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Denoising of Motor Unit Action Potential Based on Tunable Band-Pass Filter

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Abstract : When electrical electrodes are mounted on the skin surface of the muscle, a signal is detected when a skeletal muscle undergoes contraction; the signal is known as surface electromyographic signal (EMG). This signal has a noise-like interference pattern resulting from the temporal and spatial summation of action potentials (AP) of all active motor units (MU) near electrode detection. By appropriate processing (Decomposition), the surface EMG signal may be used to give an estimate of motor unit action potential. In this work, a denoising technique is applied to the MUAP signals extracted from the spatial filter (IB2). A set of signals from a non-invasive two-dimensional grid of 16 electrodes from different types of subjects, muscles, and sex are recorded. These signals will acquire noise during recording and detection. A digital fourth order band- pass Butterworth filter is used for denoising, with a tuned band-pass frequency of suitable choice of cutoff frequencies is investigated, with the aim of obtaining a suitable band pass frequency. Results show an improvement of (1-3 dB) in the signal to noise ratio (SNR) have been achieved, relative to the raw spatial filter output signals for all cases that were under investigation. Furthermore, the research's goal included also estimation and reconstruction of the mean shape of the MUAP.

Keywords : EMG, Motor Unit, Digital Filter, Denoising
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