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## #PS118 - EMG Signal Analysis

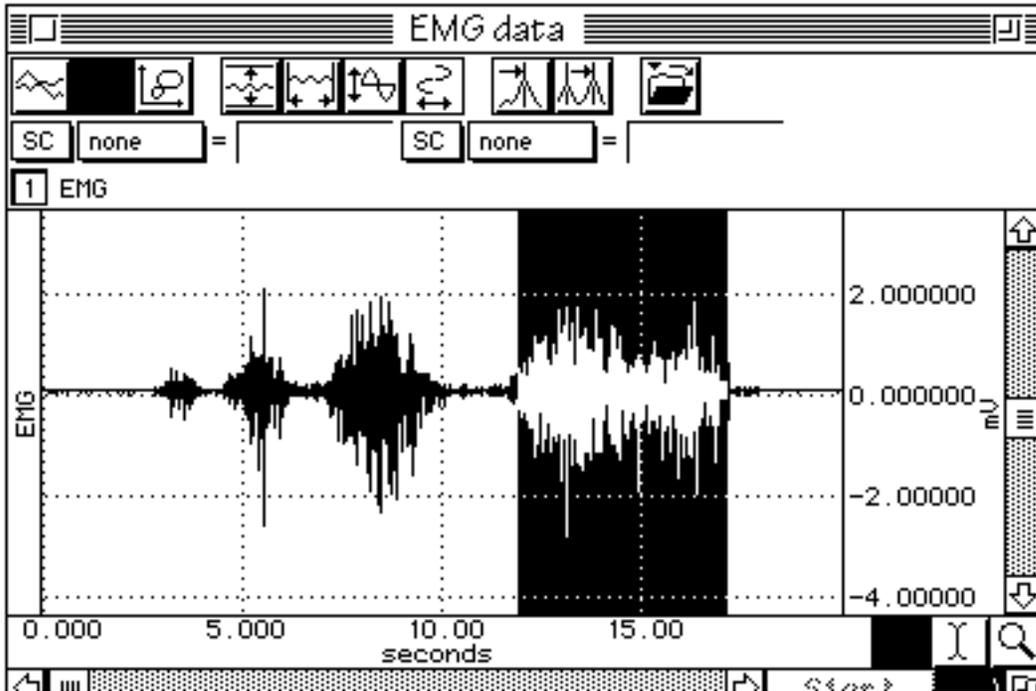
The analysis of the EMG signal in the frequency domain involves measurements and parameters which describe specific aspects of the frequency spectrum of the signal. Two parameters of the power density spectrum may be easily used to provide useful measures of the EMG frequency spectrum. The two measures of interest are:

- Median Frequency of the EMG Spectrum
- Mean Frequency of the EMG Spectrum

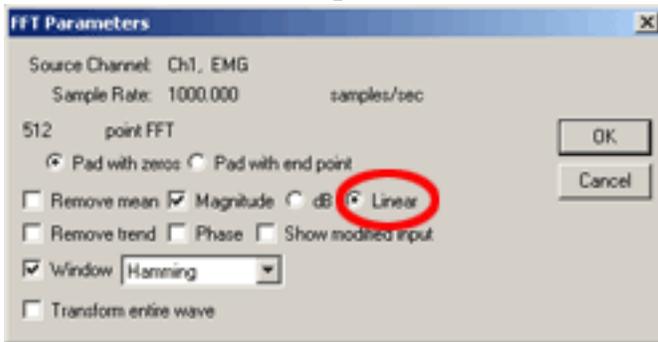
If the EMG spectrum has a normal distribution, the Median and Mean frequencies will be identical. Any deviation from normality will result in differing values for the Median and Mean frequencies.

This application note illustrates how to extract median and mean values for the frequency spectra of EMG signals. Biopac Student Lab *PRO* software is used to calculate these parameters after the EMG data has been collected.

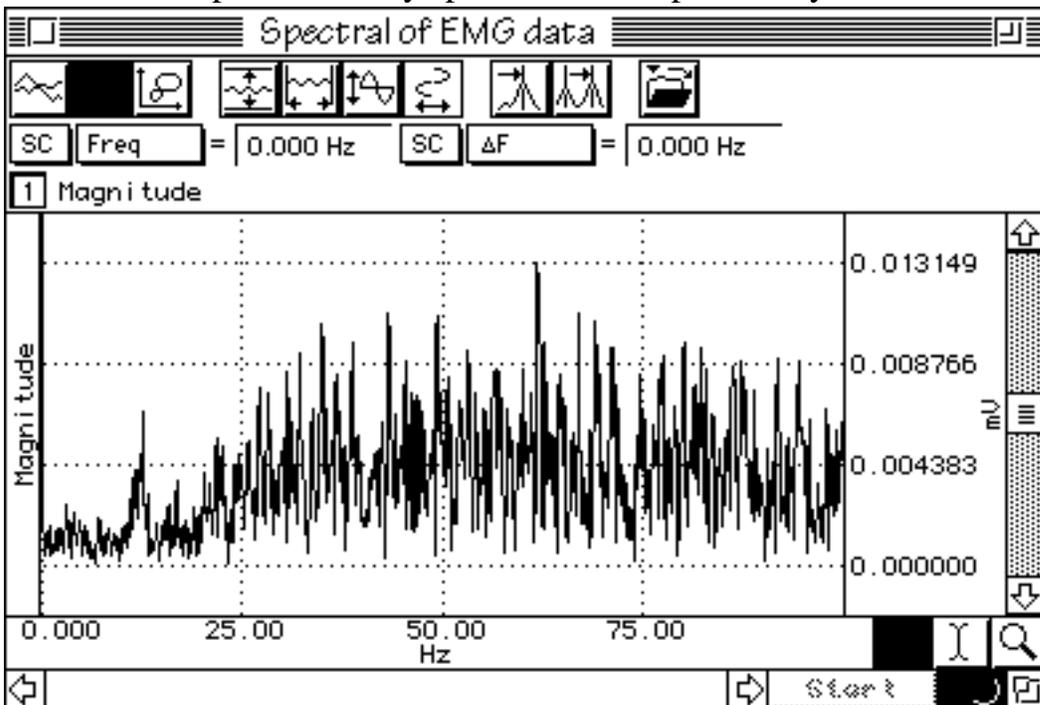
1. Click in the EMG channel (or select the side label) to make it the active channel.
2. Use the I-beam to select the desired portion of the EMG signal as shown in the following graph.



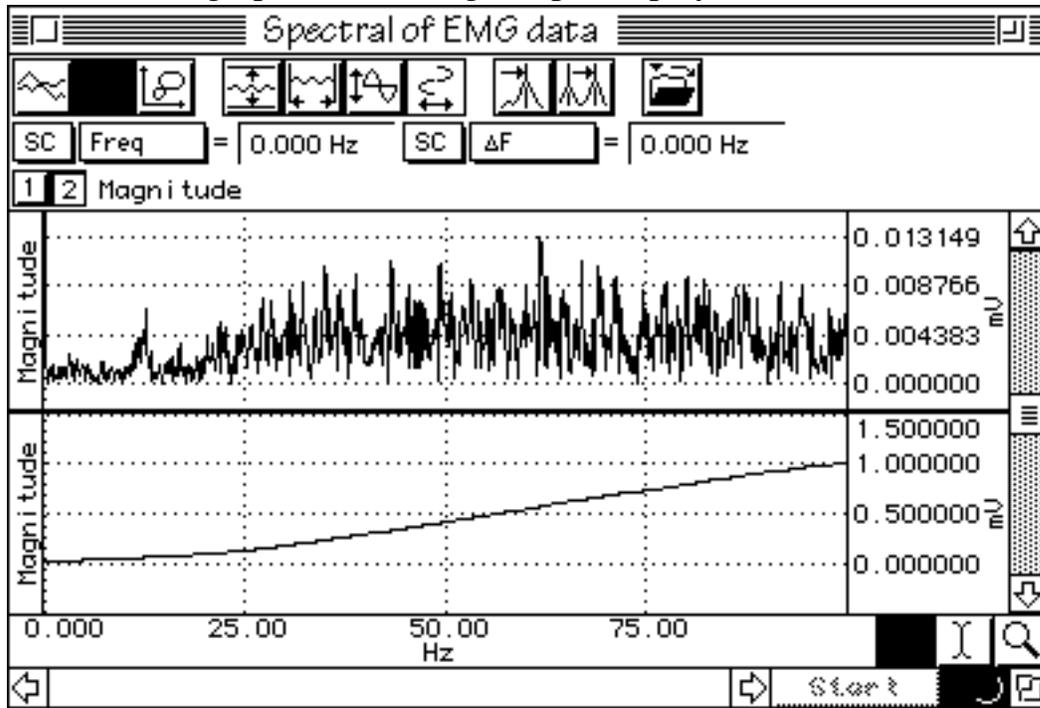
3. Perform a linear magnitude FFT on the selected area (Transform > FFT and then click in the "Linear" option).



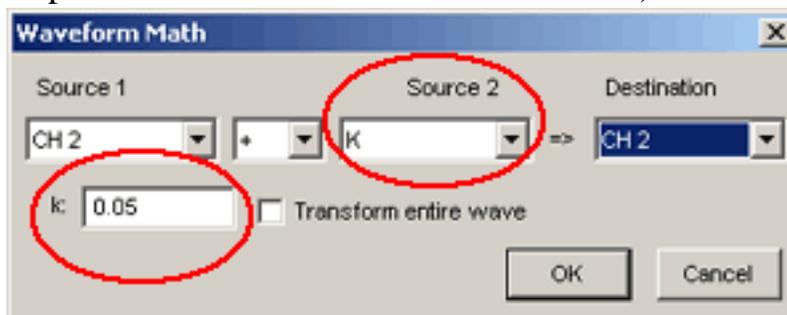
When you click OK, a new graph window will be generated with a plot that illustrates the power density spectrum of the previously selected area.



4. Click in the new "Magnitude" FFT graph to make it the active window.
5. Duplicate the spectrum (Edit > Duplicate) into a new channel.
6. Find the Integral of the duplicated spectrum.
  - a. Click in the duplicated graph to make it the active channel.
  - b. Choose Transform > Integral.
  - c. Autoscale the waveform to view the waveform, which should appear similar to the graph in following sample display.



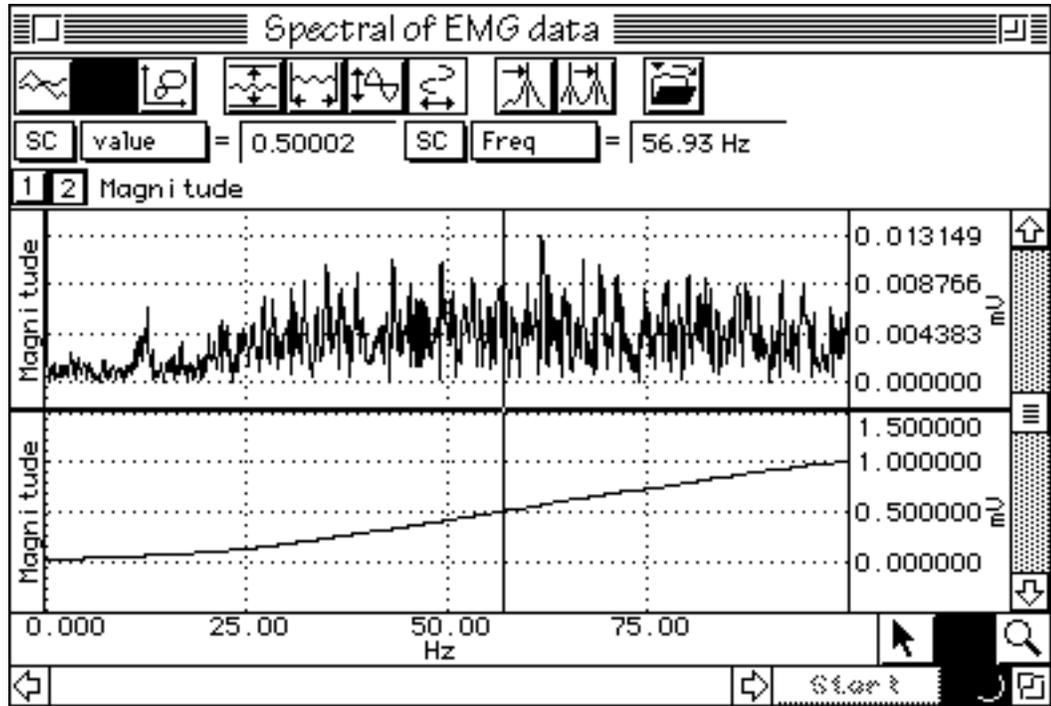
7. Determine the maximum value of the Integral spectrum.
  - a. Click in the graph of the Integral spectrum.
  - b. Click Edit > Select All.
  - c. Set a measurement for "CH 2 max" and note the result.
8. Normalize the spectrum.
  - a. Divide the integral spectrum by this maximum value (Transform > Waveform Math, and then divide CH 2 by K, where K is the max value from step 7 and is entered in the "Constant" box).



- o The maximum value should now be exactly 1.0000. The following graph shows the integral spectrum properly normalized.
9. Obtain the **median frequency of the EMG spectrum**.

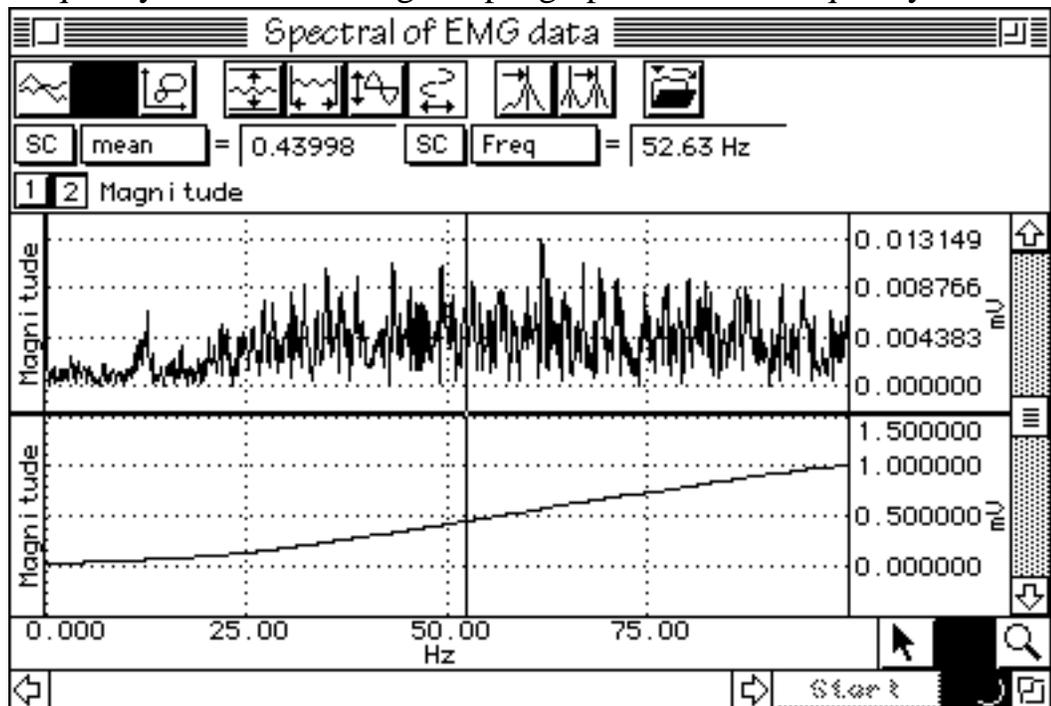
- a. Note the measurement set for Frequency ("SC" x-axis: F) SC x-axis: F and set another measurement box for Value ("SC" Value). SC value

- b. Click in the integral EMG spectrum and find a frequency that returns a Value of 0.50. In the following sample graph, the frequency which corresponds to a value of 0.50 is 56.93Hz.



**As selected above, the Median EMG frequency is 56.93Hz**

10. Find the **mean frequency in the spectrum**.
- Set a measurement for "SC" Mean.
  - Select the integral EMG spectrum channel and, if all data is not already selected, choose Edit >Select All.
  - Place the cursor at the Mean value and then read off the corresponding frequency. In the following sample graph the mean frequency is 52.63Hz.



**As selected above, the Mean EMG frequency is 52.63Hz**

11. Compare the Median and Mean frequencies. If the EMG spectrum has a normal

distribution, the Median and Mean frequencies will be identical. A deviation from normality results in differing values for the Median and Mean frequencies.

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