BACKGROUND

Whether it is something as simple as picking up an object or as complex as human locomotion, being able to restore some of an amputee's lost movements allows them to live a more normal, fulfilling life. Prosthetics have evolved drastically since the earliest days of peg legs and hand hooks. Active prosthetics, the current state-of-the-art technology, relies heavily on electromyographic (EMG) signals from an amputee's residual limb to evaluate and control modern prostheses.

Researchers continue to explore the design and development of active prosthetics and in recent years technological advancements have led to the use of EMG signals recorded from the residual muscles of lower-limb amputees to control dynamic movements. At the University of Texas-Austin customized lower-limb prosthetics (Dr. R. Neptune et. al)\(^1\) are designed for soldiers who were injured in the line of duty. This group incorporates the EMG recording from an amputee's residual limb to design a custom prosthesis to maximize the integration of the prosthetic socket with the residual limb.

keywords: prosthesis, active prosthetics, amputation, residual limb, electromyography, socket-sensor configuration, motion artifact

DR. HELEN HUANG

Since mid-2000, Dr. Huang has been working to understand how neuromuscular signals are coordinated to improve movement control of prostheses. Her research group has focused on various topics, from optimizing the filtering of EMG signals following muscle reinnervation\(^2\) to current a project involving pattern recognition of EMG signals for prosthetic arm control\(^3\). In her group’s most recent contribution, Dr. Huang and her team investigated EMG signal quality from four different collection systems (Table 1, Pros. and Orth. Int, 2014).

Fig. 1: Full prosthetic setup on transfemoral amputation.
EMG from lower-limb socket-sensors offer insight into the factors that could influence the design and clinical evaluation of prosthesis for reliability, stability and comfort.

Dr. Huang’s group compared EMG signals from four different socket-sensor prosthetic configurations worn by a transfemoral amputee while three different movement types were performed. Raw EMG signals were filtered using a 20-450 Hz band-pass filter and rectified. Motion artifacts were determined by filtering signals with a 20 Hz low-pass filter and identifying threshold voltages. Configurations were evaluated on EMG signal quality, visible skin irritation, and user comfort.

According to her study, Trigno™ Wireless EMG System was found to excel in all three categories, producing the least amount of large amplitude motion artifacts, least amount of visible skin irritation, and the most comfortable configuration according to the user.

CONCLUSION

Dr. Huang’s study published in Prosthetics and Orthotics International concludes that Trigno™ wireless sensors provide the most accurate and reliable EMG signal when used in a prosthetic socket. Of equal importance, the sensors provided the most comfortable experience for the subject.

REFERENCES


DELSYS EMG SYSTEMS

Delsys EMG systems feature wired and wireless surface EMG sensors, designed to produce a consistent EMG signal with low muscle crosstalk and reduced motion artifact.

The wireless sensors allow the subject to move freely, allowing for natural movements and accurate evaluations during prosthetic testing.

The Study Parameters:
- Sitting/Standing
- Stair Ascend/Descend
- Level ground walking

The Study Focus:
- Quality of the EMG signal
- User comfort
- Skin irritation

Delsys Instruments Used in the Study:
- 16 sensor Trigno™ Wireless EMG System
- 16 channel Myomonitor® semi-wireless EMG System