Electromyography (EMG)

Electromyography is a technique for evaluating and recording electrical activity produced by skeletal muscles (muscles attached to bones via tendons) when these muscles’ cells are stimulated. EMG is performed using an instrument called electromyograph, to produce a record called electromyogram[1].

And what can we do with that? Control anything just by flexing your arm’s muscles like MYO does, duh!

In the medical field, EMGs are performed to test the functioning of nerves that control our muscles. Looking at the pattern and amplitude of the generated electrical signals, and comparing them to actual motion of muscles, we can determine whether a problem is caused by muscle tissues or a nerve. Muscles during an activity produce signals significantly different than those at rest[2].

Electrical activity in muscles:

A muscle, made of hundreds of cells called muscle fibres, moves due to contraction of these fibres. Our nervous system sends electrical signals via neurons (motor neurons) to the muscle fibre to make it contract. A single motor neuron and the fibres that’re attached to it are called a motor unit - the fundamental unit of muscle motion.

Some motor neurons connect to only a few fibres while others connect to a large number. This gives us a varying degree of control over the different muscles (more fibres attached= less control)

Figure 1: Source: http://www.kneeandshouldersurgery.com/

EMG can be performed by inserting an electrode needle into the muscle (intramuscular EMG) or by placing the electrodes on our skin (surface EMG). An intramuscular EMG can provide electrical activity of a small number of muscle fibres while surface EMG gives an overview of the electrical activity of muscles near the electrode location.

Some good tools & resources for performing EMG:

1. A nice introduction to EMG: http://backyardbrains.com/experiments/emgspikerbox
2. The technical paper on Use of EMG in Biomechanics gives detailed explanation on how to effectively perform EMG & gather inferences from the acquired data.
3. EMG sensor kits/systems:

→ **Delsys:**
- Surface EMG products
- Hybrid EMG/movement sensor: has EMG sensor+3-axis accelerometer to compare the muscle stimulation signals with respect to the actual act of moving muscles. Wireless & battery operated
- Has biosignal sensors (like footswitches & respiration sensors) as add-ons to the EMG systems
- Provide just the electrodes as well (~$35)

→ **BioFlex:** (~$250)
- Surface EMG sensor
- Wireless + custom software to read sensor data

→ **EMG SpikerBox:** (~$100)
- EMG board which outputs the signals on an audio port so you can connect it directly to your computer or speakers

→ **Muscle sensor kit by Advancer Technologies:** (~$50)
- A muscle sensor that can be connected directly to Arduino to read the EMG signals. Available at Sparkfun.

→ **MYO:**
- Armband that analyses electrical activity in arm muscles to control a number of things.
- Currently (July 2013), available only to the developer community

**Related:**
- [Build an EMG detector](#)
- Open arms: [http://www.youtube.com/watch?v=38SnocWQFkM](http://www.youtube.com/watch?v=38SnocWQFkM)
- Open prosthetics project
- COOL RESOURCES ON DIY (ish) BIOSENSING!!
- BioControl systems: Neuro-interactive technology service providers
- Open Limbs: An amazing project by ITPers Andy, Will & Carl on muscle stimulation
- MindWave: EEG (Electroencephalography) device that monitors electrical activity around the scalp
- [http://facialemg.com/](http://facialemg.com/)
Reference: