



POLITECNICO
MILANO 1863

BIOINGEGNERIA DEL SISTEMA MOTORIO

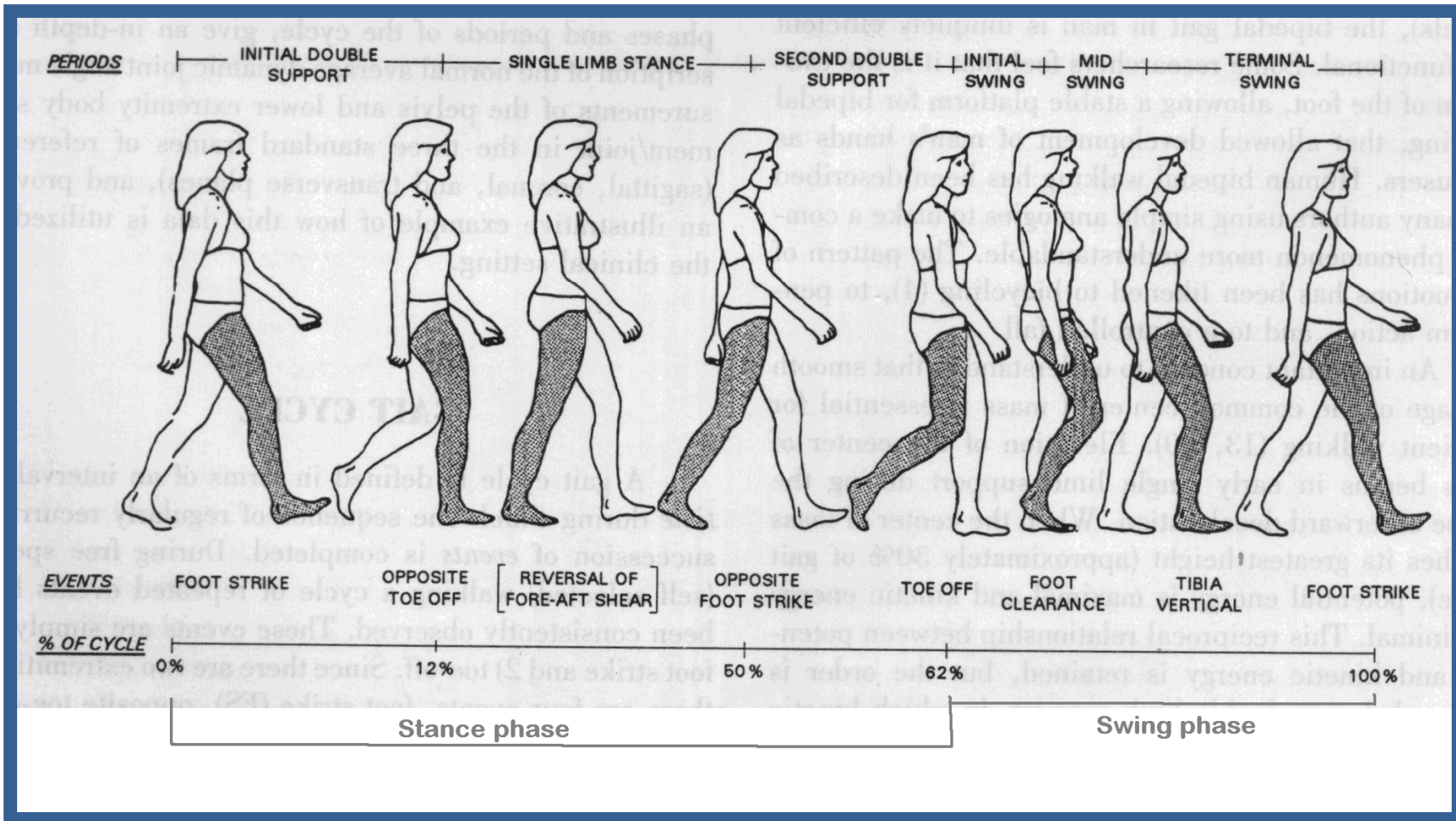
Sezione: M-Z

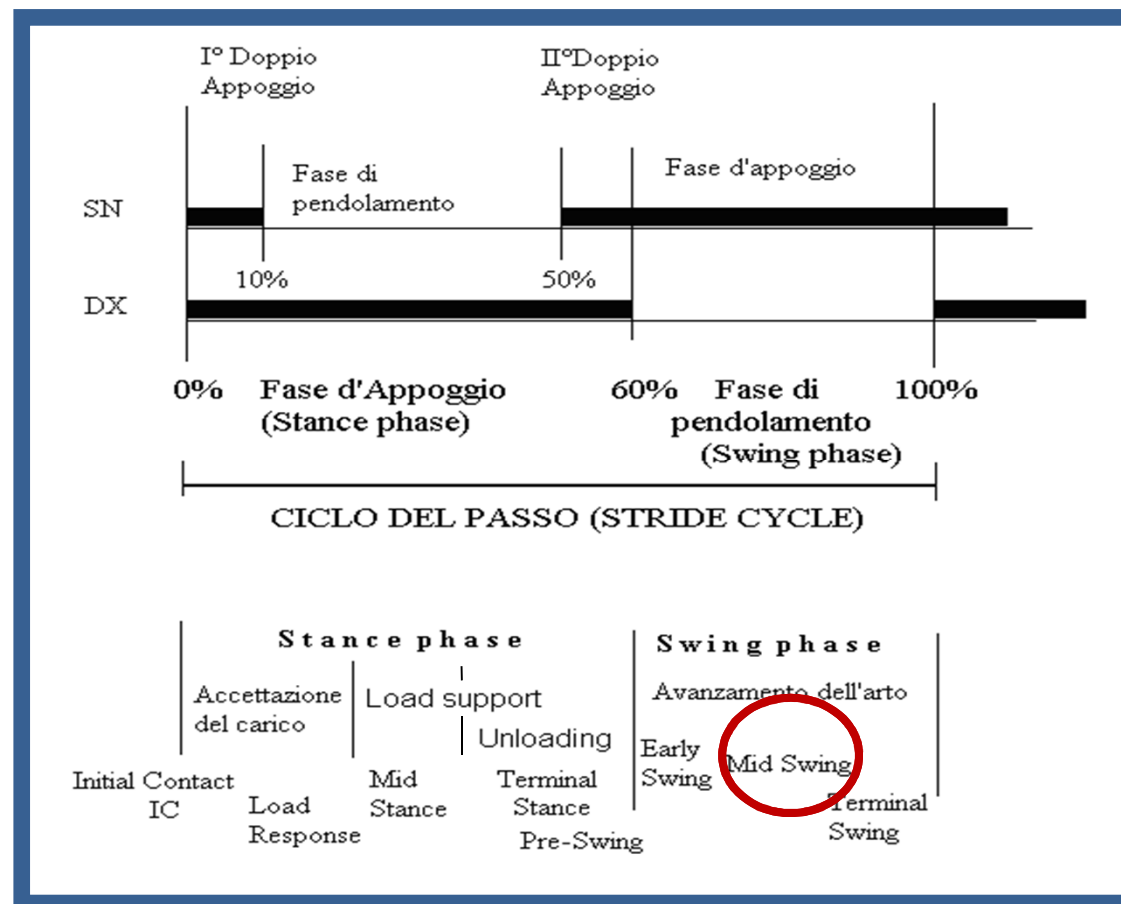
Fenomenologia della locomozione

Analisi biomeccanica della locomozione

Fasi del Gait stride

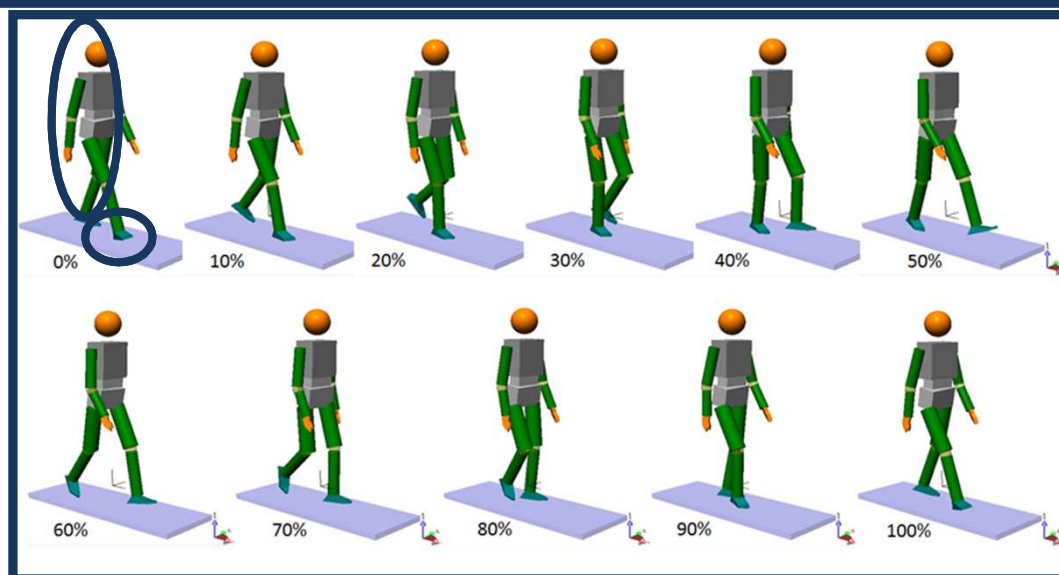
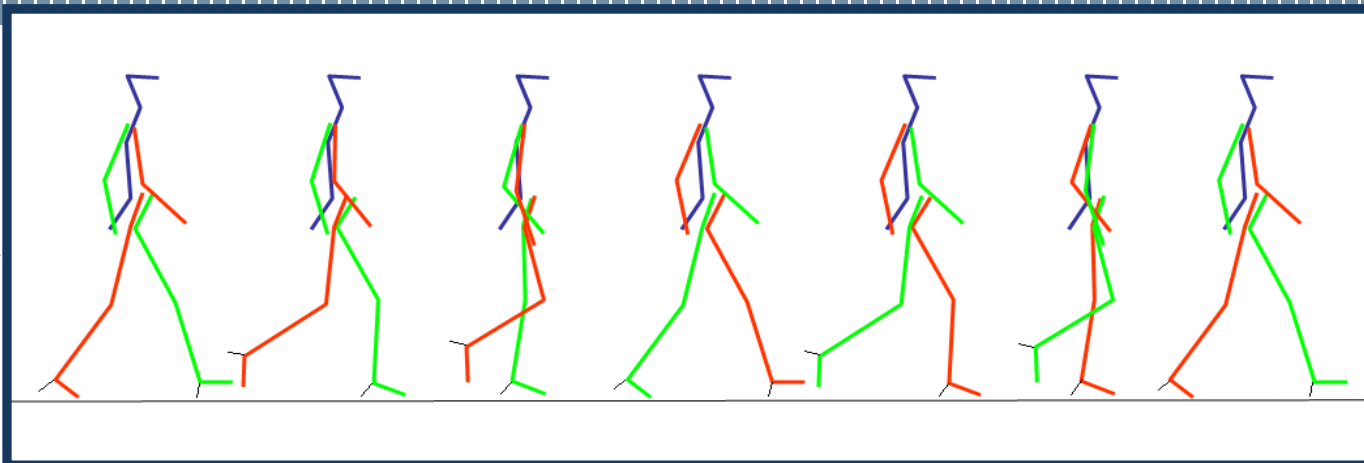
evoluzione filogenetica (della specie) e ontogenetica (dell'individuo)



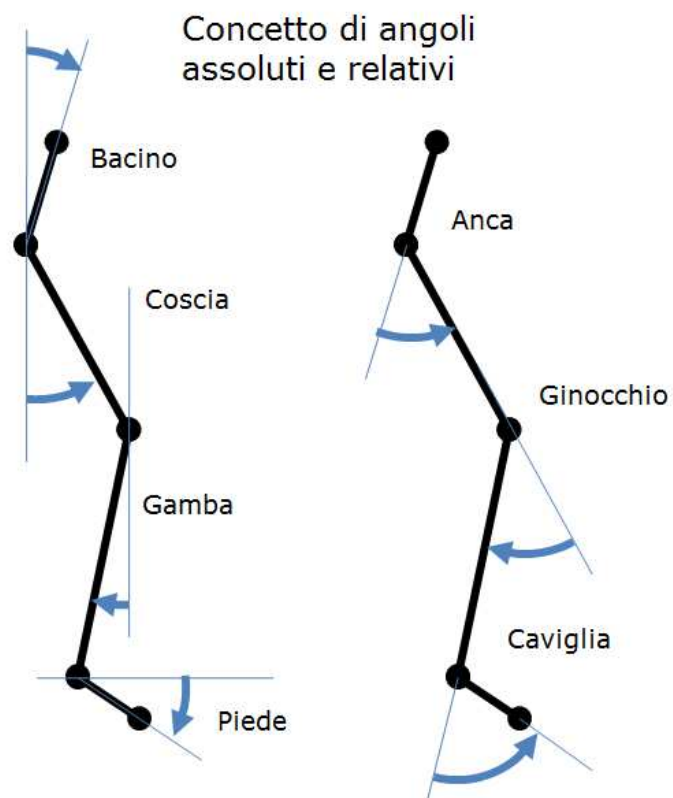
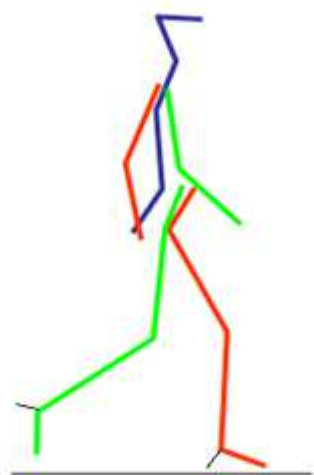


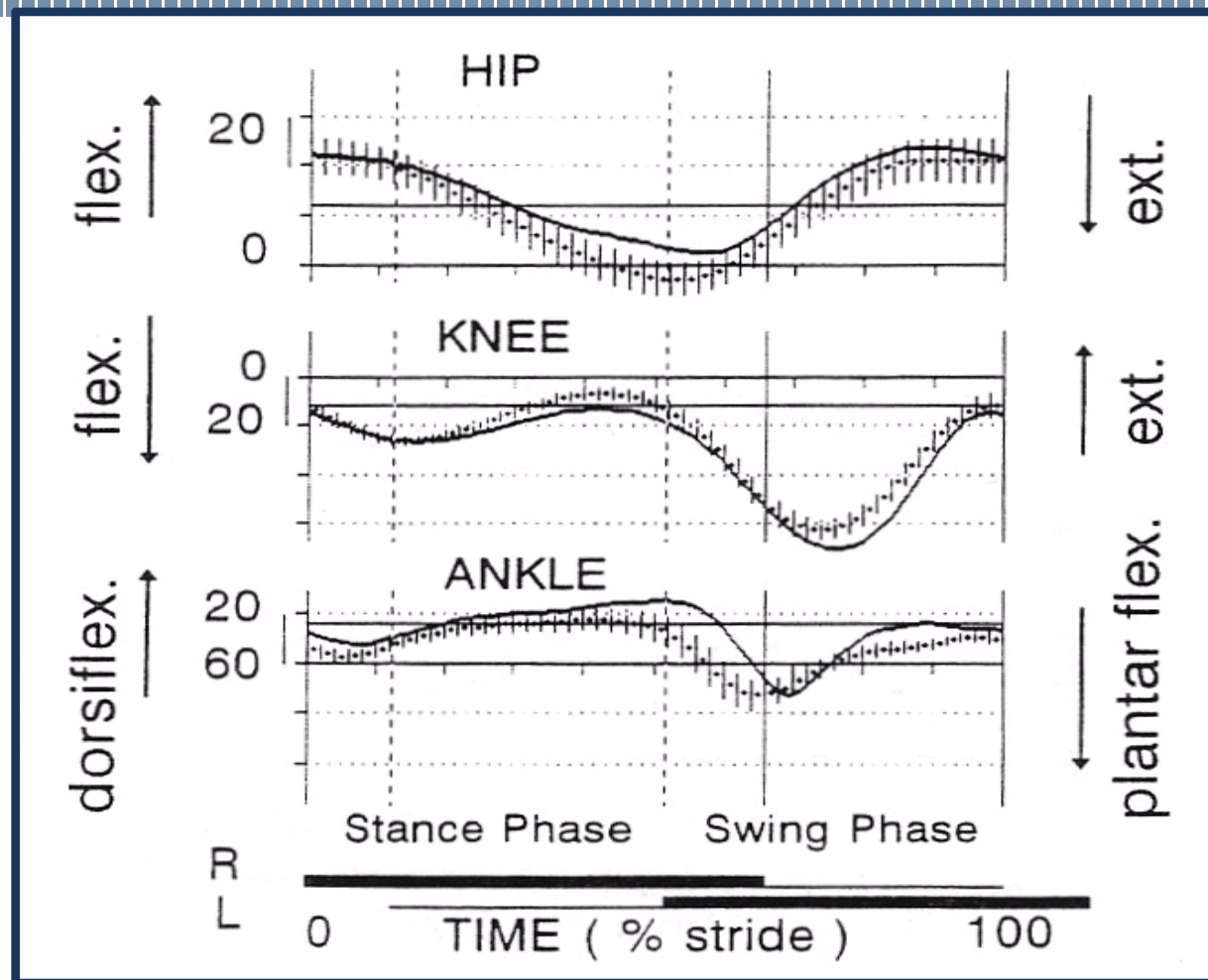
Movimenti sincroni delle varie parti del corpo

si può notare come gli arti superiori ed inferiori siano in controfase. Evidente in un soggetto SANO, ma viene a mancare in patologie come parkinson e paralisi cerebrale infantile. Questo porta per forza ad una torsione della colonna vertebrale.

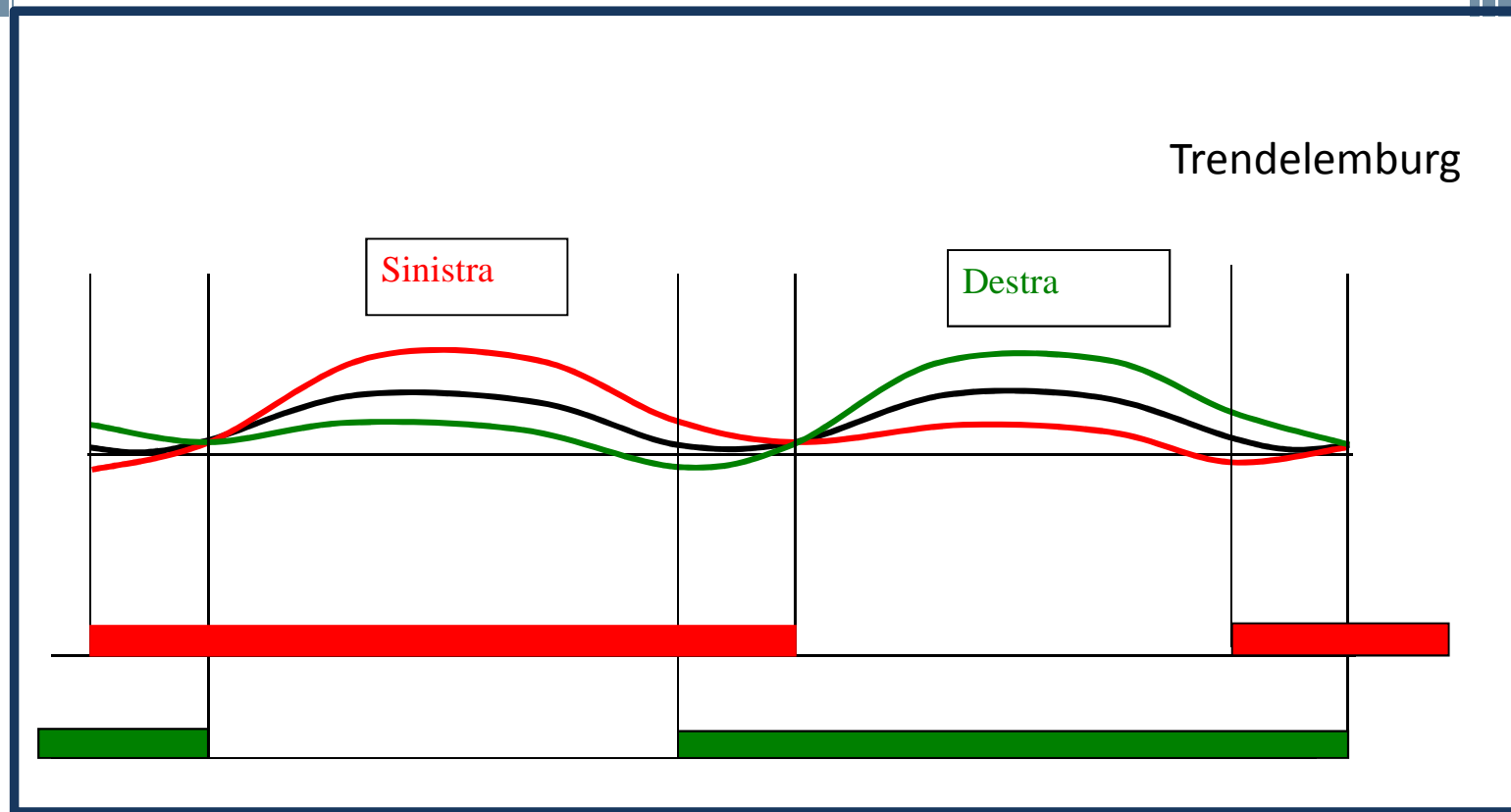


Angoli assoluti e angoli relativi

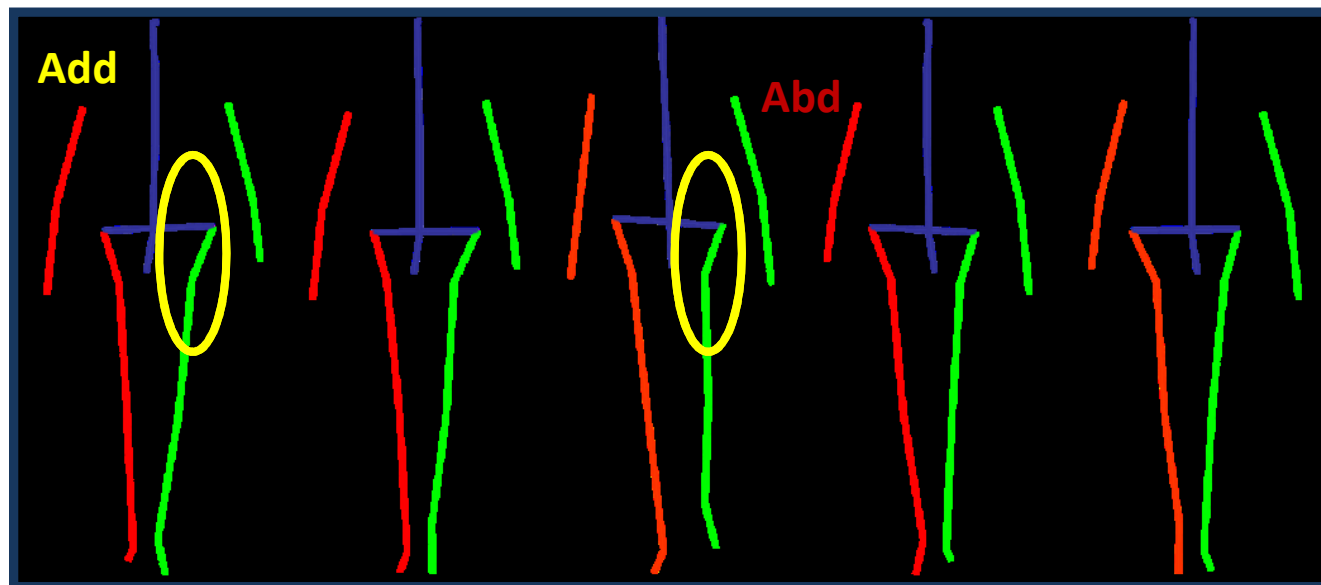




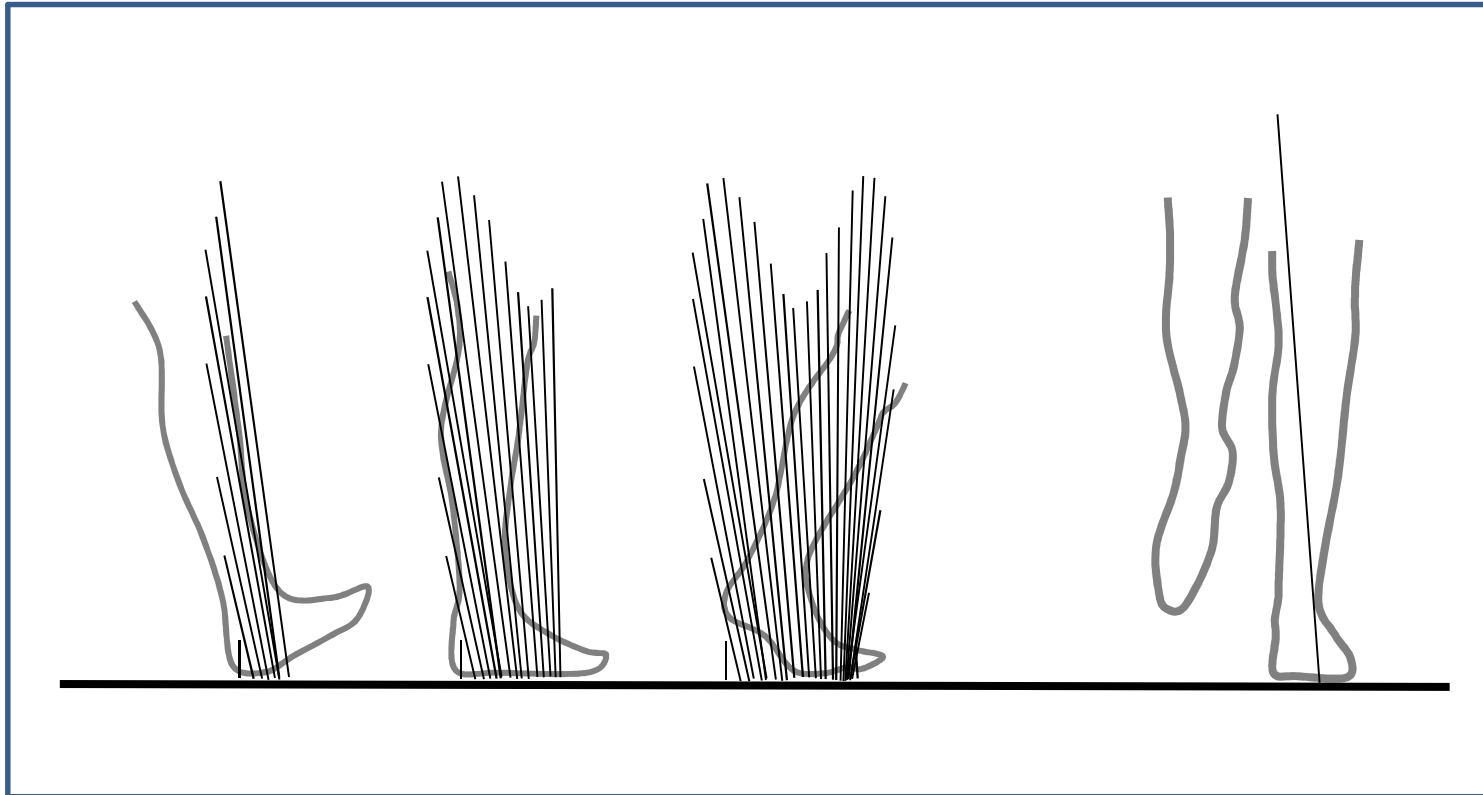
Spostamenti verticali delle sommità delle creste iliache



Piano frontale



Inclinazione vettore reazione appoggio piano sagittale e frontale



MFADOLSS.GRF

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Accettazione

Spinta

Vert. Component

Ground Reactions

[N/Bm*100]

1000

Bw

4.6[C.U.]

446.3[RMS]

Ant/Post Comp.

4.3[C.U.]

61.4[RMS]

Medial/Lat. Comp.

11.9[C.U.]

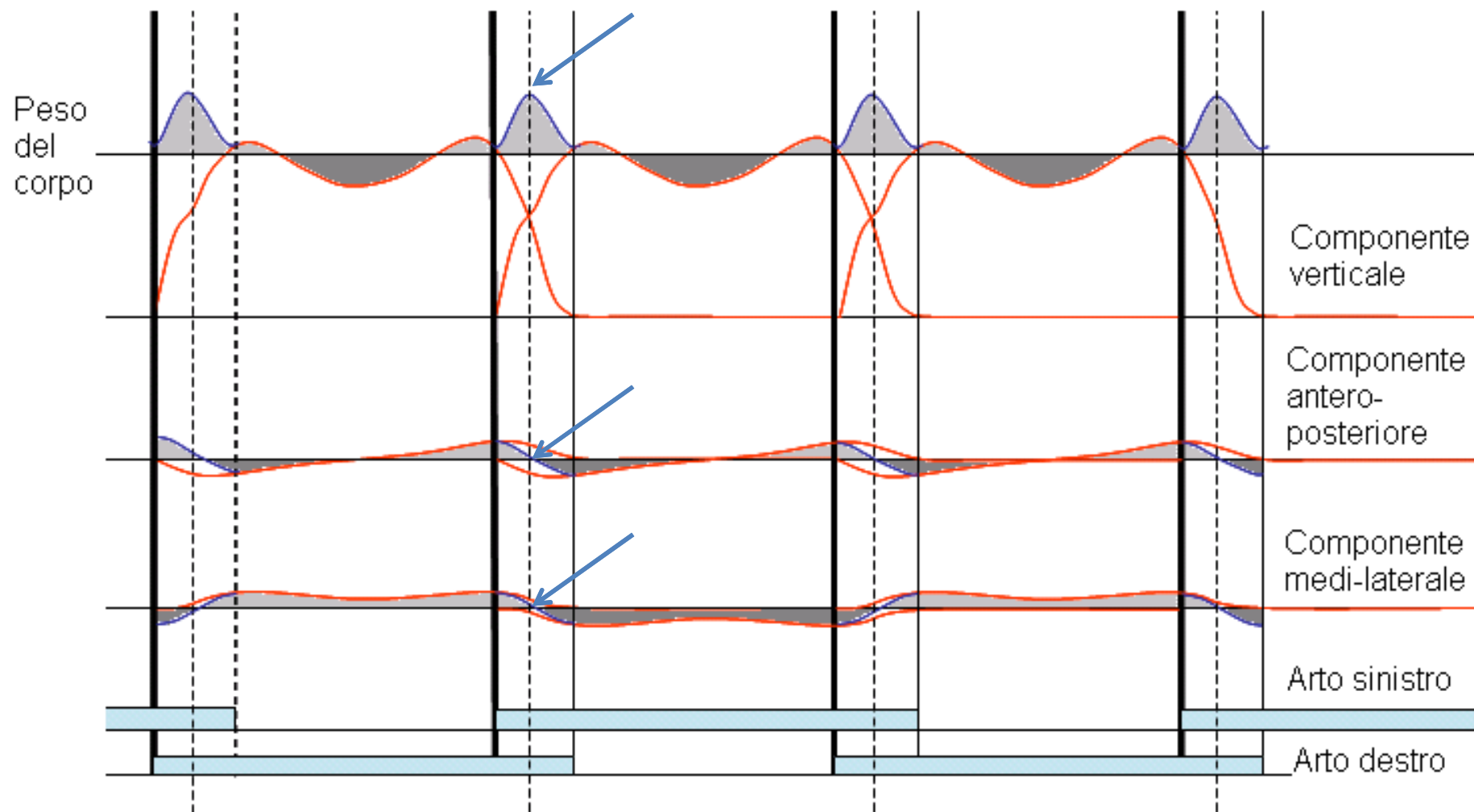
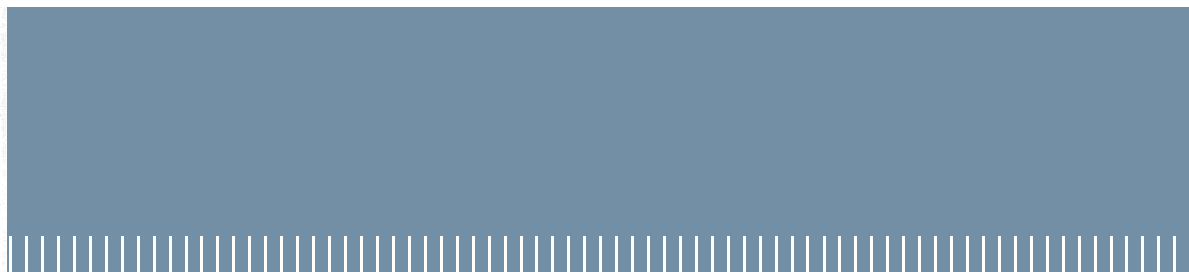
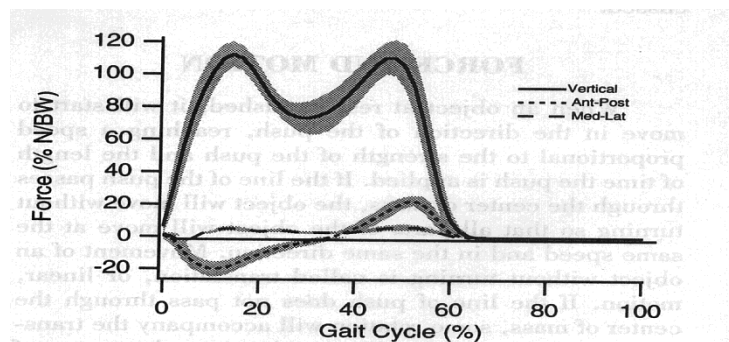
18.8[RMS]

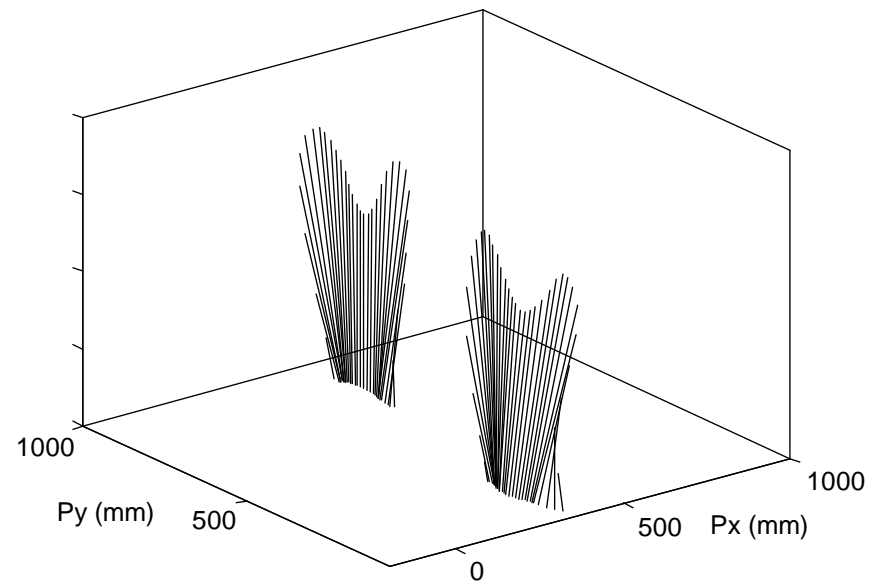
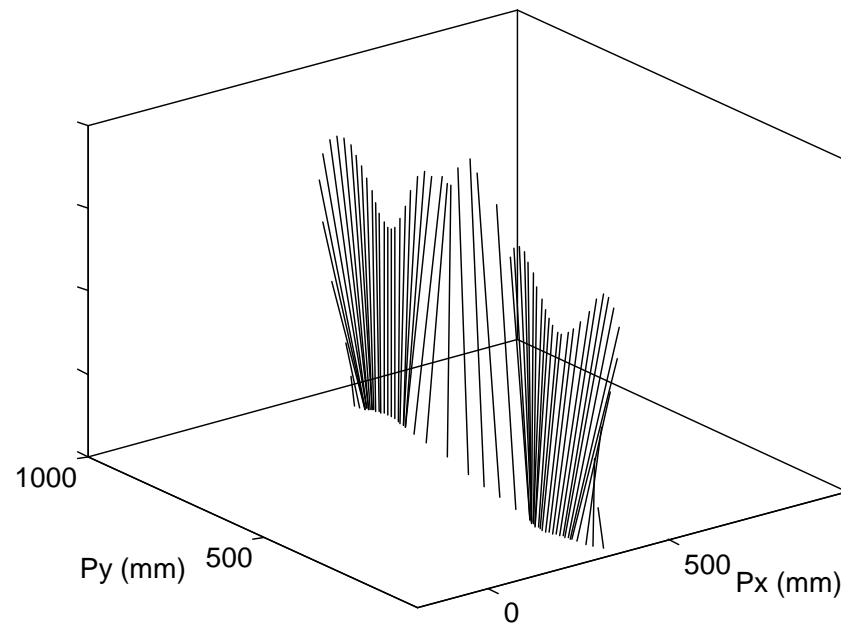
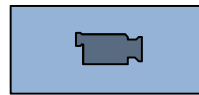
0%

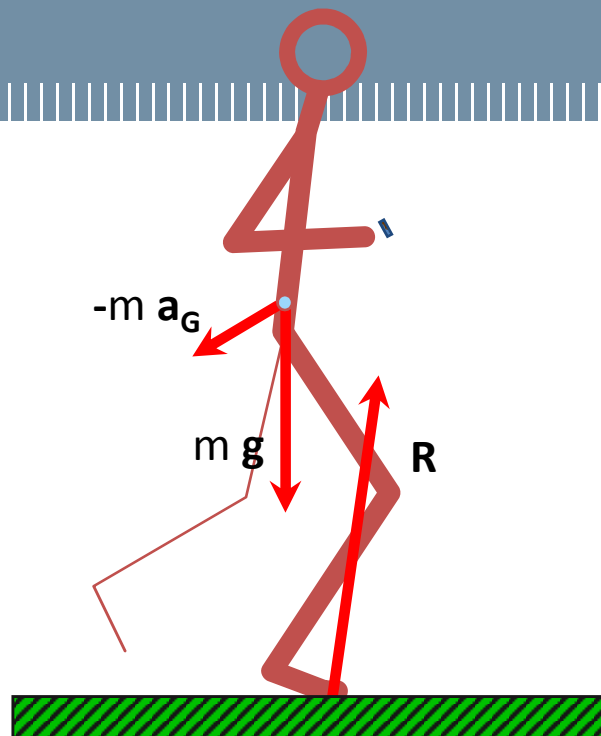
Stance Phase

Swing Phase

100%

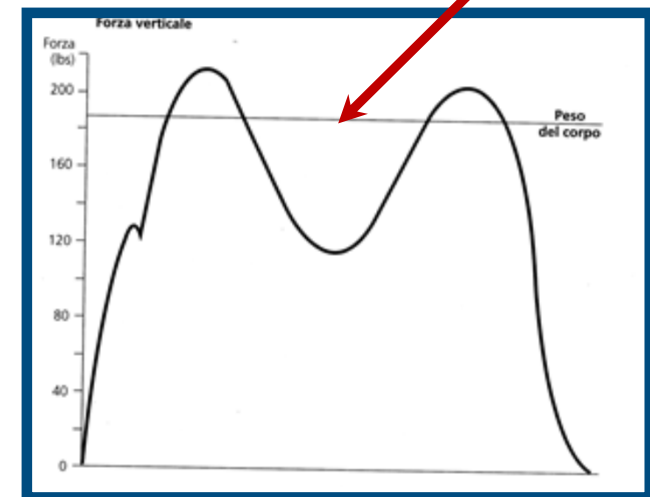






$$R - m g = m a_G$$

A meno di costanti, come il peso corporeo, la **Reazione del terreno** è proporzionale alle accelerazioni del baricentro.

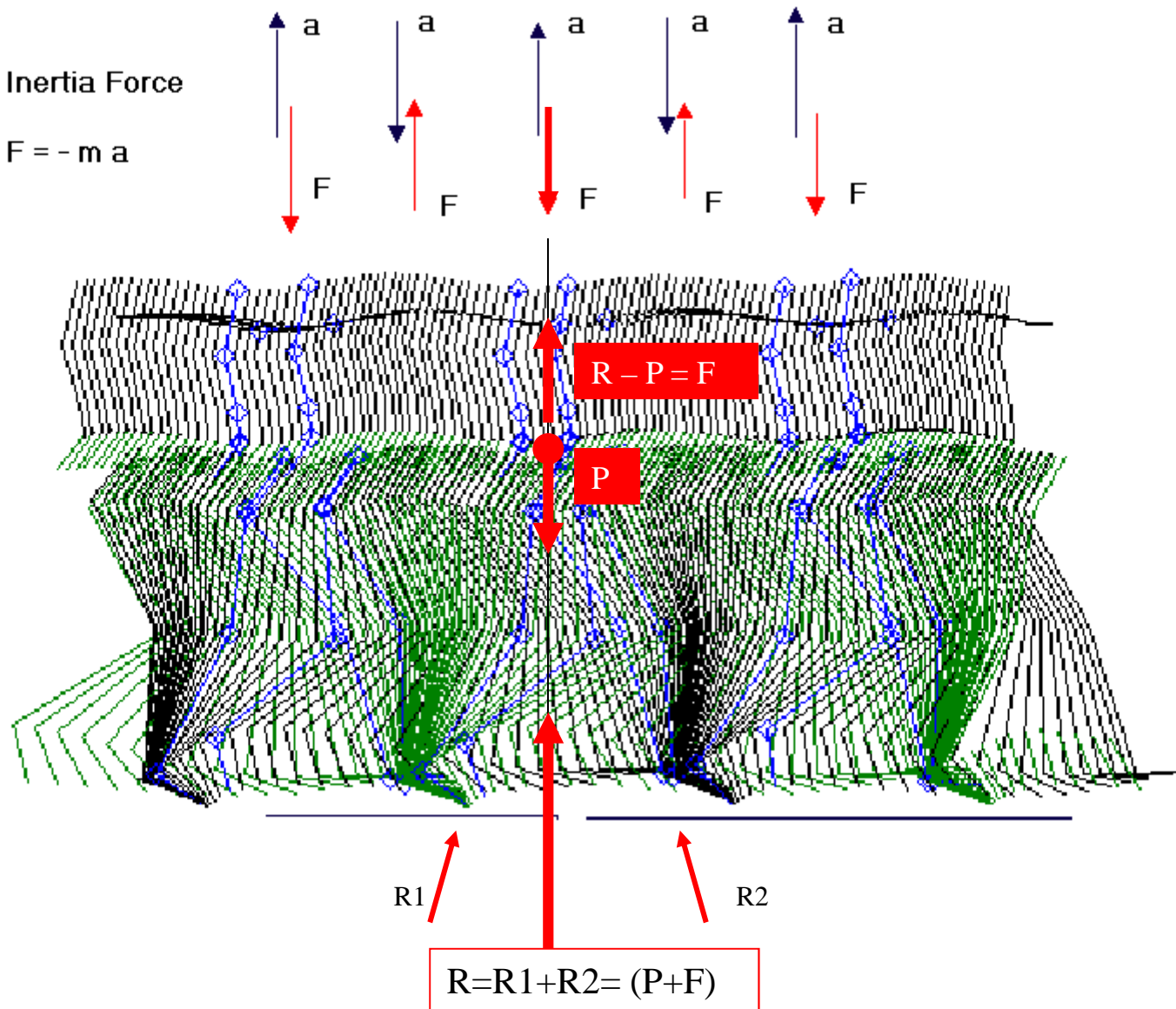


Vertical Acceleration : a

$$a = F / m$$

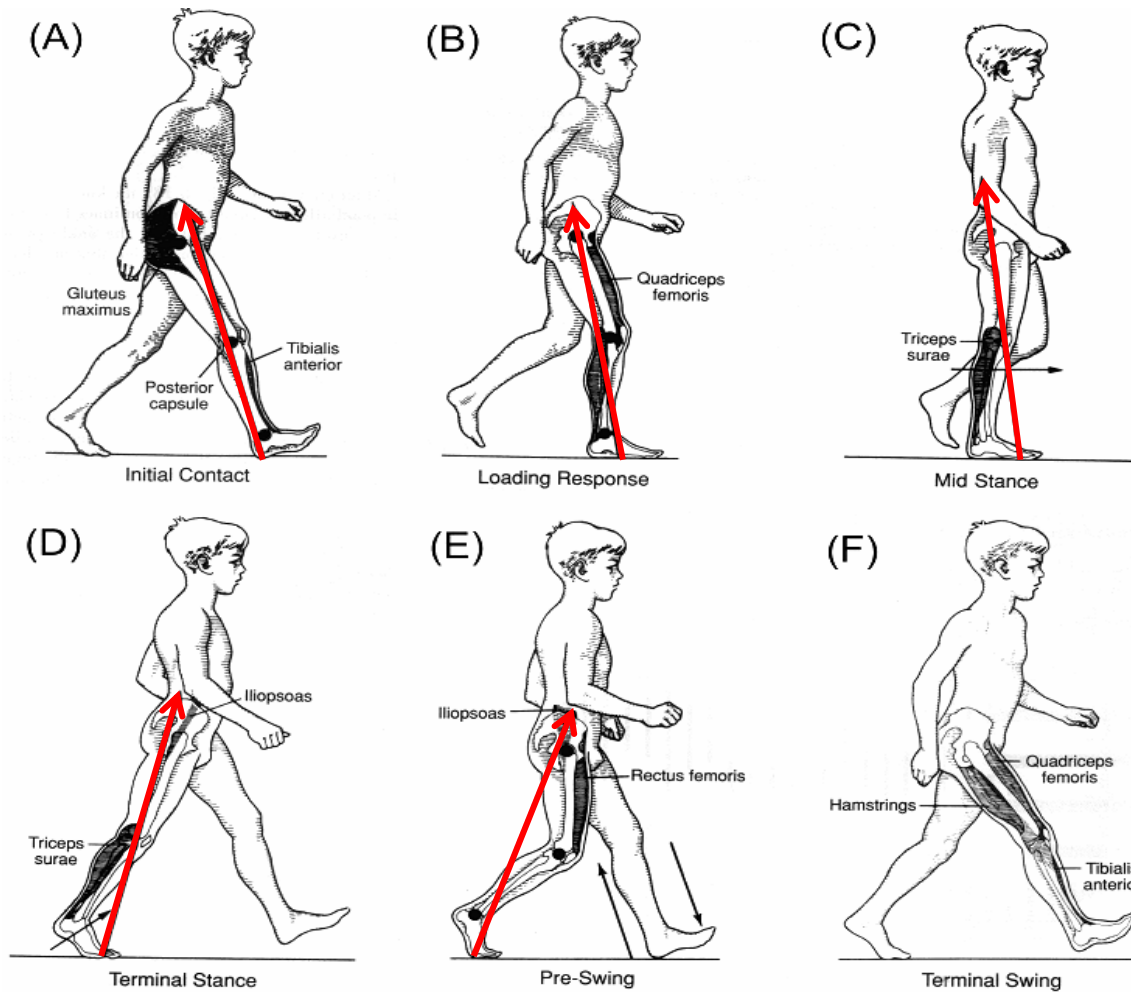
Inertia Force

$$F = - m a$$

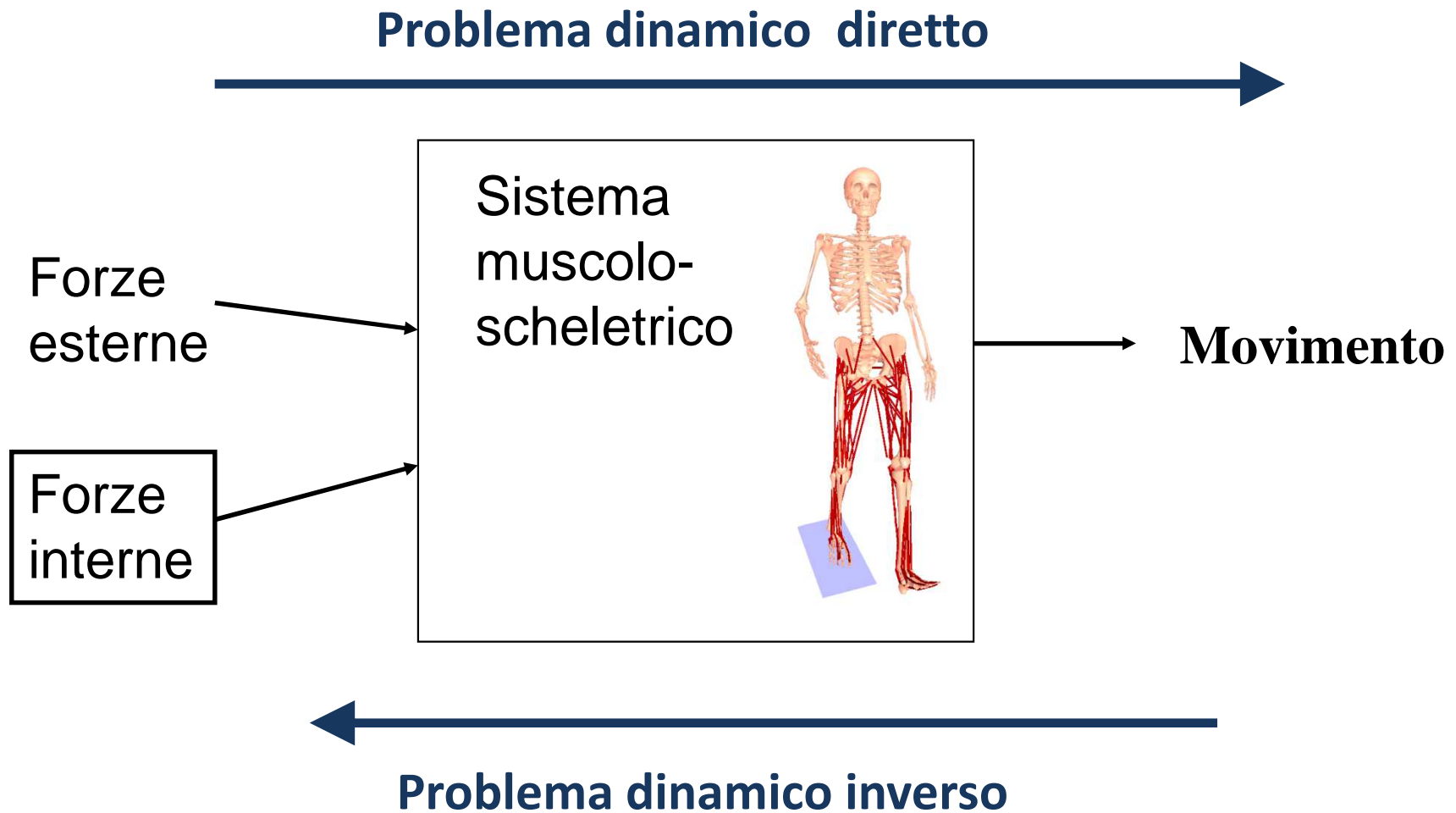


3 . 0 . 1 . F . Lo

Ruolo dei principali muscoli



Problema dinamico diretto ed inverso

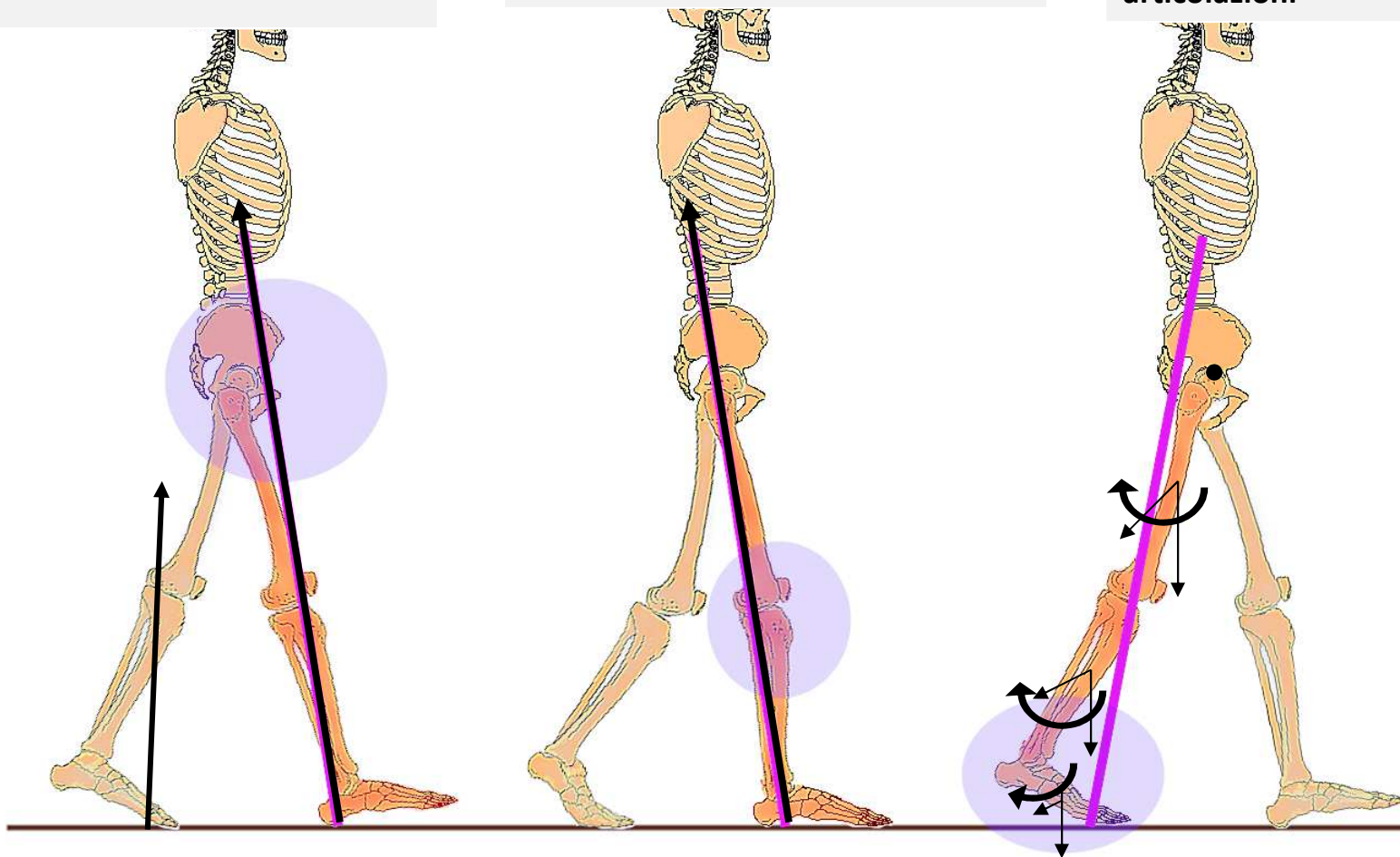


Momenti articolari

Le REAZIONI D'APPOGGIO sono forze e momenti che si sviluppano all'interfaccia piede-terreno

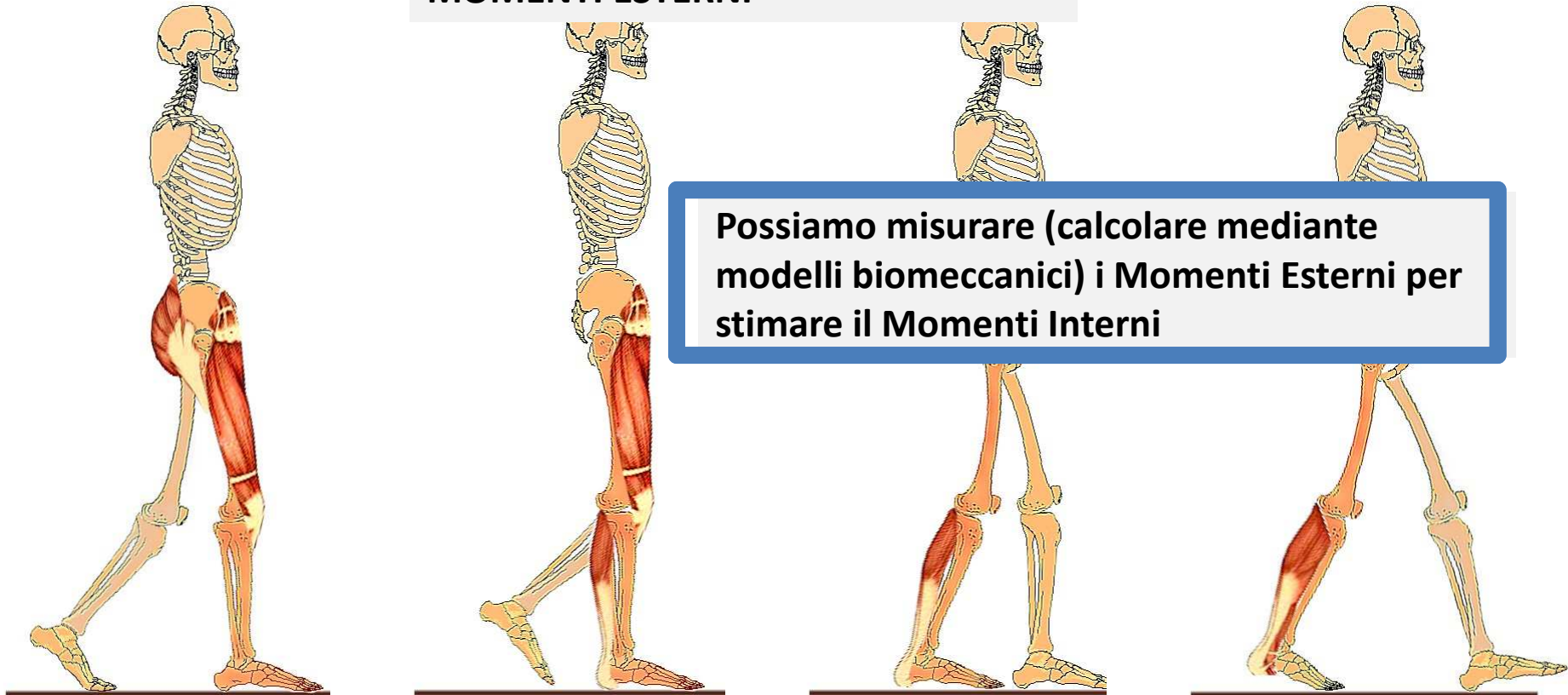
Un MOMENTO è il risultato di una FORZA che agisce ad una certa DISTANZA da un punto

Generalmente siamo interessati ai momenti delle FORZE ESTERNE rispetto ai centri delle articolazioni

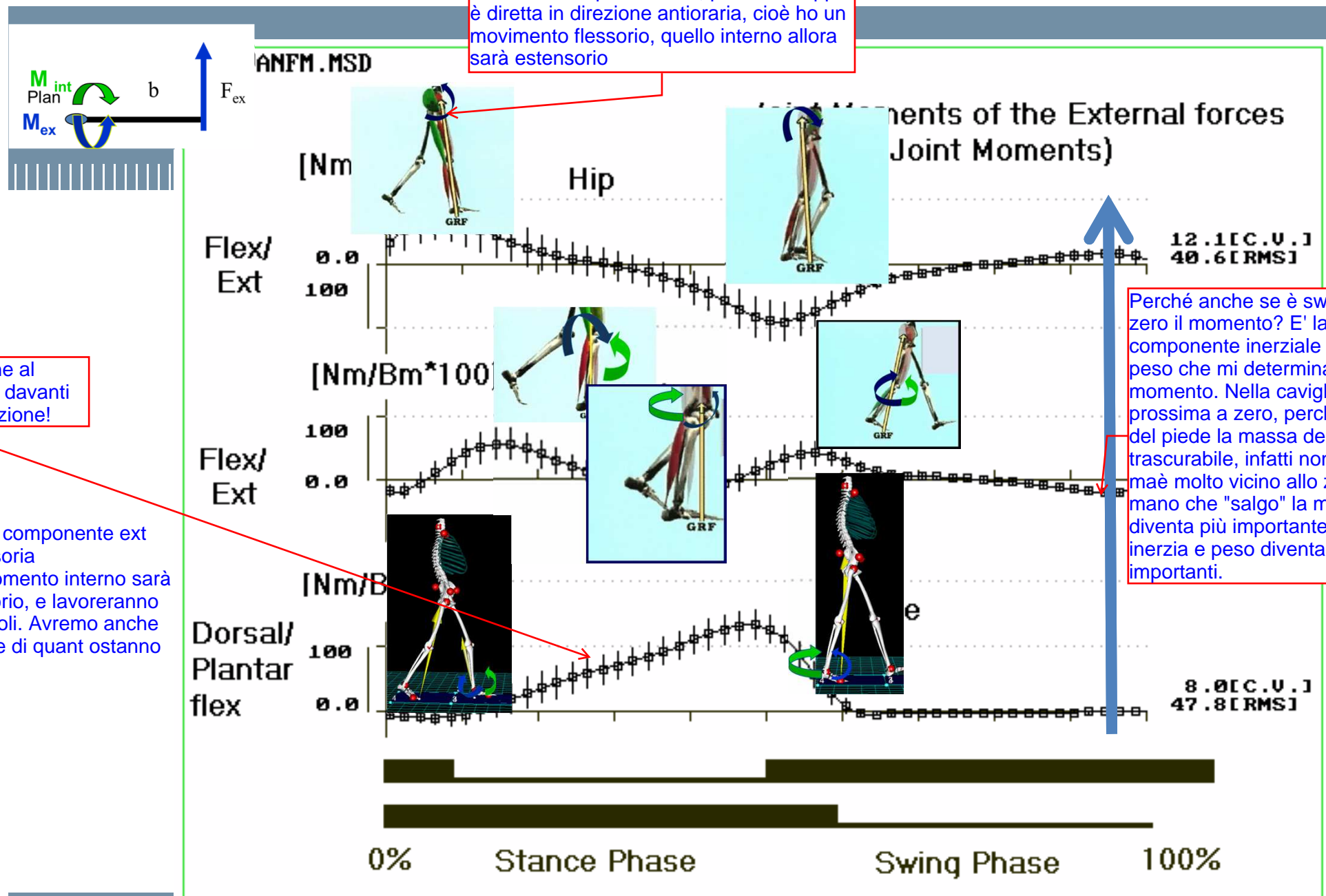


Muscoli, legamenti e altri tessuti molli peri-articolari producono MOMENTI INTERNI

I Momenti Interni contro-bilanciano i MOMENTI ESTERNI



la reazione capita davanti, perciò la coppia è diretta in direzione antioraria, cioè ho un movimento flessorio, quello interno allora sarà estensorio

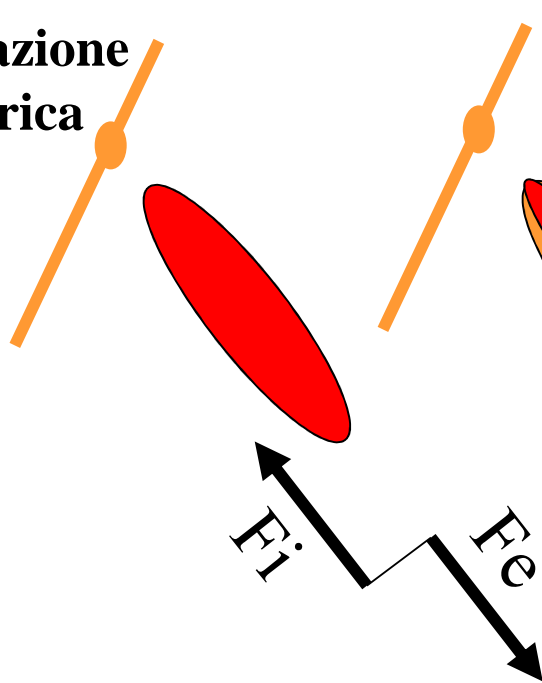


La reazione al terreno va davanti all'articolazione!

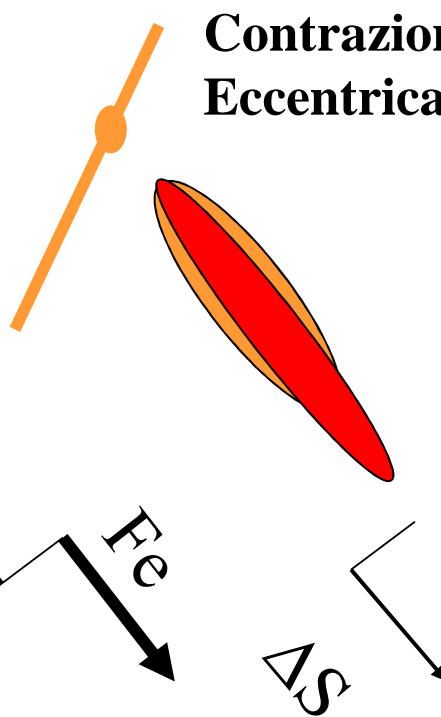
Se ho una componente ext plantaflessoria allora il momento interno sarà dorsiflessorio, e lavoreranno quei muscoli. Avremo anche indicazione di quant o stanno lavorando

Perché anche se è swing non è zero il momento? E' la componente inerziale e la forza peso che mi determina il momento. Nella caviglia è prossima a zero, perché nel caso del piede la massa del piede è trascurabile, infatti non è zero ma è molto vicino allo zero. Man mano che "salgo" la massa diventa più importante, e quindi inerzia e peso diventano più importanti.

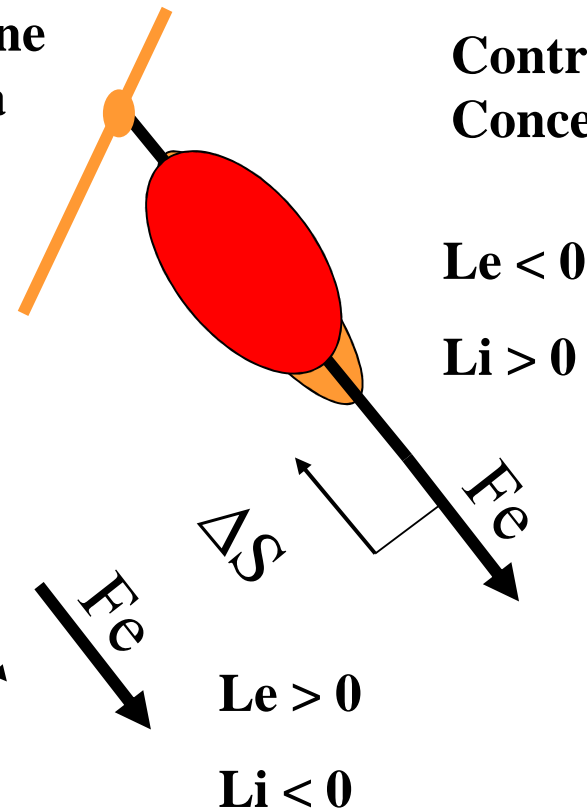
**Contrazione
isometrica**



**Contrazione
Eccentrica**



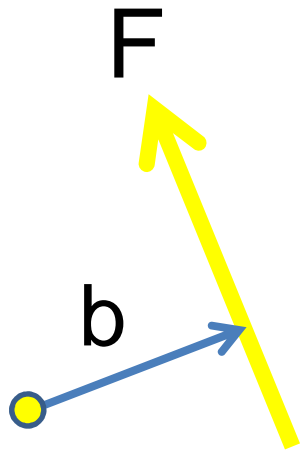
**Contrazione
Concentrica**



Lavoro Meccanico: $L = F \times \Delta S$

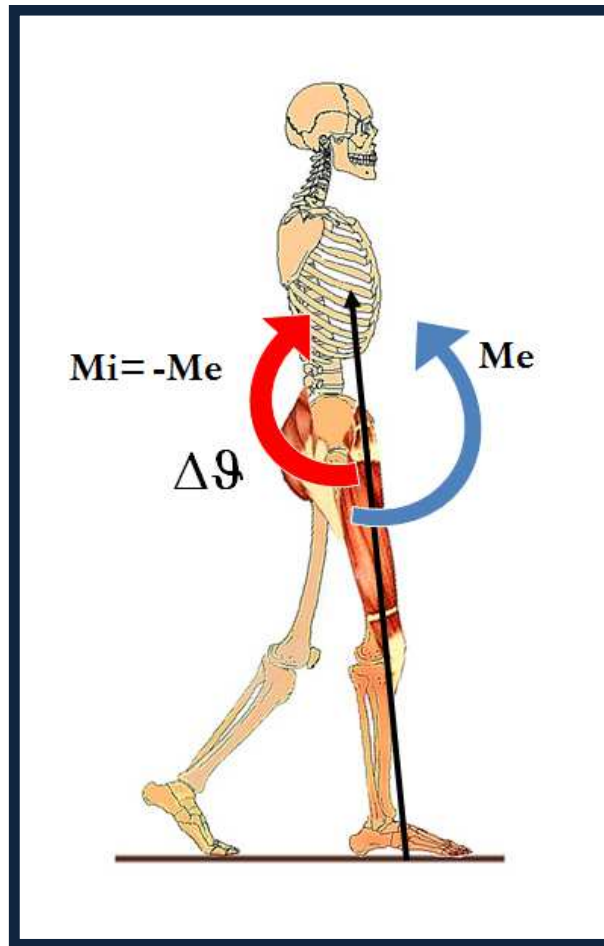
I momenti e le potenze articolari

Momento di una forza



$$M = F \times b$$

$$Li = Mi \cdot \Delta\vartheta$$



Lavoro interno:

$$L = Mi \times \Delta\vartheta$$

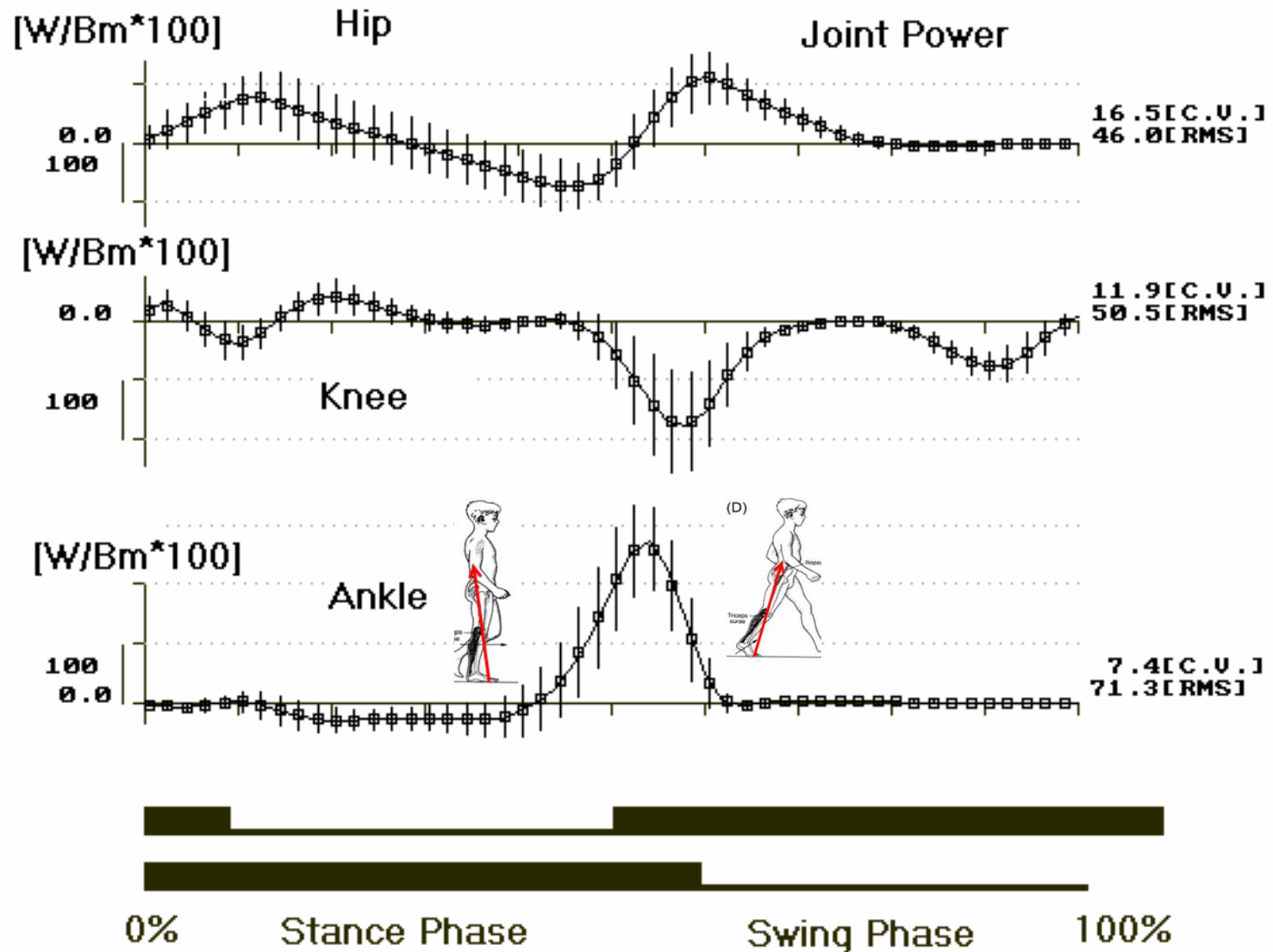
Potenza prodotta:

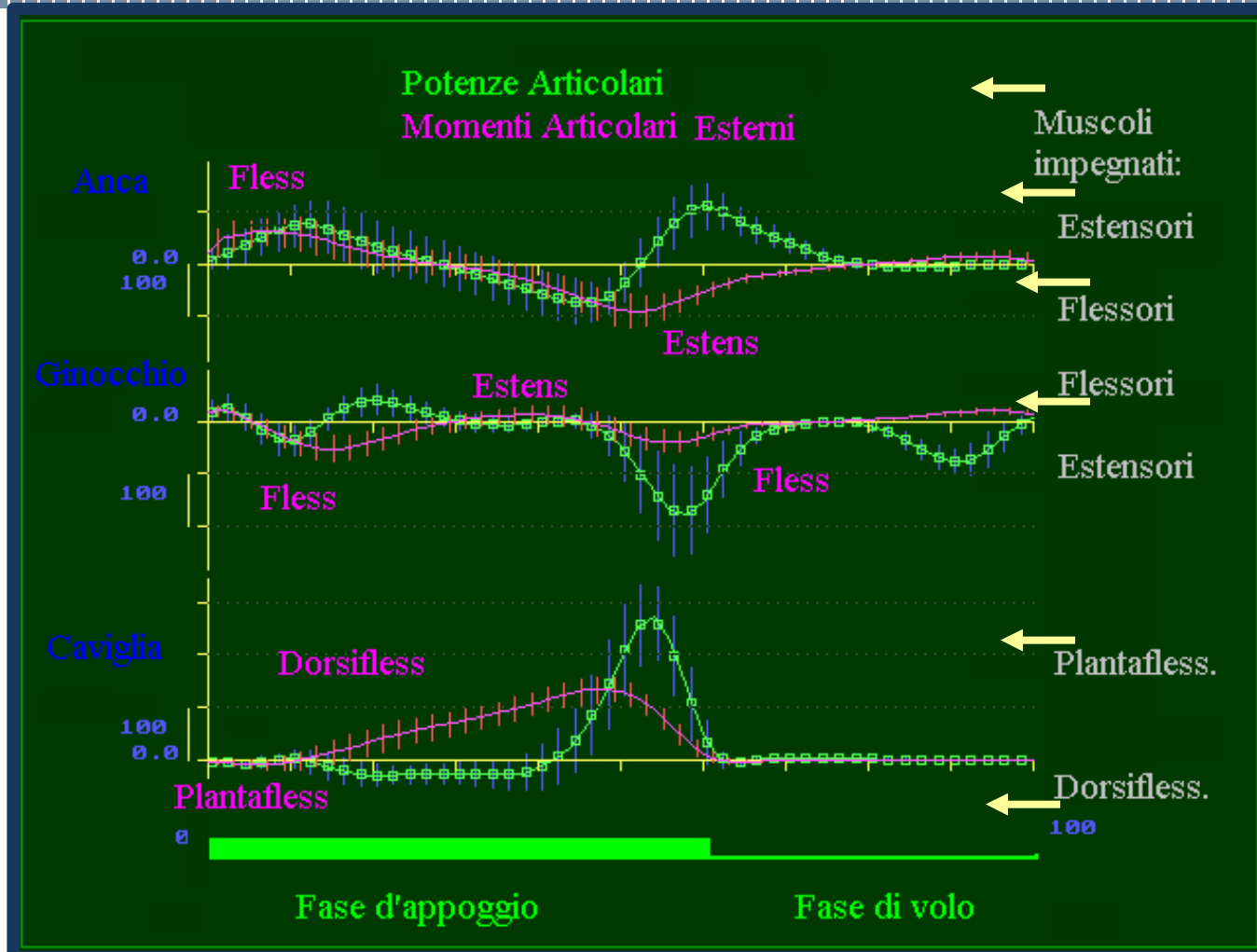
$$P = Mi \times \Delta\vartheta / \Delta t$$

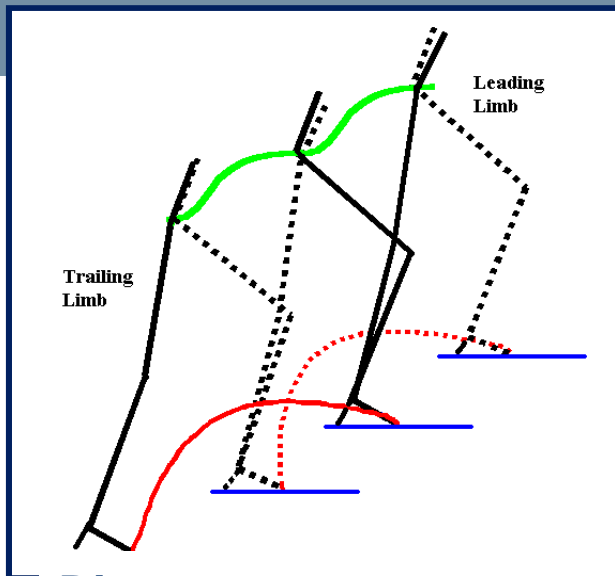
$$= Mi \times \omega$$

GIOVANFM.PSD

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Salita

-fase di stance:

- fase di doppio appoggio (double support)
- fase di supporto singolo (single limb support)
- seconda fase di doppio appoggio (second double support)

-fase di swing:

- slancio iniziale (foot clearance)
- fase di posizionamento (foot placement)

Discesa

-fase di stance:

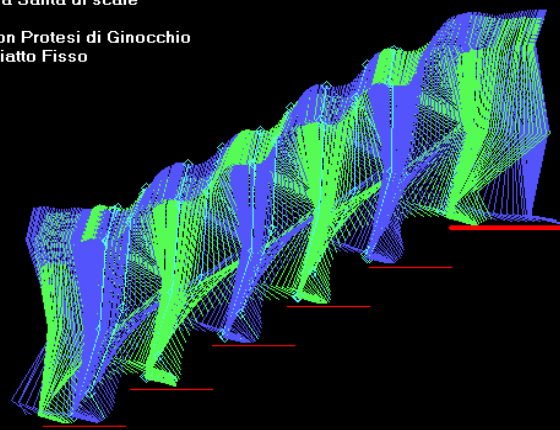
- doppio appoggio (double support)
- continuazione in avanti (forward continuance)
- discesa controllata (controlled lowering)
- secondo doppio appoggio (double support)

-fase di swing:

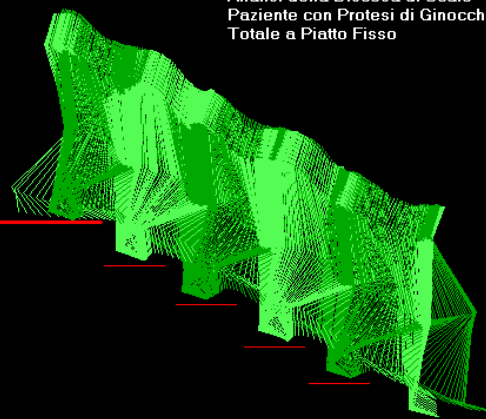
- slancio iniziale (pull through)
- fase di posizionamento (foot placement)

Analisi della Salita di scale

Paziente con Protesi di Ginocchio
Totale a Piatto Fisso

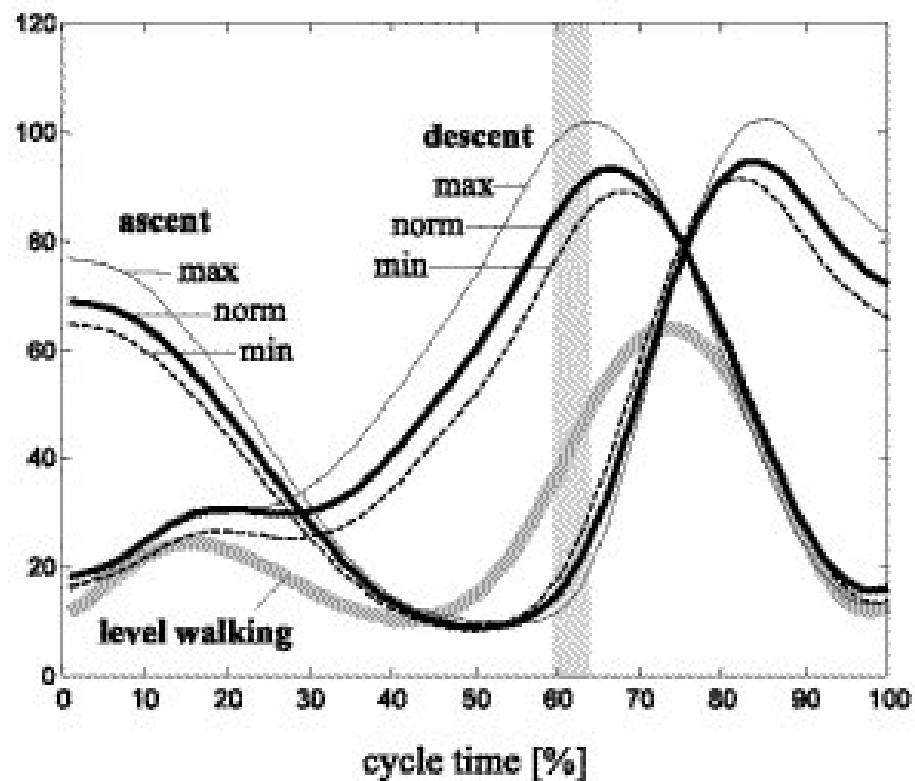


Analisi della Discesa di Scale
Paziente con Protesi di Ginocchio
Totale a Piatto Fisso

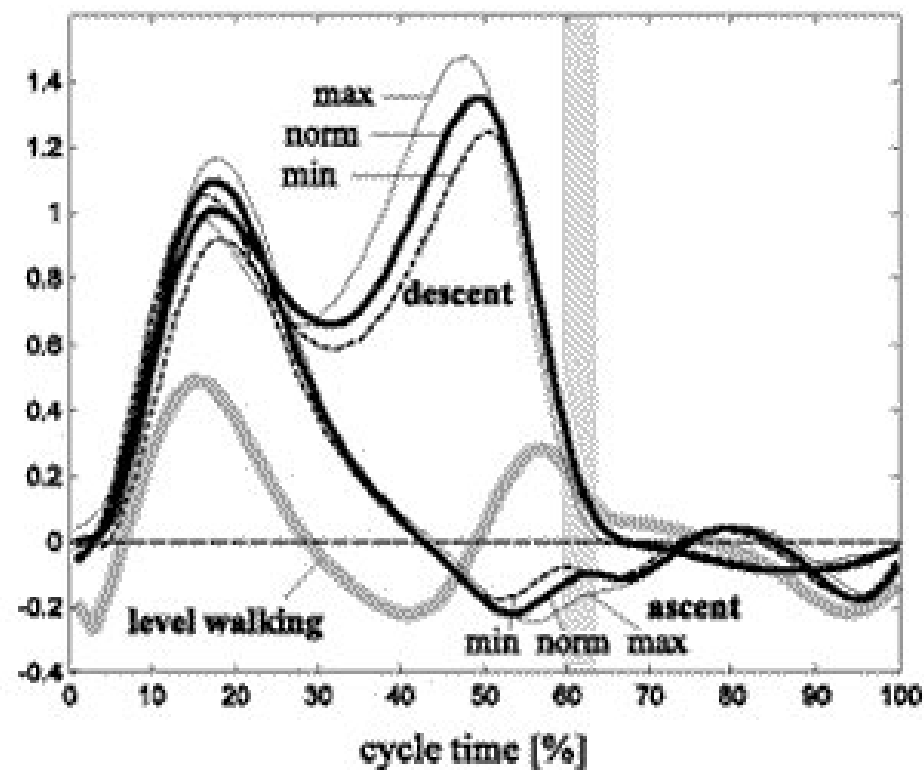


ESC = FINE PROGRAMMA FI = MENU RAPPRESENTAZ.

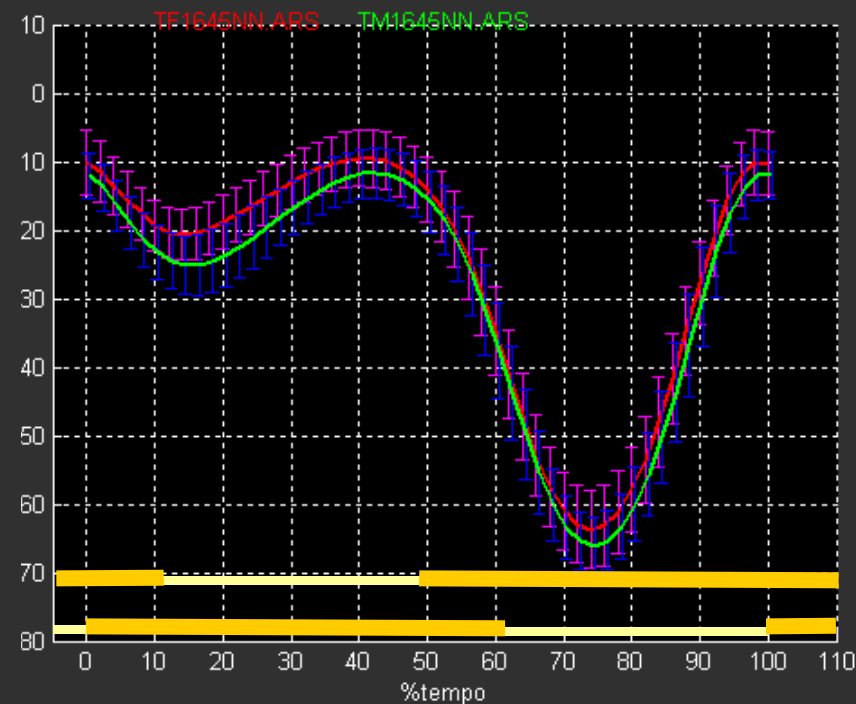
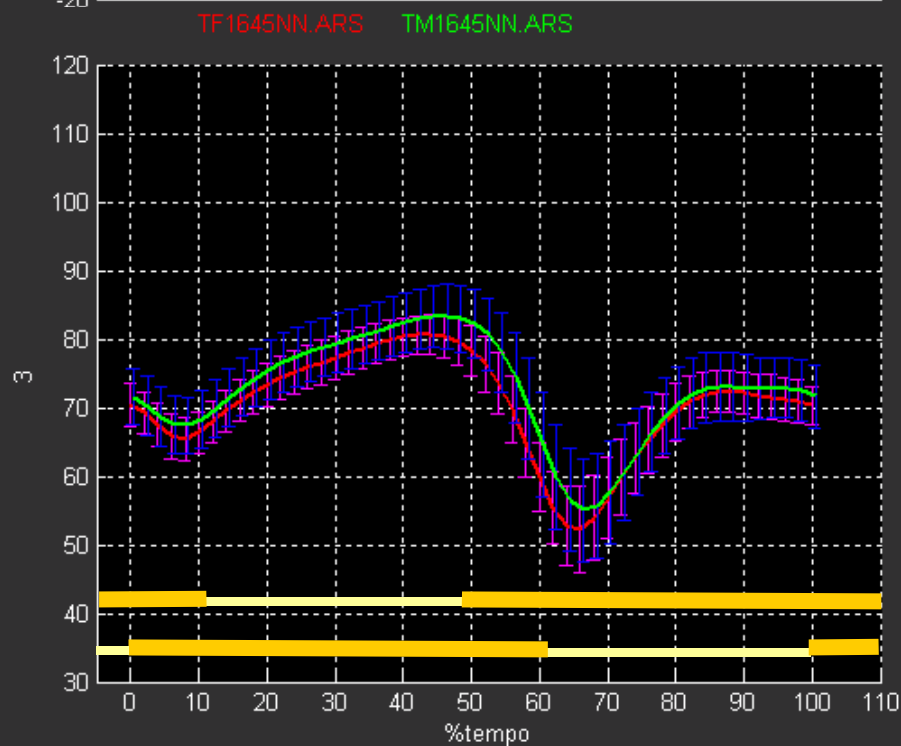
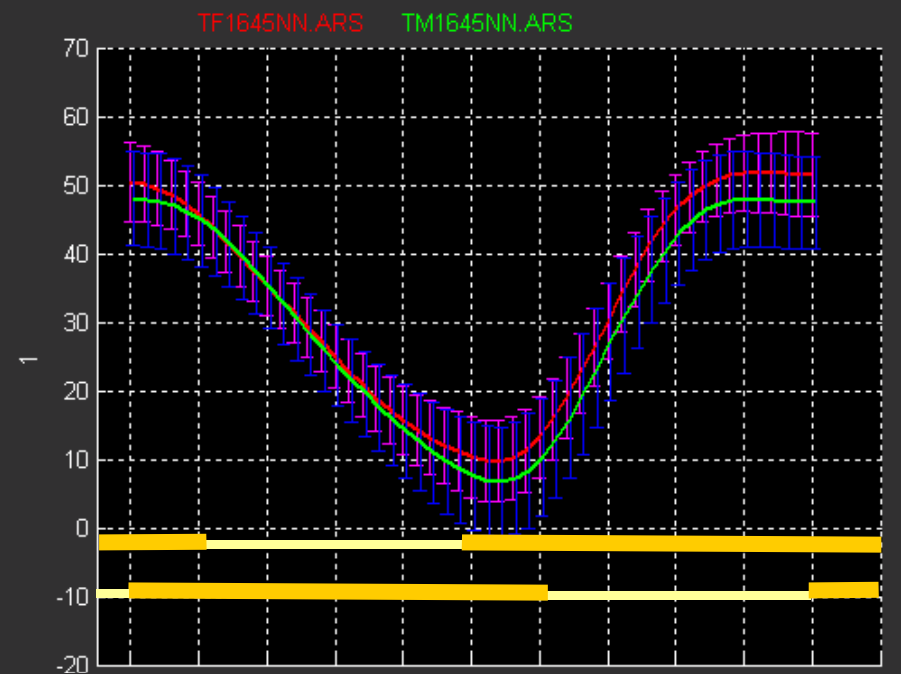
Knee Flexion Angle



Knee Extension Moment



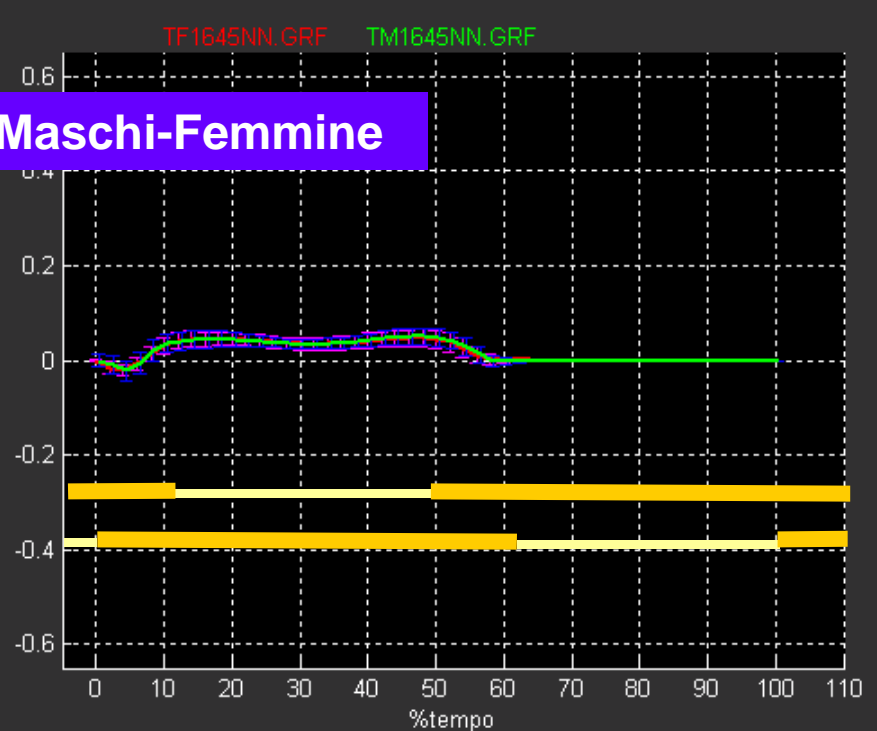
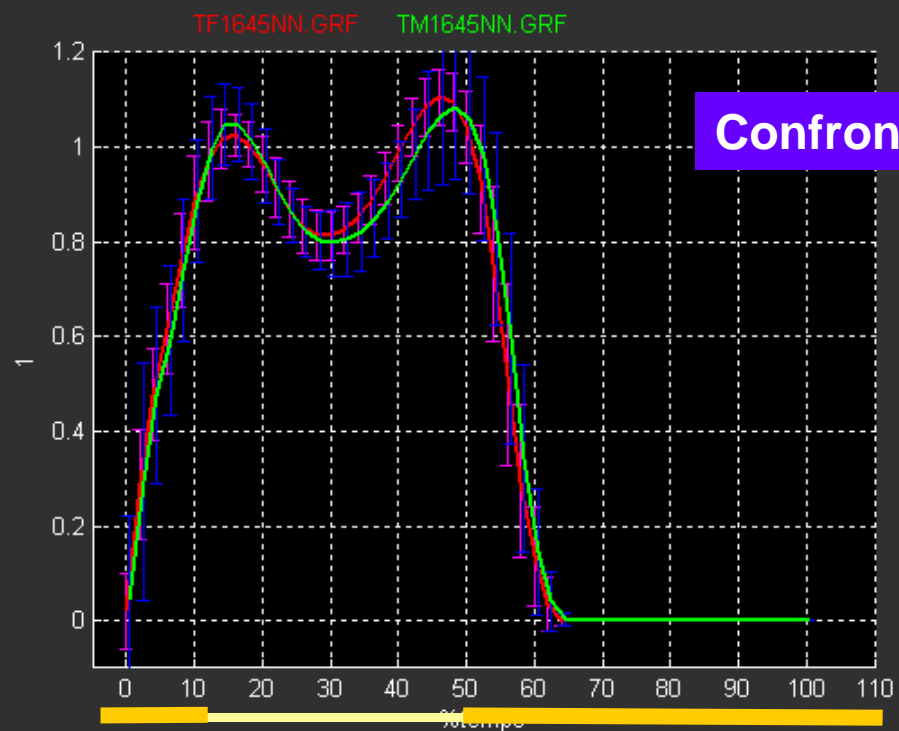
Confronto Maschi-Femmine



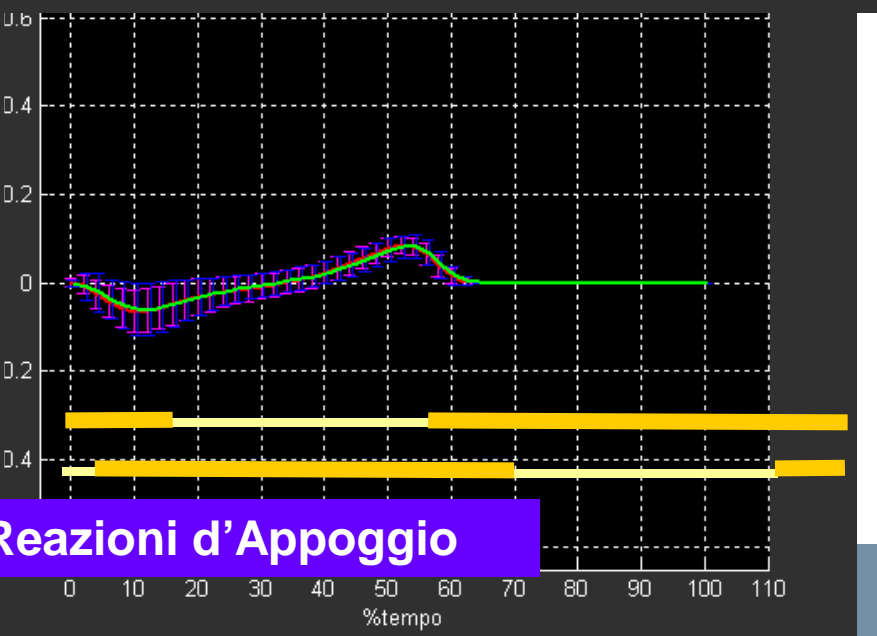
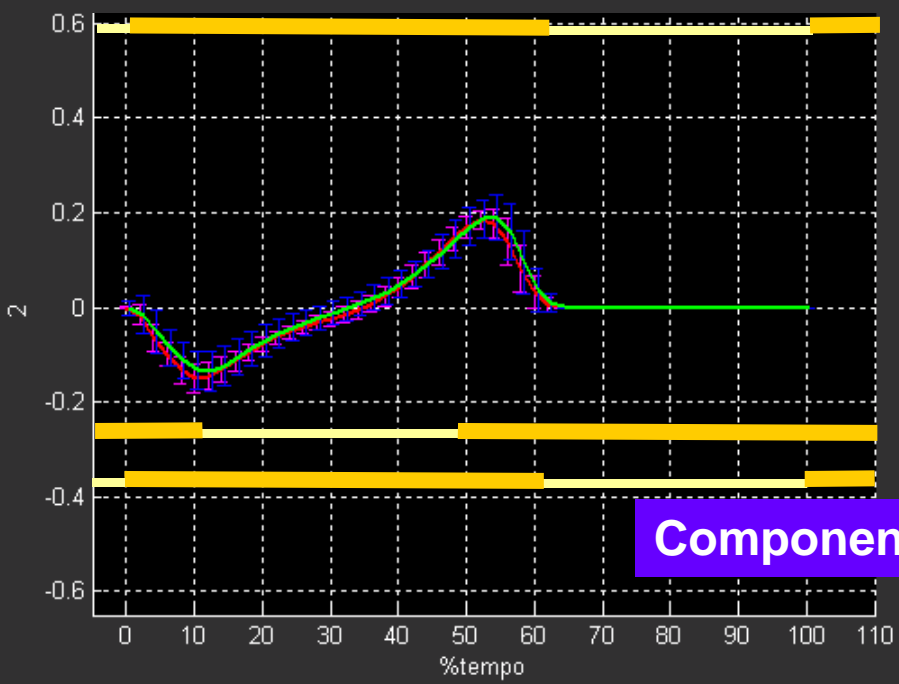
Angoli Flesso- Estensione

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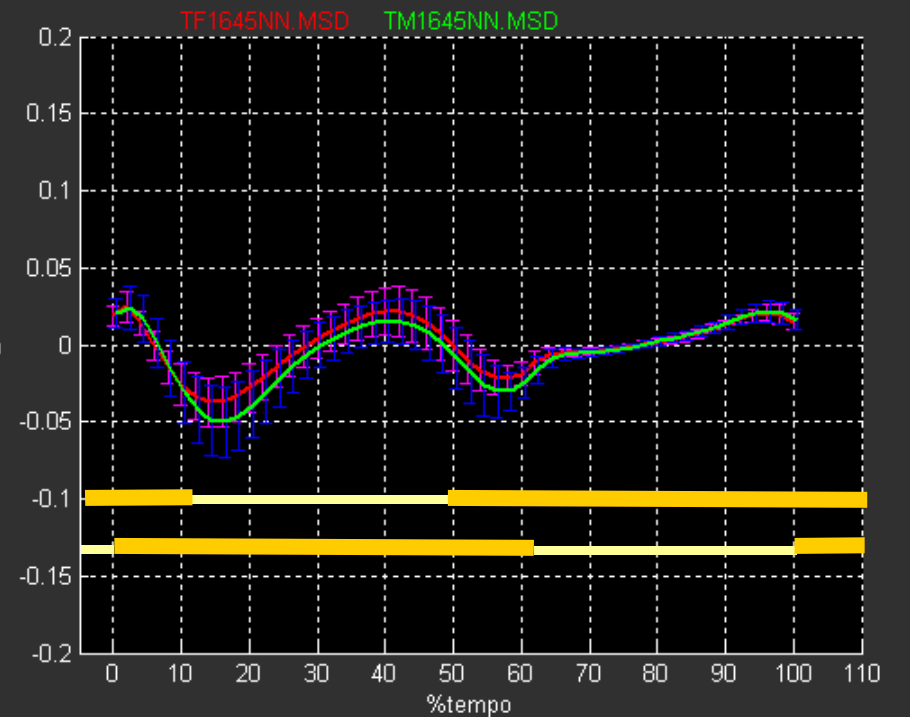
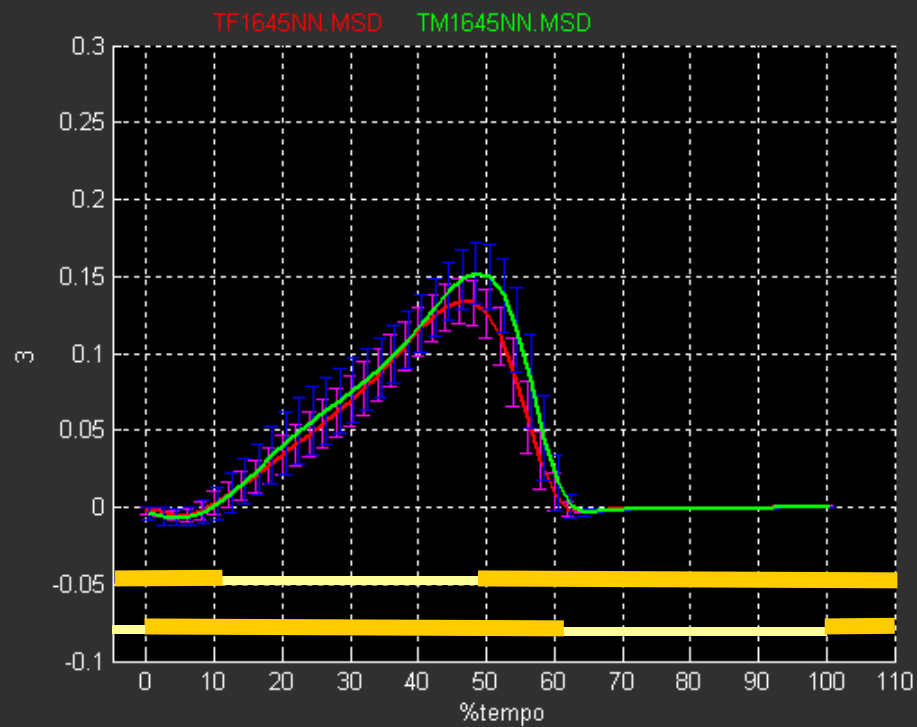
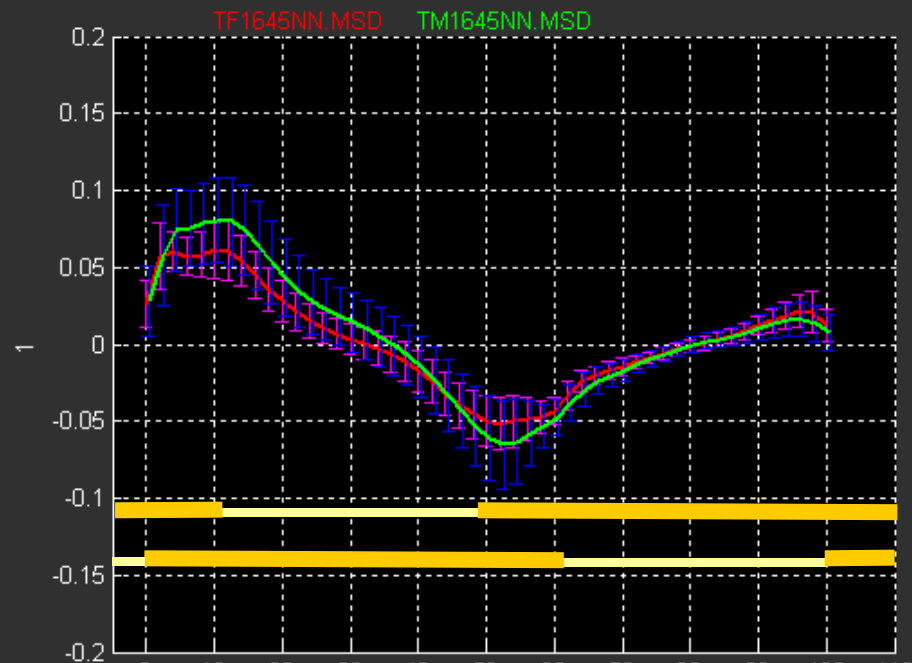
Confronto Maschi-Femmine



Componenti Reazioni d'Appoggio



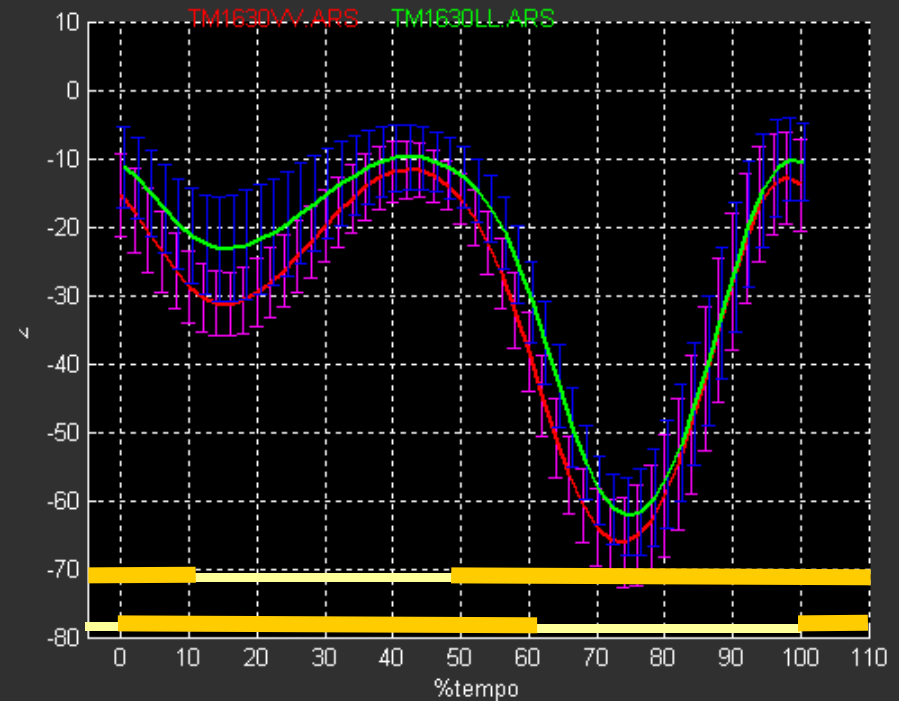
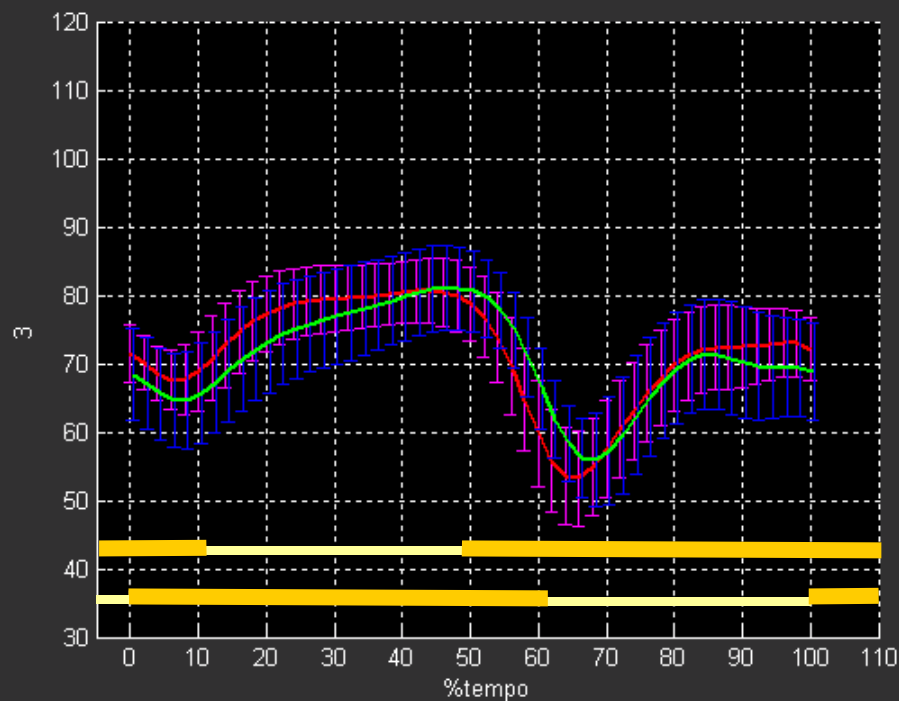
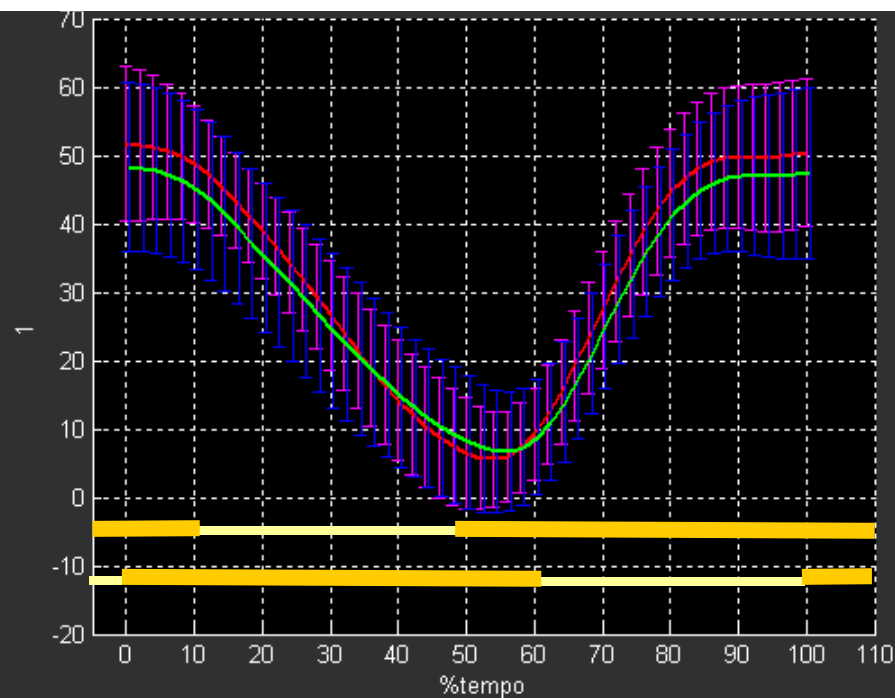
Confronto Maschi-Femmine



Momenti Flesso-Estensione

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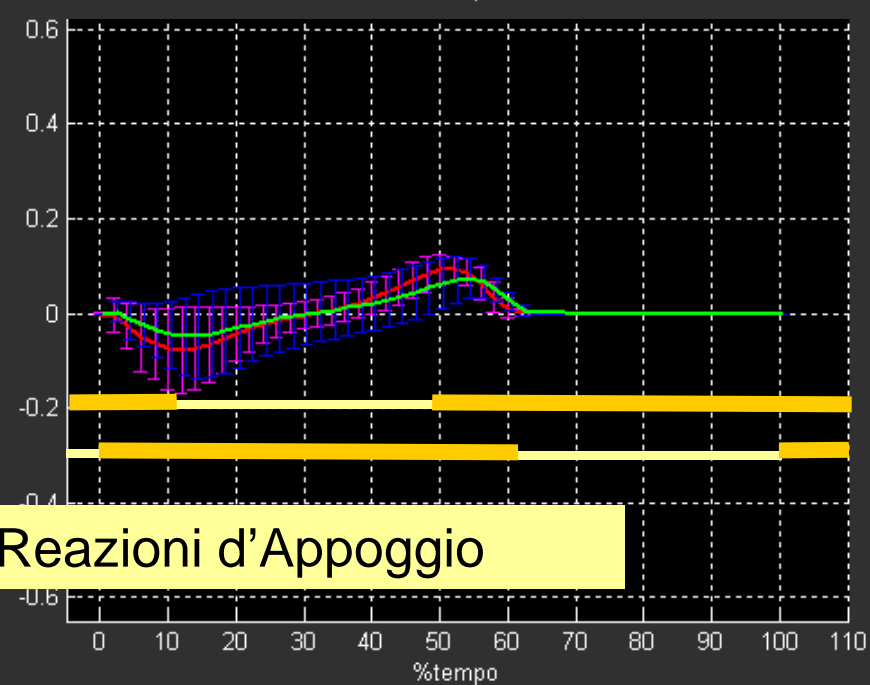
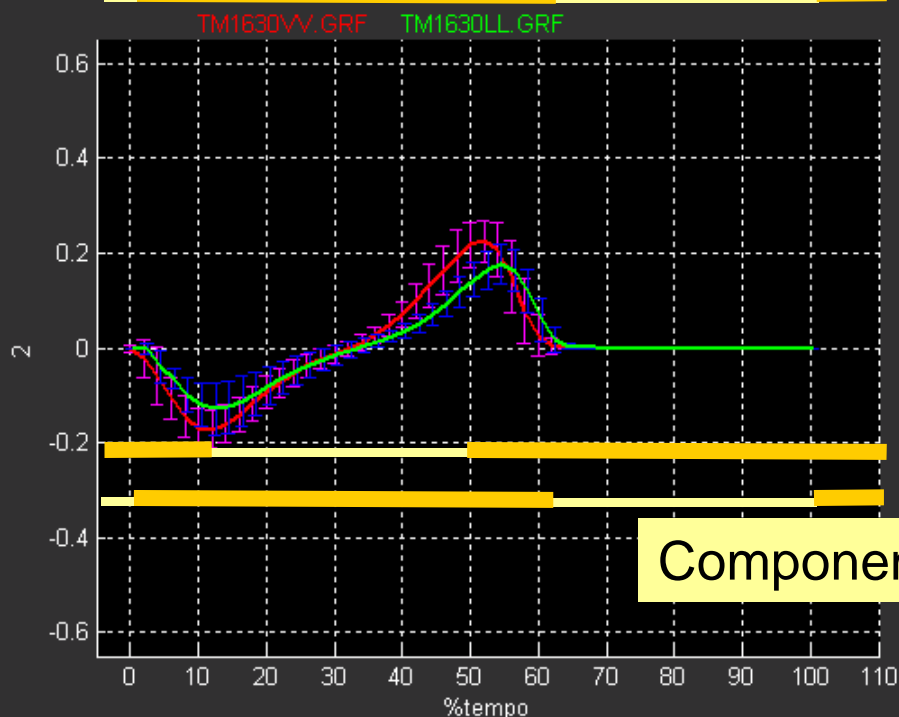
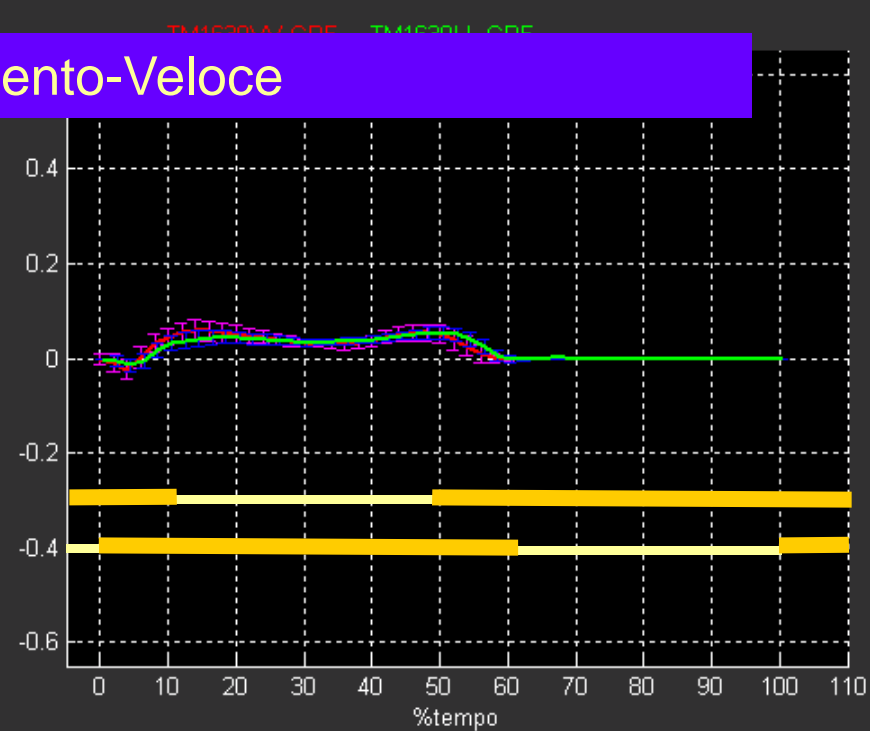
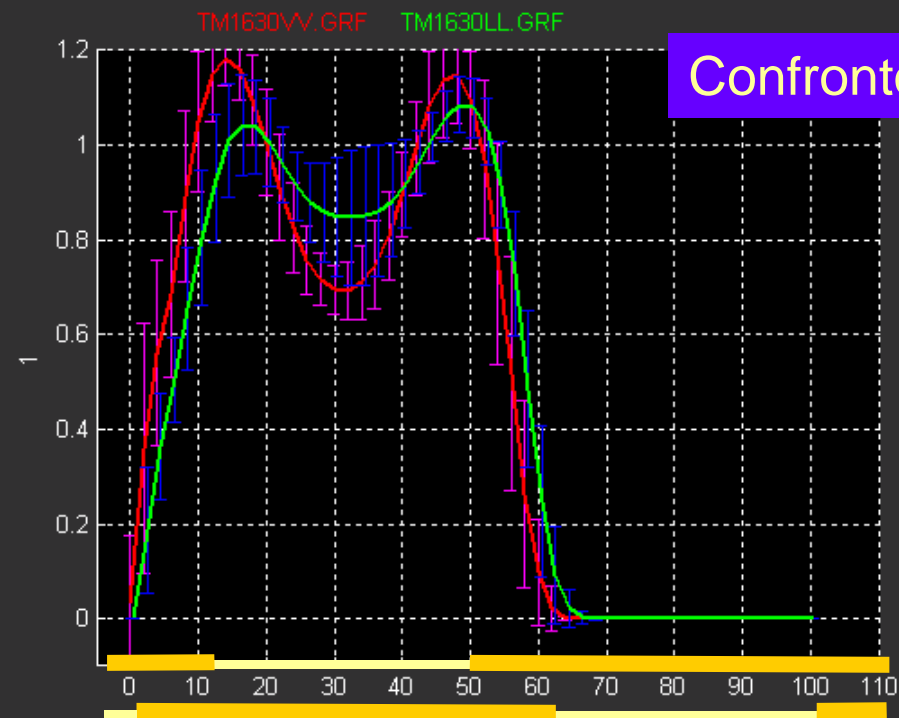
Confronto Lento-Veloce



Angoli flessione-estensione

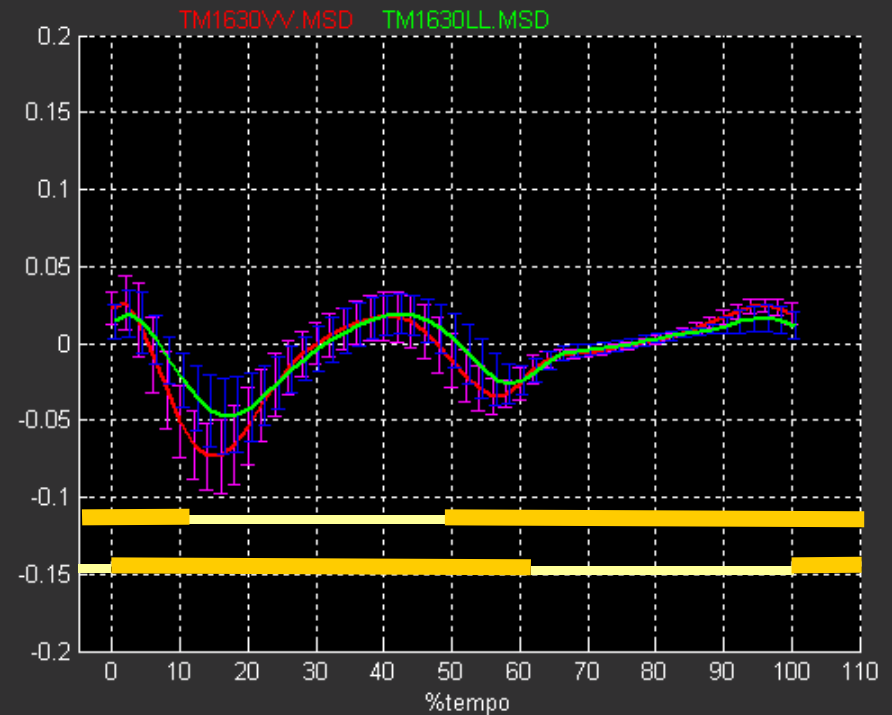
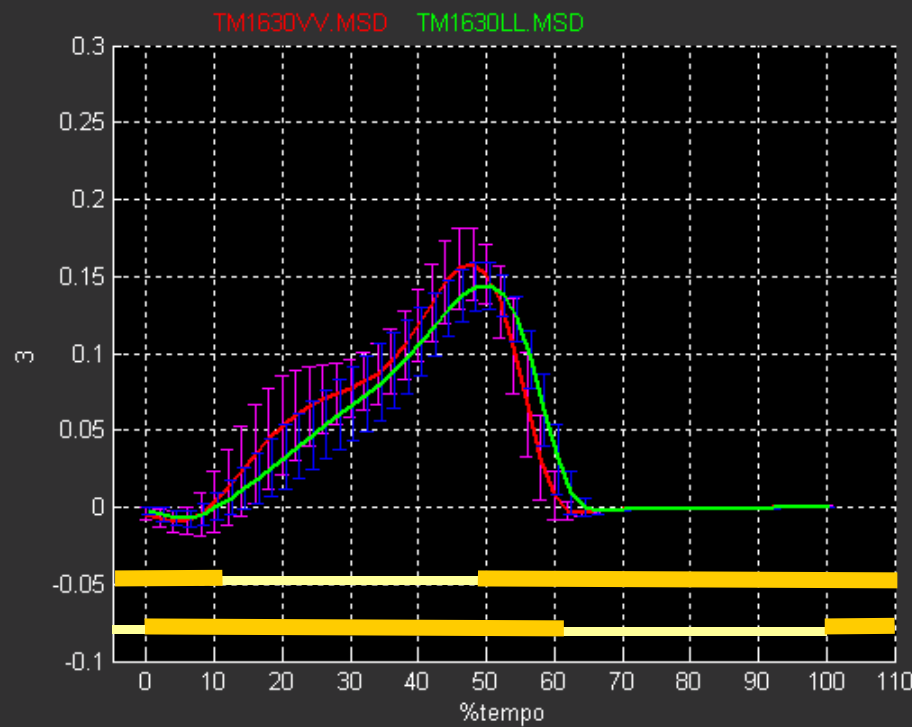
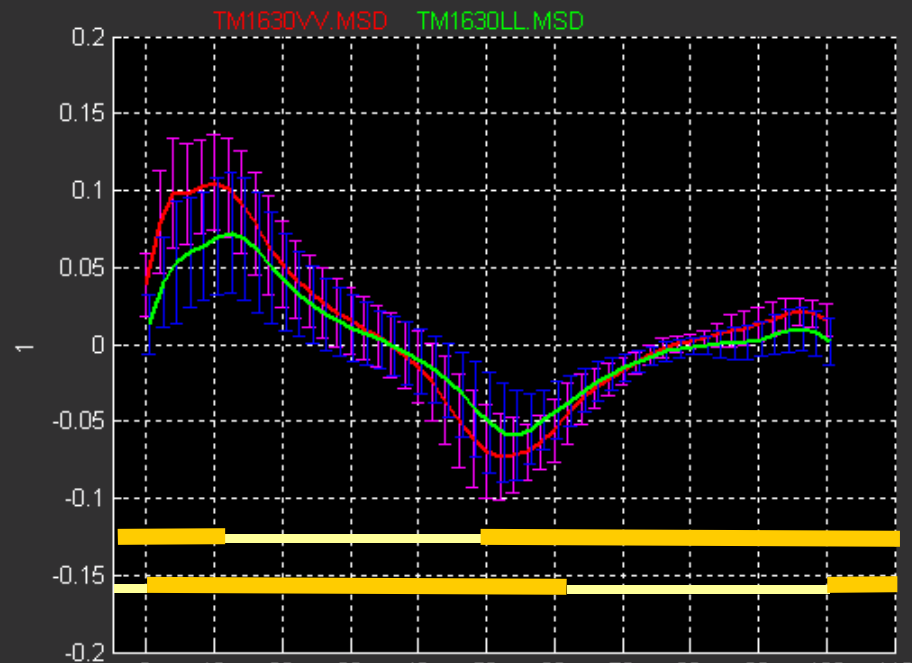
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Confronto Lento-Veloce



Componenti Reazioni d'Appoggio

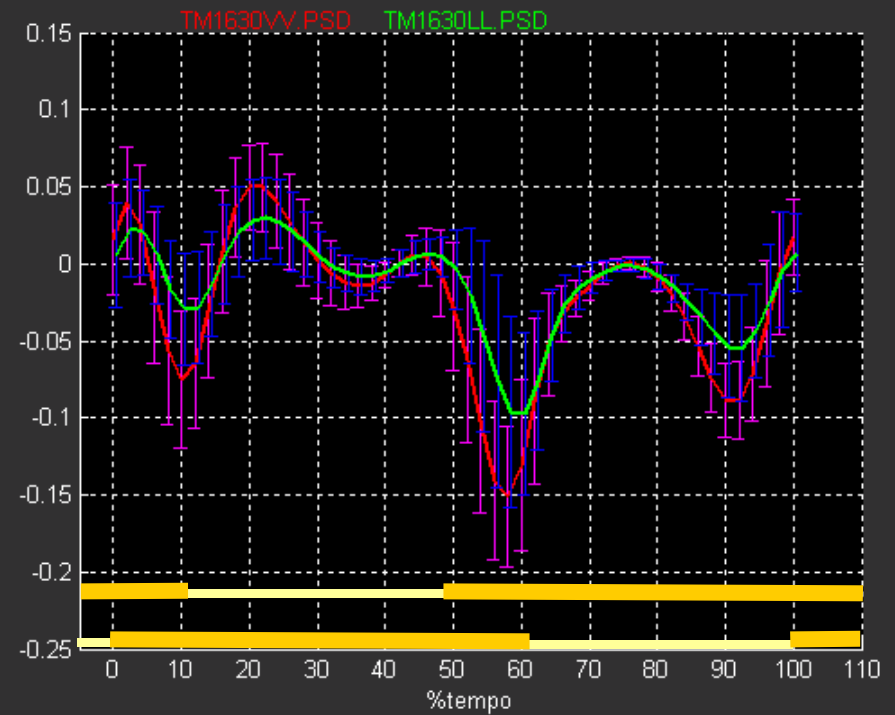
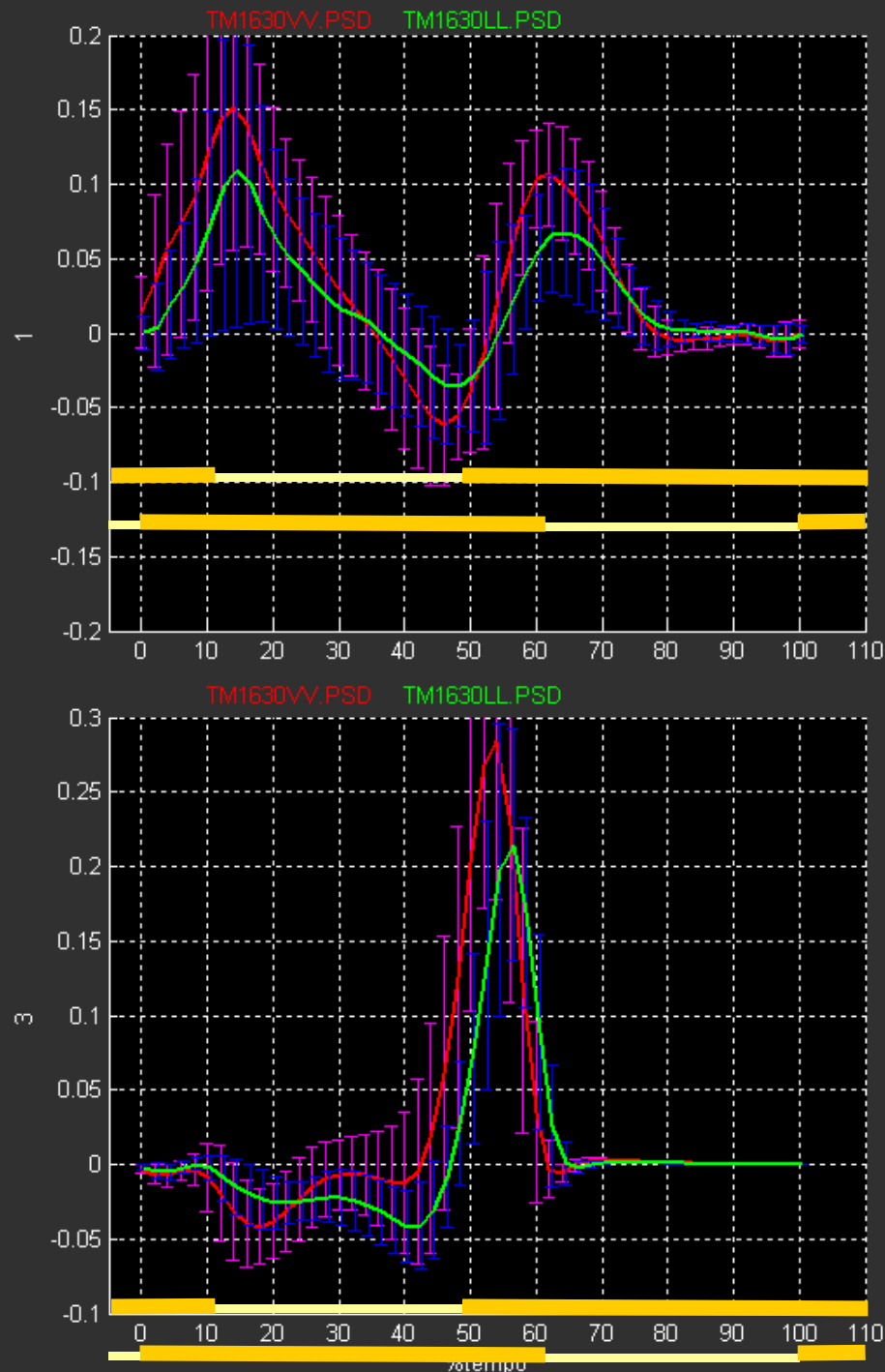
Confronto Lento-Veloce



Momenti Flesso-
Estensione

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Confronto Lento-Veloce



Potenze articolari

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