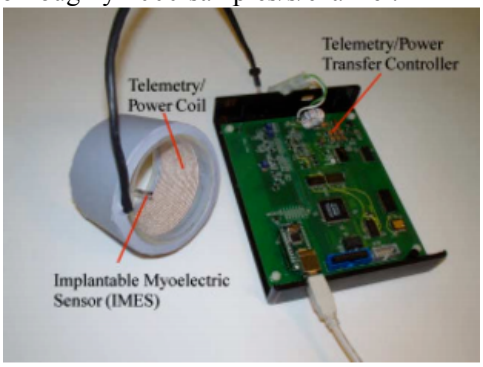
Implantable Myoelectric Sensors for Intramuscular Electromyogram Recording

Alyssa Williams – University of Rhode Island – Biomedical and Electrical Engineering

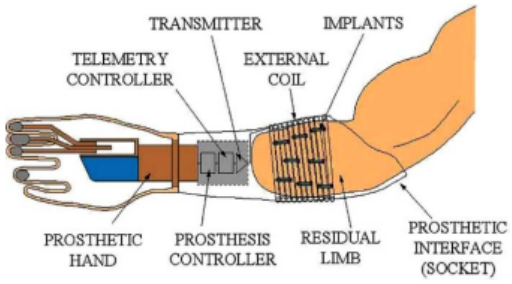
Over the years, prosthetic arms have evolved tremendously. However, they still have lots to develop. People who need prosthetic arms want them to work and function like actual hands. Currently, the only prosthetic hands are single-DOF devices. These devices can only open and close. They are controlled very differently from the natural hand and can be hard to get used to.

There are many limiting factors that cause the slow development of creating better devices. The biggest limiting factor has to do with finding sufficient control sources for the multiple DOFs that are used in a functional human arm. When making this multi-DOF system, it requires sequential control from the multiple motions and locking mechanisms to move from one DOF to another. This causes problems because the system would be too slow and counterintuitive. Because of this, the device would be underutilized or rejected.

Implantable Myoelectric Sensors (IMES) System a new technology that Richard F. Weir and his co-workers have come up with. The picture of this device is shown below. It uses a transcutaneous magnetic link that connects straight to the prosthetic arm. The device allows multiple control sources, so there are multiple-DOFs. It records myoelectric signals at their source with low levels of interelectrode cross talk. This creates independence between the two sources. The IMES system is capable of measuring raw EMG at 8-bit resolution of up to 32 implants/sites with a sample rate of roughly 1000 samples/s/channel.



The way the IMES system works is extremely interesting. An amplified electromyogram (EMG) signal is passed through the prosthesis controller. It then receives and processes the signals from up to 32 implanted myoelectric sensors. The external coil is laminated into the prosthetic interface like shown in the picture below. Signals from the implants control the prosthesis via reverse telemetry while implanted power is supplied through the external coil using forward telemetry.



Richard F. Weir and his coworkers have chronically implanted this device in the legs of three cats. The device is still completely operational nine months after implantation, and they are still monitoring these animals. They are mainly doing this to see if there is implant migration and to collect results for the analysis of data over time. They are still in the testing stage of the device and have only used it for measuring impulses from the arm. They have discovered many issues that they are still trying to fix before they can get any farther. In the future they hope to create a functional, useable hand that acts like an actual human hand.

References:

Weir, Richard F., et. al. "Implantable Myoelectric Sensors (IMESs) for Intramuscular Electromyogram Recordings." IEEE Transactions on Biomedical Engineering 56.1 (2009): 159-171.

Weir, Richard F., et. al. "Simulation of intramuscular EMG signals detected using implantable myoelectric sensors (IMES)." IEEE Transactions on Biomedical Engineering 53.10 (2006): 1926-193