This document contains extracts from the Mathworks web site, with a simple introduction to spectral analysis.

The power spectral density (`psd`) measures power per unit of frequency and has power/frequency units.

Spectral analysis objects contain property values for the particular algorithm. To calculate a spectrum estimate, you first create an estimator object using one of the algorithms (`h = spectrum.burg`). You then pass your data and the estimator object to a spectrum estimation algorithm (`Hpsd = psd(h,x)`)

In this example, we construct a PSD estimate of a signal using Welch's overlapped segment method.

Copy and paste the following code at the MATLAB command prompt.

```
Fs=10000; %sampling frequency in samples per second
t=0:(1/Fs):1; %one second time vector, 10001 elements
y=0.4*cos(2*pi*2000*t)+0.2*sin(2*pi*1000*t)+randn(size(t));
```

This creates a time series `y`, which is the sum of a 2 kHz signal and a lower amplitude 1 kHz signal, with a bunch of random noise thrown in.

The next step is to create a default Welch spectrum object.

```
h = spectrum.welch;
```

Entering `h` at the command prompt shows the default settings for the Welch spectrum object:

```
h =

    EstimationMethod: 'Welch'
       SegmentLength: 64
     OverlapPercent: 50
         WindowName: 'Hamming'
       SamplingFlag: 'symmetric'
```

If you want to specify parameters instead of using default values, you can use syntax such as the following:

```
h=spectrum.welch('kaiser',128,50);
```

The code creates a Welch spectrum object using a Kaiser window (see `kaiser`). We have set the segment length equal to 128 with an overlap percentage of 50. The Kaiser window has an additional parameter, `beta`, which governs the tradeoff between the width of the main lobe and level of energy in the sidelobes. Larger values of `beta` decrease the height of the

sidelobes at the expense of widening the main lobe. You can specify additional parameters for a chosen window by passing them to the spectrum object in a cell array. For example,

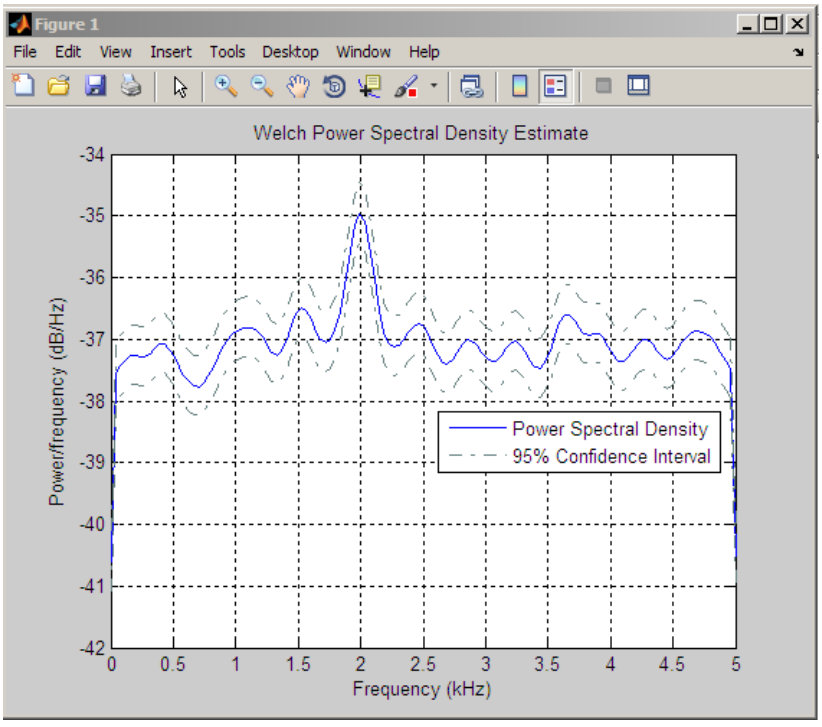
```
h=spectrum.welch({'Kaiser',0.2},128,50)
h =

    EstimationMethod: 'Welch'
       SegmentLength: 128
      OverlapPercent: 50
          WindowName: 'Kaiser'
                Beta: 0.2000
```

(For additional information on changing the property values of spectrum objects, see Changing Spectral Analysis Object Property Values at http://www.mathworks.com/access/helpdesk/help/toolbox/signal/gs/bqucwck-1.html for more information.)

To generate a PSD estimate, simply apply a spectral estimation method on the spectrum object and data, and then generate a plot:

```
h = spectrum.welch;
Hpsd=psd(h,y,'Fs',Fs,'ConfLevel',0.95);
plot(Hpsd)
```



This produces a plot that goes from 0 to 5 kHz, with a frequency spacing of 1 Hz based on the sampling rate divided by the number time intervals

(10,000/10,000) and with only half of the points available to be used to produce the spectrum (Nyquist criterion).

The 2kHz signal component is very visible. The 1 kHz component is not very apparent, likely due to the amount of noise in the signal.

For more information and examples, see the Getting Started with Spectral Analysis Objects by entering the following in the MATLAB command window:

```
showdemo spectralanalysisobjsdemo
```