EMG SENSOR SETUP

1 Background

Electromyography, or EMG, involves acquiring and studying the electrical activity of muscles. The instrument used to measure the contraction of a muscles is called an electromyograph but the term EMG sensor is often used as well. An electromyograph measures the electric potential generated by muscle cells and this recorded voltage is called an electromyogram. EMG signals are of interest to the developers of prosthetic devices, such as artificial limbs, and this is called myoelectric prosthesis. EMG is also found in bio-instrumentation, as a clinical diagnostic tool to identify neuromuscular diseases, assisted control in aircrafts, and unvoiced speech recognition.

The QNET Myoelectric Trainer shown in Figure 1.1 includes a two-electrode electromyograph with a grounding strap and a servo. The on-board processed EMG signal can be measured and the servo can be driven by the PWM. Through EMG signal processing and control, the clamp on the servo can be opened and closed through muscle contraction, similarly to myoelectric prosthesis.

Figure 1.1: QNET Myoelectric trainer (MYOELECTRIC)

1.1 EMG Signals

The electromyogram acquired from the EMG is very qualitative. It depends greatly on how the sensor is placed, how close it is to the muscle, and what muscle is being measured. A typical EMG signal is shown in the first plot of Figure 1.2. As illustrated, EMG signals are very noisy and have a small amplitude, usually ranging around 5 mV. It can contain frequencies ranging from 10 Hz to 1 kHz.

To remove some of the noise, the electrodes on the QNET Myoelectric Trainer include a differential amplifier as well as a local band-pass filter. See the QNET Myoelectric Trainer User Manual for the common mode rejection ratio (CMRR) and filter specifications of the electromyograph. The EMG signal received from the instrument is isolated and amplified on the QNET Myoelectric Trainer circuit, as described in the QNET Myoelectric Trainer User Manual .

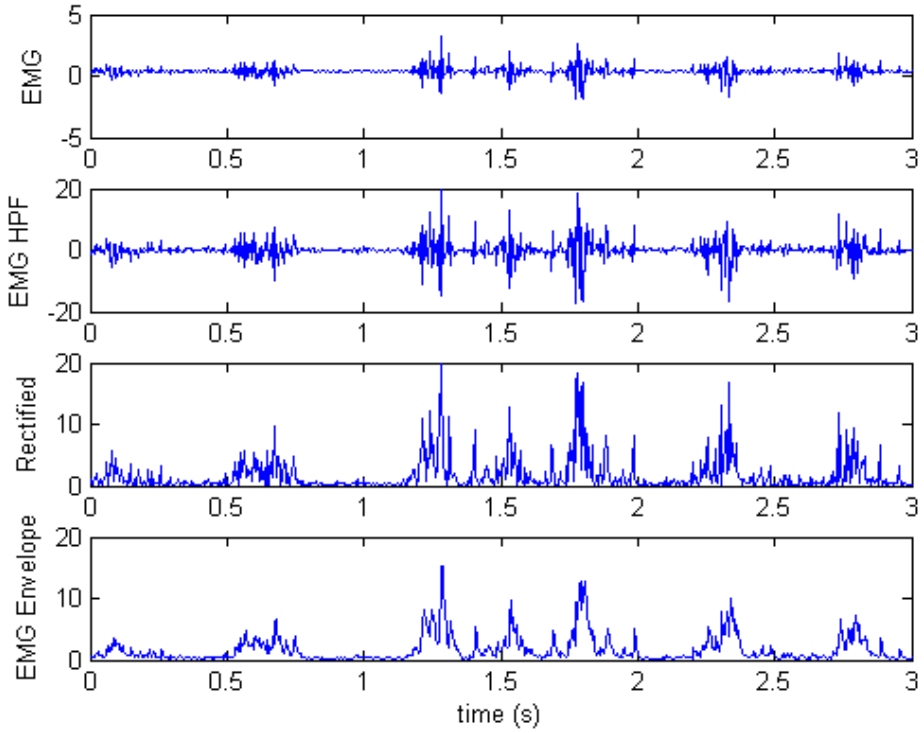

Figure 1.2: Measured and processed EMG signal

1.2 EMG Sensor Setup Virtual Instrument

The NI ELVISmx Dynamic Signal Analyser, shown in Figure 1.3, is used to verify that the EMG sensor has been properly setup.

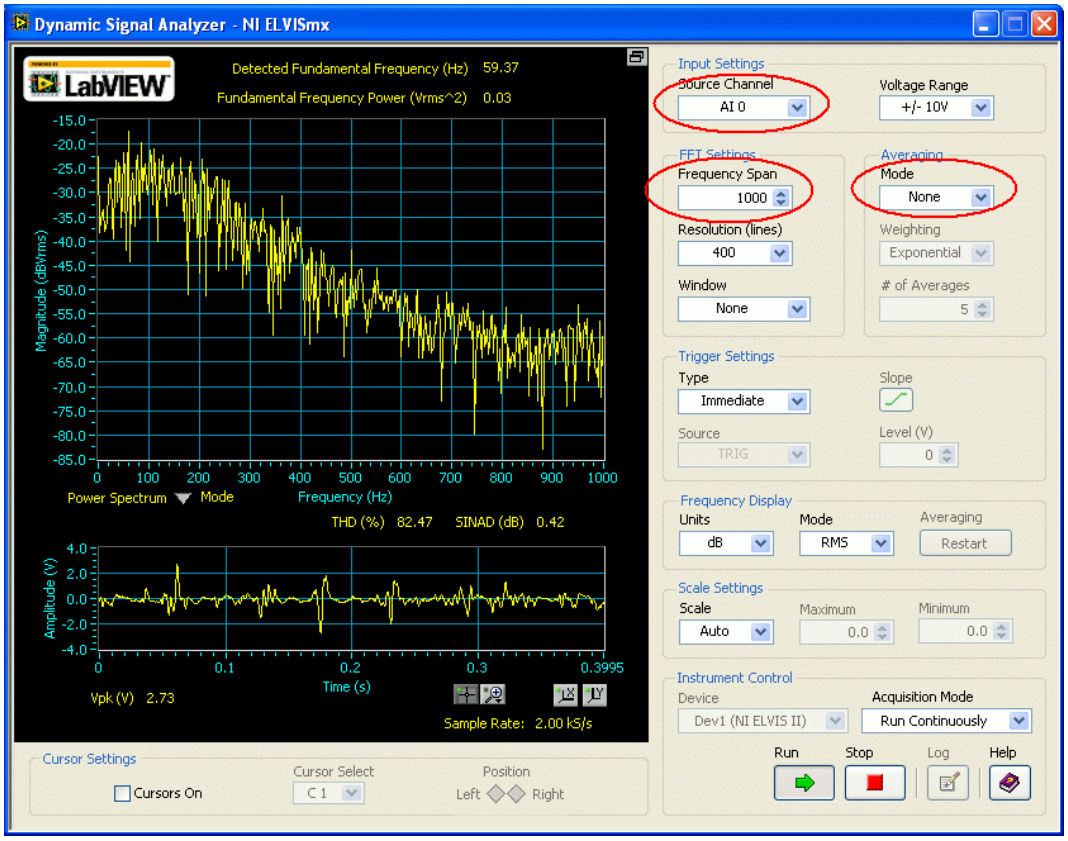

Figure 1.3: Setting up the Dynamic Signal Analyzer instrument

2 In-Lab Exercise

1. Setup the QNET Myoelectric Trainer and power up the ELVIS, as described in the QNET Myoelectric Trainer User Manual .

2. Fasten the grounding strap on of your forearm, as illustrated in Figure 1.1. It should be snug to ensure the ground terminal is making contact with your skin.

3. Wrap the EMG electrode around the upper portion of your forearm, as shown in Figure 1.1. Ensure the electrodes on the EMG sensor are facing inside your arm (you should not see the metal probes). Position the electrodes such that they make contact with the the upper-inner muscle of your forearm.

4. Turn *ON* the EMG Sensor power switch. Also, make sure there are batteries.

5. Run the Dynamic Signal Analyzer NI ELVISmx instrument. By default, this is located under *Start - All Programs - National Instruments - NI ELVISmx - Instruments*.

   For traditional NI ELVISusers: Go to *Start - All Programs - National Instruments - Traditional NI ELVIS - NI ELVIS Traditional* and then select *Dynamic Signal Analyzer* in the ELVIS- *Instrument Launcher*.

6. As shown in Figure 1.3, set the following in the Dynamic Signal Analyzer instrument:

   - Source Channel = AI 0
   - Frequency Span = 1000
   - Averaging Mode = None

7. Try to contract the muscles in your forearm and examine the voltage measured from the EMG sensor in the bottom scope called Amplitude (V). As shown in Figure 1.3, the peak should exceed 2.0 V when the muscles are contracted. If not, then the EMG sensor has not been properly setup and you need to go through Steps 1 to 3 again.

   Note: If more problems are encountered see the Myoelectric Troubleshooting Guide section in the QNET Myoelectric Trainer User Manual .

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