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Project : EMG simulation

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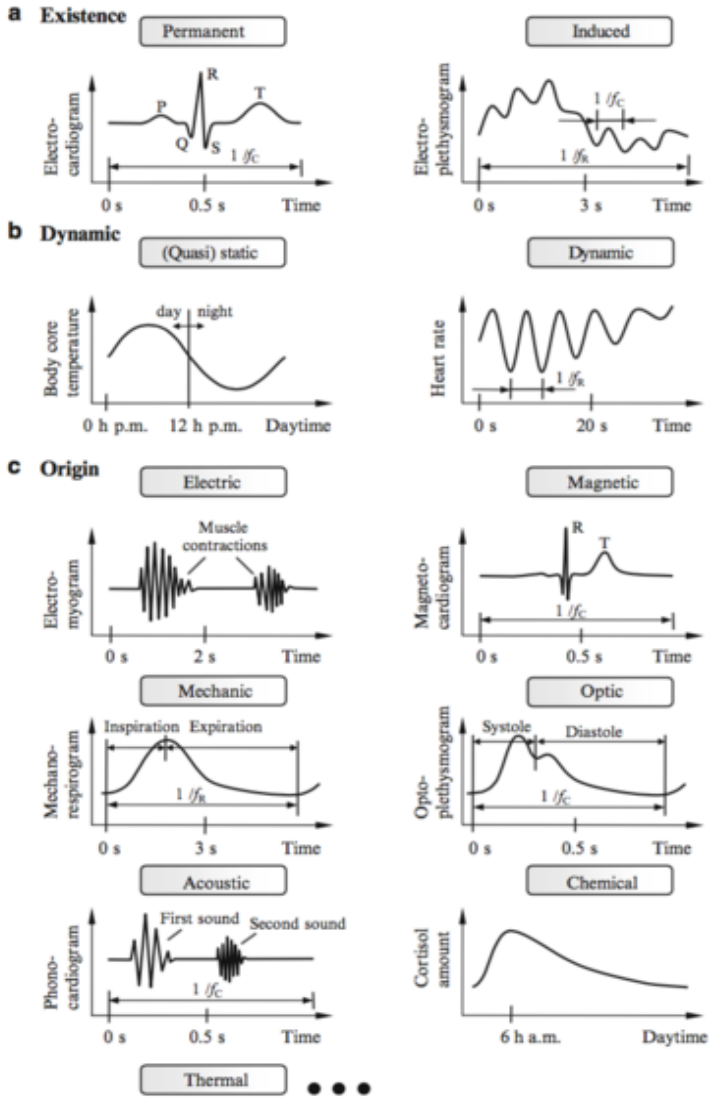
Biosignals

- Biosignals are any signal in living beings that can be measured and moitored.

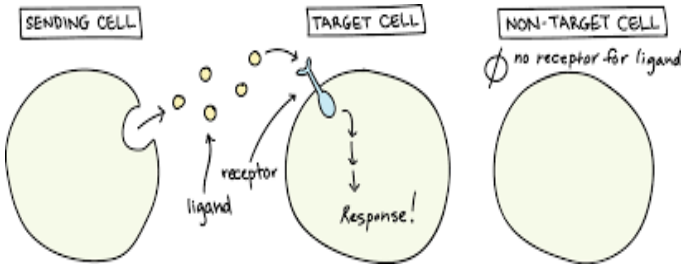
- Biosignals are electrical and non electrical .

- The electrical biosignalsrefers to change in the electric current produced from electric potential diffrence in human body.

- Eamples of electric signals (electroencephalogram(EEG) , electromyogram(EMG) , electrocardiogram(ECG) , electrooculogram(EOG) and others).

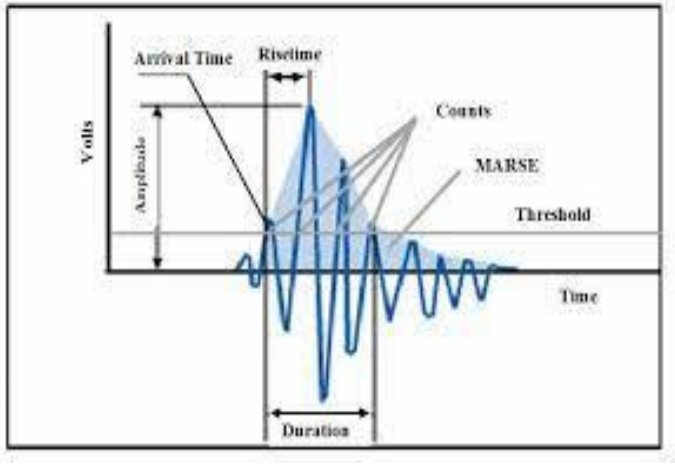


Biosignals



The nonelectric signals

- Mechanical signals (mechanomyogram (MMG).
- Acoustic signals (photic and non photic utterances).
- Chemical signals (PH, oxygenation).
- Optical signals (movements). The nonelectric signals



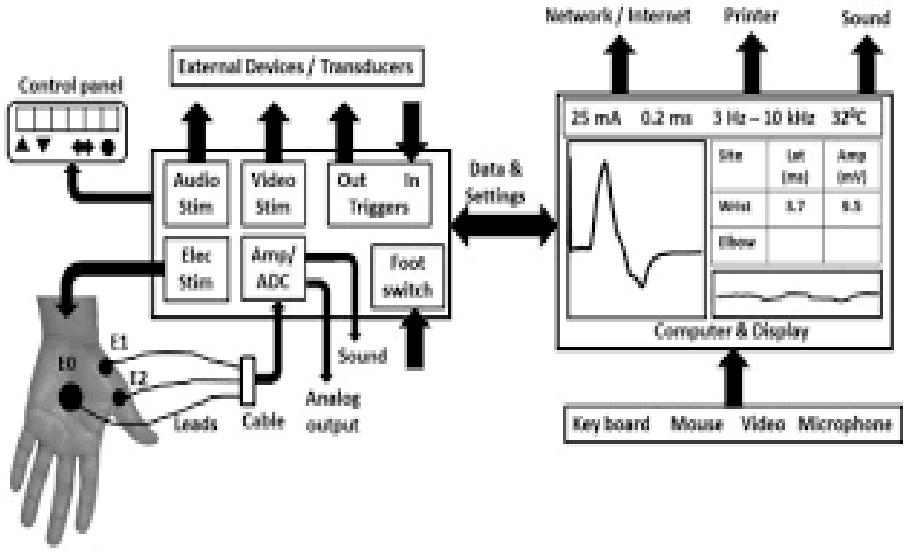
Elctromyography(EMG)

EMG measures muscle response or the electric activity in response to a nerve simulation of the muscle.

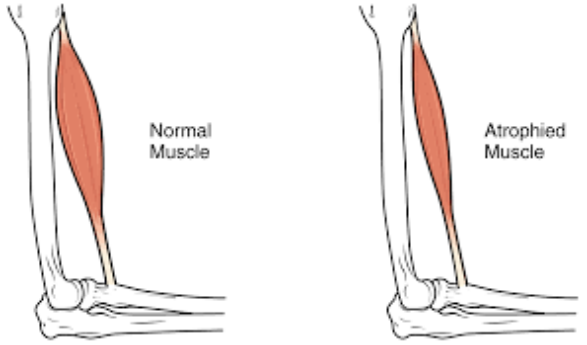
During the test one or more needles (electrode) are inserted through the skin into the muscle.

The output displayed on an oscilloscope (monitor) that display the electric activity as a wave.

EMG measures the electric activity of muscle during rest ,sligth contraction and forcefull contraction .



The importance of EMG and NCS



EMG signals have various applications in different fields like muscular disorder, ergonomics, prosthesis control.

Also EMG appears the diseases that affect the connection between the nerve and the muscle.
Examples of the muscle disorder (muscular dystrophy , polymyositis).

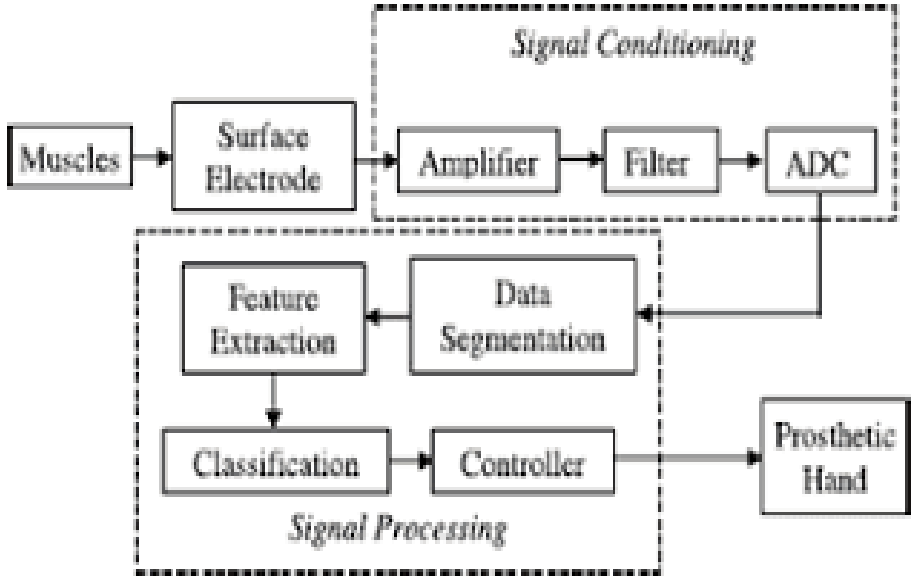
The disorder of the nerve outside spinal cord (carpal tunnel syndrome or peripheral neuropathies).

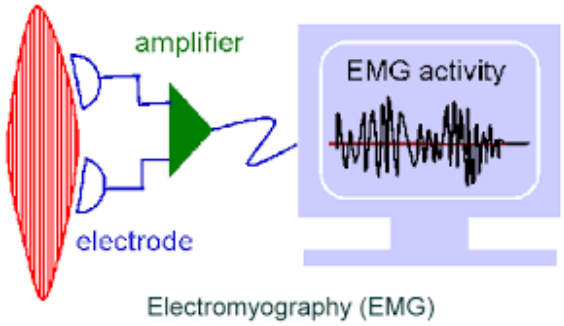
Calibration of EMG

In the calibration process we need a simulator device to simulate the electric signal from the muscle.

There are many process in electromyograph after measuring the signal as removing noise , get the signal amplified ,using filters , and the processing of the signal (software).

In this project we will make the simulation part of the signal.



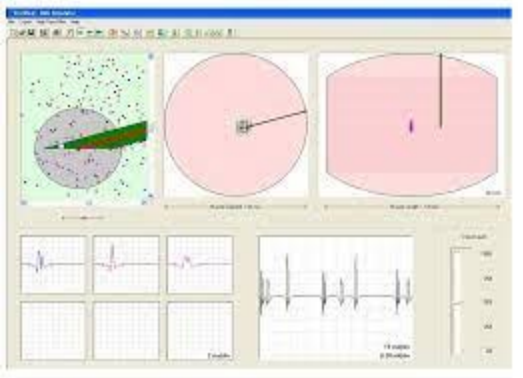


Real simulator device

EMG Simulator is a professional education and research tool. The MUP is generated as the sum of individual muscle fibre action potentials in the motor unit.
The contribution from each muscle fibre is calculated on the basis of up to date knowledge from literature. Operation: the position of motor unit fibres are generated randomly by the software.

A number of fiber parameters (diameter, jitter) motor unit parameters (number of fibres, position of individual fibres, end-plate localization, number of motor units, firing threshold for motor units and recording parameters (type of electrode, position of the electrode in the muscles) can be changed optionally by the user.

Most of the common situations seen in an EMG lab can be simulated.



EMG simulation

In this simulation of the EMG signal I use the labview and the biomedical toolkit with it

In the front panel

I use two graphs the first is EMG simulator graph that shows the simulated signal in terms of amplitude and time. And the second is MNF graph(will talk about it in the next slide).

In the block panel

- From biosignal DAQ and simulation we choose the simulated EMG(that shows the associated in the front panel) and create graph indicator.
- From biomeasurement we choose mean power frequency (that shows the second graph)and create an indicator.
- And we perform all the component in while loop and use wait(ms) function to slow down the simulation.

MNF definition and the rule of calculation

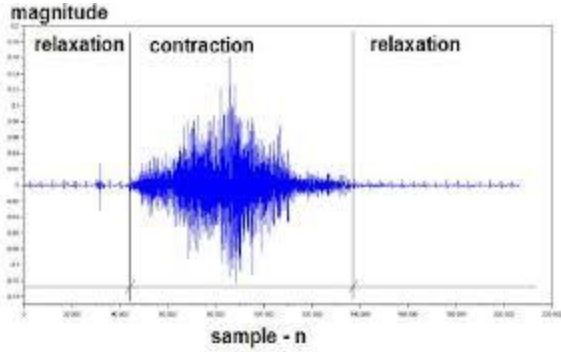
Frequency-domain or spectral-domain features are usually used in the assessing muscle fatigue and analysing MU recruitment.

To transform the EMG signal in the time-domain to the frequency-domain, a Fourier transform of the autocorrelation function of the EMG signal is employed to provide the power spectrum (PS) or the power spectral density (PSD).

MNF is an average frequency which is calculated as the sum of product of the EMG power spectrum and the frequency divided by the total sum of the power spectrum.

The definition of MNF is given by

$$MNF = \sum_{j=1}^{M} F_j P_j \Big/ \sum_{j=1}^{M} P_j$$



The simulation options of EMG signal in lab view

Dialog Box Options

Output options

Output amplitude = 4milli volt
White noise amplitude =0
Power noise amplitude =0
Power frequency=50or60 HZ
Sampling rate =1000 Block size default 3 Timing mode (simulate acquisition timing)

Waveform morphology

Contraction time = 3 sec
Contraction type(that specifies wave form morphology)

The simulation of EMG signal in lab view

Follow Dialog box options

Spectrum settings

Low frequency = 20HZ
High frequency = 300HZ

Spectrum Preview

that displays the ideal spectrum of the simulated EMG signal

Block diagram input

Block size Error in (no error)
Initialize?
Sampling rate
Stop?

Bolck diagram output

EMG
Error out

Refrences

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Computational Intelligence in Electromyograph Analysis – A perspective on Current Applications and Future Challenges
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