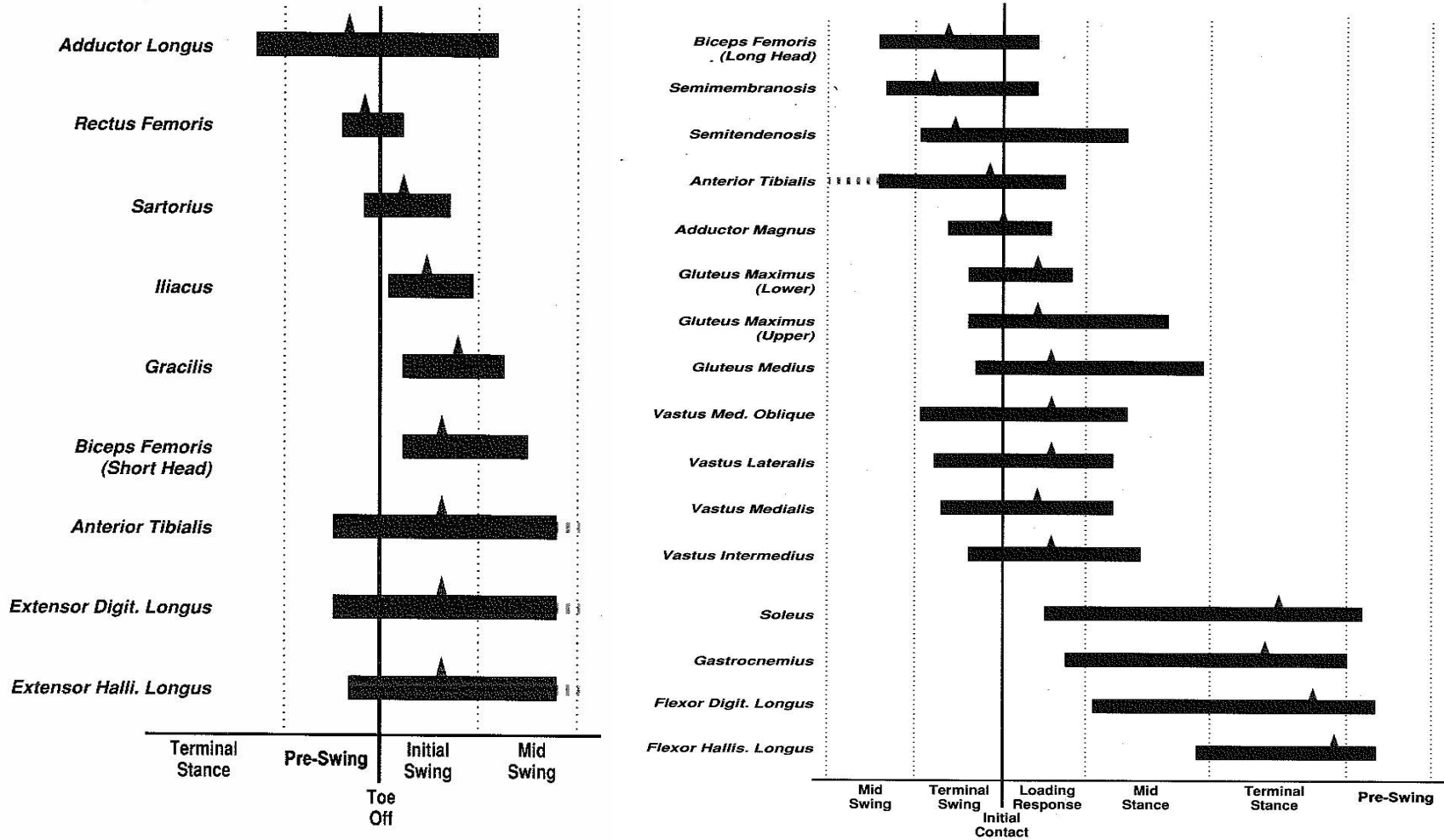


KINEMATICS, KINETICS and EMG

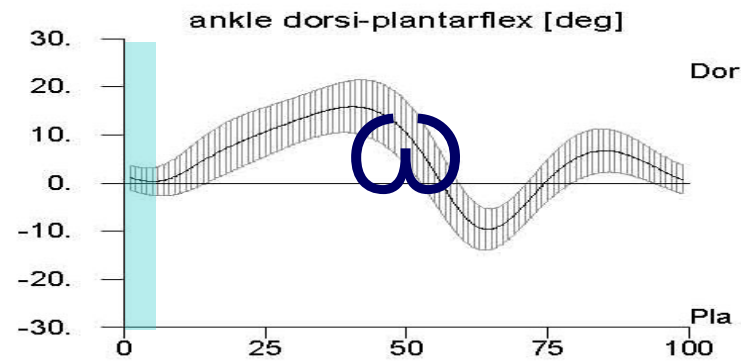
C. Rigoldi



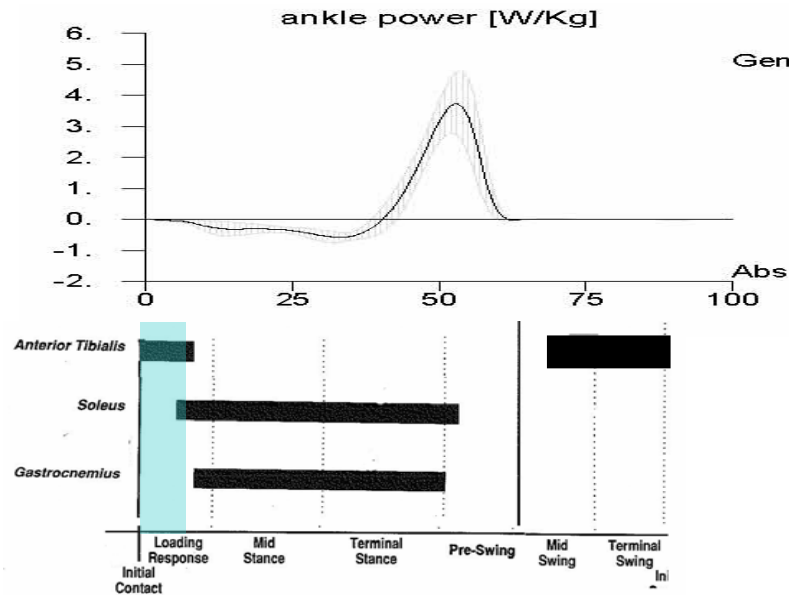
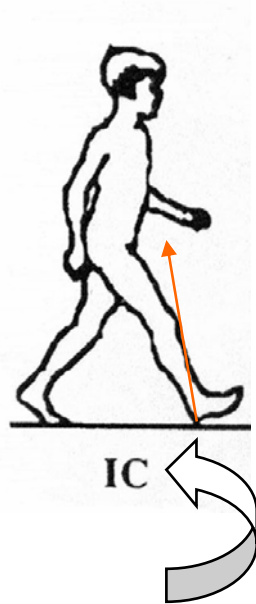
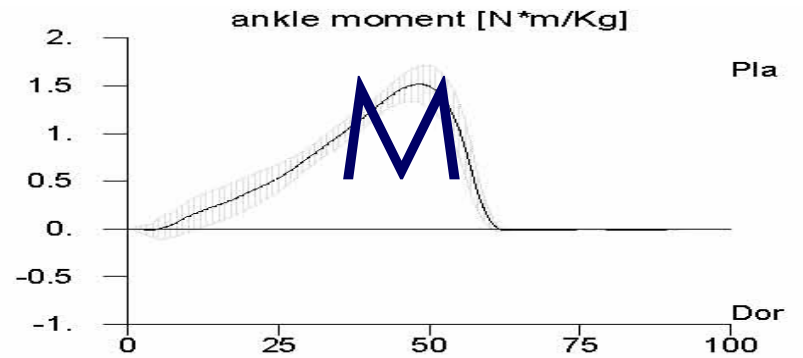
NORMAL WALKING: MUSCLE ACTIVITY



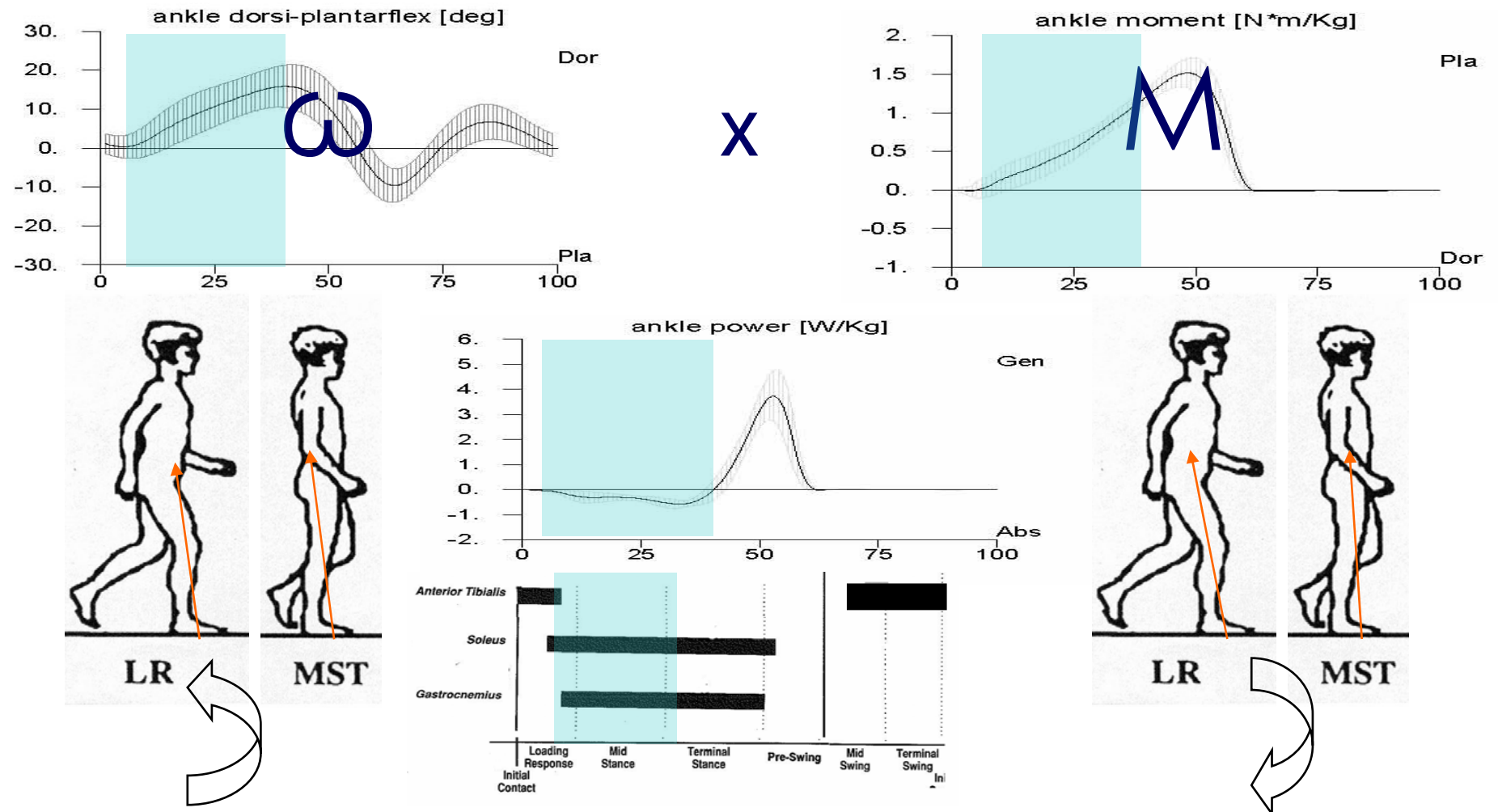
K+K+EMG: TIBIOTARSICA



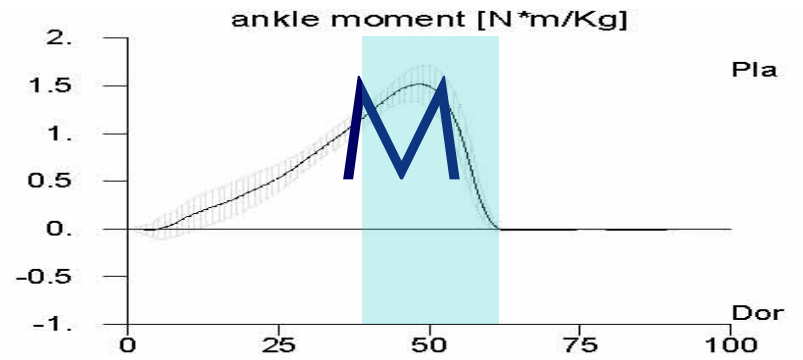
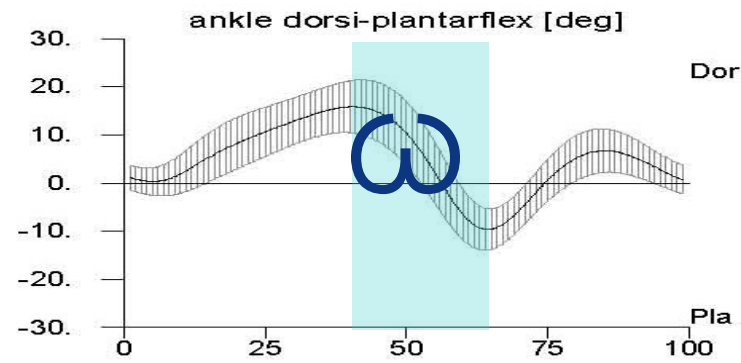
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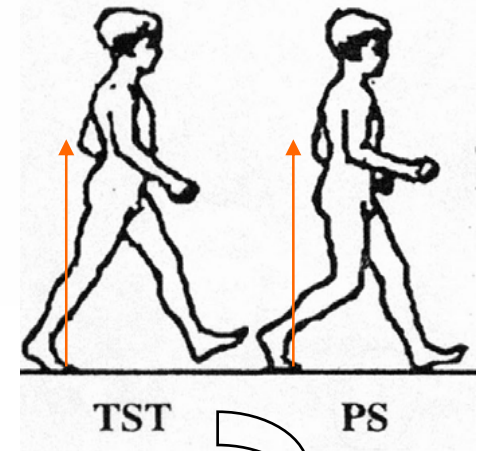
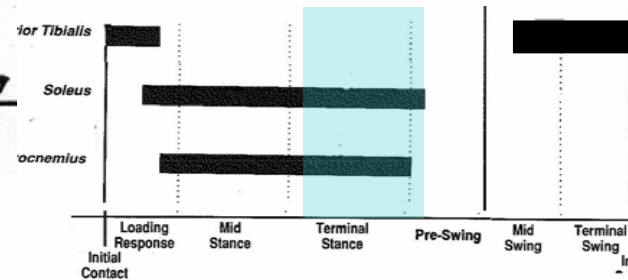
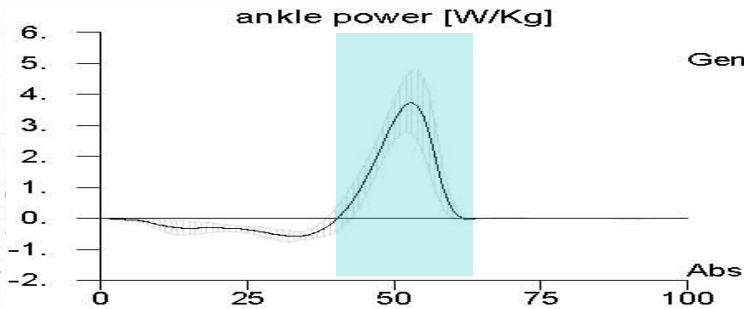
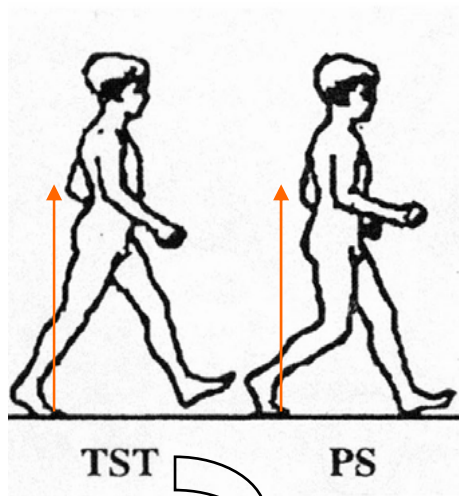
K+K+EMG: TIBIOTARSICA



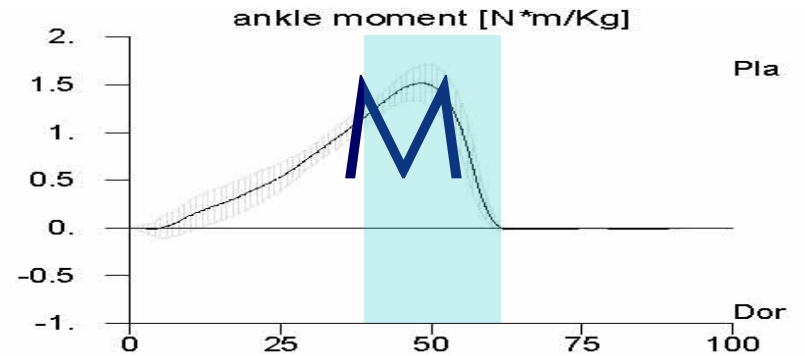
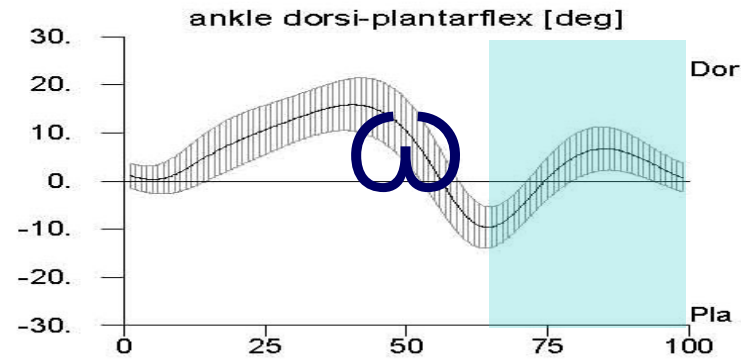
K+K+EMG: TIBIOTARSICA



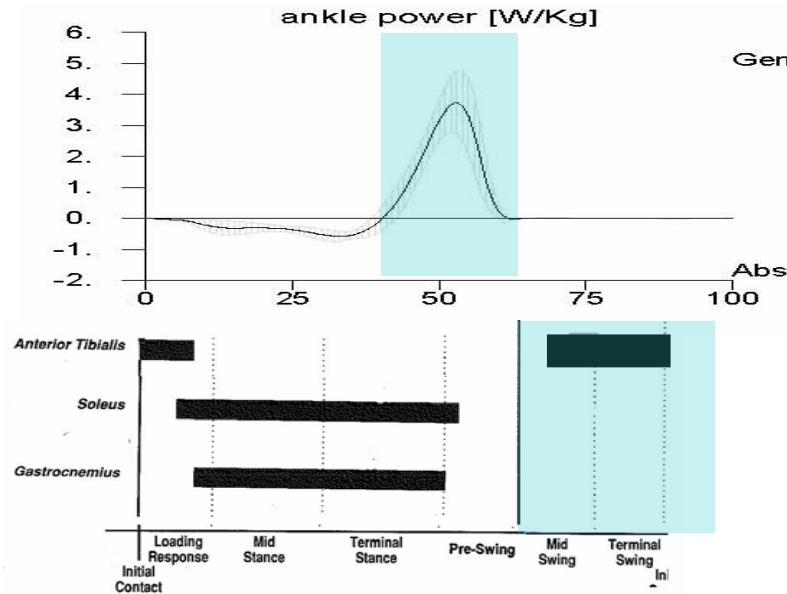
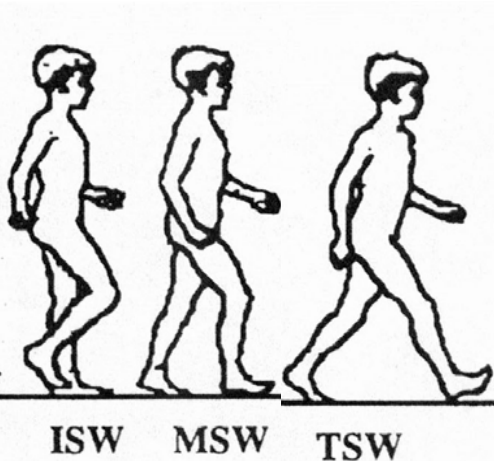
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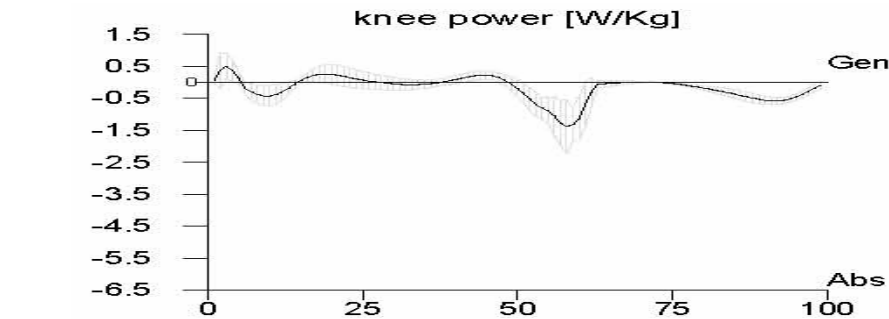
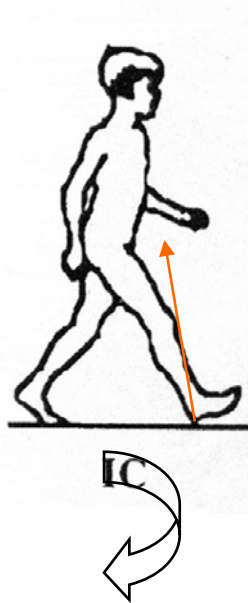
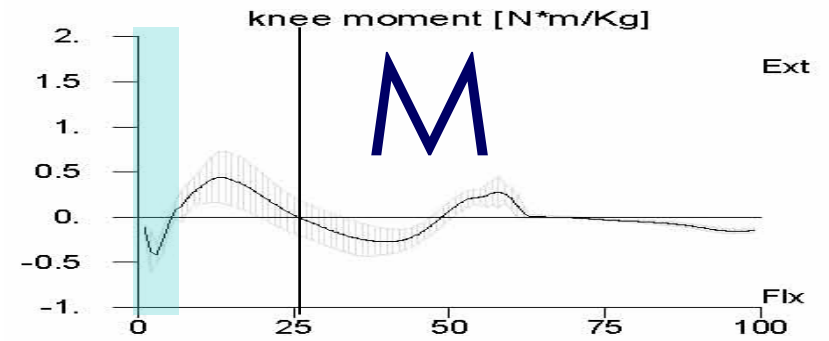
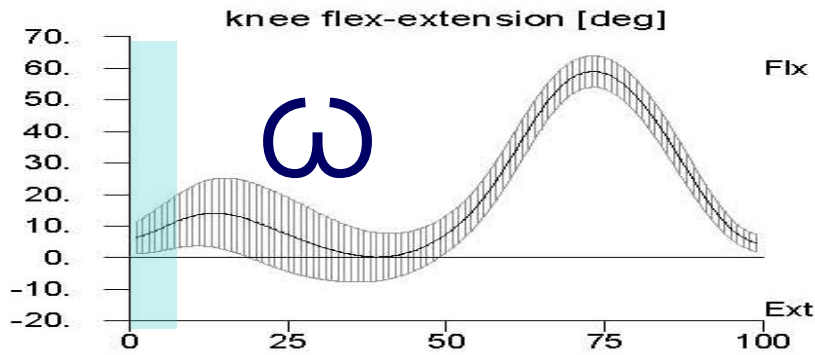
K+K+EMG: TIBIOTARSICA



X



K+K+EMG: GINOCCHIO



Biceps Femoris
(Long Head)

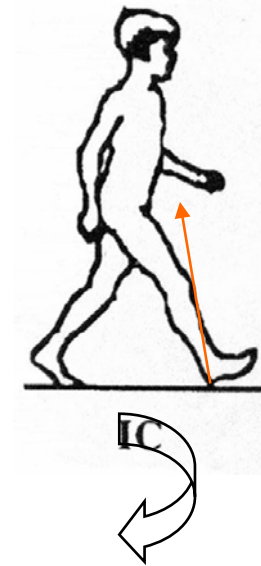
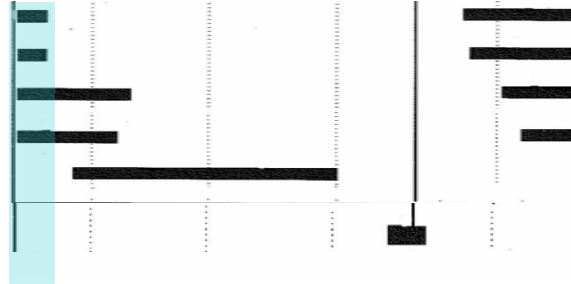
Semimembranosus

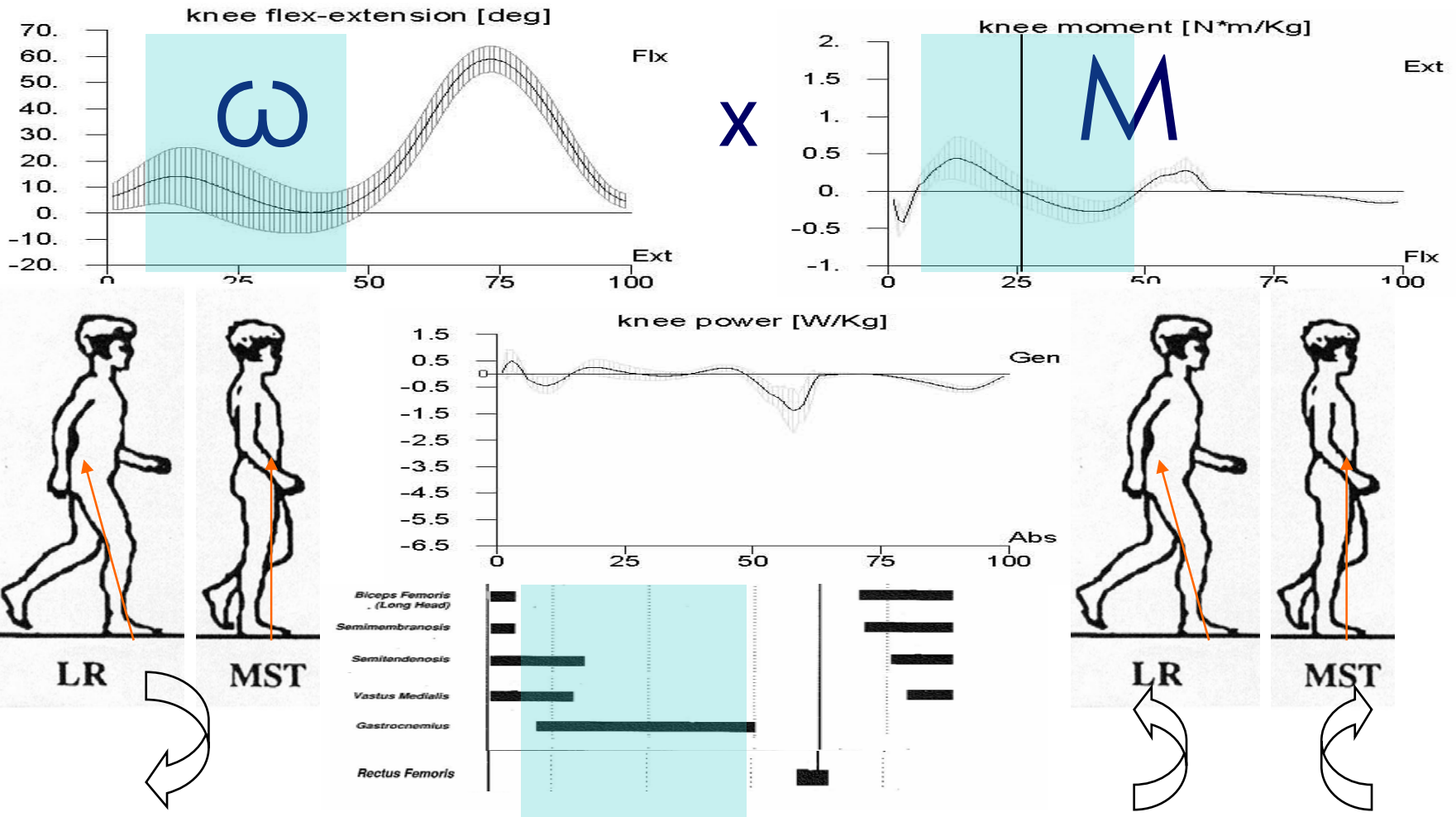
Semitendinosus

Vastus Medialis

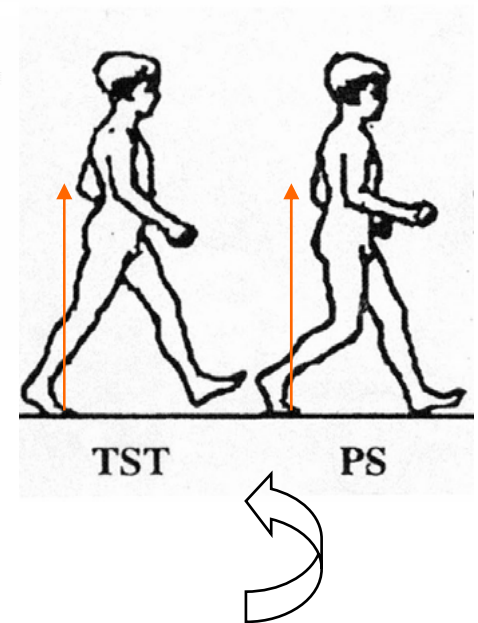
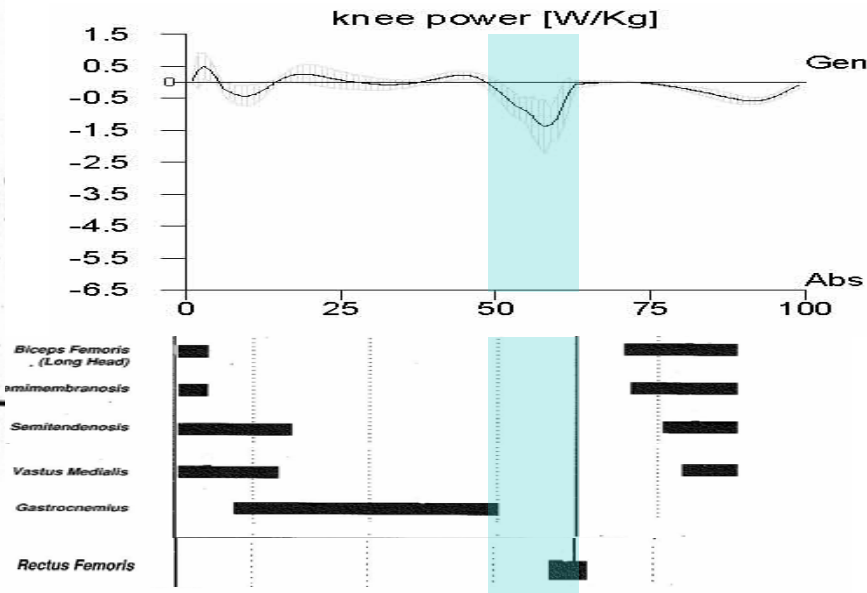
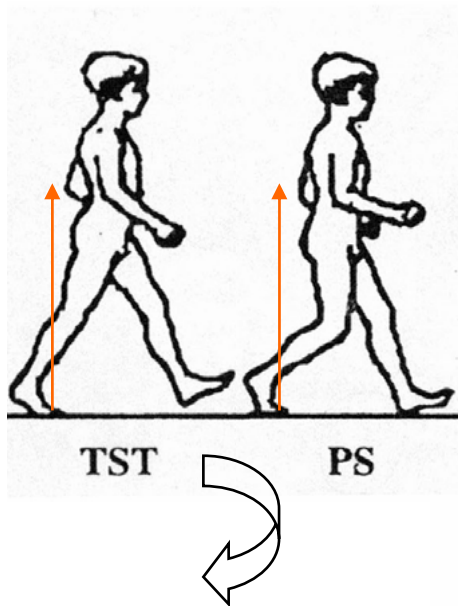
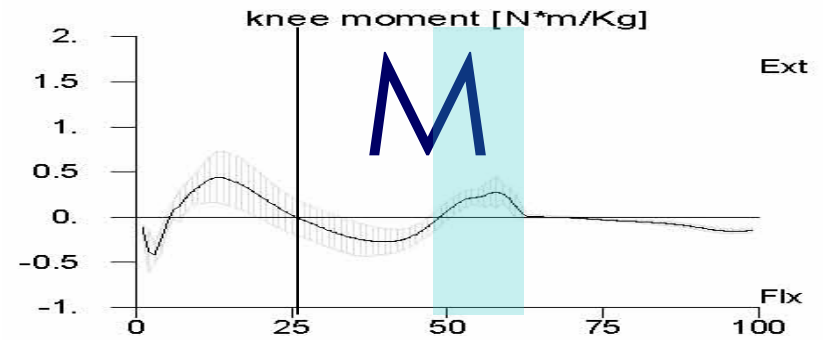
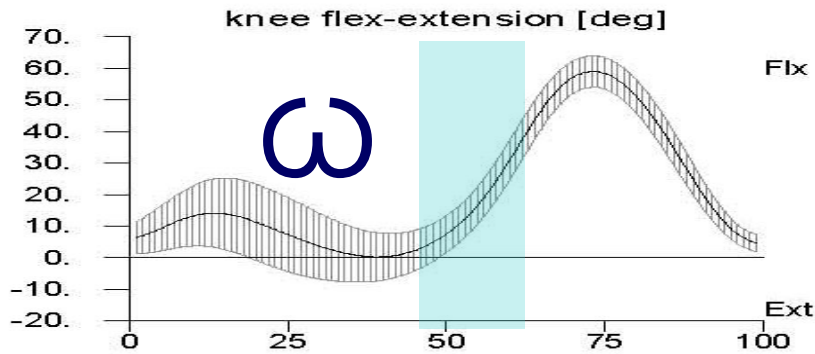
Gastrocnemius

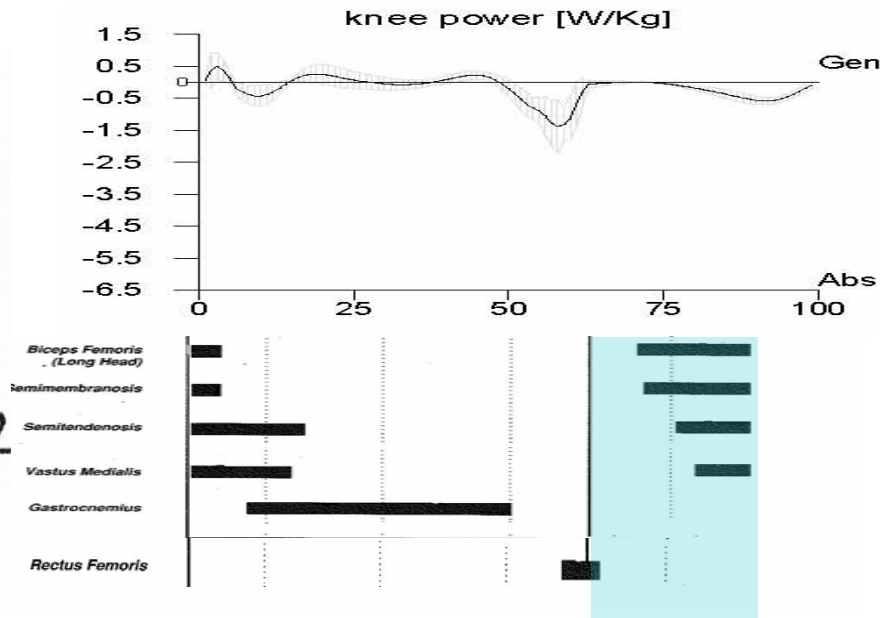
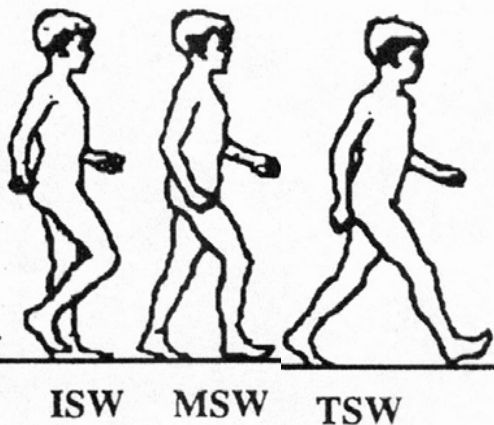
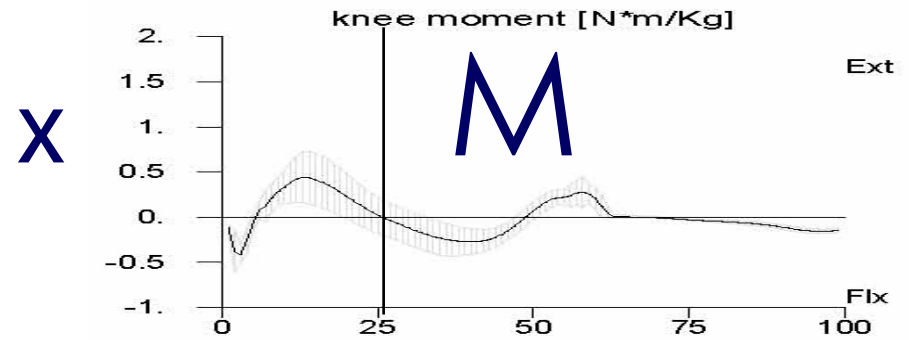
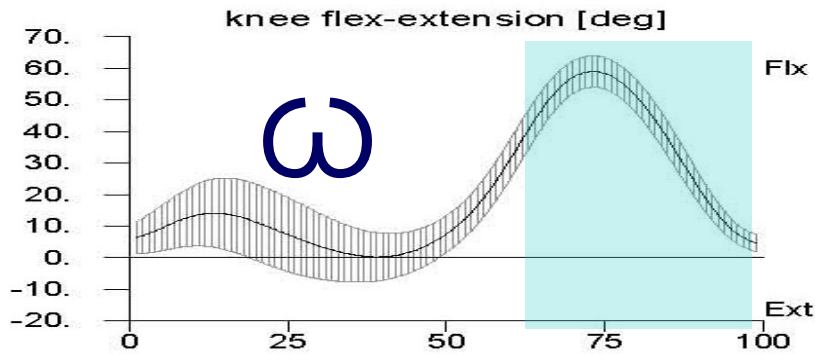
Rectus Femoris

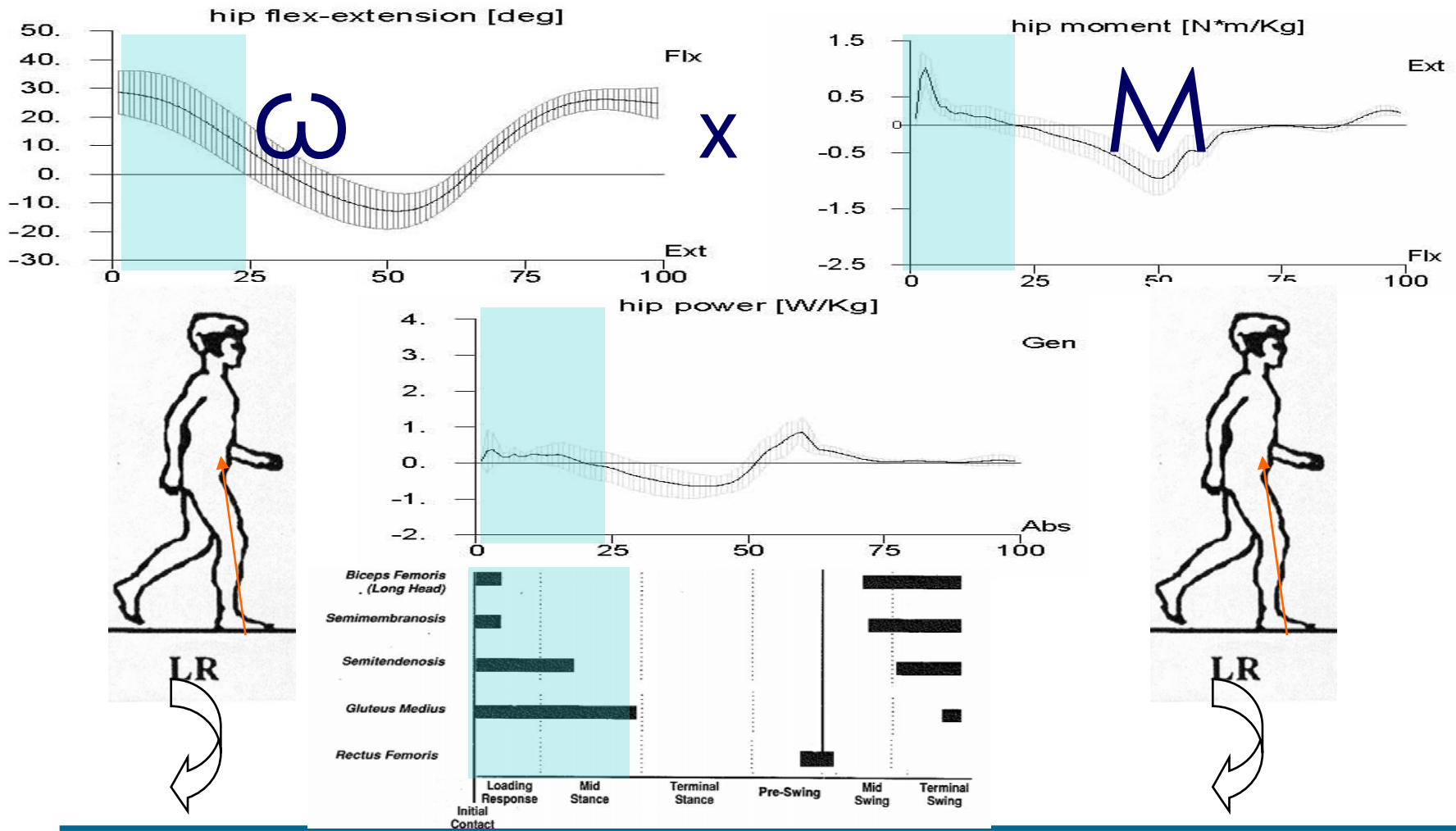




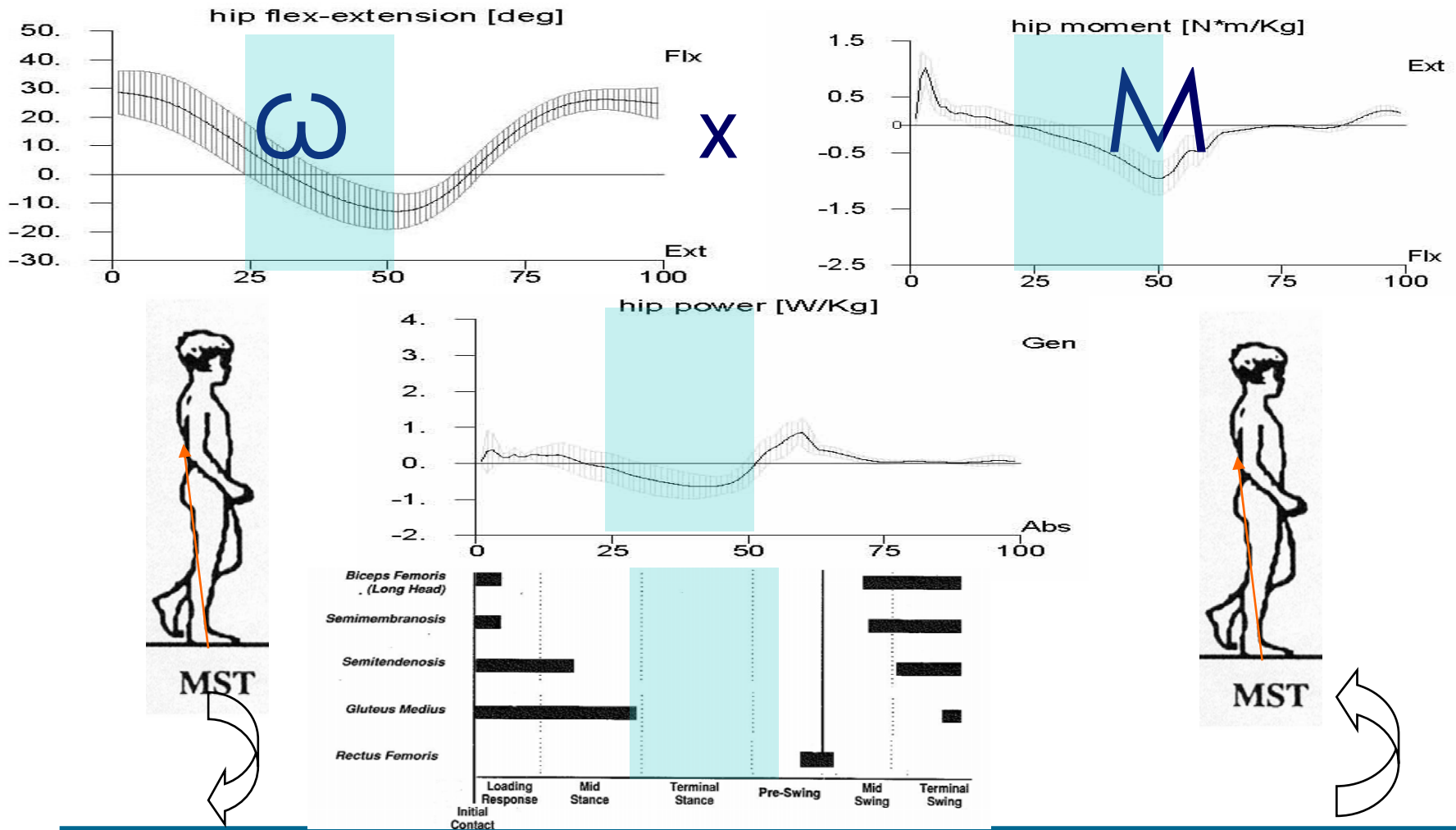
K+K+EMG: GINOCCHIO



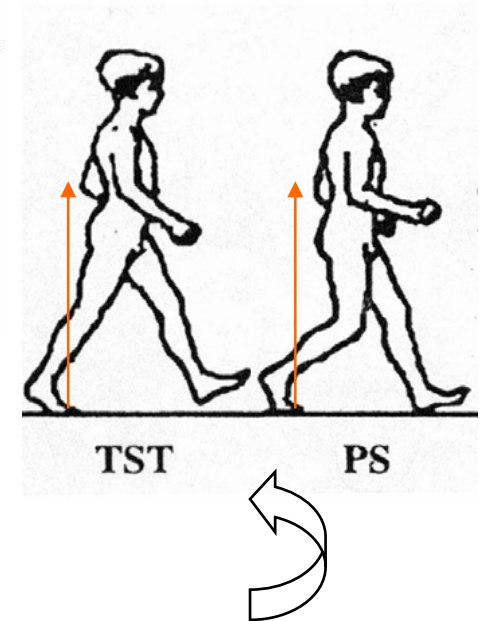
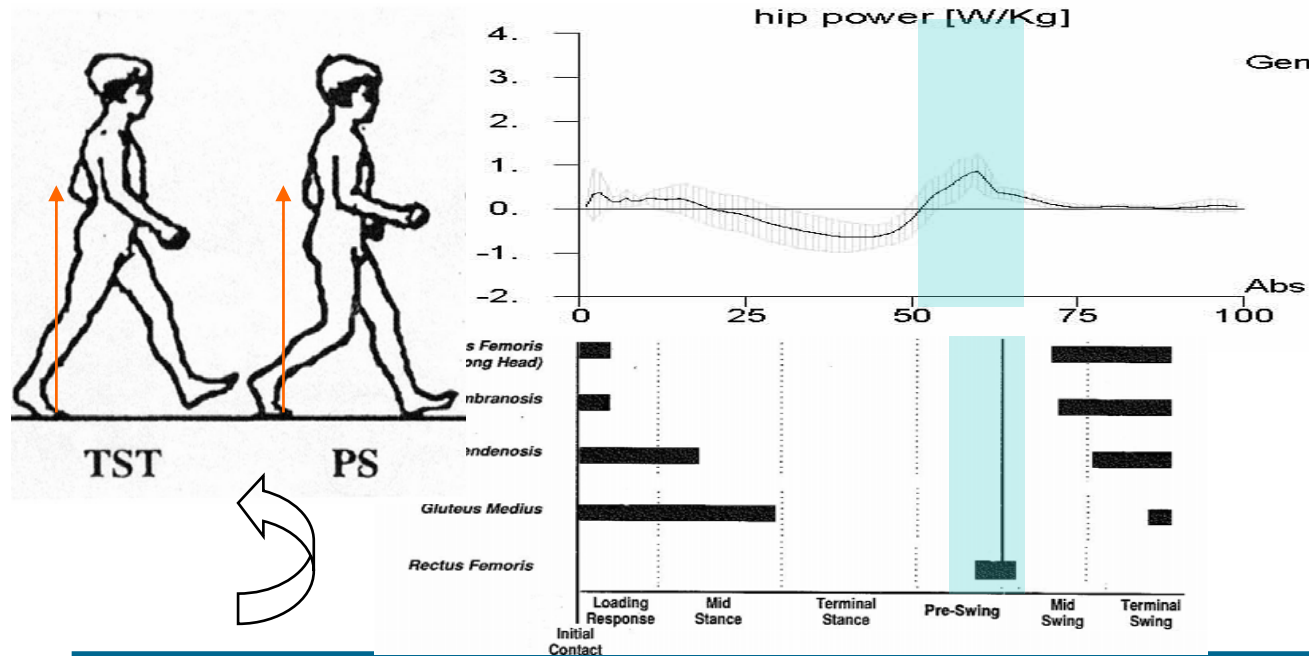
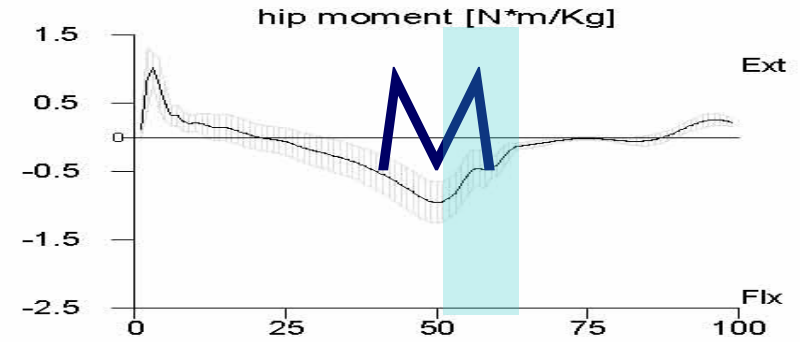
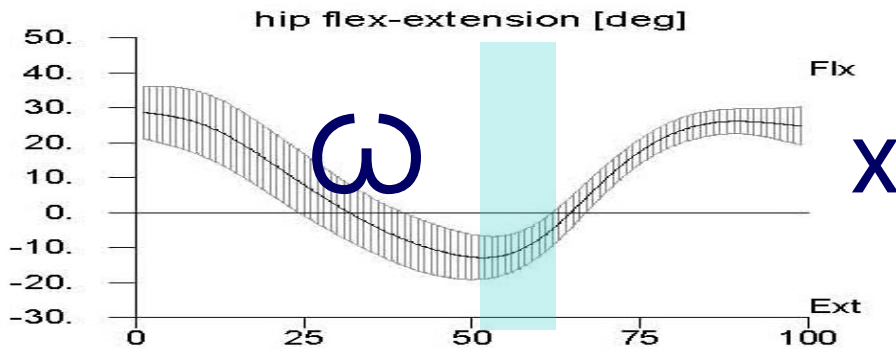


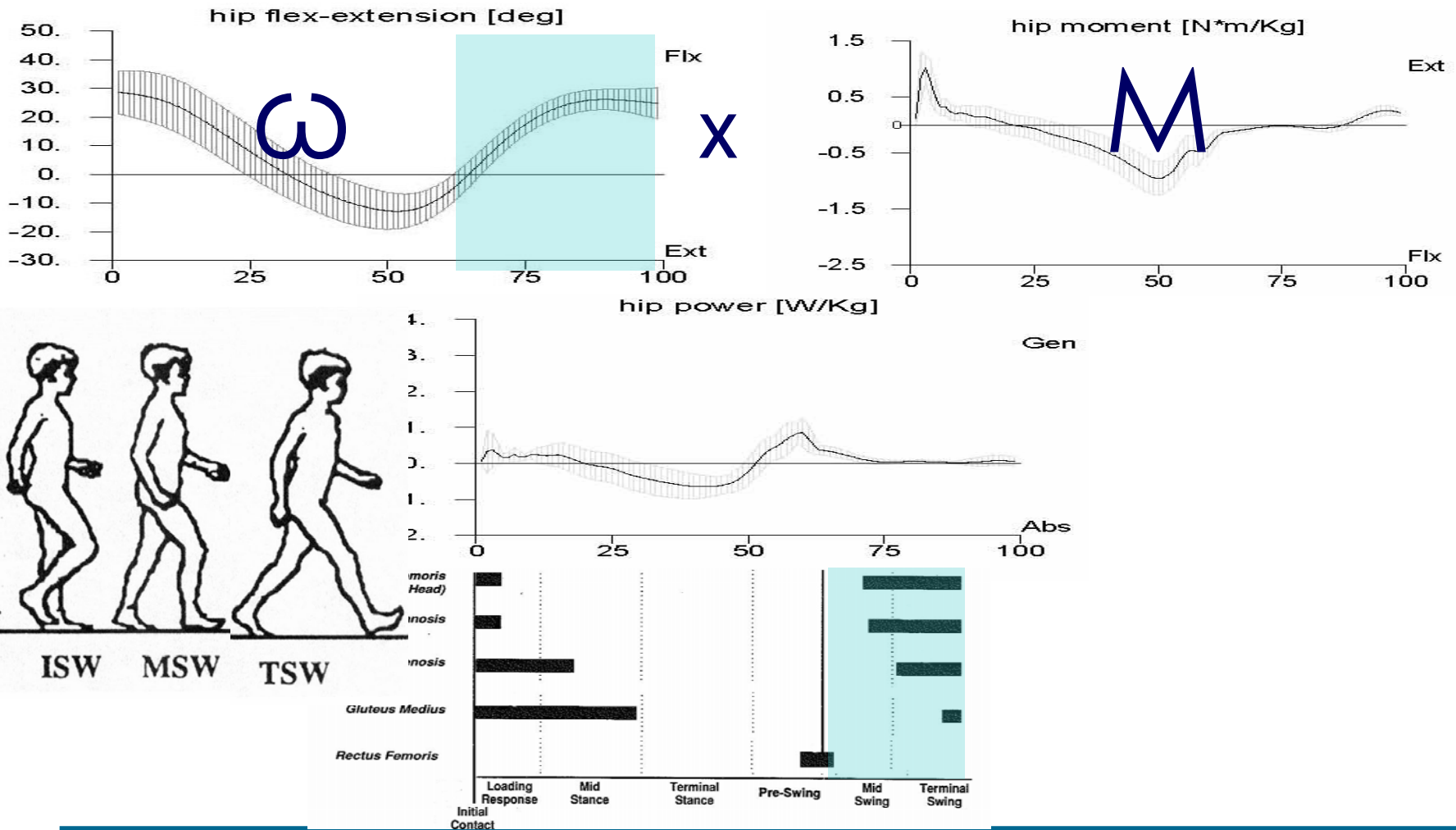


K+K+EMG: ANCA



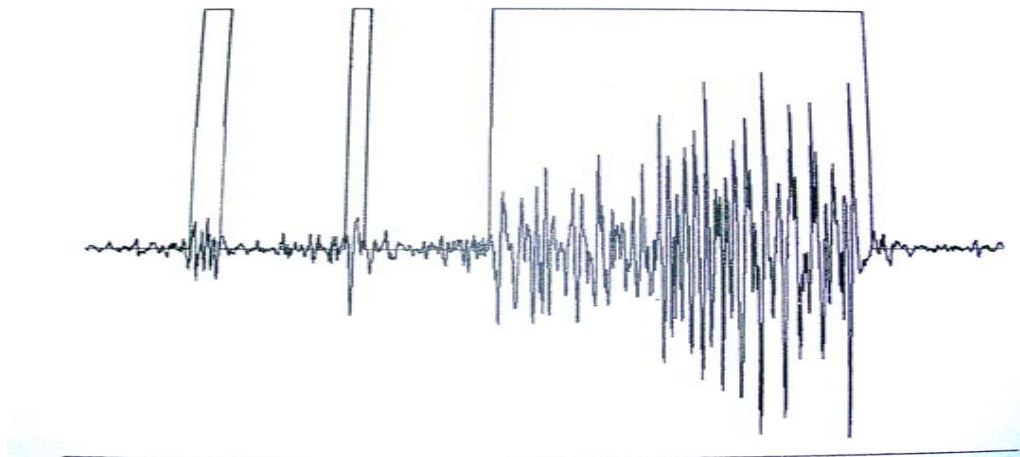
K+K+EMG: ANCA



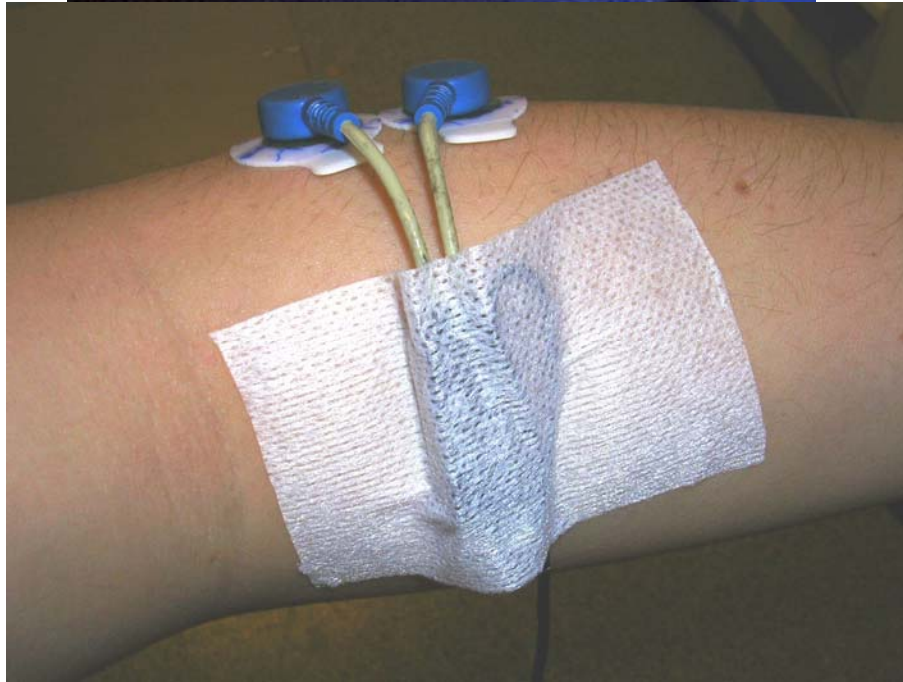


DEFINITION:

EMG signal is the voltage detected by 2 or more electrodes put in the conductor volume (if deep EMG) or on the skin (superficial EMG).



SUBJECT PREPARATION



- ✓ SHAVING
- ✓ SKIN WASHING
- ✓ ELECTRODES APPLICATION
- ✓ PRE-AMPLIFICATOR FIXING
- ✓ SUBJECT UNIT FIXING
- ✓ THREADS CONTROL

PREPARAZIONE DEL PAZIENTE



- ✓ Introduction of needle in muscle
- ✓ Check through electrical stimulator
- ✓ Pre-amplificators fixing
- ✓ Subject unit fixing
- ✓ Threads control



INSTRUMENTATION (the old one...)



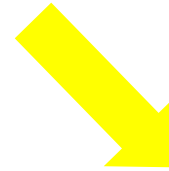
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Dipartimento di Bioingegneria
Politecnico di Milano



RECEIVING TECHNIQUES

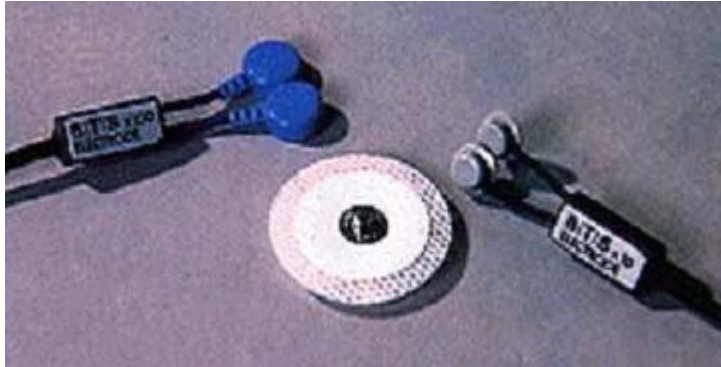


TELEMETRY

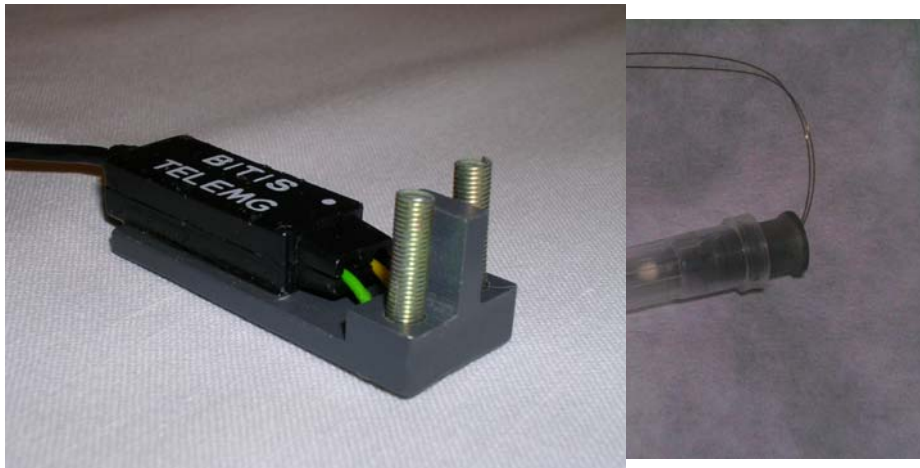


OPTICAL FIBER





SUPERFICIAL



DEEP



SUPERFICIAL EMG VS DEEP EMG

- **SPATIAL RESOLUTION:** detection volume is in general the volume in which the signal contributions are distinguishable from noise signal. Volume depends by the distance between electrodes, varying from few centimeters in superficial EMG to 0.5-1 mm in deep EMG.



Superficial registration techniques lead to obtain global information with no morphological details



SUPERFICIAL EMG VS DEEP EMG

- FREQUENCY BAND: superficial EMG signal has a smaller frequency band than deep EMG, this is due to different geometric characteristics of electrodes and to different filter effect due to tissues between muscular fibers and electrodes.

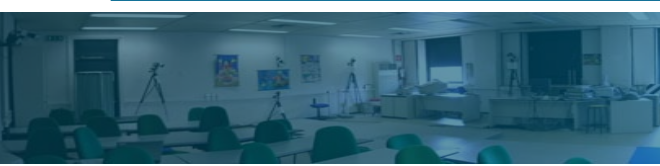
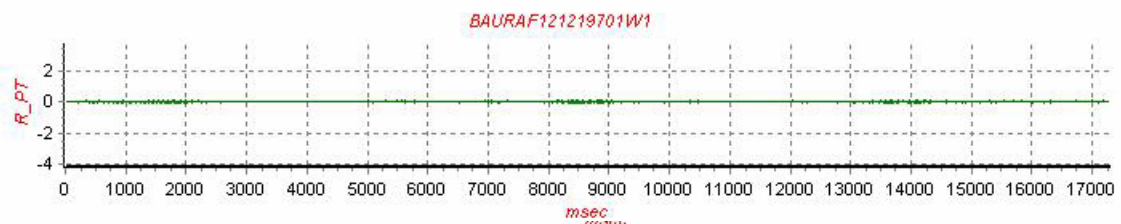
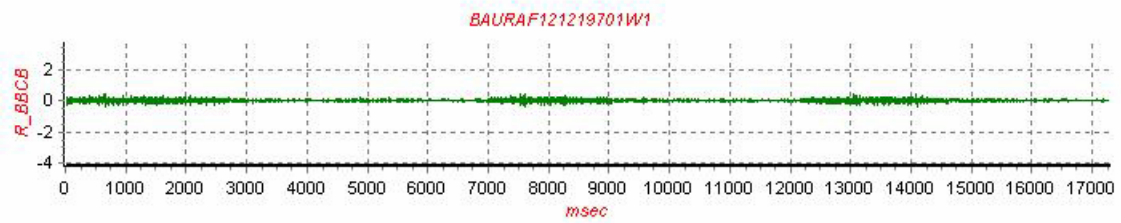
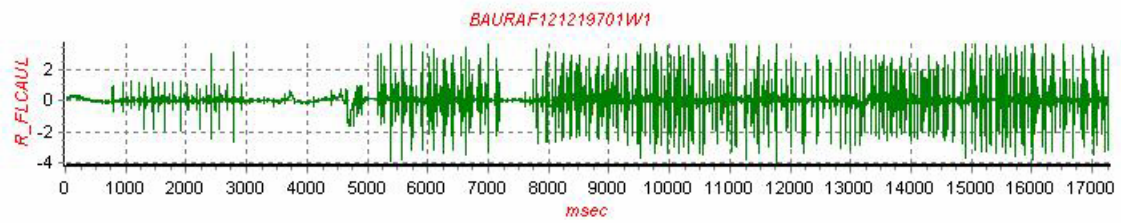
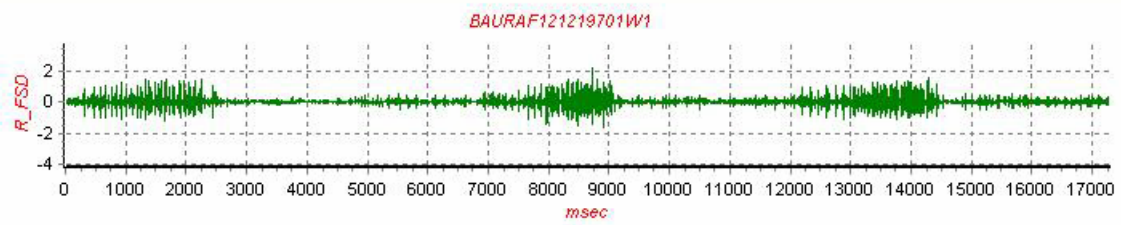
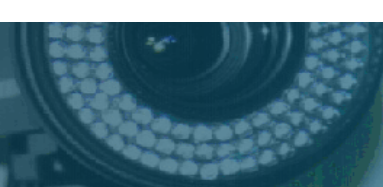


Superficial EMG has a power spectra from 10 Hz to 400-500 Hz, deep EMG from 10 Hz to 1,5 KHz



- EMG AMPLITUDE: Superficial EMG is in general smaller in amplitude than deep EMG

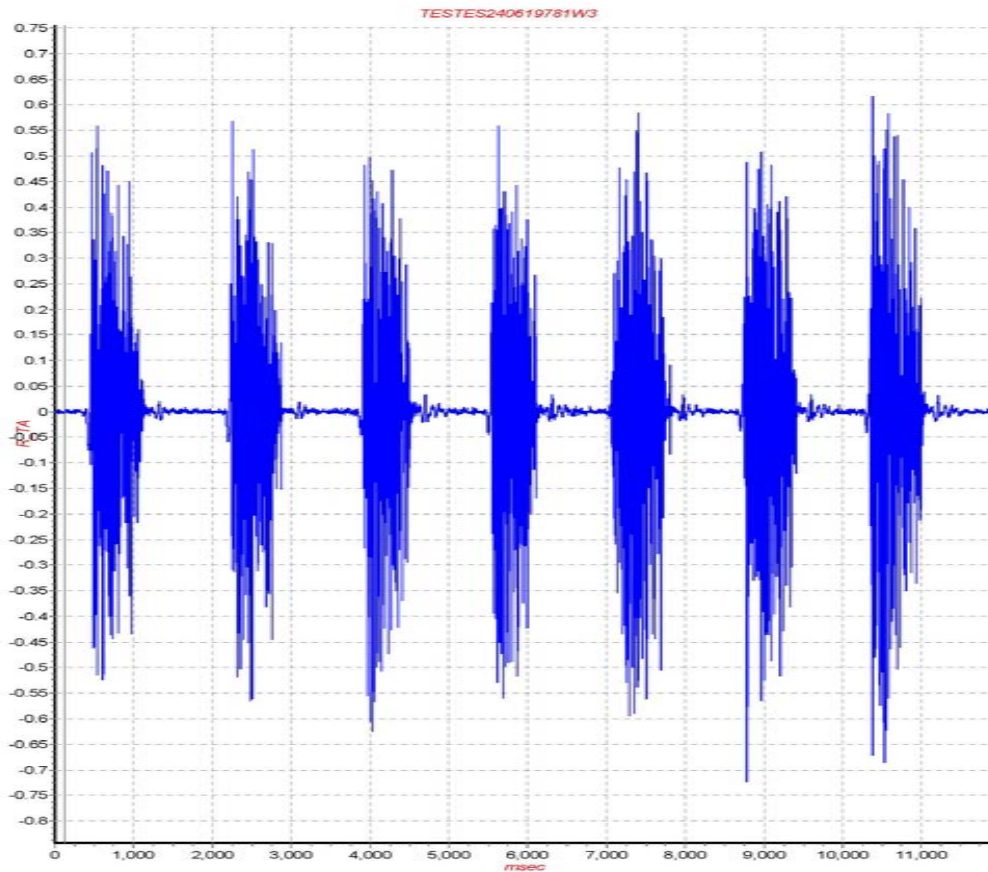
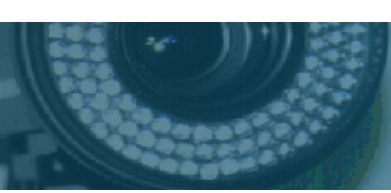




Subject preparation is very important, it influences the goodness of the measure

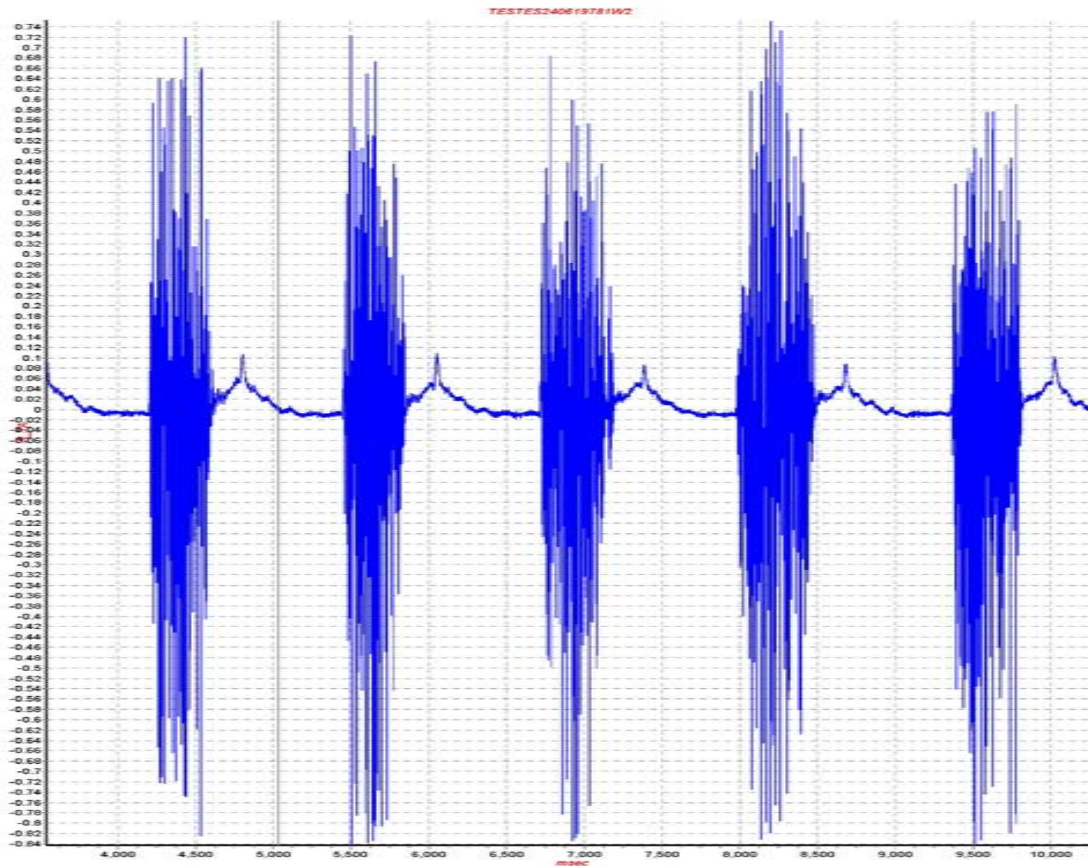
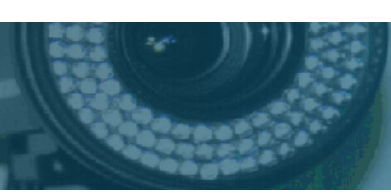
- ✓ Anatomic individual variability and fat tissue can damp and make an alteration in EMG signal.
- ✓ Take care to crosstalk, i.e the registration of muscular activity by a muscle near the muscle we want to analyze.
- ✓ Avoid movement artifacts due to the instability of the interface between skin and electrodes.





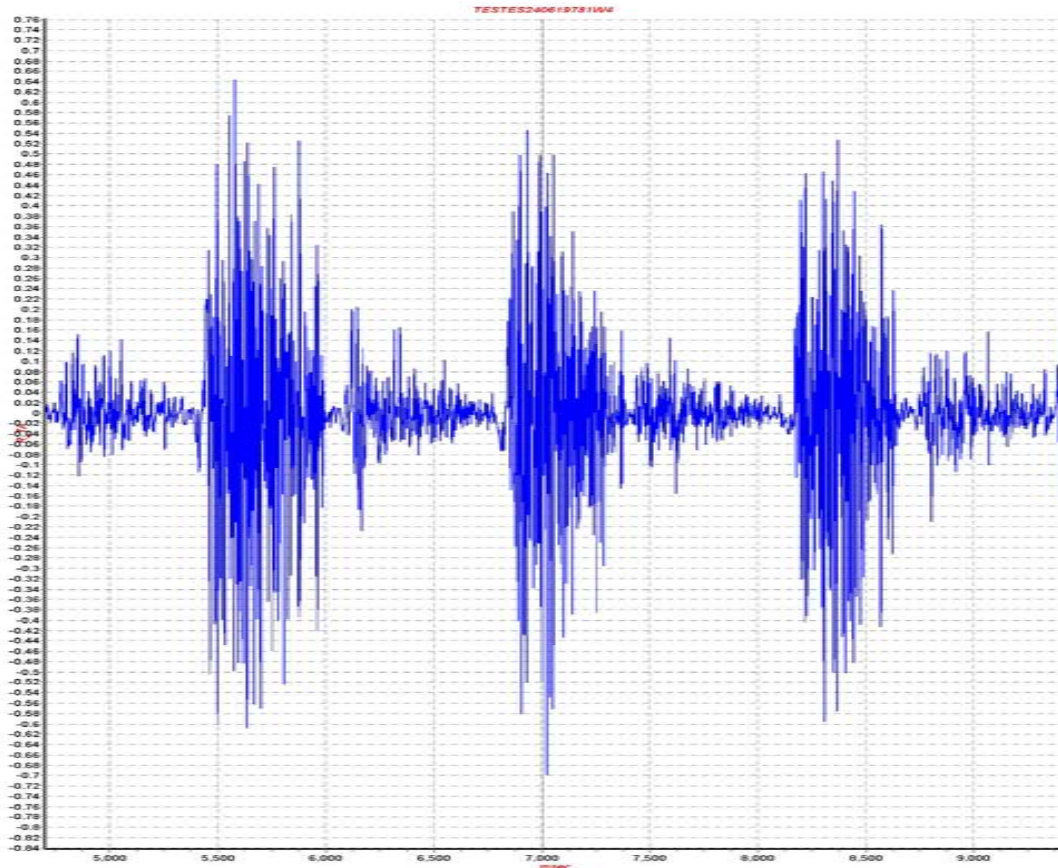
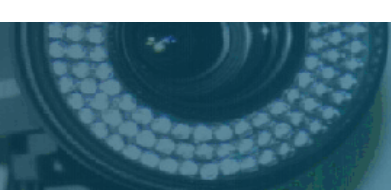
Dorsiflexion:
Correct electrodes
position





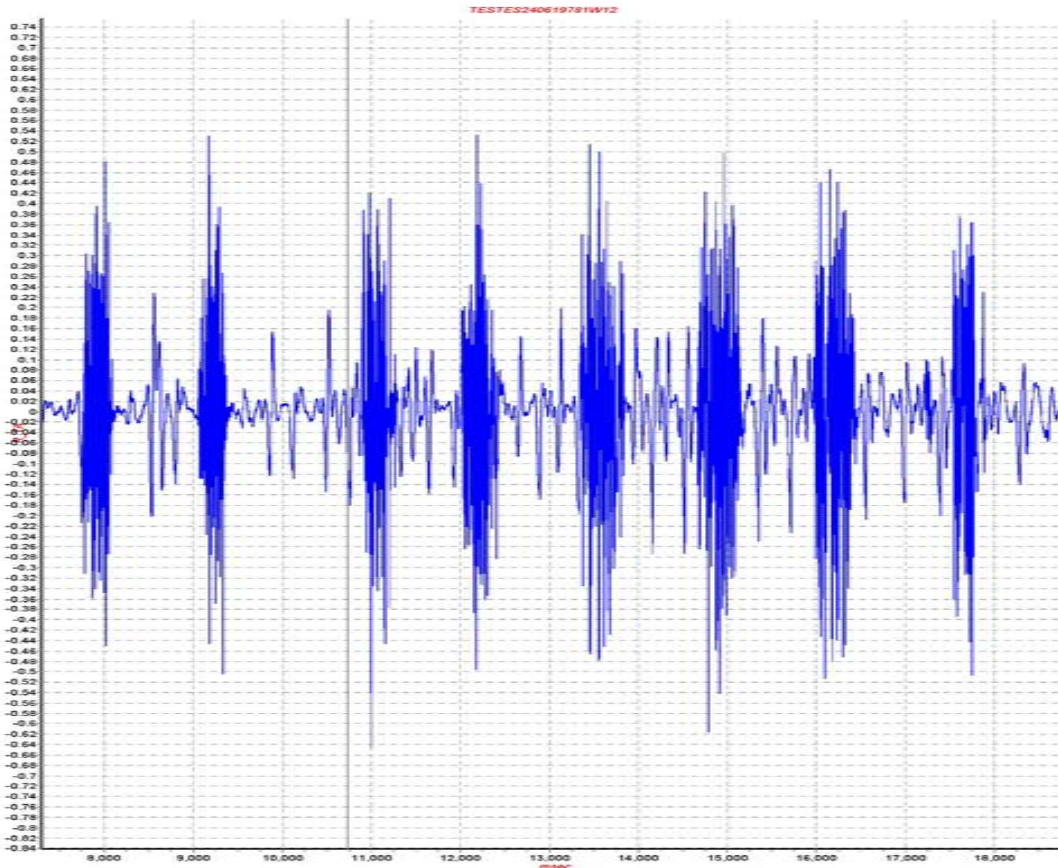
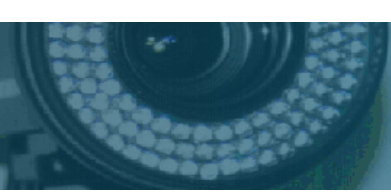
Dorsiflexion:
No zero
reference





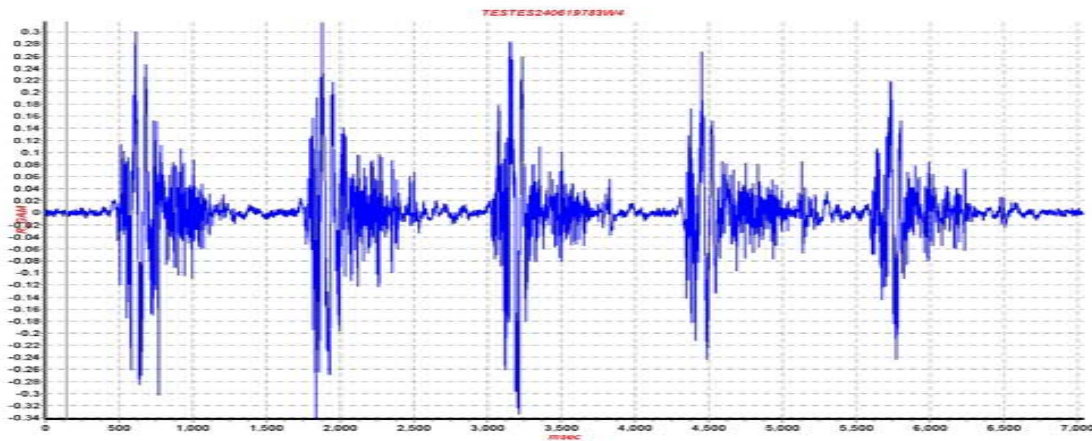
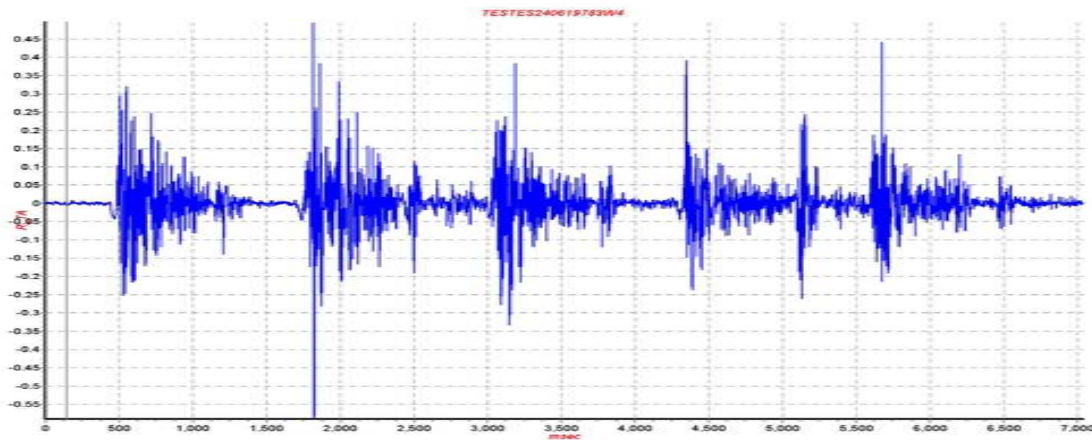
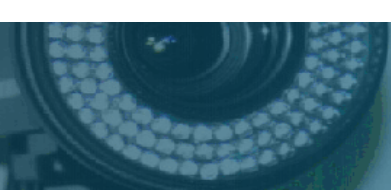
Dorsiflexion:
Zero reference
on GAM





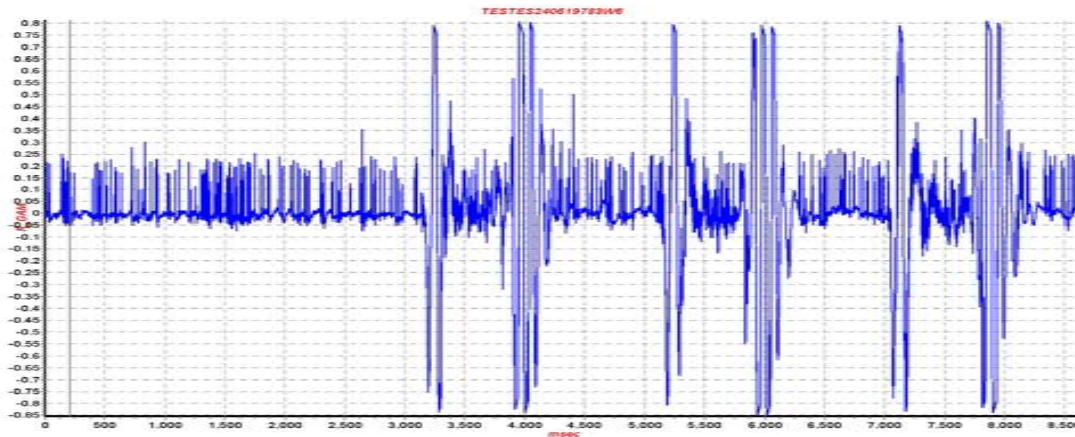
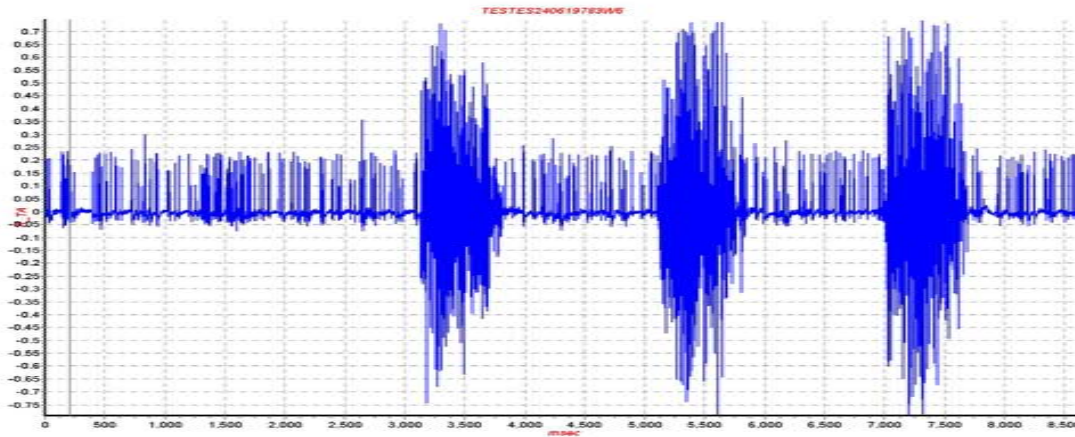
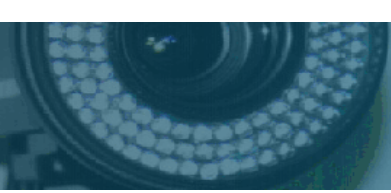
Dorsiflexion
“Mechanical”
noise





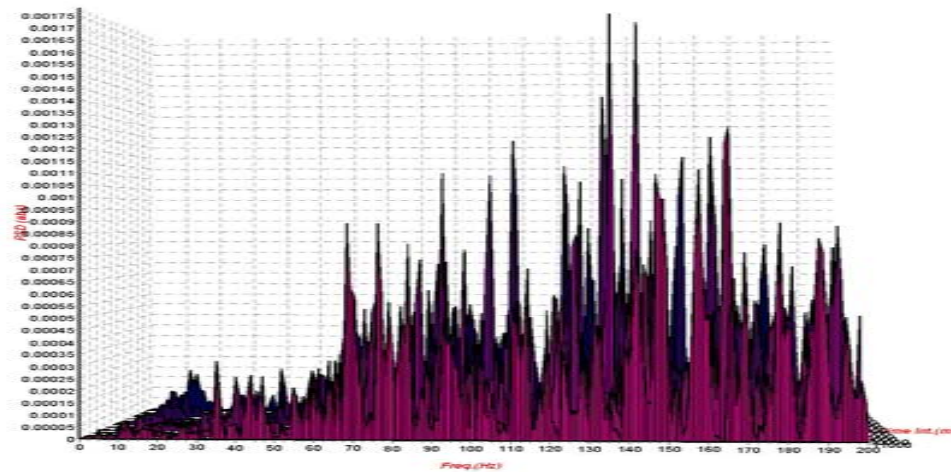
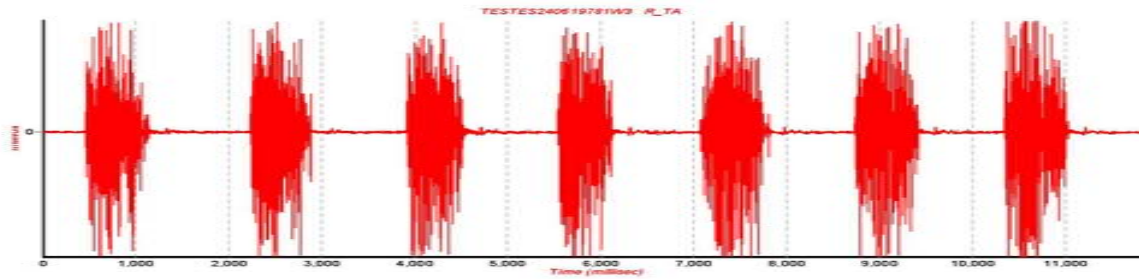
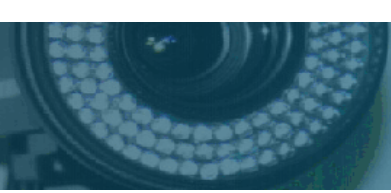
Crosstalk





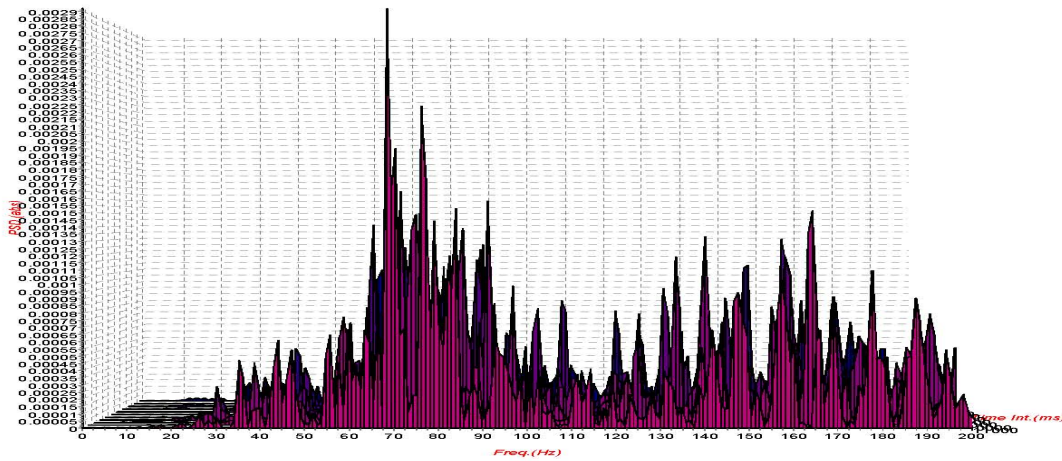
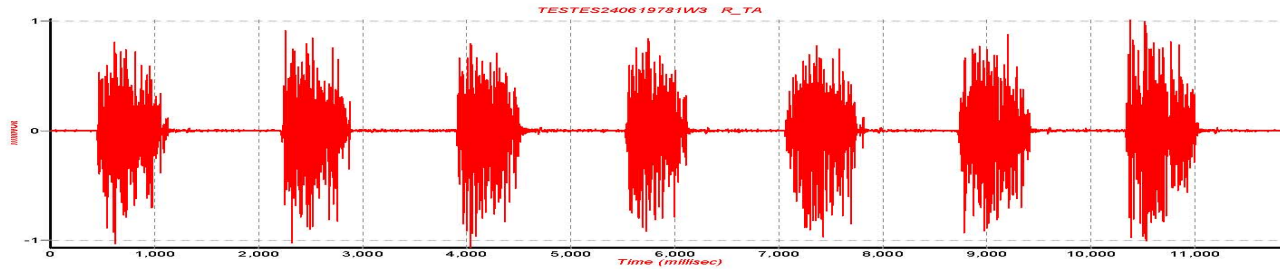
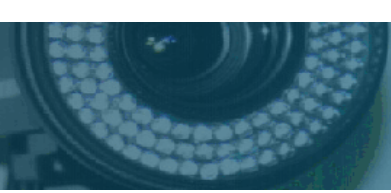
Dorsiflexion telemetry

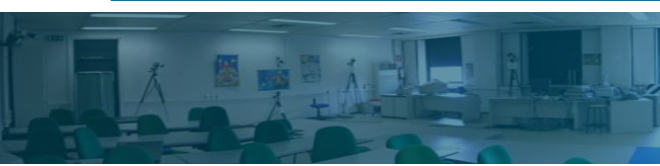
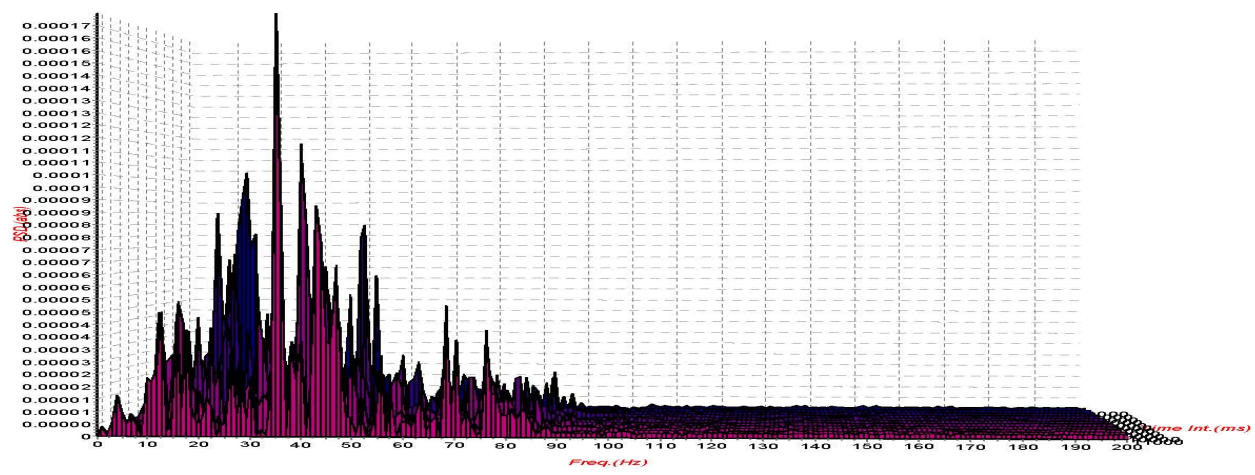
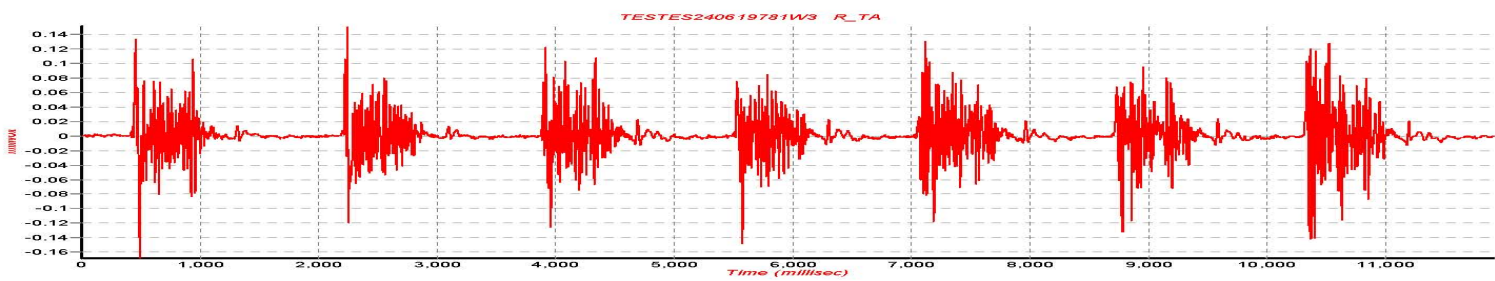
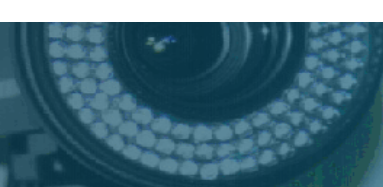


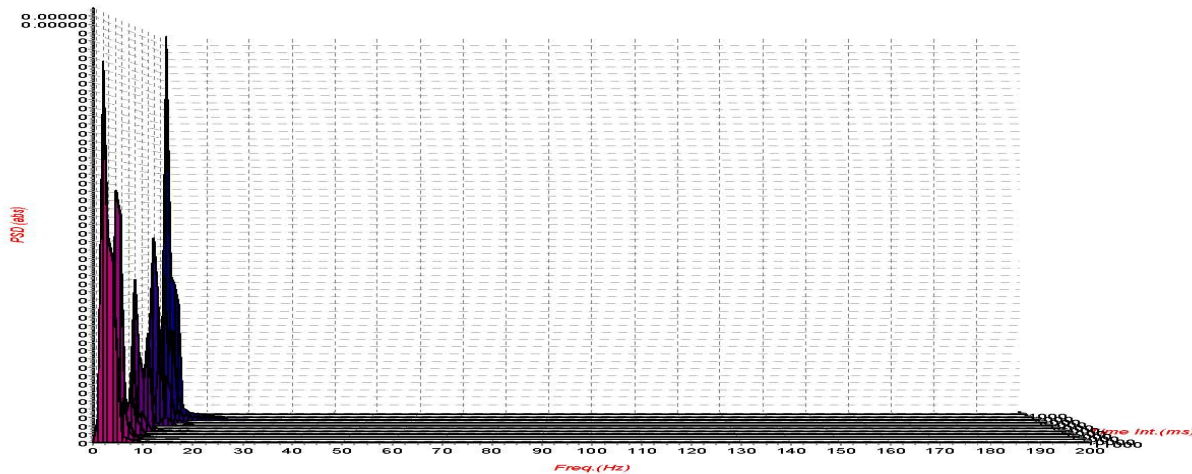
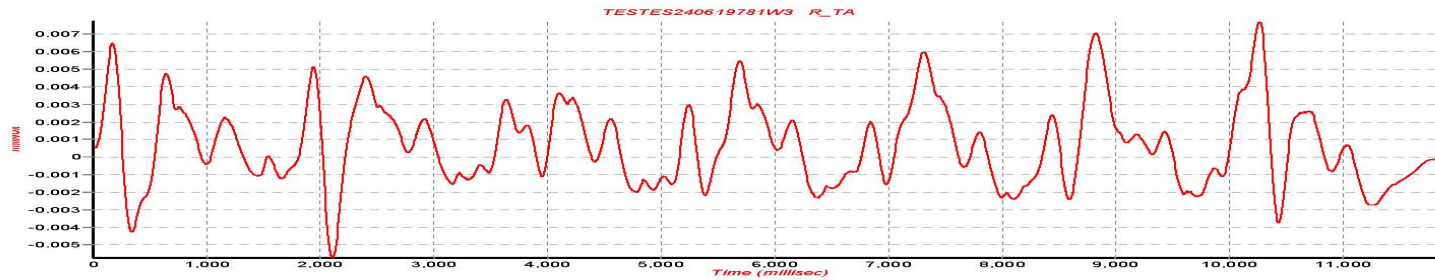
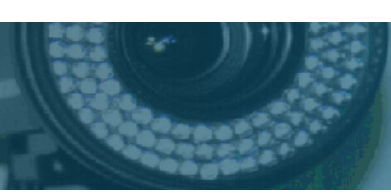


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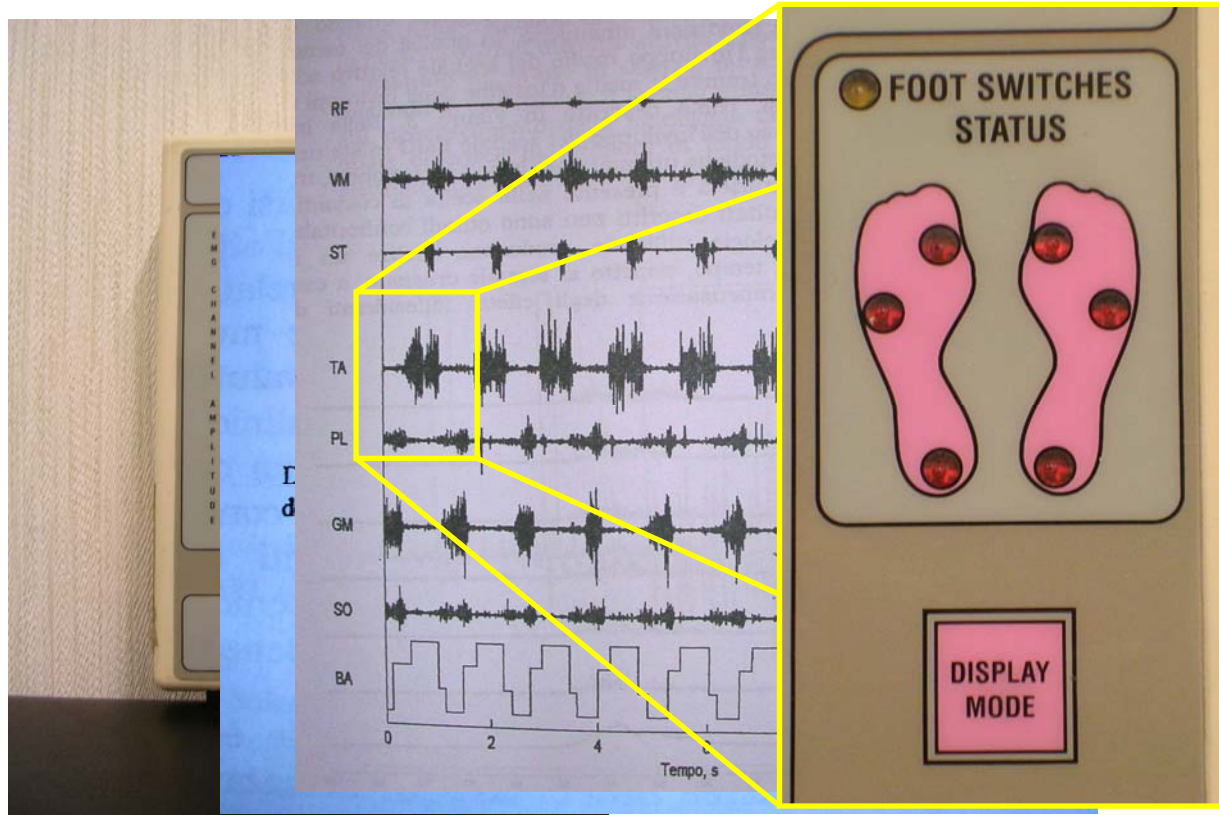
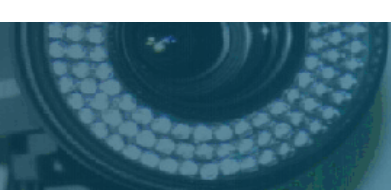






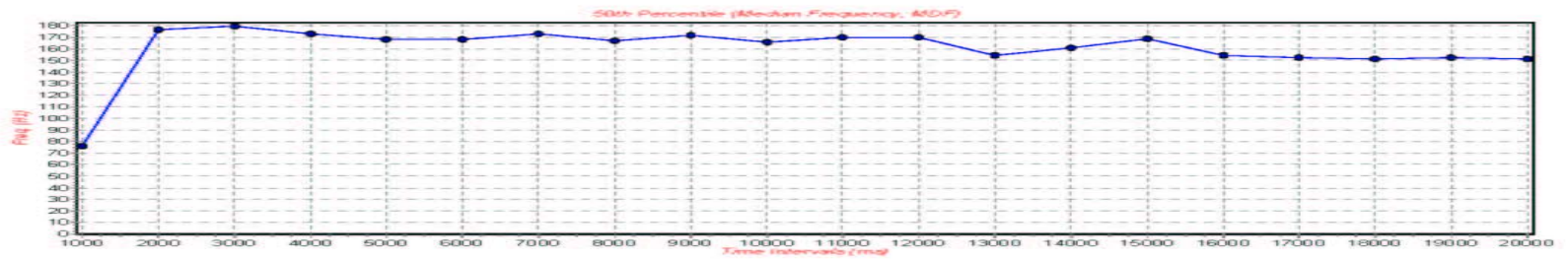
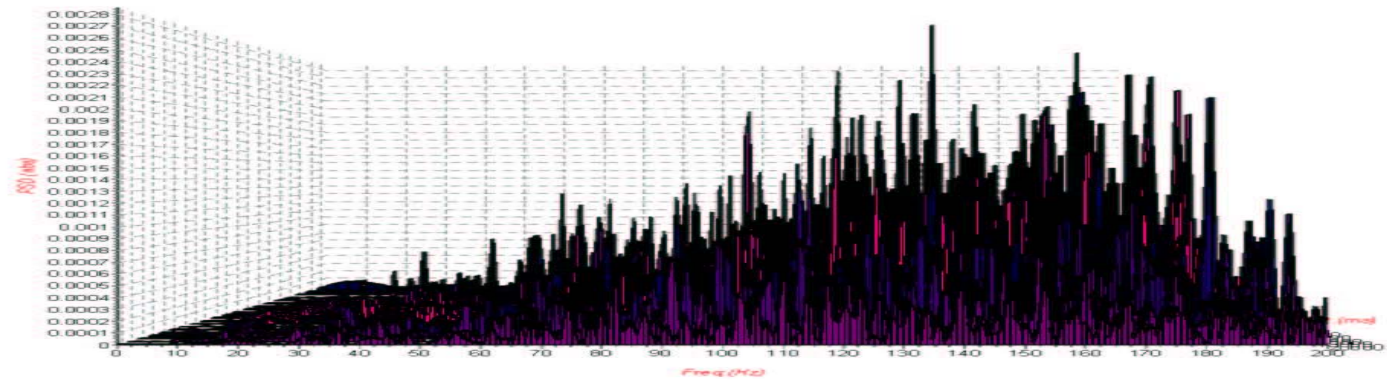
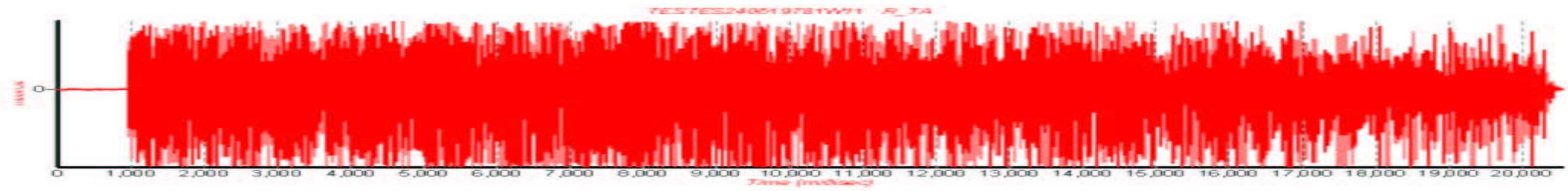
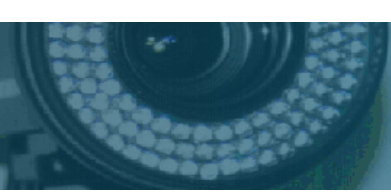
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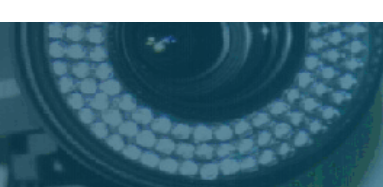




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PROBLEMS

In dynamic condition the effect of factors different from physiological phenomena is more relevant than in isometric condition: for example, the EMG amplitude depends by the electrodes displacement. If the position of electrodes in respect to muscular fibers changes because of changing of angle joint during a task, the amplitude can change even if it does not mean different level of activation.

In clinical field the EMG amplitude can not be considered as good parameter to describe the movement!

