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Upper Limb Prosthesis Using EMG Signal: Review

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Abstract:
Time and frequency domain features of the surface electromyogram (EMG) signal acquired from multiple channels have frequently been investigated for use in controlling upper-limb prostheses. We propose the use of EMG signal whitening as a pre-processing step in EMG-based motion classification. Whitening decor relates the EMG signal and has been shown to be advantageous in other EMG applications including EMG amplitude estimation and EMG-force processing. Drawbacks of using whitening include its substantial added computation and memory requirements, the need to collect calibration data, and possible robustness issues in the presence of high frequency noise. This draw backs can be overcome by the degrees of freedom (DOFs). DOFs implements pattern recognition algorithms that use surface electromyography (EMG) signals show great promise as multi-DOF controllers. Unfortunately, current pattern recognition systems are limited to activate only one DOF at a time. This study introduces a novel classifier based on Bayesian theory to provide classification of simultaneous movements. This approach and two other classification strategies for simultaneous movements were evaluated using non amputee and amputee subjects classifying up to three DOFs, where any two DOFs could be classified simultaneously. Similar results were found for non-amputee and amputee subjects. The new approach, based on a set of conditional parallel classifiers was the most promising with errors significantly less than a single linear discriminant analysis (LDA) classifier or a parallel approach. The low error rates demonstrated suggest than pattern recognition techniques on surface EMG can be extended to identify simultaneous movements, which could provide more life-like motions for amputees compared to exclusively classifying sequential movements. The current statistics includes average of 18,496 upper-extremity amputations every year, compared to 113,702 of the lower extremity. Of those, only 1900 are above the wrist. Among upper-limb amputees, typically fewer than half wear prosthetic arms. An estimated number of 541,000 Americans were living with some form of upper limb loss in 2005 and this number is projected to more than double with an aging and growing population by 2050.

1. Introduction

When a person becomes a limb amputee, he or she is faced with staggering emotional and financial lifestyle changes. The amputee requires a prosthetic device(s) and services which become a life-long event. Prosthesis is an artificial extension that replaces a missing body part such as an upper or lower body extremity. It is part of the field of bio mechatronics, the science of fusing mechanical devices with human muscle, skeleton, and nervous systems to assist or enhance motor control lost by trauma, disease, or defect. An artificial limb is a type of prosthesis that replaces a missing extremity, such as arms or legs. The type of artificial limb used is determined largely by the extent of an amputation or loss and location of the missing extremity. Artificial limbs may be needed for a variety of reasons, including disease, accidents, and congenital defects.

There are four main types of artificial limbs. These include the transtibial, transfemoral, transradial, and transhumeral prostheses:

1.1. Transradial Prosthesis

Transradial prosthesis is an artificial limb that replaces an arm missing below the elbow. Two main types of prosthetics are available. Cable operated limbs work by attaching a harness and cable around the opposite shoulder of the damaged arm. The other form of prosthetics available are myoelectric arms. These work by sensing, via electrodes, when the muscles in the upper arm moves, causing an artificial hand to open or close.

1.2. Transhumeral Prosthesis

Tanshumeral prosthesis is an artificial limb that replaces an arm missing above the elbow. Transhumeral amputees experience some of the same problems as transfemoral amputees, due to the similar complexities associated with the movement of the elbow. This makes mimicking the correct motion with an artificial limb very difficult.

1.3. Transtibial Prosthesis

Transtibial prosthesis is an artificial limb that replaces a leg missing below the knee. Transtibial amputees are usually able to regain normal movement more readily than someone with a transfemoral amputation, due in large part to retaining the knee, which allows for easier movement.

1.4. Transfemoral Prosthesis

Ttransfemoral prosthesis is an artificial limb that replaces a leg missing above the knee. Transfemoral amputees can have a very difficult time regaining normal movement. In general, a transfemoral amputee must use approximately 80% more energy to walk than a person with two whole legs. This is due to the complexities in movement associated with the knee. In newer and more improved designs, after employing hydraulics, carbon fibre, mechanical linkages, motors, computer microprocessors, and innovative combinations of these technologies to give more control to the user.

1.5. Myoelectric Prostheses

Myoelectric technology uses electromyographic (EMG) activity, a form of electrical signal, from the voluntary movements of the stump muscles. EMG signals, which control the flow of energy from the battery to the electric motor, are captured through surface electrodes. The amplitude of the EMG signal is generally proportional to the contraction of the residual muscle. After amplification and transmission, the myoelectric control system activates the electric motor to operate the terminal device. Surface electrodes can be affected by donning, or by surface conditions such as perspiration. As well, during the journey from the muscle to the skin‘s surface, EMG signals may encounter noise and interference from other tissues. One option to increase signal control is needle/implant electrodes inserted into active muscle fibres. However, this approach is not immune to many technical issues and introduces its own pros and cons. More information about implantable electrodes can be found elsewhere. The motion of the wrist and terminal device are controlled by myoelectric sensors located either at a single site (muscle) or dual sites. Switching between the two different modes (wrist or terminal device) is usually directed by proportional control (fast or slow muscle contraction) or simultaneous control (muscle co-contraction). In proportional control, the power of the muscle determines the speed or force of the prosthetic device. Advanced sockets (integrating sensors and metal connections within silicone) and elastomeric liners have helped improve EMG signal acquisition. The incorporation of programmable microprocessors in myoelectric prostheses increases the adjustment range for EMG signal characteristics and the modification of prosthetic control parameters. Using microprocessors, EMG signals are filtered and a real-time signal analysis is provided. Microprocessors also accommodate pattern recognition-based control, which increases functionality of the prosthesis with higher involvement/input of the user and, in return, decreases the cost and time involved during initial fitting.

One major advantage of myoelectric prostheses appears to be its greater range of motion established during functional movement. For example, it executes both opening and closing of the terminal device voluntarily (not exclusively one or the other). Unlike that of a body-powered prosthesis, a myoelectric prosthesis does not require significant body movements or extra space to complete a hand movement. As well, it is not required to be situated in front of an object to manipulate it. Under the control of small electric motors, a myoelectric hand generally allows better grip and pinch than a body-powered hand. Recent models with programmable microprocessors are able to adjust the force applied and perform multiple functions. They can operate sequential movements of the elbow, wrist and terminal device. Myoelectric prostheses carry rechargeable batteries and do not need accompanying cables or harnesses to operate, thus their appearance is more acceptable.

2. Literature Survey

Katsutoshi Kuribayashi et al. [1] proposed that electromyographic and shape memory alloy is used to control upper limb prosthesis using neural network. They composed of two processes. First rectifying and integrating EMG signal. Second neural network processes. Compared to EMG signal SMA is used due to light weight and compact. Finally SMA prosthesis which has three degree of freedom was designed.

Francesco Tenore et al. [2] proposed that EMG based upper limb prosthesis was designed. The individual finger and hand movement cannot be controlled by two degree of freedom. So they moved to three degree of freedom control. EMG electrodes with 32 surfaces were placed on the forearm to control individual movement of fingers. Using the time domain with neural network, 12 individuated flexion and extension movements of the fingers can be done with accuracy greater than 98 percentages.

Francesco V. G. Tenore et al. [3] proposed that to control the movement of the individuated fingers using electromyography. First to control the large number of degree of freedom is necessary, preferably using non-invasive signals. With single degree of freedom hook-based configuration, the individual each finger flexion and extension movement is achieved with the accuracy greater than 90 percentages.

Johnny L. G. Nielsen et al. [4] proposed that novel method associated with surface electromyogram and record information from one upper limb to force produced by the contralateral limb. They recorded along with isometric forces in multiple degrees of freedom from the right wrist. This method requires only the measured forces from one limb and simultaneous control of multiple degrees of freedom in myoelectric prostheses

R. Brent Gillespie et al. [5] proposed a method that a novel form of sensory feedback and novel control paradigms is used. Here, the motorized elbow brace to feed back grasp forces is used in the form of extension torques about the elbow. The EMG signal is drawn from biceps muscles. It will work well in four different conditions with and without force display, using biceps myoelectric signals ipsilateral and contralateral to the force display, and it is used to correctly identify objects. This significantly increased with sensory feedback. It is implemented in 7 able-bodied persons and the result obtained is successful.

Fathia H. A. Salem et al. [6] proposed a method in prosthesis hand. There are two types in prosthesis hand. They are passive hand and mechanical hand. The author considers the case of amputation below the elbow with two movements i.e. opening and closing the hand. They perform two tasks. Developing the operation of the body-powered prosthetic hand by controlling it and the surface electromyography signal through dsPIC30f4013 processor and a servo motor and software based on fuzzy logic concept is implemented in patient. The result obtained is successful.

Lauren H. Smith et al [7] proposed that the relationship between the classification error , controller delay and real time controllability. The upper-limb prosthesis using pattern recognition of electromyogram (EMG) signals was designed. Here the classification error was decreased with longer window length. With the help of target achievement control the real time controllability is evaluated. So based on the classification error the window length must be increased or decreased.

J. Carpaneto et al. [8] proposed that the electromyography signal is used for hand prosthesis. EMG based control is done by pattern recognition in the central nervous system and the use of electrodes implanted into muscles or peripheral nerves. By vector machine algorithm, different grip types and grasp movements using EMG activity of distal and proximal upper limb muscles is predicted. This experiment is implemented in three able-bodied.

Sarthak Jain et al. [9] proposed that the upper limb prosthesis is controlled using novel adaptive myoelectric decoding algorithm.this algorithm is designed for slow and fast changes that occur in myoelectric signals. The collected myoelectric data from an able bodied user for 4 ½ hours and the user performed repetitions of eight wrist movements. The advantage of using this algorithm is lower decay rate and produce high accuracy.

Netta Gurari et al. [10] proposed that the adaptive feedback is used for foot, arm and finger tip. This enables the user to interact with environment. Using a telemanipulation system that emulates an ideal prosthesis, able-bodied subjects tapped on materials of varying stiffness while vibration signals were recorded using an accelerometer. This vibrating feedback work well in foot of the tip than in upper limb.

Ryait et al. [11] proposed that the developments in the area of myoelectric prostheses. The article consists of three parts, the first explaining EMG signal properties, the second on mathematical models to analyze EMG signals, and the third describing different artificial hand designs which use EMG signals. Citing papers from conferences of the Institute of Electrical and Electronics Engineers, they point out recent experimental advances in myoelectric prostheses. The authors conclude that for a well-designed physical device, ―The ideal requirements are material for mechanical structure having mechanical strength, flexibility and weight like bone, the controller having computational capability, speed and adaptability like brain, actuator having high torque and flexibility like muscles, and the feedback elements having sensing capability like skin. They underline that for EMG signals to be used for a multifunction prosthesis, correlation between physiological and physical factors and the EMG signal has to be drawn.

Jones et al. [12] proposed that epidemiological features of upper limb amputations, changes in surgical management, cerebral function following amputation, immediate rehabilitation after amputation, prosthetic options, suspension and harnessing systems, prosthetic training, and long-term management issues. In their ‗prosthetic options' section, the authors emphasize that the team and the amputee should decide on the prosthesis together, taking into account factors such as: level of amputation, phantom/stump pain, viable muscle sites (for myoelectric control), patient's life style, cosmetic requirements, social and financial situation, comorbidities, and expectations of the family and friends. The authors explain prosthesis types including passive, mechanical, and electrical terminal devices. Myoelectrical hooks are defined as having stronger grip strength, a higher speed and less weight compared to myoelectrical hands.

Millstein et al. [13] proposed that when stating the positive association between return-to-work and prosthetic use, distal level of amputation, and availability of vocational services. They also refer to the Roeschlein et al. which relate return-to-work with successful prosthetic rehabilitation, fewer complicating factors, higher education level, and being employed at the time of amputation. In general, distal amputations lead to higher utilization of upper limb prostheses. Some studies found higher utilization with loss of dominant hand and older age. The authors point out that almost all of the studies on upper limb prosthetic use have small sample sizes (20-60) and have prosthetic usage rates between 35-81%. One broad statement that the authors agreed on was, ―Acceptance or rejection of a prosthesis is a complex mixture of psychological and technical factors.

Datta et al. [14] proposed a method that upper limb prosthesis using myoelectric signals. First, a general overview of upper limb prostheses is presented. This includes the history of the development of various prostheses, suspension and socket designs, power types (body-powered/externally-powered prostheses), methods of control (manual, voluntary, myoelectric, etc.), terminal devices (passive, active), and feedback mechanisms (sensory (visual/auditory), somatosensory (tactile), and proprioceptive (position). Then author describes myolelectric prostheses in detail. A list of available devices is presented. Patient acceptance is explained with regards to four aspects: 1) comfort and fit; 2) static and dynamic appearances; 3) function, efficiency, and effort; and 4) reliability.

Godfrey S et al. [15] proposed that the upper limb prostheses with properties of four types of terminal devices (voluntary opening split hooks, voluntary closing grip prehensile devices, myoelectric devices and aesthetic hands). And also the author compares upper limb prosthetic devices with the intact human hand and ranks them according to certain characteristics, including prehension capacity, active control, and control of gripping pressure, innate feedback, size, and weight. The importance of a full assessment of the amputee including general physical condition, injuries, age, occupation, type and level of amputation, and psychological factors, is emphasized. The author favours amputee involvement in the prosthesis decision and recommends that the financial capacity of the amputee and various insurance regulations differing across the country should be taken into account. The relationship between early prosthesis fitting and return-to-work is emphasized. Unilateral below-elbow amputees are considered to have the highest potential to accept prostheses. Good self-concept, limb/body condition, and family and workplace support are important factors in prosthetic acceptance. Return to work is mostly determined by the pre-injury occupation.

3. Market Survey

In the United States, about 1.7 million people live with limb loss and approximately 185,000 amputation-related hospital discharges occur annually. Although trauma-related amputations are decreasing compared to disease-related amputations (the annual incidence rate in the US of trauma-related amputations dropped from 11.37 to 5.86 between 1988 and 1996), they still constitute the majority of upper limb amputations. Usually, young, active, and economically productive people are affected by traumatic amputations. Upper limb traumatic amputations occur twice as frequently as traumatic amputations of lower limbs. In 1984, major upper limb amputations (excluding thumb and fingers) made up 15% of all acquired major limb amputations in the United States. Acquired upper limb loss was more common in males between the ages of 15-45 and for 75% of these cases the cause was trauma. Dillingham et al. studied nationally representative hospital discharge data from 1988-1996 in the United States. About 70% of all upper limb amputations were trauma-related and most were below the elbow. In Denmark, upper limb amputations were 3% of all amputations and 74% were trauma-related, generally occurring in unskilled or skilled industrial jobs, and in traffic accidents. In 1986, in the UK, upper limb amputees were about 17% of the total amputee population. In New South Wales, Australia, major upper limb amputations accounted for 5-6 % of all major amputations in the period 1991-1994, and the rate of trauma-related amputations amongst all major upper limb amputations increased from 49% to 57%, from 1991 to 1993. A descriptive study from England reported arm amputations due to accidents to be double the number compared to disease-related ones (in the 1958-1988 period), and the majority of them occurred in industrial accidents. In a survey of Australian upper limb amputees, 31% of 70 respondents were transradial and 10% were through-wrist amputees. In an urban area in Finland, in 1984-1985, the rate of major upper limb amputations, which required prosthetic application, was 0.3 per 100,000 persons per year. Bhaskaranand et al. studied upper limb amputees fitted with prostheses in India. Sixty-six percent were below-elbow amputees. rural or urban areas) influence the prosthetic choice. For example, a study by LeBlanc comparing prosthetic use in different countries shows the effect of cultural and psychosocial factors along with functional needs on prosthetic choices. According to this study, 72% of upper limb prosthesis users in the US preferred hooks as a terminal device; whereas in three European countries this percentage was lower, varying between 12-30%.

There is an average of 18,496 upper extremity amputations every year, compared to 113,702 of the lower extremity. Of those, only 1900 are above the wrist Among upper-limb amputees, typically fewer than half wear prosthetic arms. lower-extremity patients outnumber upper-extremity patients 30:1. This small population means that most prosthetists do not get much experience in upper-limb patient care. However, there are other causes of amputation. Approximately 8,900 children receive amputations each year due to lawn mower accidents. Birth defects result in a lifelong need for prosthetic devices. About 6,000 of these are upper extremity amputees in a given year. Walter Reed Army Medical Center is treating about 1,000 military amputees. The Veterans Administration has 40,000 amputees currently receiving services in the VA healthcare system. In western developed countries the rate of amputations of lower limbs is 17.1 amputations per 100,000 inhabitants

4. Market Trends

In last decade of the 20th century and the first years of the new millennium has been a period of rapid technological advances in lower limb prostheses. Paradoxically, this has occurred concurrently with an estimated reduction in funding for amputee care of 20% compared to prior decades. Despite these technological improvements in components and materials, aggregating studies from Europe and the United States suggest that overall amputee satisfaction with the prosthesis has remained relatively constant, varying between 70-75% of those polled. Pending decreases in academic research in prosthetics have forced commercial component manufacturer to divert profits into increased product research and development to fill the void in academic research. The accuracy of that prediction was borne out during the 1990s when published research from universities and government research organization dropped dramatically. In the past fifteen years, virtually all applied research has come from the commercial sector, e.g. new suspension options, innovative socket configurations, advances in knee mechanisms, and guidelines for prescription and reimbursement of prostheses. The recent global economic down-turn has exasperated the rate of commercial R&D for limb prosthetics innovation. All markets have been hit hard. Third party payers are more restrictive. Money for start-up prosthetic device companies has all but dried up. However, because of the Iraq and Afghanistan, U.S. Department of Defense budgets have been increased by tens of millions of dollars to finance limb prosthetic innovation. Increased understanding of the biomechanics of locomotion combined with clinical experimentation has led to a steady evolution in lower limb prosthetics, especially in the area of socket design. In general, today’s sockets emphasize diffuse rather than localized weight bearing, to reduce peak pressures and hopefully increase amputee comfort.

5. Technology Involved

- Brain-computer interface
- Brain-machine interface
- Myoelectric prosthesis
- Bionics
- Biomechatronics

5.1. Brain-Computer Interface

It has been suggested that Brain-Computer Interfaces (BCI) may one day be suitable for controlling a neuroprosthesis. For closed-loop operation of BCI, a tactile feedback channel that is compatible with neuroprosthetic applications is desired. Operation of an EEG-based BCI using only vibrotactile feedback, a commonly used method to convey haptic senses of contact and pressure, is demonstrated with a high level of accuracy.

5.1.1. Advantages

- High time resolution
- Cheaper
- portable

5.1.2. Disadvantages

- Low spatial resolution
- Still not user friendly

5.1.3. User Interface

- Mind machine interface

5.2. Brain-Machine Interface

A paralyzed individual who has lost an upper limb would presently use a mechanically powered or myoelectrically controlled prosthetic limb. Control strategy based on body movement or muscle signals is quite unnatural and provides only very limited degrees of freedom to control these advanced prosthetic limbs. Hence, the interest in futuristic brain machine interface, wherein the prosthetic limb would be directly actuated and controlled by the brain signals

5.2.1. Advantage

- Accuracy

5.2.2. Disadvantage

- Difficult in designing

5.2.3. User Interface

- Neural interface

5.3. Myoelectric Prostheses

Myoelectric control of prosthesis or other system utilizes the electrical action potential of the residual limb’s muscles that are emitted during muscular contractions. These emissions are measurable on the skin surface at a microvolt level. The emissions are picked up by electrodes and are amplified for use as control signals to the functional elements of the prosthesis. The myoelectric emissions are used only for control. Because the electrical signals are not powerful enough to operate the electric motors in the prosthesis, a rechargeable 6-volt battery, which is accommodated in a socket in the prosthesis, is used to operate the motors which, in turn, produce the movements of the prosthesis.

Three Categories of Upper-limb Prosthetics used in myoelectric prostheses are

There are three major categories of upper-limb prosthetics: (1) cosmetic, (2) body powered and (3) myoelectrically controlled self-powered prostheses.

5.3.1. Advantages And Disadvantages Of Myoelectrically Controlled Prosthetics

The below-elbow myoelectric system is well suited for amputees such as salespersons, students, business people and professionals who are engaged in light work. The myoelectric unit is not usually recommended for patients involved in heavy work such as farming or construction. These users, however, may find the myoelectric unit appropriate as a secondary prosthesis.

The myoelectric system is more cosmetic than the conventional body-powered prosthesis. The cosmetic benefits make the myoelectric prosthesis the overwhelming choice of our female patients. Without the harness control of the body-powered prosthesis, the myoelectric controlled hand provides a greater range of motion, particularly when overhead motions are involved.

The biggest single drawback to myoelectrically controlled prostheses is their high cost. The myoelectric prosthesis is often triple the cost of the ordinary, body-powered device and it will require more care and maintenance than the body-powered hook prosthesis. Despite the high price tag of the system, with proper documentation to justify the device, many insurance companies cover the expense.

5.3.2. User Interface

- LabVIEW with graphical user interface

5.4. Bionic

Bionics is a term which refers to the flow of concepts from biology to engineering and vice versa. in medicine, bionics means the replacement or enhancement of organs or other body parts by mechanical versions. Bionic implants differ from mere prostheses by mimicking the original function very closely, or even surpassing it. Touch bionic launched the first commercially available bionic hand, named "i-Limb Hand". According to the firm, by May 2010 it has been fitted to more than 1,200 patients worldwide. New technologies have transformed artificial limbs into robotic arms and robotic hands, bionic arms and bionic hands, sports prostheses, work-out prostheses and electric fingers.

5.4.1. Advantages

- Lower Initial Cost
- Lighter
- Easier to repair
- Offer better tension feedback to the body

5.4.2. Disadvantages

- Mechanical appearance
- Difficult to use for some people because they depend on the user’s physical ability

5.4.3. User Interface

- DARPA's (Defense Advanced Research Projects Agency) Reliable Neural-Interface Technology (RE-NET) program aims to improve the speed and reliability of neural interfaces. Such interfaces can happen in the brain, as in the case of Hemmes, or someplace else farther down the line, closer to the missing limb, as in the case of TMR (Targeted Muscle Reinnervation).

5.5. Biomechatronics

Biomechatronics is a sub-discipline of mechatronics. It is related to develop mechatronics systems which assist or restore to human body. A biomechatronic system has four units: Biosensors, Mechanical Sensors, Controller, and Actuator. Biosensors detect intentions of human using biological reactions coming from nervous or muscle system. The controller acts as a translator between biological and electronic systems, and also monitors the movements of the biomechatronic device. Mechanical sensors measure information about the biomechatronic device and relay to the biosensor or controller. The actuator is an artificial muscle (robot mechanism) that produces force or movement to aid or replace native human body function. Typical usage area of biomechatonics is orthotics, prosthesis, exoskeletal and rehabilitation robots, neuroprosthesis. In this chapter, rehabilitation robots will be discussed in terms of bio-mechatronics systems. Some important reasons for the utilization of robots in rehabilitation are

- Robots easily fulfill the requirements of cyclic movements in rehabilitation;
- Robots have better control over introduced forces;
- They can accurately reproduce required forces in repetitive exercises;
- Robots can be more precise regarding required therapy conditions.

5.5.1. Advantages

- simplified mechanical design
- rapid machine setup
- rapid development trials
- adaptation possibilities
- optimized performance, productivity, reliability

5.5.2. Disadvantages

- increased power requirements
- real-time calculations/mathematical models

5.5.3. User Interface

- biomechatronic hand with multi-FSRs (Force Sensitive Resistor) interface

6. Cost

Upper-extremity amputees can buy a non-functional cosmetic hand for $3,000 to $5,000 that "just fills a sleeve”. It allows getting by in public without being noticed. $10,000 will buy a transradial upper-extremity prosthesis that is a functional "split hook" device for below-the-elbow amputees. Cosmetically realistic myoelectric hands that open and close may cost $20,000 to $30,000 or more. These contain processors that tell how much pressure the amputee putting on a held object and whether it is hot or cold. A neuroprosthetic arm may cost as much as $100,000. Yearly third party health insurance caps on prosthetic services range from $500 to $ 3000 and lifetime restrictions range from $10,000 to one prosthetic device during a person's lifetime.

7. Proposed Methodology

There are different methods which have been employed in the past in order to develop a lost hand which could be replaced by a prosthetic hand which helps them in assisting as well as in doing the works which they could have been done using the normal hand . The problem arises in controlling when a powered upper limb prosthesis it is important not only to know how to move the device, but also to know when not to move. And other problem is that the Current state of the upper limb myoelectric prostheses is limited in their joint movements. Most of the multifunction prostheses use a mechanical switch to control individual degrees of freedom sequentially. This process usually allows for control of 2 degrees of freedom and more mentally burdensome systems are often abandoned by patients. Other challenge involved is choosing a muscle activity for recording EMG. Muscle near the surface of the skin and may involve the contribution of more than one muscle because of EMG cross talk. When multiple EMG sites are used muscle co-activation (which is present in most upper-limb articulations) adds another layer of complexity. Co-activation complicates the task of resolving the intended force about a joint.

Our proposed system helps in overcoming the limitation which has been specified above. In this we make use of the joints in shoulder and an upper arm which can help in the joint angles corresponding to the elbow movements such as extension and flexion and also which would help in assisting the forearm in the movements of pronation and supination. These two movements thus help's in the simultaneous control of both degrees of freedom. This overcomes the use of many electrodes and stimulus which help in providing the individual input to assisting the particular finger. As we pick up the multiple signals from different area of forearm and shoulder there would be multiple noise as we take the impulse from the surface area and crosstalk as mentioned above. Therefore methods to eliminate or to reduce the effect of noises have been one of the most important problems. Power line interference or instability of electrode skin contact can be removed using typical filtering procedures but the interference of white Gaussian noise is difficult to remove using previous procedures.

The Use of Wavelet algorithms an advance signal processing method which could been used in the removal of white Gaussian noise.

8. Conclusion

Thus the proposed system helps the people in the joint angles corresponding to the elbow movements such as extension and flexion and also which would help in assisting the forearm in the movements of pronation and supination. The cost is less when compared to other system of approach.

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