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Review EMG Signal Muscle Activity Detection and Wavelet Spectrum Matching Using DB Transform Method

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Abstract- Purpose of this research paper is to Review identify the Electromyography Signal from muscle activation Signal. Electromyogram (EMG) is a complex signal, which was collected by nervous system depends on the anatomical and physiological properties of the muscles. The EMG signals were collected from the laboratories and experimentally recorded using surface electrode of healthy, myopathic and neuropathic subjects. These signals get corrupted by the noise while travelling through different tissues.

Keywords- Electromyogram (EMG) signal, Motor Unit Action Potential (MUAP), Wavelet transform, feature extraction, myopathic, neuropathic.

I. INTRODUCTION

The EMG signals are highly complex and non-linear signal. These signals are widely used in clinical trials for the diagnosis of neurological and neuromuscular problems [1]. Because of the complexity of EMG signals many times even experienced researchers are fail to provide enough information about these signals. EMG signals involve a great deal of information about the nervous system with anatomical and psychological properties of muscles. It is a record of electrical potentials generated by muscles cell [4].

The changes in the voltage difference between electrodes are sensed and amplified before it is transmitted to a computer program to display the tracing of the voltage potential recordings [2].

There are numerous neuromuscular disorders that influence the spinal cord, nerves or muscles. Early finding and diagnosis of these diseases by clinical examination is crucial for their management as well as their anticipation through prenatal diagnosis and genetic counseling.

This information's are also valuable in research, which may lead to the understanding of the nature and eventual treatment of these diseases [4].

In the previous literatures Fast Fourier Transform (FFT) was used for analysis of EMG signals, but FFT suffers from large noise sensitivity [5]. Parametric power spectrum methods such as autoregressive (AR), reduces the spectral loss problems and gives better frequency resolution [5]. Since, EMG signals are non-stationary; the parametric methods are not suitable for frequency decomposition of these signals. Another method is Short Time Fourier Transform (STFT) which provides resolution in short window of time for all frequencies. FFT, AR, STFT do not have time and frequency resolution at same time [7].

II. EMG DISEASES

An EMG is a clinical test used to find function of muscles and the nerves that control them. EMG signals studies are used to help in the diagnosis of disorders such as the muscular dystrophies and neuropathies. Nerve conduction studies that measure how well and how fast the nerves conduct.

Neuromuscular diseases are a group of disorders which contain motor nuclei of the cranial nerves, anterior cells of the spinal cord, nerve roots and spinal nerves cause muscular weakness [14]. Neuropathies describe damage to the peripheral nervous system which transmits information from the brain and spinal cord to every other part of the body.

III. RESEARCH MOTIVATION

Like many physical systems, the human body relies on electrical potentials to generate control signals for different biological systems, such as the muscular system. The electrical activity of the muscular system, known as electromyography (EMG), can be measured on the surface of the skin and processed for use in the diagnosis of muscular disorders, kinesiology, ergonomics and prosthesis control (Sornmo and Laguna).

IV. LITERATURE REVIEW

Jonathan R.Torres-Castillo, Neuromuscular disorders detection through time-frequency analysis and classification of multi-muscular EMG signals using Hilbert-Huang transform: Electromyographic (EMG) signal analysis plays a vital role in diagnosing neuromuscular disorders (NMD). It is based on the clinician's experience in interpreting the signal's shape and acoustic properties. For accurate detection of these disorders, developing new techniques to analyze these signals comprehensively has increased.

Temel Sonmezocak, Machine learning and regression analysis for diagnosis of bruxism by using EMG signals of jaw muscles: Bruxism is known as the rhythmical clenching of the lower jaw (mandibular) by involuntary contraction of the masticatory muscles (masseter muscles) together with parafunctional grinding of the teeth that usually occur during sleep. It affects patients' quality of life adversely due to tooth wear, tooth loss, and pain and fatigue in the jaw muscles. It is a common condition that is difficult to diagnose and treat. Bruxism diagnosis is often made by monitoring electromyography (EMG) activity of the masseter muscles during sleep. In this study, fatigue and pain in lower jaw muscles are examined together with teeth grinding and clenching activities. 13 time- and frequency-related features that are widely used in the literature were extracted from EMG signals.

Jun-YaoWang, Feature layer fusion of linear features and empirical mode decomposition of human EMG signal: To explore the influence of the fusion of different features on recognition, this paper took the electromyogram (EMG) signals of rectus femoris under different motions (walk, step, ramp, squat, and sitting) as signals, linear features (time-domain features (variance (VAR) and root mean square (RMS)), frequency-domain features (mean frequency (MF) and mean power frequency (MPF)), and nonlinear features (EMD) of the signals were extracted.

Hemant Amhia, Stability and Phase Response Analysis of Optimum Reduced-Order IIR Filter Designs for ECG R-Peak Detection: Cardiovascular health and training success can be assessed using electrocardiogram (ECG) data. For over a quarter of a century, an individual's resting heart rate is varying more.

Yazan AliJarrah, High-density surface EMG signal quality enhancement via optimized filtering technique for amputees' motion intent characterization towards intuitive prostheses control: Electromyogram (EMG) based pattern recognition (PR) strategies have been well investigated and applied as viable control strategies for upper limb prostheses. Transhumeral amputees often do not have enough residual muscles to produce high-quality signals needed to control the device adequately, so EMG-PR based prostheses for above-elbow amputees have not yet gained widespread acceptance in clinical and commercial settings. The limited acquired signal from these amputees often contains noises that make it challenging to accurately decode their limb movement intent.

JiaqiXue, Dynamic gripping force estimation and reconstruction in EMG-based human-machine interaction: Electromyography (EMG) can reveal the state of muscle activity in advance, therefore, it has been widely used in human–machine interaction (HMI) to predict human intention. Force estimation from EMG signals is acknowledged as an important research topic in HMI. In order to develop a simple and smooth HMI system, it is necessary to estimate the dynamic force effectively and smoothly from a small number of EMG electrodes. In this paper, we have proposed an EMG-based dynamic force reconstruction scheme applied in HMI system.

Rahul Dubey, Automated diagnosis of muscle diseases from EMG signals using empirical mode decomposition based method: Muscle activity decreases due to various conditions like age factors and muscle diseases namely, amyotrophic lateral sclerosis (ALS) and myopathy. Electromyogram (EMG) signals are regularly explored by specialists to analyze the irregularity of muscles. Manual investigation of EMG signals is a tedious task for medical practitioners.

LizhiPan, An enhanced EMG-driven Musculoskeletal model based on non-negative matrix factorization: In recent years, electromyography (EMG) signals have been widely used in human–machine interfaces (HMIs). Musculoskeletal models (MMs) have been employed to decode human movement intentions from EMG signals in HMIs. Non-negative matrix factorization (NMF) has been adopted to extract neural control information from surface EMG signals. The aim of this study was to investigate if the NMF could extract the control information from surface EMG signals to substitute muscle activations of the deep muscles of the MM.

An enhanced MM based on NMF (NMF-MM) was proposed to predict wrist pronation/supination (Pro/Sup) joint angles from surface EMG signals. We extracted the muscle activations of a pair of virtual agonist–antagonistic muscles with NMF from multi-channel EMG signals and inputted the extracted signals into the MM. Eight able-bodied subjects were recruited and tested in four different upper limb postures. Eight bipolar electrodes were attached to the upper forearm to record EMG signals.

Zahra Taghizadeh, Finger movements classification based on fractional Fourier transform coefficients extracted from surface EMG signals: EMG signals have played a pivotal role as a fundamental component of myriad modern prostheses to control prostheses' movements as well as identifying individual and combined hand or finger gestures.

Florent Moissenet, Normalisation of a biarticular muscle EMG signal using a submaximal voluntary contraction: Choice of the standardised isometric task for the rectus femoris, a pilot study: Electromyography (EMG) signal amplitude is often altered by factors related to the participants and the measurement system.

Firas Sabar Miften, A new framework for classification of multi-category hand grasps using EMG signals: Electromyogram (EMG) signals have had a great impact on many applications, including prosthetic or rehabilitation devices, human-machine interactions, clinical and biomedical areas. In recent years, EMG signals have been used as a popular tool to generate device control commands for rehabilitation equipment, such as robotic prostheses.

This intention of this study was to design an EMG signal-based expert model for hand-grasp classification that could enhance prosthetic hand movements for people with disabilities. The study, thus, aimed to introduce an innovative framework for recognizing hand movements using EMG signals. The proposed framework consists of logarithmic spectrogram-based graph signal (LSGS), AdaBoost k-means (AB-k-means) and an ensemble of feature selection (FS) techniques. First, the LSGS model is applied to analyse and extract the desirable features from EMG signals. Then, to assist in selecting the most influential features, an ensemble FS is added to the design.

C.Tepe, Real-Time Classification of EMG Myo Armband Data Using Support Vector Machine: 14 features of the EMG signals have been extracted and non-real-time classification has been made for each feature; the highest accuracy of 96.38% was obtained using root mean square (RMS) and integrated EMG features.

Gelareh Hajian, Bagged tree ensemble modelling with feature selection for isometric EMG-based force estimation: EMG-based force estimation is crucial in applications, such as control of powered prosthetic and rehabilitation devices. Most previous studies focus on intra-subject force modelling. However, a generalized EMG-force estimation model, which is capable of estimating force across users, is needed for surgical and rehabilitation robotics. In this study, EMG signals are recorded from the long head and short head of the biceps brachii, and brachioradialis using 3 linear surface electrode arrays, during isometric elbow flexions, at different joint angles and forearm postures, while recording the induced force at the wrist.

Daniel J.Romero, The effect of EMG magnitude on the masseter vestibular evoked myogenic potential (mVEMP): We found that the tonic EMG target had no effect on mVEMP latency. Additionally, although mVEMP amplitudes "scaled" to the EMG target, there was a tendency for the subjects' EMG level to

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"undershoot" the EMG target levels greater than 50 µV. While some individuals did generate differences in EMG activation between sides, there were no significant differences on average EMG activation between sides. Further, while average corrected amplitude asymmetry was similar across EMG targets, some individuals demonstrated large, corrected amplitude asymmetry ratios.

Manisha Choudhary, Chapter 6 - A machine learning approach to aid paralysis patients using EMG signals: This work focuses on hand movement classification from electromyography (EMG) signals using machine learning algorithms. The use of EMG signals for the human–human interface to move a paralyzed person is discussed. EMG signals are generated when the electric potential of the muscles changes after receiving signals from the brain due to the contraction or expansion of muscles.

Table 1. Text Here Your Table Title.

Paper Title	Author	Result	Methodology	Parameters	Scope of the study
Normalisation of a biarticular muscle EMG signal using a submaximal voluntary contraction: Choice of the standardised isometric task for the rectus femoris, a pilot study	Florent Moissenet	Signal-to-noise ratio during ISO-K and ISO-H was ≥ 15 dB in respectively 51% and 98% of all task repetitions.	submaximal voluntary contraction (subMVC) normalisation approach	signal-to-noise ratio	Some additional improvements might thus still be needed to obtain a normalisation protocol allowing more reproducible measurements.
The effect of EMG magnitude on the masseter vestibular evoked myogenic potential (mVEMP)	Daniel J. Romero	The results of this investigation suggest that, as with cVEMP recordings, the underlying EMG activation may vary between subjects and could impact mVEMP amplitudes, yet could be mitigated by amplitude correction techniques.	The results of the present investigation showed that when subjects were asked to match a higher EMG target, they were more likely to produce EMG activation below the target level.	Raw peak-to-peak amplitude	Further it is important to be aware that even young normal subjects have difficulty maintaining large, tonic EMG activity during the mVEMP recording.
Preliminary results of homomorphic deconvolution application to surface EMG signals during walking	Simone	This methodology, originally proposed in, allows the estimation of MUAP parameters, like amplitude, scale and shape of MUAP as a function of time, when applied to a windowed signal.	Surface EMG Signal Model	motor unit action potential (MUAP)	Further development could focus on the direct comparison of the results achieved in the present study with outcomes

Recording activity in proximal muscle networks with surface EMG in assessing infant motor development	Automatic decomposition of pediatric high density surface EMG: A pilot study
Sini Hautala	Maoqi Chen
The muscle networks showed consistent change in network density during Spontaneous movements between supine and prone position. Moreover activity correlations in individual pairs of back muscles linked to infant´s motor performance.	hese results indicate that using the APFP framework single motor uni activity can be reliably and automatically extracted from pediatric surface EMG signals recorded by an electrode array.
Amplitude envelope correlations	Automatic progressive FastICA peel-off (APFP) framework
Muscle activation index (MAI)	average matching rate
There were also preliminary indications that the overall muscle network assessment might provide a new tool to recognize abnormal central control of posture and	Further development of appropriate parameters (both temporal and spatial) characterizing motor unit features is required after surface

Low-Price Prosthetic Hand Controlled by EMG Signals
Alexy A. belov
In this paper a prototype of low-price prosthetic hand with multifinger control has been presented. It has been shown that developed device has technical characteristics similar to existing devices.
Pulse width modulator (PWM)
Average speed
The future study will be focused on developing of peripherals. Among them vibrating tactile feedback, user-friendly interface, and fastening device.

IV. CONCLUSION

The review of the relation function of EMG on musculoskeletal disorder (MSDs) is shown and the used of surface EMG to access the features and characteristic of the signal was reviewed. The purpose of this paper is to provide the details of information of surface Electromyography for the analysis of MSDs on the methodologies used for detecting and processing the EMG signal. In an analysis of EMG signals, one of the most important processes is to extract the suitable features that will affect the developed application of the chosen technique.

There are some other techniques have been used in the analysis, however, the common techniques of analysis is selected to be explored and the features of time domain, frequency domain and time-frequency domain have been extracted from the analysis of EMG signal in order to diagnose and localise the exact problem of the muscles that will contribute to MSDs problems.

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