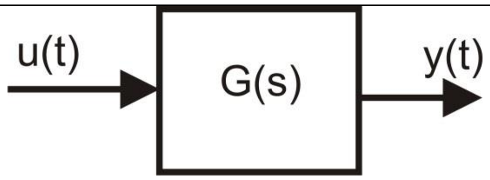
Modelling and control summaries

by Anthony Rossiter

Nyquist 1: Introduction



SUMMARY of Frequency response (See Bode notes for more background.)

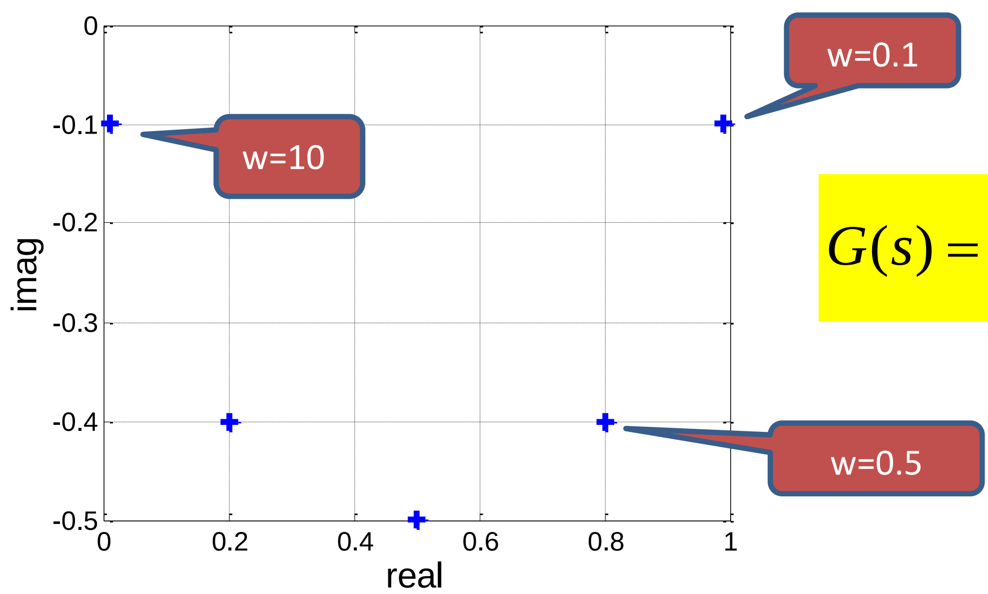
$$G(jw)$$

WHAT IS A NYQUIST DIAGRAM?

A Nyquist diagram is a plot of G(jw), in the complex plane, for all real values of w.
[Initially the focus is on just positive values of w, but later we will include negative values as well.]

A simple example is given below:

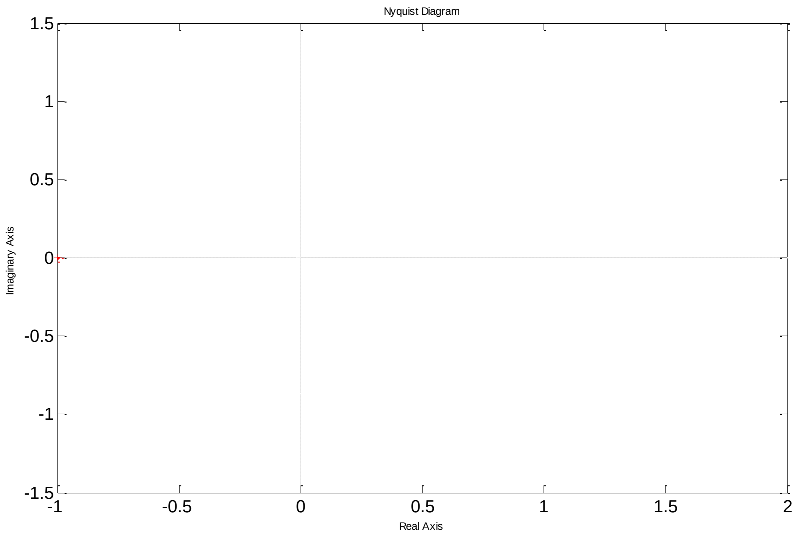
w	0.1	0.5	1	2	10
1+jw	1+.1j	1+.5j	1+j	1+2j	1+10j
G(jw)	.99(1-.1j)	.8-.4j	.5-.5j	.2-0.4j	.01-.1j
Phase	-5.7	-26	-45	-63	-84



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

REMARK: The definition of a Nyquist diagram is very simple, just compute G(jw) for several frequencies, tabulate the real and imaginary parts and then plot in an Argand diagram. Clearly however, this is somewhat tedious in practice!

Try sketching the following example for yourself by first computing G(jw) at many frequencies.

w=0.1 w=1 w=3 w=5 w=10	$G = \dfrac{6}{(s+1)(s+3)}$ $\lvert G(jw)\rvert = \dfrac{6}{\sqrt{(w^2+1)(w^2+9)}};$ $\angle G(jw) = -\tan^{-1} w - \tan^{-1} \dfrac{w}{3}$
	

You can check your answers using the Nyquist command in MATLAB

Frequency list

```
>> nyquist(G)
>>[re,im]=nyquist(G,[0.1,0.5,1,2,10]);
```

Real and imaginary parts of G(jw)

SUMMARY: The tabulation method is tedious so a more efficient method is needed.