

# Introduction to Bio - Signals

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# Overview

- ◆ Introduction to Peripheral Nervous System
- ◆ Generation of surface EMG – A Model based approach
- ◆ Factors affecting the surface EMG
- ◆ Wavelet based feature extraction technique for the classification of the surface EMG.



# Bio - Signals

- ◆ EMG - Electromyogram (Muscle)
- ◆ EEG - Electroencephalogram (Brain)
- ◆ ECG - Electrocardiogram (Heart)
- ◆ EOG - Electrooculogram (Eyes)

# The Peripheral Control System

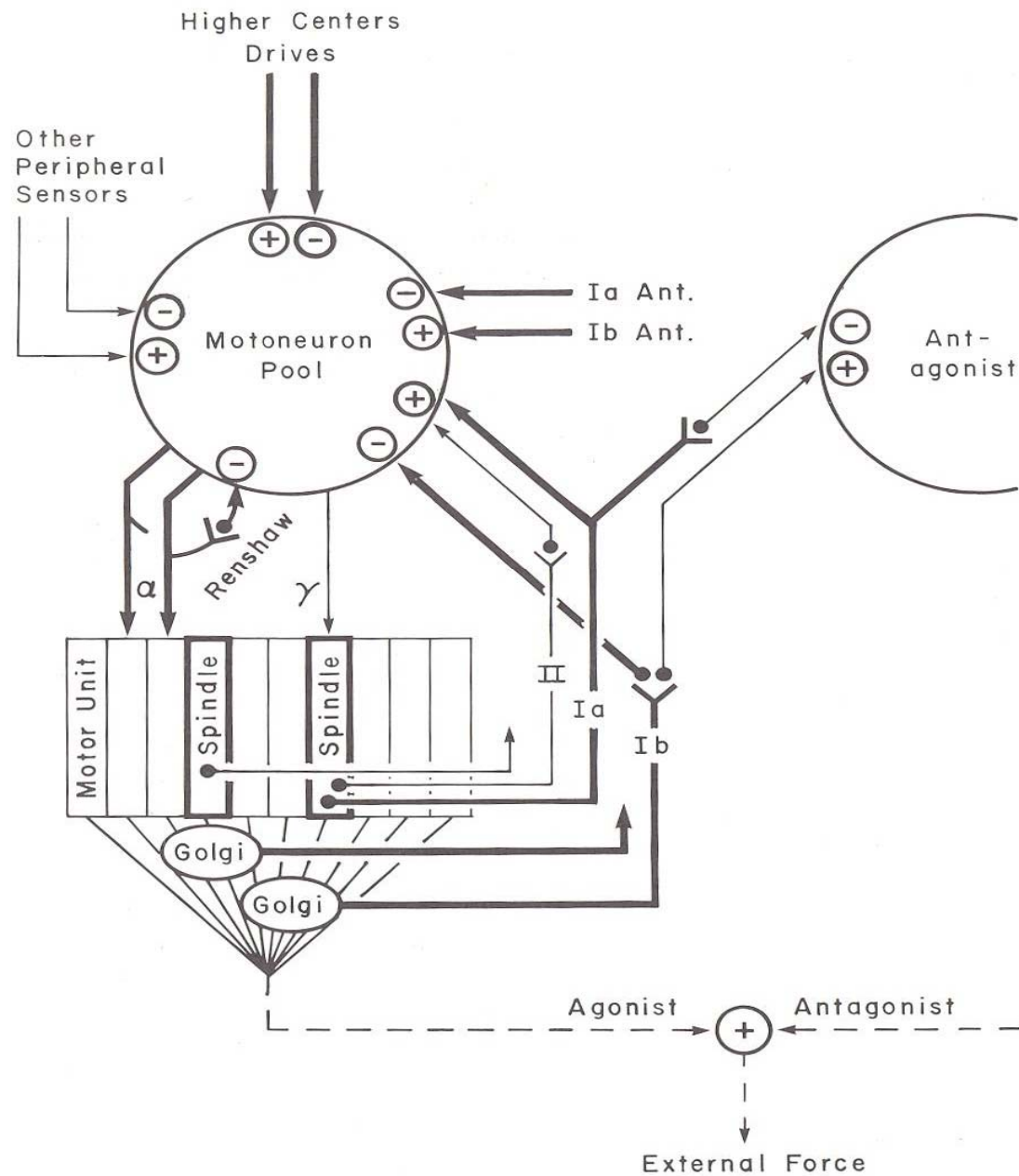


# Constituents of the PNS

- ◆ The Muscle Spindle
  - ◆ Located inside the body of muscle.
  - ◆ Capsule having fusiform shape, attached at both ends of the muscle fibre.
  - ◆ Monitors muscle length and/or change in length (velocity)

## ◆ The Golgi Organ

- ◆ Located in the stiff aponeuroses extending from tendon.
- ◆ Provide no info about muscle length.
- ◆ Sensitive to muscle tension.
- ◆ Innervated by the group of Ib motoneurons
- ◆ Have inhibitory affect on the motoneuron pool.





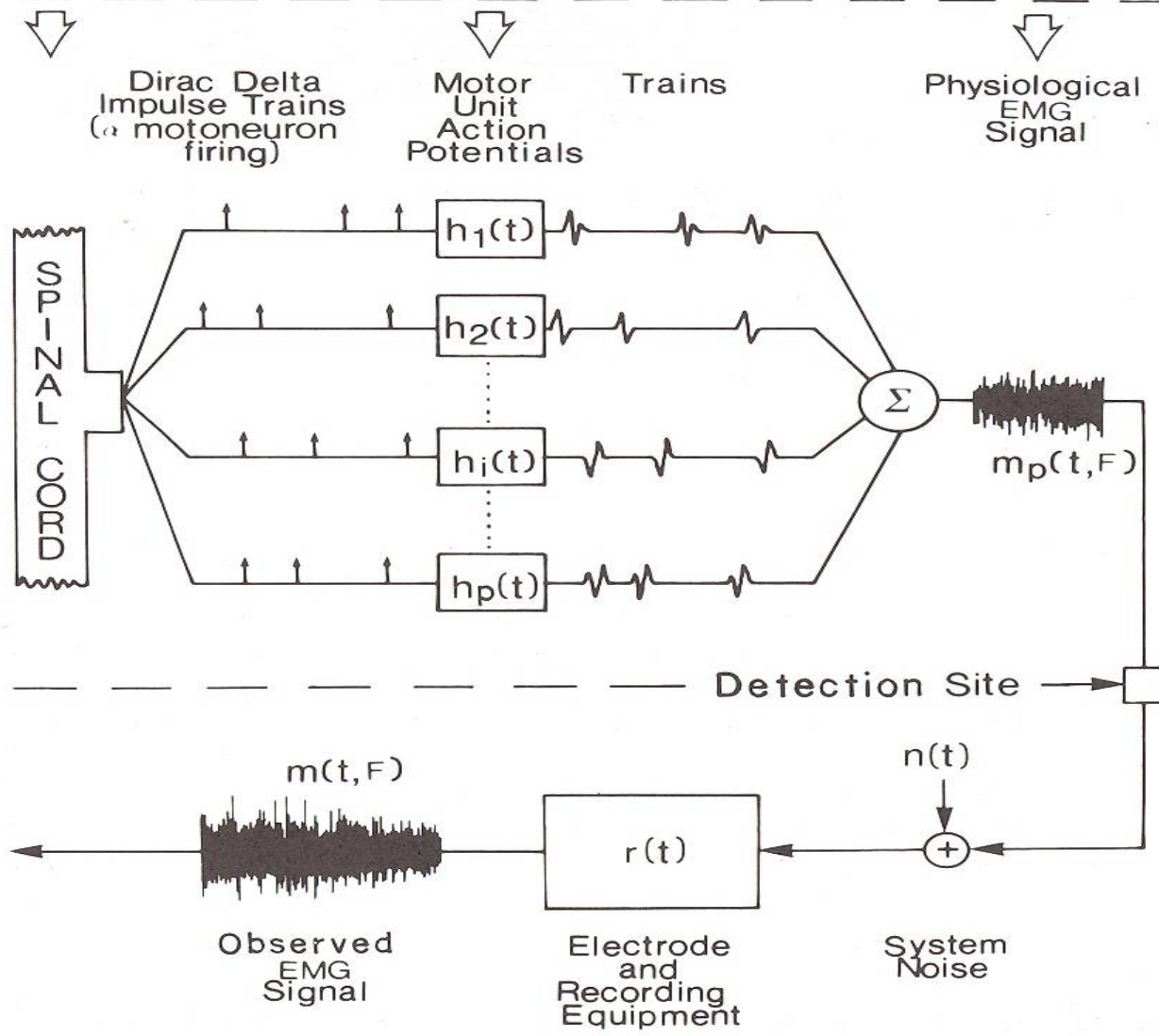
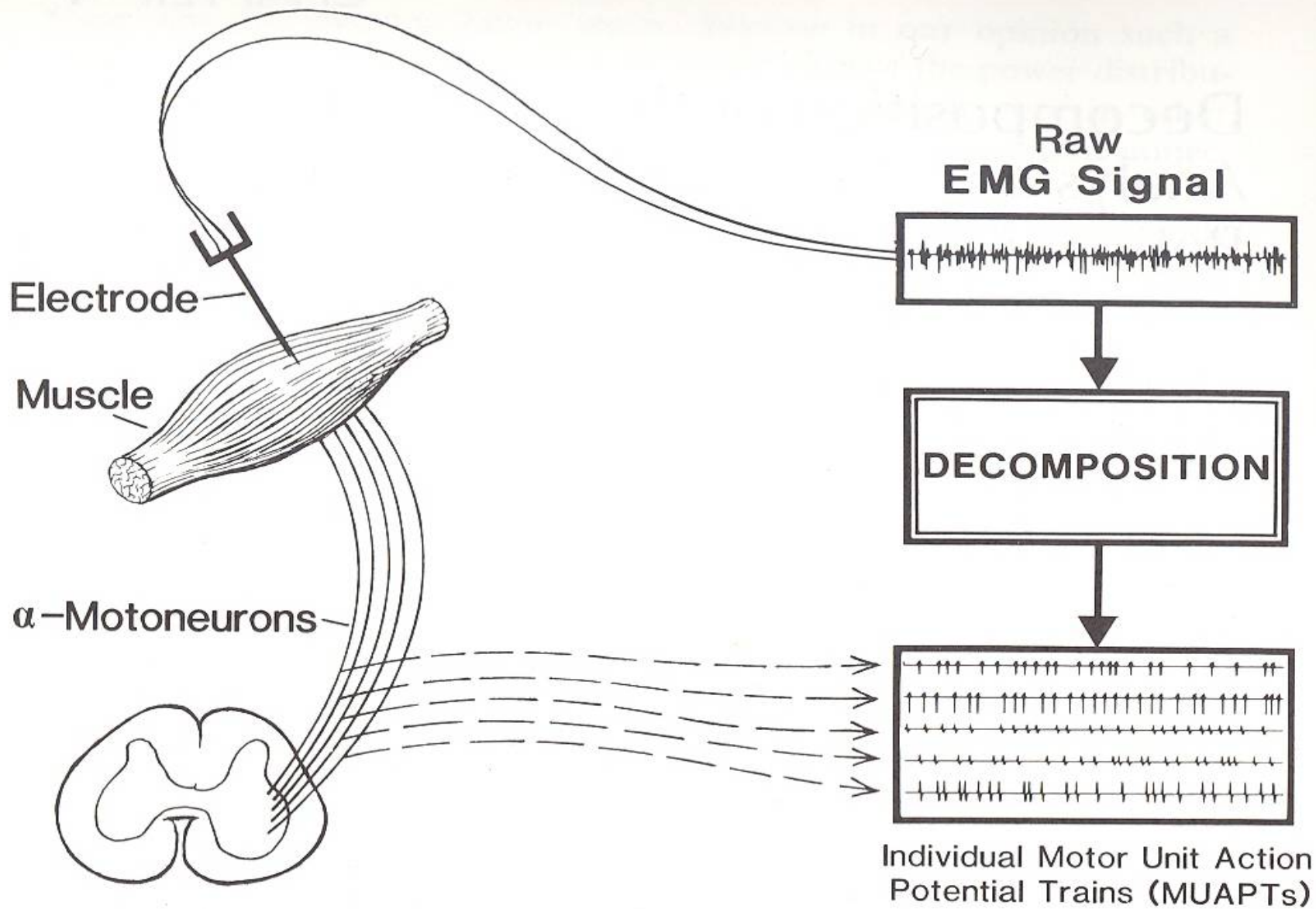


Figure 2-10 Schematic representation of the physiological model for the generation of an EMG signal.

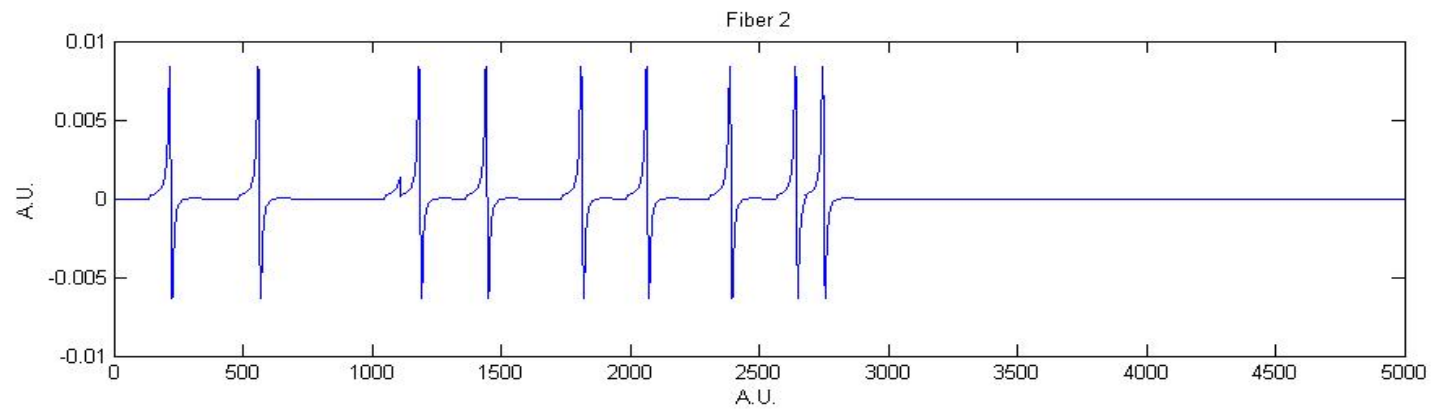
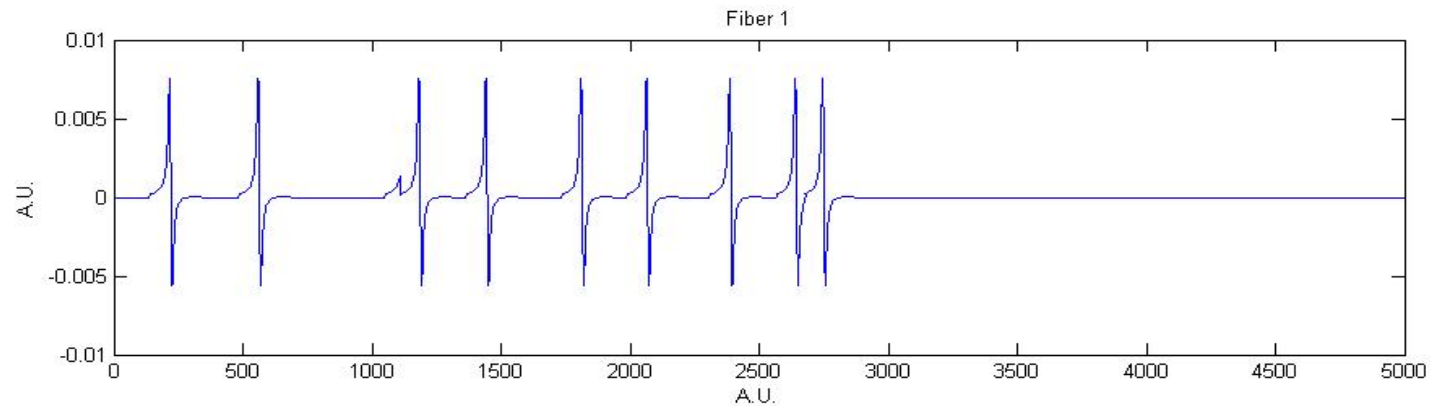


# Generation of surface EMG – A Model based approach



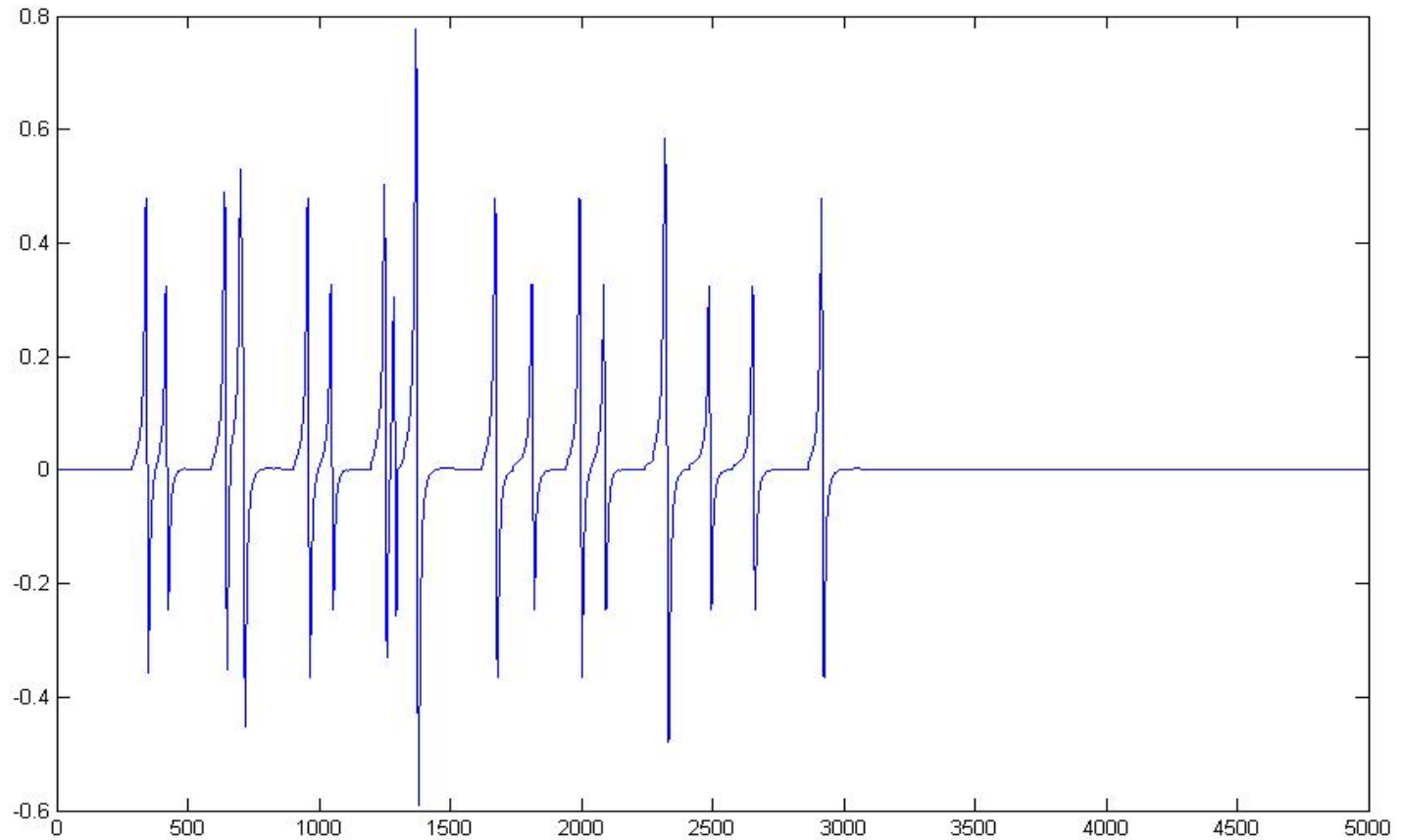
# Synthesized EMG

## Muscle Fibres

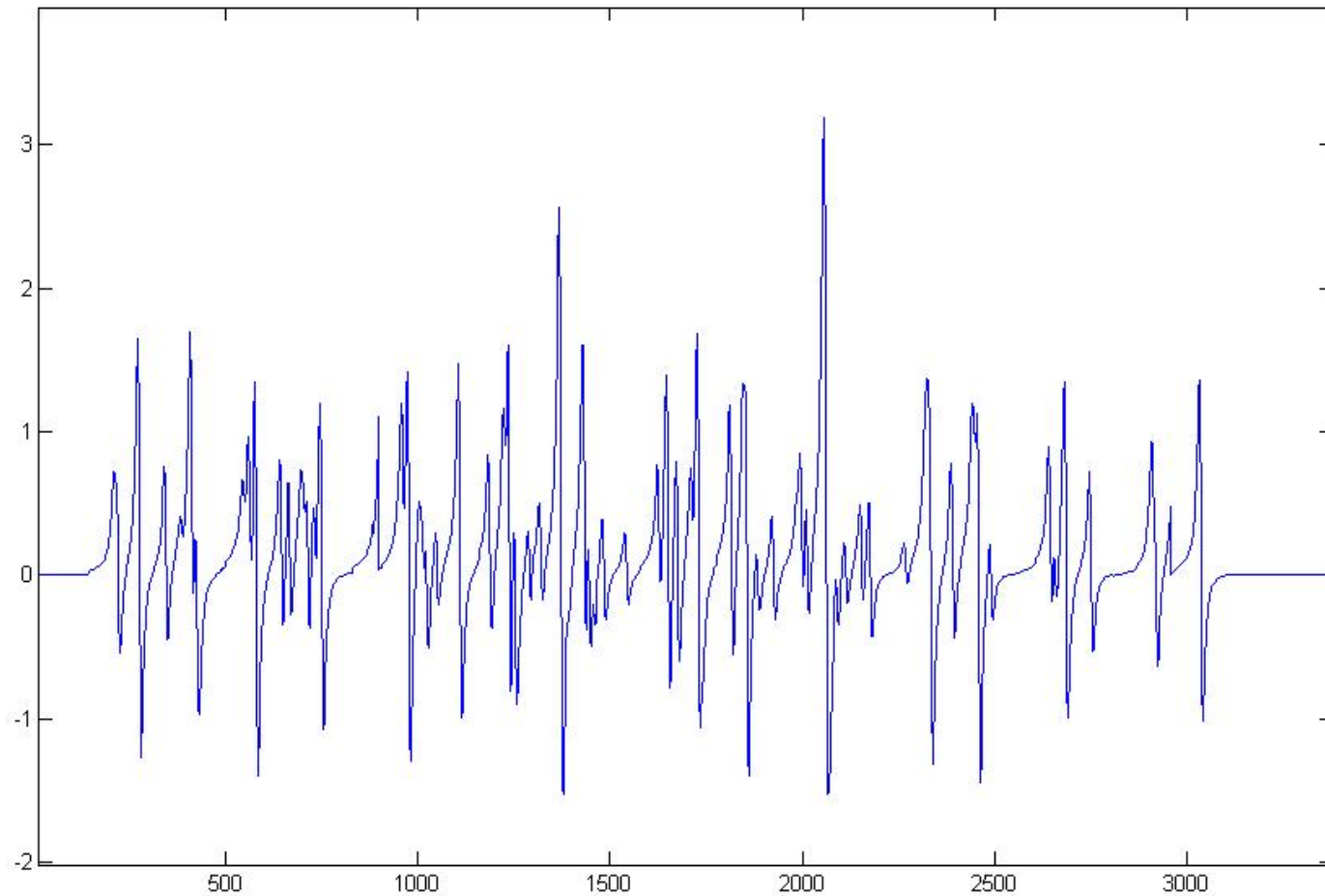




# Motor Unit



# Synthesized Surface EMG



# Factors affecting the surface EMG



- ◆ Surface EMG is a pseudo – random signal and can't be represented mathematically
- ◆ Many factors affect the observed surface EMG, like
  - ◆ Different on different days – even for the same person.
  - ◆ Different for different people – depending upon individual anatomy, thickness of fat tissue etc (Cross talk)
  - ◆ Presence of glands and blood vessels.
  - ◆ Characteristics of the recording equipment.
  - ◆ Positioning of electrodes (exemplified on the next slide)

# Observed difference from different positions



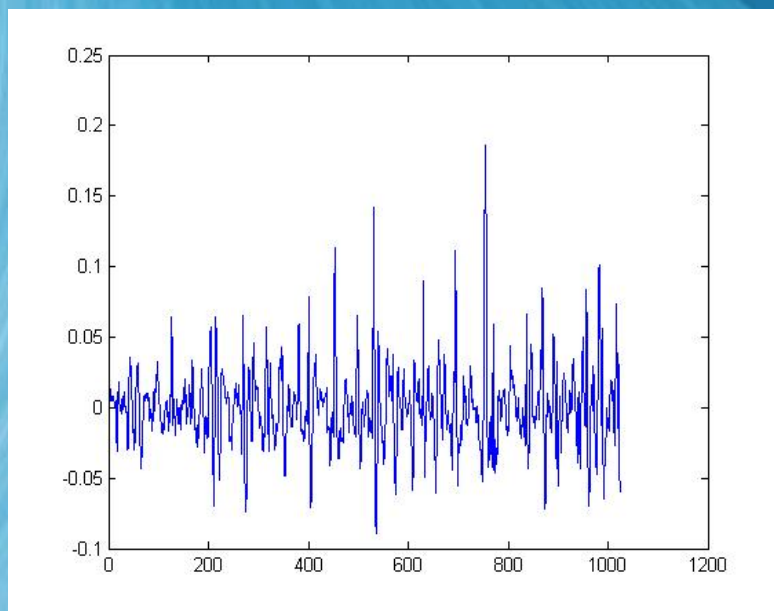
# Wavelet based feature extraction technique for the classification of the Surface EMG



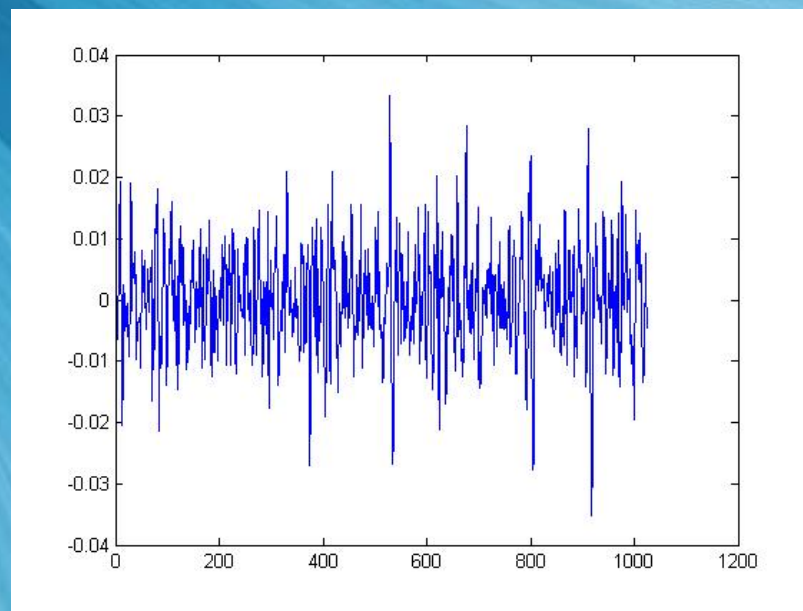
# Four different Movements Investigated

- ◆ Little and Ring Finger flexion
- ◆ Index and Middle Finger flexion
- ◆ All Fingers flexion
- ◆ Wrist Adduction

EMG signal from FCU while Index and middle fingers maintaining isometric contraction at minimal effort level for one second



EMG signal from FCU while wrist adduction and maintaining isometric contraction at minimal effort level for one second



Scatter Plot of the features shows that different motions can be classified.

