

G2,3: gain always decreases

G3: smallest initial gain

G1: Phase goes into quadrant 4, then back to quadrant 3.

G3: Phase begins in quadrant 3, then moves slightly into quadrant 2.



G2,3: phase changes from -90 to -180

G1,2,3: gain always decreases

G1: Phase begins in quadrant 4, then back to quadrant 3.

```
>>G1=tf(9*[1 1/3],[1 3 2 0]);G2=tf([2 3],[1 3 2 0]);G3=tf([0.3 1],[1 3 2 0]);
>>bode(G1,G2,G3)
>>nyquist(G1,G2,G3)
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