Wrocław University of Technology

(EMG CONTROLLED) ARTIFICIAL HAND

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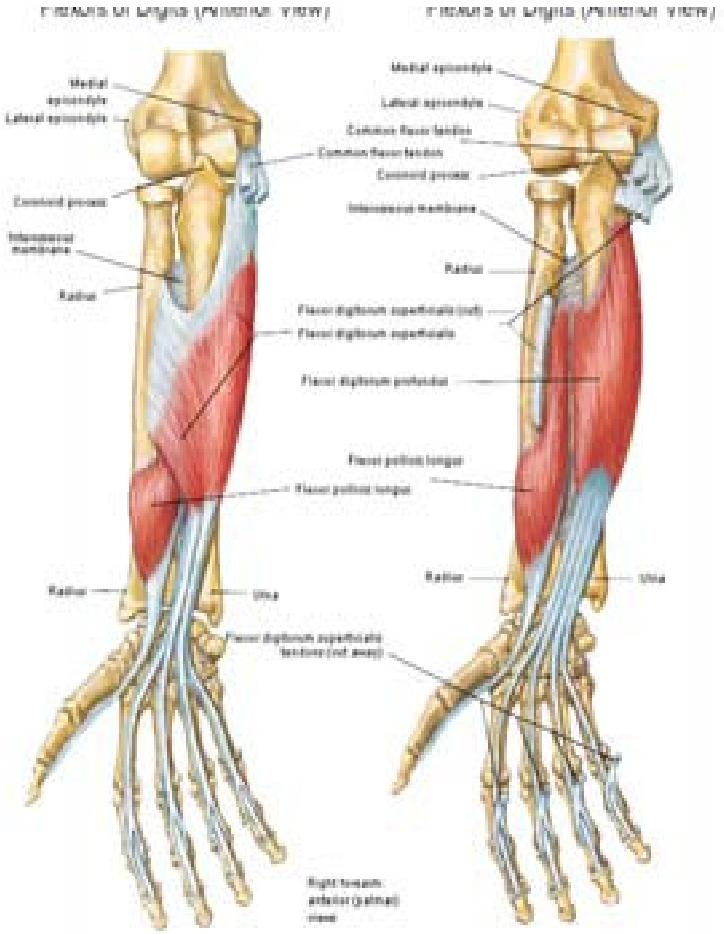
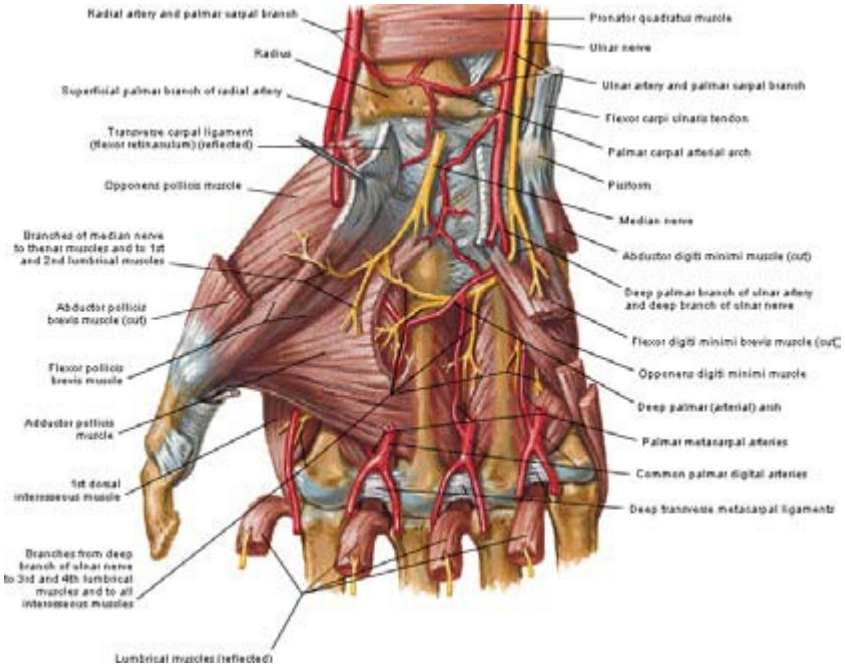
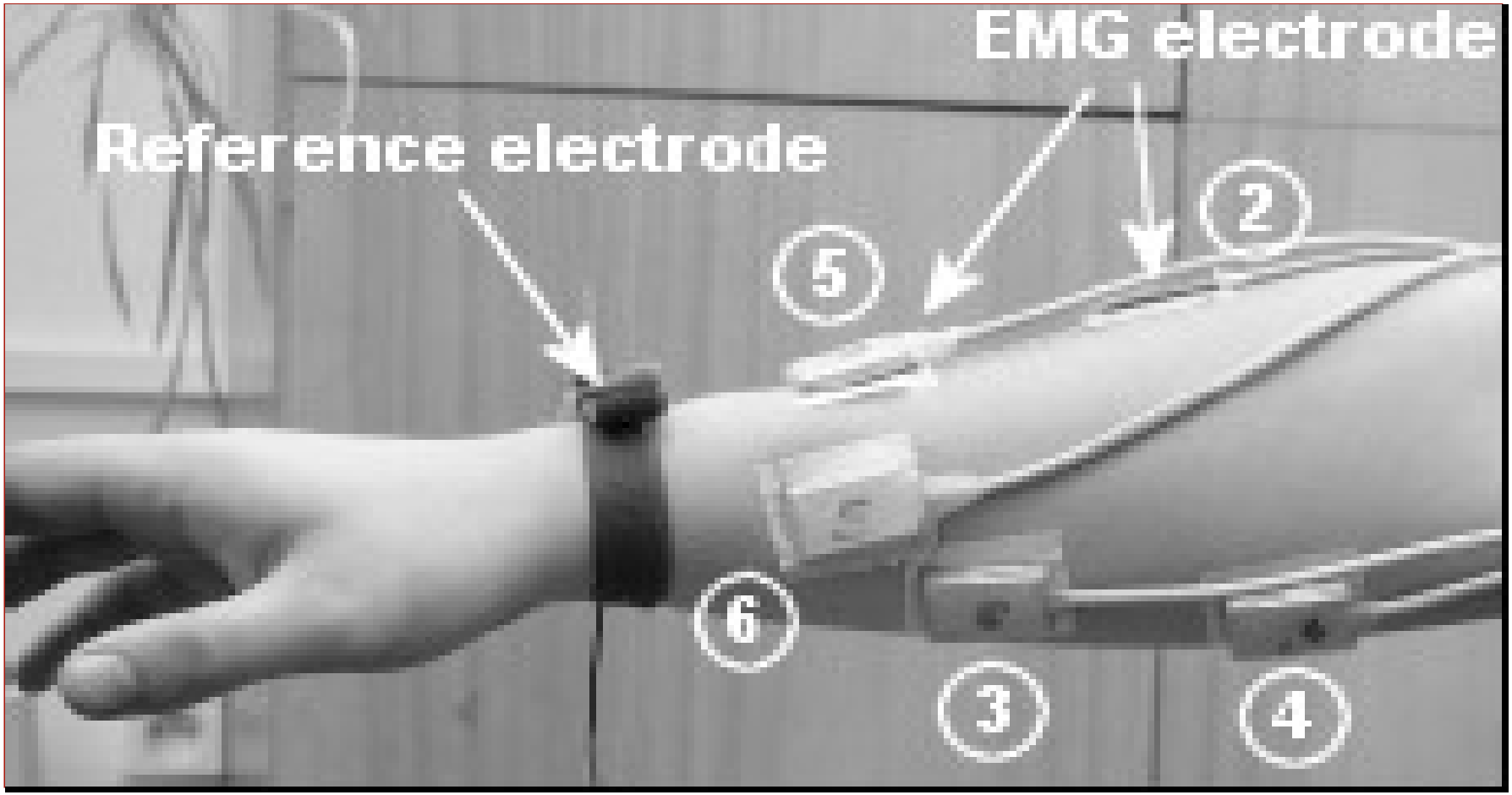
TARGET

To make a prosthesis behaving (more or less) like a real hand ...

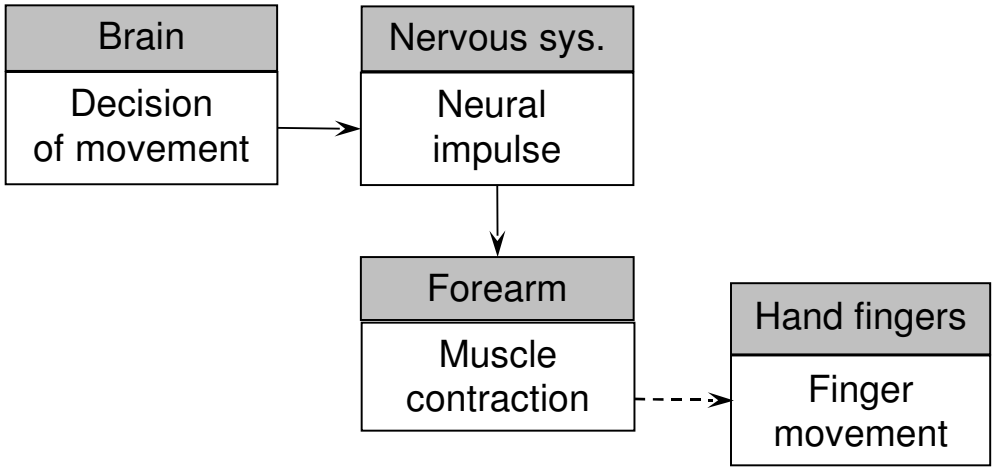




MYOPOTENTIALS (EMG)

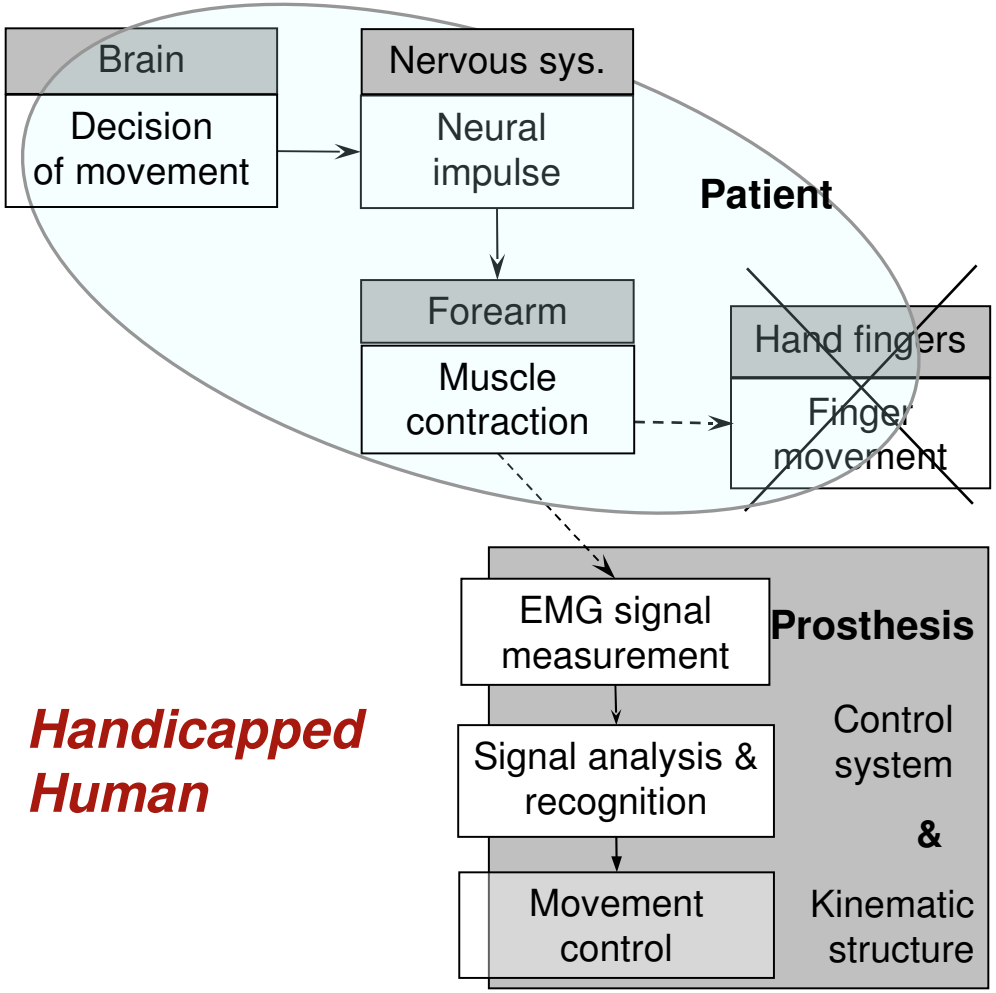


HOW IT WORKS ...



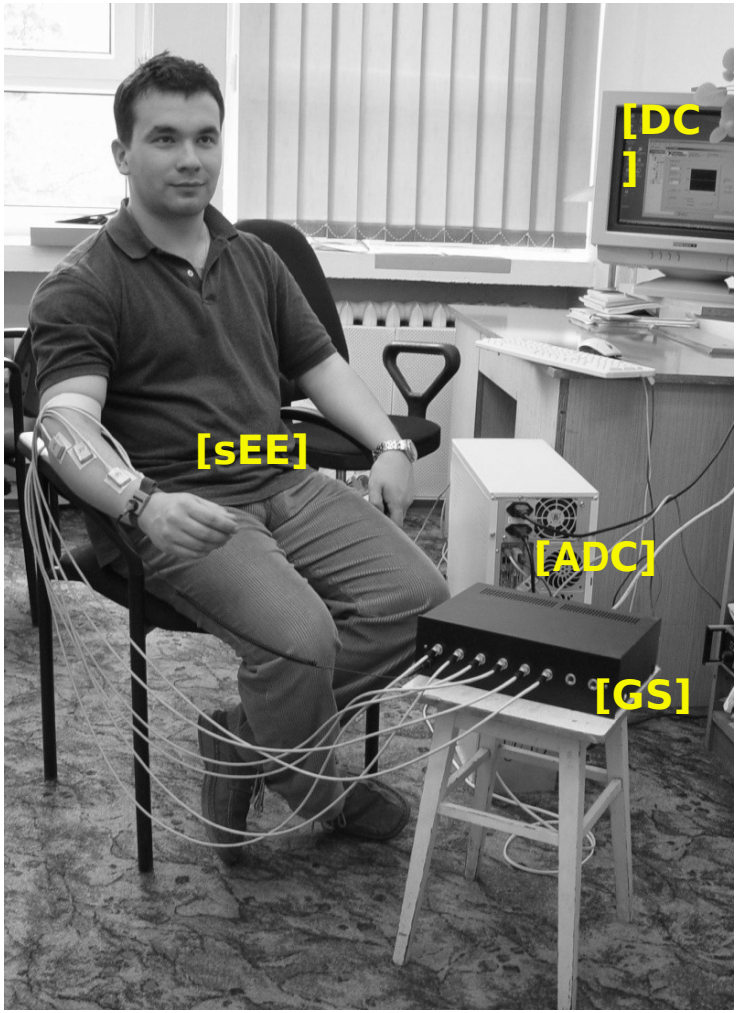
Regular Human

HOW IT WORKS ...



- *ACQUISITION*
- *EXTRACTION*
- *CLASSIFICATION*
- *ACTUATORS CONTROL*
- *MOVE*
- *(FEEDBACK ...)*

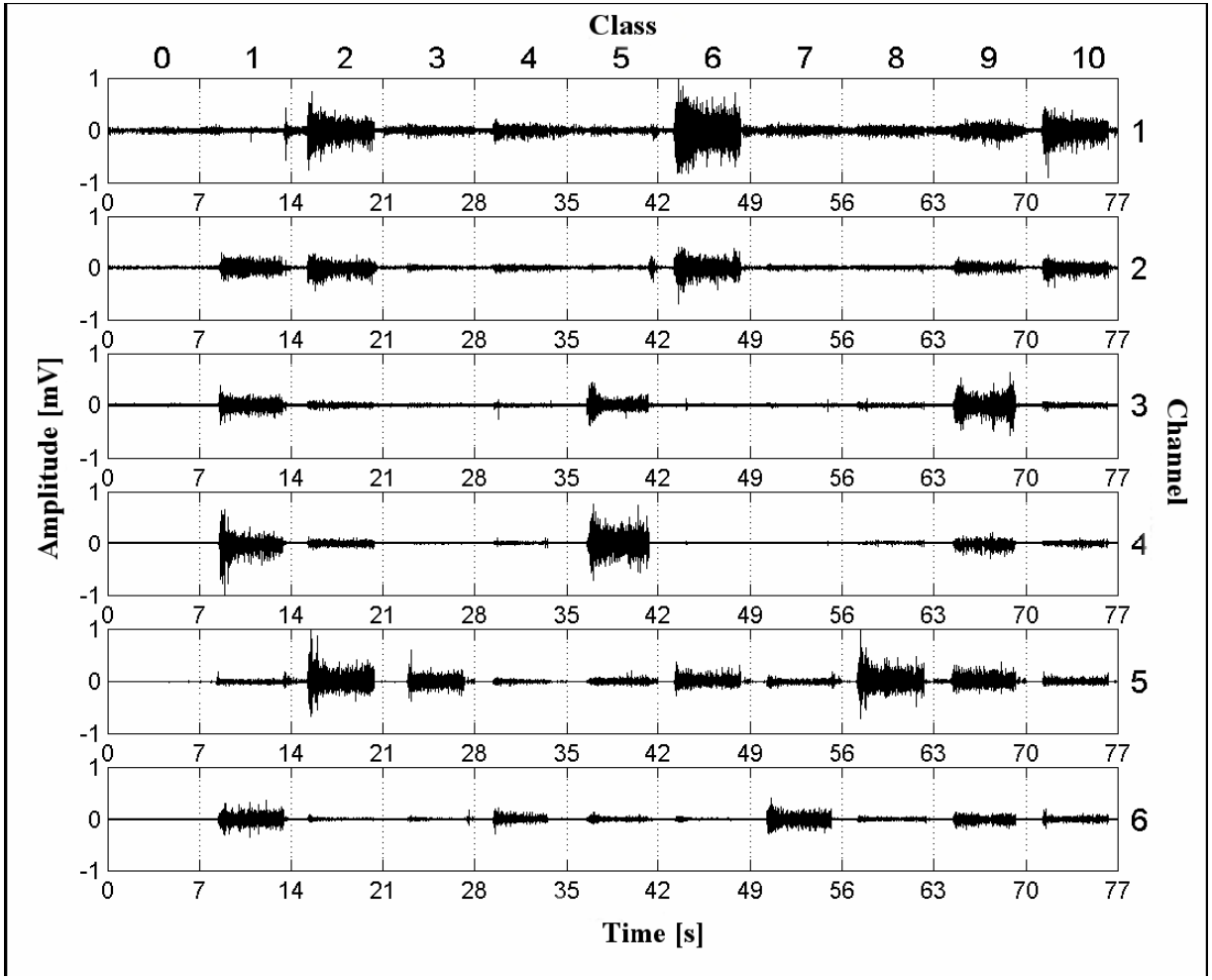
EMG ACQUISITION



- Surface electrode (sEE);
- Galvanic Separator(GS);
- A/D (ADC)
- Digital Camera (DC);

(*or sensoric glove*)

10 KINDS OF HAND MOVE - 10 CLASSES



ALGORITHMS

EMG signal Feature Extraction

- FFT
- Partial DFT
- DWT

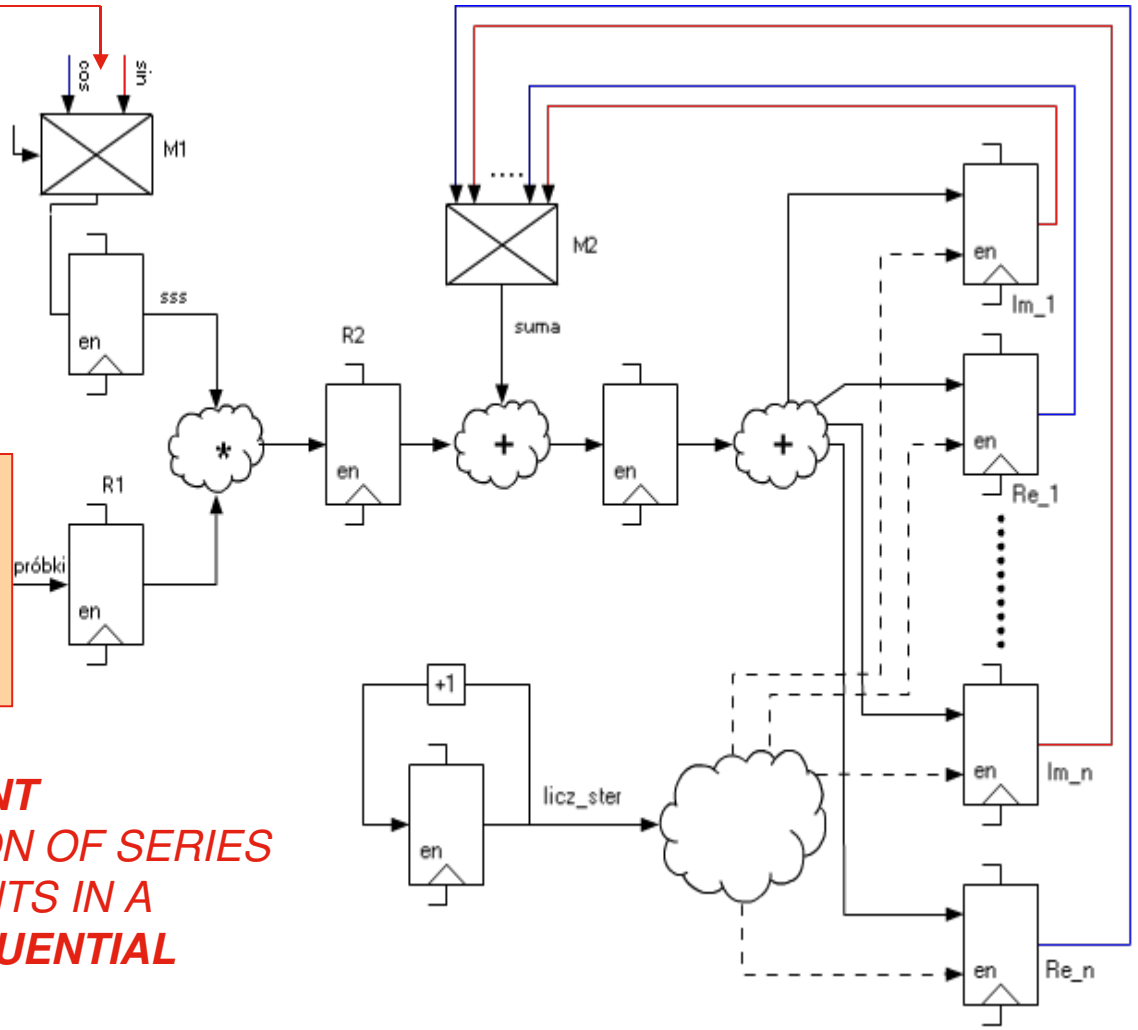
Intention Recognition

- kNN (Nearest Neighbour)
- LVQ (Kohonen Neural Network)

… IMPLEMENTED IN DEDICATED HARDWARE

sin/cos samples 60 MHz

EMG samples 1kHz



CONCURRENT *CALCULATION OF SERIES OF DFT POINTS IN A SINGLE* ***SEQUENTIAL*** *MACHINE*

FPGA IMPLEMENTATION

Parameter	Non-pipelined design	Pipelined design (12 steps)
Flip-flops (33280)	16403 (49%)	19479 (58%)
Look-Up Tables (33280)	27285 (81%)	23154 (69%)
DSP blocks (84)	16 (19%)	16 (19%)
RAM blocks (84)	2 (2%)	2 (2%)
Maximal clock frequency	18.373 MHz	116.292 MHz
Time of calculations	14.94 µs	3.03 µs

256-point FFT

SPARTAN-3A DSP

www.xilinx.com/spartan3adsp

TWO NEURAL NETWORKS

1. ARTIFICIAL

(embedded in a hand)

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2. NATURAL

(human – how to think properly ...)

RESUME

We are strong in

- EMG acquisition
- Intention recognition algorithms
- (and implementation)
- Kinematics

... and not so strong in

- Mechatronics

(i.e. *we need a hand* ;)

THE PLAN, RESULTS, IMPACT

COMBINE

our electrodes, recognition

and control algorithms

with a hand

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1. PROSTHESIS

(our target)

2. REMOTE HAND

(new issue: EMG as an alternative for sensoric glove)