Artificial Foot

Rajeshri Todkar, Jyoti Warrier, Preeti Athavale, Swagatika Mishra

Abstract— In this study, one of the applications which implemented a non-invasive Emg Controlled Functional Electrical Stimulation (FES) system was developed and tested with normal subjects to restore foot drop during gait. to Control the Stimulation Output of the system, the subjects must retain some dorsiflexor muscle power. The control signal that adjust the electrical stimulus intensity of the ankle dorsiflexor is based on the detection of the amplified, Electromyography (EMG) Signal recorded using surface electrodes positioned over the ankle dorsiflexor and associated group of muscles. The voluntary contraction of ankle dorsiflexor could serve as the trigger of the stimulation of the system and to adjust the stimulus intensity automatically.

Index Terms— Non-invasive techniques; foot drop; strokes; dorsiflexion; electromyography; voluntary contraction.

1 INTRODUCTION

Orthosis is a correct term for an externally applied device to provide external support to achieve one or more steps of goal:

- Control biomechanical alignment
- Correct or accommodate deformity
- Reduce pain
- Increase Mobality
- Protect and Support an injury
- Assist rehabilitation
- Increase independence

1.1 ANKLE- FOOT ORTHOSIS

An ankle foot orthosis (AFO) is defined as a medical mechanical device to support and align the ankle and foot.
This device is used to assist weak and paralyzed muscles of the ankle and foot, to prevent or correct ankle and foot deformities and to improve the functions. An Ankle-foot orthosis (AFO) is an Orthosis or brace that surrounds the ankle and at least part of the foot.AFO'S are L shaped & are externally applied to the leg & foot.
The main objective is to make Artificial Foot for the Patient of Hemipersis or Hemiplegia.for this one of the applications which implemented a non-invasive EMG controlled functional electrical stimulation (FES) system

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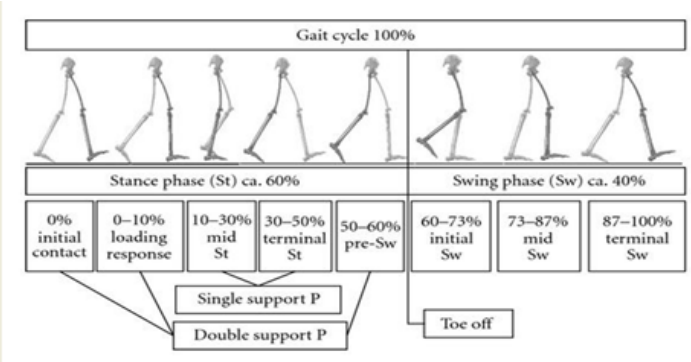
Hemi means one side and persis means partial paralysis or Plegia means complete paralysis.
The diseases which occure of hemi persis due to central nervous system injury such as stroke,cerebral palsy,because of this it causes gait disorder which is also called as foot drop ,In this disease the patient is inability to raise the foot while walking and therefore it also dragging of foot instability and increase effort during walking.
Gait cycle is an important criteria which helps to study the gait of a normal & Hemipersis condition.The standard gait cycle comprises of the stance phase(60% of gait cycle) and swing phase (40% of gait cycle).



1.2 Treatment

A conventional approach to the treatment of drop foot gait is a splint. This is usually a custom fitted ankle-foot orthosis (AFO), which is a plastic support worn inside the shoe. An AFO for drop foot is used to keep the ankle at 90 degrees and prevent the foot from dropping towards the ground, so the ankle joint is maintained in a neutral position. This treatment has limitations, being both uncomfortable and awkward to use. An active approach to the treatment of drop foot gait is functional electrical stimulation (FES). FES is the electrical

stimulation of a muscle deprived of nervous control for providing muscular contraction and there by producing a functionally useful movement. FES is a methodology that uses bursts of short electrical pulses. Surface or implanted electrodes can activate the motor nerves. Today, FES is mainly routinely applied for cardiac pacemakers, bladder voiding and pain suppression. In recent years few neuroprotheses for walking were introduced FES has been used to correct foot drop in hemiplegics, since the 1961. Liberson et al. introduced the method and proposed that electrical stimulation of the anterior tibial muscles can be coordinated with the gait cycle, and can improve gait quality in patients with a central foot drop. That the FES system for the treatment of drop foot improves gait and effort of walking in stroke patients, is also reported by other researchers. A study of Taylor et al. showed that Electrical stimulation to correct drop foot improved the physiological cost index (PCI) and walking speed. A clinical study of Burridge et al. has reported that the quality of life and range of motion are improved due to use of FES system
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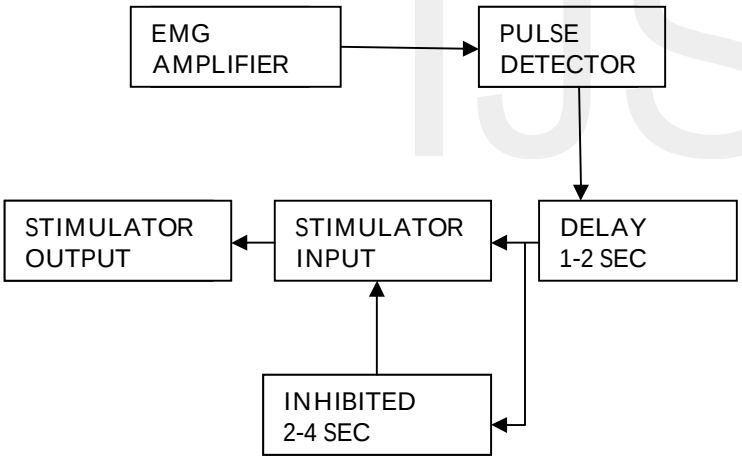
2. METHODOLOGY



SYSTEM SUMMARIZATION

The Block diagram of the Artiicial foot comprises of the following Blocks:

- EMG AMPLIFIER
- PULSE DETECTOR
- DELAY(1-2 SEC)
- STIMULATOR INPUT
- STIMULATOR OUTPUT
- INHIBITED (2-4 SEC)

Electrode Assembly:

The first step is acquisition of EMG signal,which is made through application of three electrodes placed on the skin.surface that enable an appropriate electrical conduction with low impedance,after acquisition the signal undergoes amplification & filtering.

EMG Amplifier:

The Block shown is Designed to capture EMG signal from different locations of patients leg naming is tibialis Anterior,these Muscle is responsible for planter flexion Movement,signal which are taken from tibialis anterior Muscle is very small and hence EMG amplifier placed in a circuit to amplify this signal.

Filtering:

As Mentioned Previously, for the transmission of Pure Emg,the high and low frequency Noise Should be detected.for this purpose ,only specific band of frequency should be carried.forward.This can be made possible wih the help of a band pass filter.

Pulse Detector:

This is basically use in wave shaping circuit, these produces an output signal that swings positively only, after it compares the absolute value and after that the pulse to be detected.

Delay:

EMG signal is converted into pulse detector, this pulse are given to a delay circuit which creats a delay of about 1-2 sec, which is input for the stimulator.

Inhibitor:

Inhibitor which produces a pulse of time period of 2-4 sec.Thus inhibits unwanted genuin trigger.

3 Results

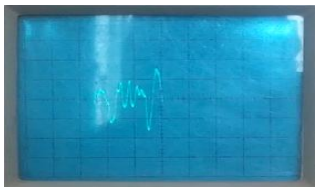


Fig: EMG captured

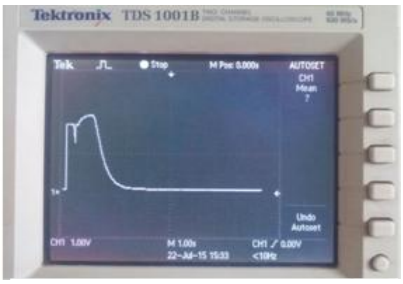


Fig: Positive envelop detector

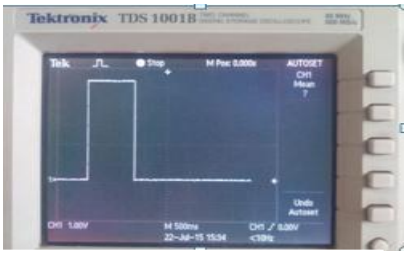


Fig: 1 sec Delay

Fig: Stimulation pulse

Fig: 2-3 sec inhibited pulse

Fig: 15v amplitude high pulse

Fig: High voltage stimulation which will activate nerve

4 CONCLUSIONS:

2 Types of electrodes for obtaining EMG signal. There are two types of electrodes for obtaining EMG signals, inserted (invasive) electrodes and surface (non-invasive) electrodes. The ease of use of surface electrodes makes their implementation for this project preferable. EMG signal is taken from different locations of patients leg naming is tibialis Anterior, These muscle is responsible for Planter flexion Movement, Signal which are taken from Tibialis Anterior muscle is very small and hence EMG amplifier placed in circuit to amplify this signal. After Amplification, EMG signal is then converted into pulse through the pulse detector, this pulse are given to a delay circuit which creates a delay of about 1-2 sec, which is input for the stimulator. Inhibitor circuit which produces a pulse of time period of 2-4 sec. Thus inhibits unwanted genuin trigger.

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