# Decomposition of surface EMG signals from cyclic dynamic contractions

*File name = Decomposition of surface EMG signals from cyclic dynamic contractions*

Decomposition of EMG into MUAPS

* <https://pubmed.ncbi.nlm.nih.gov/15298438/>

MUAPTs = motor unit action potential trains

* <http://www.bu.edu/nmrc/files/2010/04/002.pdf>
* <https://www.youtube.com/watch?v=vXb0ZvkFkS8&ab_channel=khanacademymedicine>
* <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/motor-unit-potential#:~:text=The%20motor%20unit%20action%20potential,needle%20and%20individual%20muscle%20fibers>.

Spike = short and big change in signal amplitude

Spike trains = sequence of spike

Issue with sEMG decomposition:

* During the contraction of the muscle, the shape and the amplitude of the MUAPs changes (the space between the electrode changes) which has influence on the measure

Not finished

# Detecting the unique representation of motor-unit action potentials in the surface electromyogram

*File name = farina2008.pdf*

Need multi-channel system to identify action potential using surface EMG because of the low-pass filtering induced by the tissues interposed between the fibers and the electrode

Needs to identify single motor unit from sEMG

Uses a grid of 11x11 emg sensor

* 1 Laplacian channel is composed of 5 electrodes (one and its 4 neighbours)
* Channels can be grouped

Test the capacity of selected recording configurations to discriminate the action potentials of single motor units in sEMG recordings

* Relation between # of motor unit identified and # of channels (more channel = more action unit identified)
* Low pass filtering of tissues (skin…) makes the signal almost indistiguishable for sEMG under som conditions (this study aims to find these conditions)

Result : need larger sEMG grid

# The effective neural drive to muscles is the common synaptic input to motor neurons

*File name = farina2014.pdf*

Analyse the transformation of common oscillatory input signals to the pool of motor neurons innervating a muscle, with the aim of explaining the relation between common oscillatory components sent to motor neurons and the motor neuron output

PIF neuron model

Hypotheses that the synaptic input to motor neurons in not distorded in the low-frequency band width.

* Hypothese proved by the study

Mathematical representation of the input of motor neurons

The common input to motor neurons is mirrored in the low-pass bandwidth of the cummed motor neuron outputs, up to frquencies corresponding to the motor neuron sidcharge rates and for a sufficient number of motor neurons

# Man/machine interface based on the discharge timing of spinal neurons after targeted muscle reinnervation

*File name = farina2017.pdf*

TMR = targeted muscle reinnervation

* When someone has a missing limb, deinnerve a remaining muscle and reinnerve it with neurons that used to control the missing muscles. Then, use EMG on the reinnervated muscle to control a prosthesis
* Why not use ENG ?

Decoded motor-neuron discharge timing

* Method for EMG classification
* Almost perfect result (97% classification accuracy), where the classic approach gets 70%

# Characterization of human motor units from surface EMG decomposition

*File name = farina2016.pdf*

BSS = blind source separation

Limited Methods for EMG analysis :

* Spike analysis, fractal theory, high-order power spectral moments

AP = action potential

MUAP = sum of AP of the pool of neurons innervating a muscle

Increasing selectivity spacial filtering

sEMG classification needs method that is not influenced by temporal overlapping of MUAPS

* Because number of overlap in sEMG is so large
* Need BSS methods

CKC decomposition algorithm

* For sEMG classification
* Has been improved for online tracking

Difficult to estimate motor neuron input from their output because they operate non linearly

* However, motor neuron pool is approximately linear
* Spike trains contains 2 components :
  + The component due to the actual input. Separeted into 2
    - Component due to an input signal shared by all motor neurons (common input)
      * -> the only of all those component which is present in all motor neuron output spike trains
      * The only input that generates muscle force
    - Component dur to an input signal independant across motor neurons
  + The component generate by the motor neuron non-linearity

Other method to identify characteristics of common input to a motor neuron pool

* Estimate the coherence function between the cumulative spike trains of groups of motor neurons