HIGH-DENSITY EMG FOR SIMULTANEOUS MULTIPLE MYOSITE VISUALIZATION AND IDENTIFICATION FOR MYOELECTRIC PROSTHESIS FITTING

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ABSTRACT

Myosite location is one of the most important steps in the process of myoelectric prosthesis fitting. This is because identification of the best locations for electrode placement governs the quality of EMG signals and the subsequent performance of control algorithms [1]. The process requires precision, even for two-site based direct control systems that use antagonistic muscle groups. The current industry standard is to manually palpate the residual limb while the patient performs a contraction to identify broad areas of muscle movement and then to use a differential electrode system for finer identification of myosites [2]. Shifting an electrode even by <1 cm over the muscle causes significant changes in sEMG amplitude subsequently affecting the quality of control [3]. The time required as well as the reliability of this process is solely dependent on the skillset of the prosthetist, thus making it a highly specialized procedure.

New control strategies such as pattern recognition [4-5] use up to eight EMG sites for signal acquisition. In the case of above elbow patients, all eight of these electrodes need to be placed in specific locations on the residual limb to maximize information content of each channel. With these emerging control strategies, the problem of myosite identification becomes increasingly difficult over traditional two-site direct control systems. Thus, there is a significant need to improve upon the traditional brute force method of myosite location.

We have developed a novel flexible High-Density EMG [6-8] array to "image" a patient's residual limb prior to socket fabrication. This system generates muscle activity maps from 128 channels of simultaneously recorded monopolar EMG signals. The muscle activity maps provide a visual means of identifying all potential myosite locations for a given contraction. Moreover, by analyzing different muscle activity maps for different hand motions and contractions, it is possible to determine the most unique combination of sites that provide differentiable patterns for control.

Use of this HD-EMG interface allowed for optimized identification of eight myosites for pattern recognition-based prosthesis fitting of a patient with a transhumeral amputation. Interestingly, in this case study, we identified unique EMG sites where there was little visually identifiable movement of the residual limb. Such sites would likely be missed by traditional myosite selection methods. Using the selected sites, the patient was subsequently successfully fit with a pattern recognition prosthesis. Thus, HD-EMG is a valuable myosite visualization and identification tool that augments the prosthetists' skillset in myosite location.

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