



BIOPAC Systems, Inc.

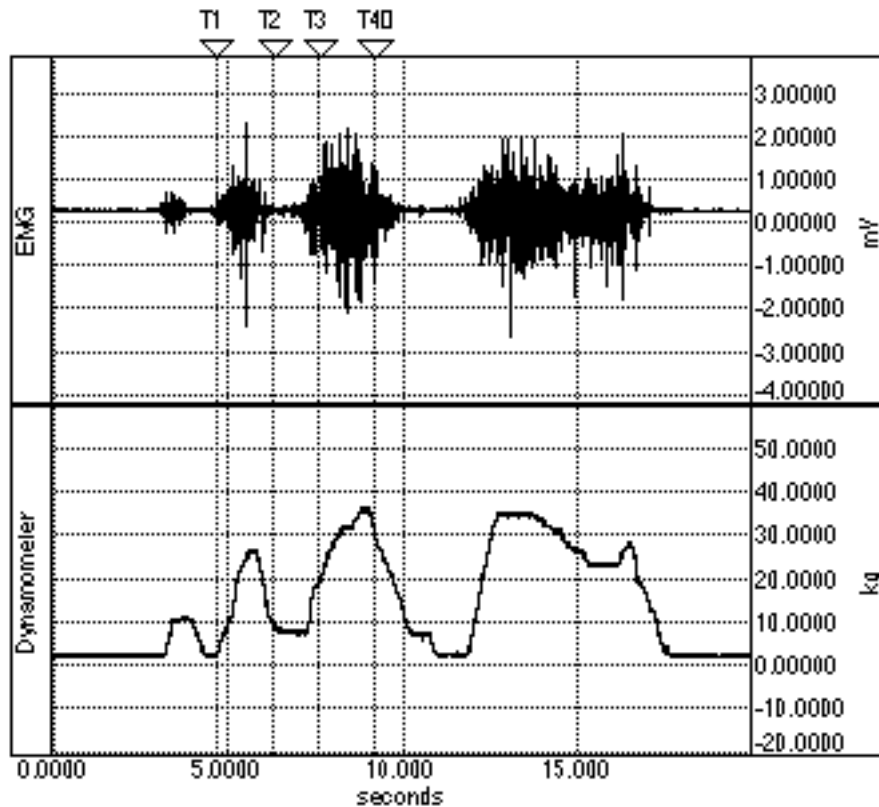
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EMG Power Spectrum Analysis

The **Power Spectrum Density** (PSD) is a common tool for investigating the EMG. This application note illustrates how to obtain the PSD from an acquired EMG signal.

The data collected for this application note was sampled at 200 Hz using the MP100WS system. The EMG data was collected via surface electrodes (EL503) using the EMG100A amplifier. The force data was collected using a Hand Dynamometer connected to the DA100A amplifier.

The following graph shows raw EMG acquired in conjunction with the force manifested by the muscle contraction. The delta time periods (T2-T1) and (T4-T3) are analyzed separately and compared using the PSD.



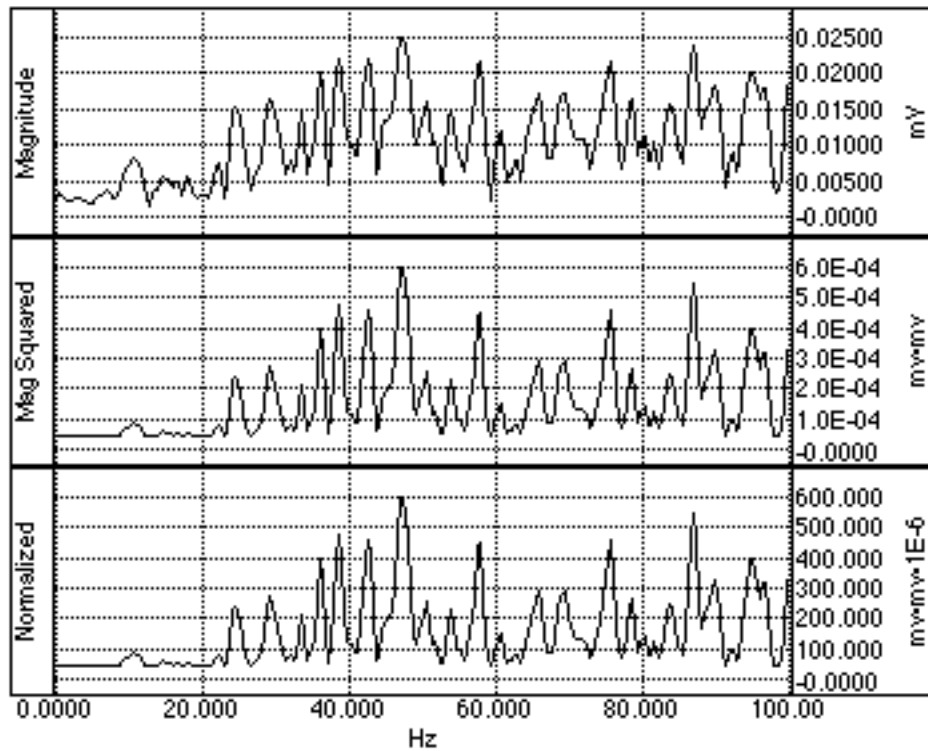
EMG and Contraction Force

PSD Analysis

1. Select the time period (T1 to T2).
2. Choose FFT from the Transform menu.
3. Set the following FFT options:
 - Pad with Zeros
 - Remove Trend
 - Remove Mean
 - Linear Magnitude
 - Hamming Window
4. Choose Waveform Math from the Transform menu.
5. Square the FFT result to obtain the second trace (Mag Squared).
6. Normalize EMG Power Spectrum to (seconds/1000 or ms) instead of (seconds).
 - To normalize with respect to (ms), just multiply the Mag Squared trace by $(1000)^2$.

The result is shown as the bottom channel in the

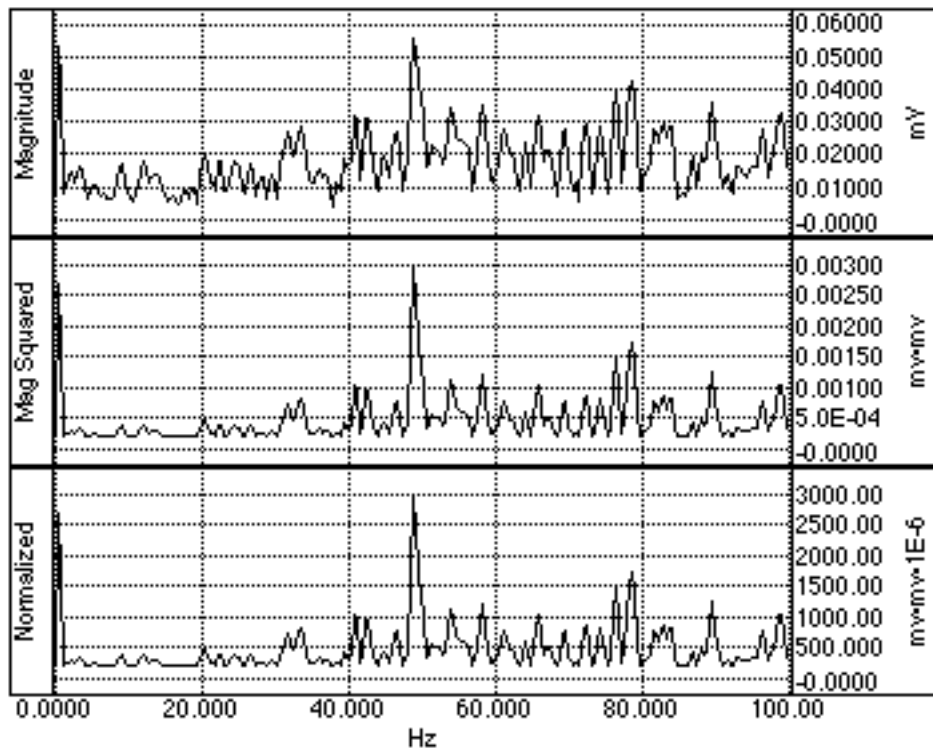
following diagram.



Power Spectrum of EMG from T1 to T2

7. Repeat the procedure for additional time periods (i.e. T3 to T4).
 - **It's very important** that the selected time periods compared using the PSD are equivalent. Namely (T2-T1) should be equal to (T4-T3). If this is not the case, the FFT spectrums will require further normalization to be compared.
8. Compare the results.

Comparing these sample results, the second graph demonstrates significantly higher amplitudes of the closest frequency component to 50 Hz.



Power Spectrum of EMG from T3 to T4