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Intelligent Algorithm for Optimal sEMG Channel using Machine Learning

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Introduction

Surface electromyography (sEMG) signals are used in many studies as a prosthetic control input. In this study, we present the combination of multiple domain features set for improving performance of the gait phase recognition for an intelligent knee prosthetic control system.

Problem Statement

While using the raw sEMG signal is very difficult to classify movements, various domains extracted from raw signal, such as time domain, frequency domain and time-scale domain were introduced to make the classification more reliable[1-2]. Use of only one domain feature is able to show limited signal information.

Methodology

sEMG signal from Rectus femoris, Vastus medialis and Biceps femoris were recorded from normal subjects. They were instructed to walk in a comfortable pace on a hard floor. The classified phases are stance phase and swing phase. The recorded sEMG signals were segmented into 256-sample window and extracted into 3 typical domain features: time domain, frequency domain and time-scale domain. Time domain features consist of Mean Absolute Value (MAV), Variance (VAR), Waveform Length (WL), log-Detector (logDet) and Willison Amplitude (wAmp). Fast Fourier transform (FFT) and Wavelet Packet transform (WPT), were applied for frequency domain and time-scale domain feature extraction, respectively. The combinations of two different domain features were made by choosing selectively one feature from time domain and another feature is from FFT or WPT.

Each combination feature was then reduced to lower dimension data by principle component analysis. Support vector machine which has Radial Basis Function as the kernel was the classifier used in this study to recognize the gait phase.

Discussion

The combinations between time domain feature and frequency or time-scale domain can improve the accuracy of the gait phase classification.

References

[1] Dennis T, et al. J of NueroEngineering and Rehabilitation, 2010, 7:21

[2] Zeeshan O K, et al. BioMedical Engineering Online, 2010, 9:41