MATLAB Session 7 Web Supplement

Here, we add a few more words on using the **`freqresp()`** function. There is no magic in the functions `nyquist()` or `bode()`. The purpose of this exercise is to help better understand the plots. To follow a textbook verbatim, we would need a polar plot of the magnitude versus the phase angle in a Nyquist plot. To graph the complex number G(jω), we can just plot the real versus imaginary parts on the complex plane—a more straightforward task and the route actually taken by `nyquist()`.

The starting point is the more basic `freqresp()` function. What it does is essentially make the s = jω substitution in a given transfer function G(s) for a predefined vector of frequencies, ω.

For example, take the following transfer function:

```
G=tf(1,[1 0.4 1]);
w=logspace(-1,1);
```

and instead of using `bode()`or `nyquist()`, we do

```
gjw=freqresp(G,w);   % does the s=jw calculation for each w
```

Let's repeat the use of `nyquist()`:

```
[re,im]=nyquist(G,w);
plot(re(1,:),im(1,:))
hold
```

Now, let's make use of `gjw`:

```
R=real(gjw(1,:));           % Real part of gjw
I=imag(gjw(1,:));           % Imaginary part of gjw
plot(R,I,'x')
hold off
```

Yes, the results are identical. One more try. This is what we do with `bode()`:

```
[mag,phase]=bode(G,w);
subplot(211), loglog(w,mag(1,:)), ylabel('Magnitude')
subplot(212), semilogx(w,phase(1,:)), ylabel('Phase')
```

We can do this instead with the variable `gjw`:

```
M=abs(gjw(1,:));         % abs() gets the magnitude
P=angle(gjw(1,:));       % angle() gets the phase in radians
P=P*180/pi;              % Converts P from radian to degree

subplot(211), hold on, loglog(w,M,'x')
subplot(212), hold on, semilogx(w,P,'x')
hold off
```

Again, the results are identical.

We have mentioned that we can use `nichols(G)` to make a Nichols chart, which is a log magnitude-phase plot of the same information. So after we have calculated [mag,phase] with `bode()`, we can do the Nichols chart ourselves:

```
plot(phase(1,:),20*log10(mag(1,:)),'x')
title('Nichols  Plot'),ylabel('Mag'),xlabel('Phase')
hold
nichols(G)                % see that results are identical
```