Unraveling CEMG-SEMG Correlation Dynamics: Investigating Influential Factors

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Abstract

The electromyography (EMG) signal provides insight into neuromuscular activity which is used in medical and technological fields. Traditional needle electrodes and surface electrodes have several drawbacks making them less suitable for portable and long-term use. In contrast, emerging capacitive electrodes offer promising features over the existing electrodes. Yet, the full potential of capacitive electrodes remains untapped due to the lack of comprehensive design optimization for consistently reliable signal quality. This study highlights the complex interplay of factors influencing correlation in capacitive EMG (CEMG) and surface EMG (SEMG) signals. The study emphasizes the importance of the surface area of capacitive electrodes, muscle force, preprocessing, and sampling frequency in understanding and improving the correlation between CEMG and SEMG signals, providing valuable insights for future research and applications in the field. The study reveals that the electrode area has no significant effect on the correlation. However, the correlation significantly depends on the muscle force. In addition, removing artifacts from the CEMG increases the correlation, especially for lower force where artifacts are significant. Again, oversampling the EMG signal above 800 Hz does not have any impact on increasing the correlation but the correlation decreases with higher inter-electrode distance (IED). In this research, the highest correlation of 92.94% between CEMG and SEMG has been achieved for high muscle force with a plate area of 4 cm2. Therefore, the capacitive electrode can be an alternative for EMG signal acquisition.

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