



RUBICON

CHIROPRACTIC  
CONFERENCE

2019

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# Biomechanics, Human motor control, Chiropractic

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# Introduction

- Motion

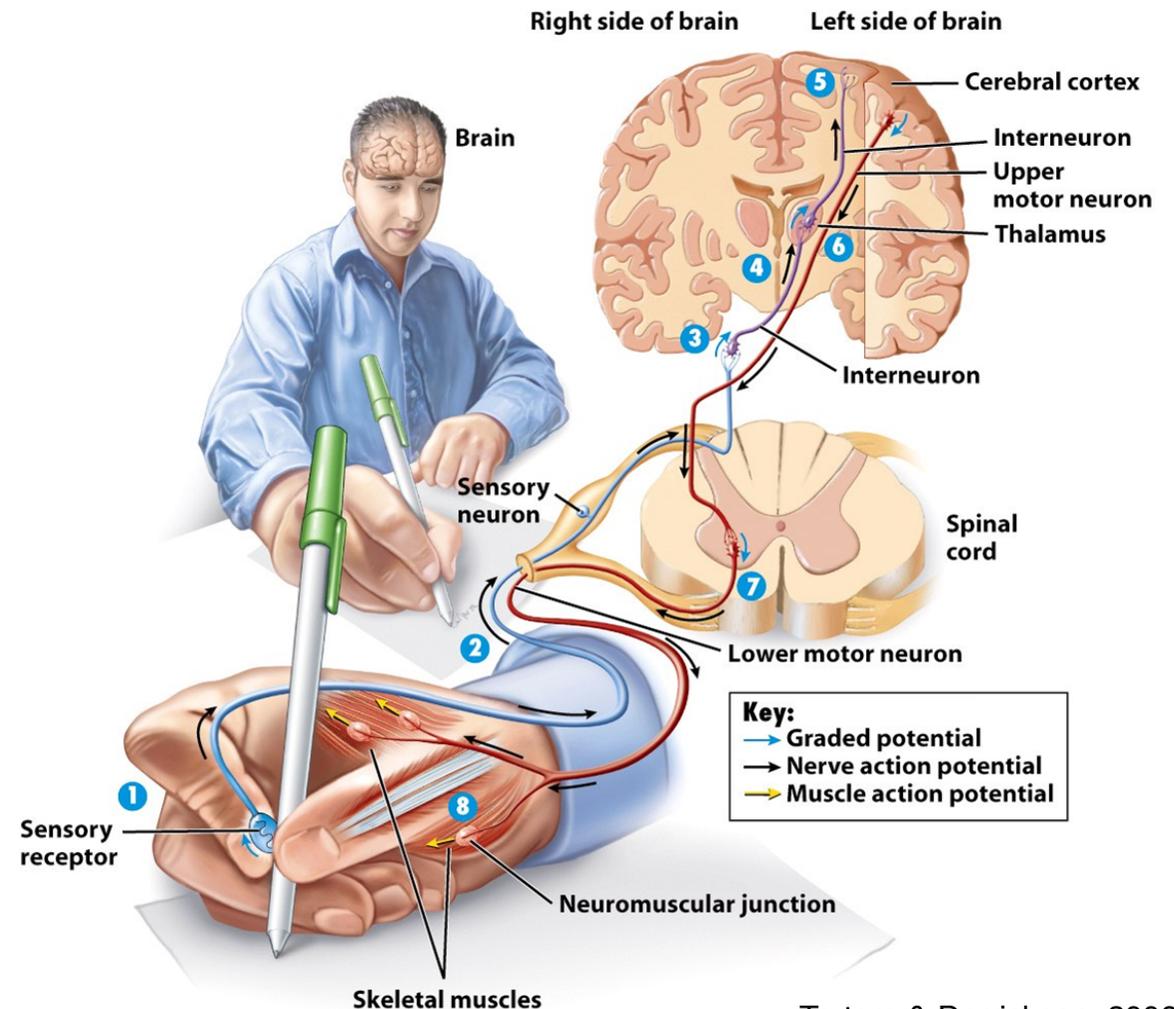


- Body and/or weight support



# Introduction

- To be effective, the “action” needs
  - Sensory informations
  - Motor informations
- However, Infinite number of joint configurations can successfully accomplish the task.



# Motion / Body (or weight) Support

## Motor redundancies

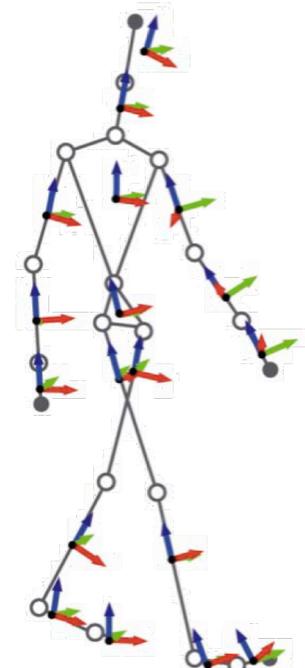
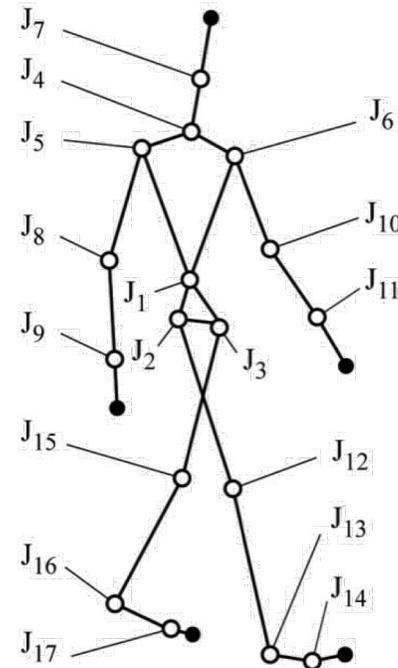
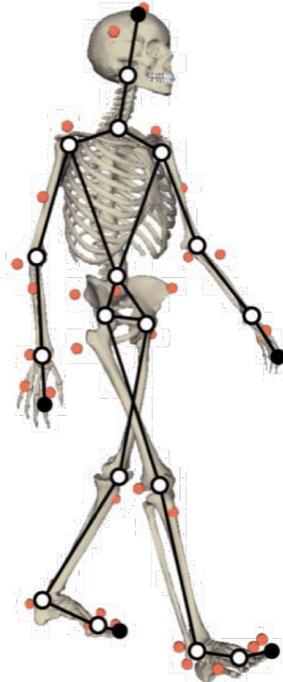
- Kinematic redundancy → Kinematics + Biomechanics !



# Kinematics - Biomechanics

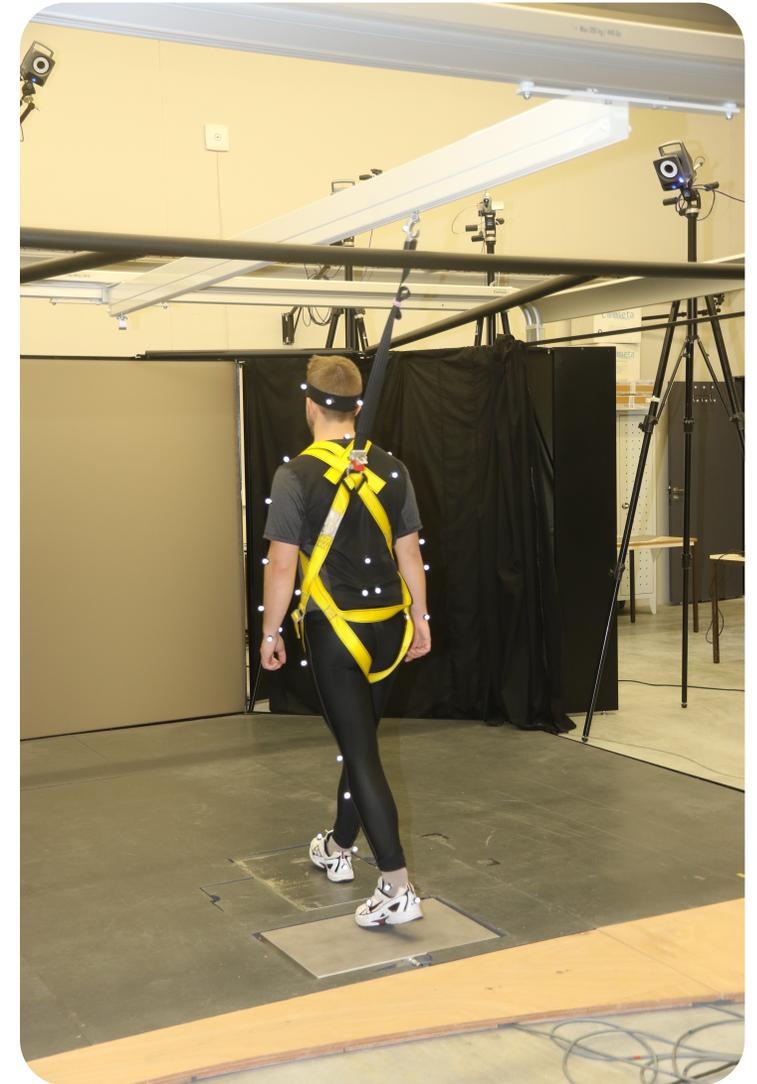
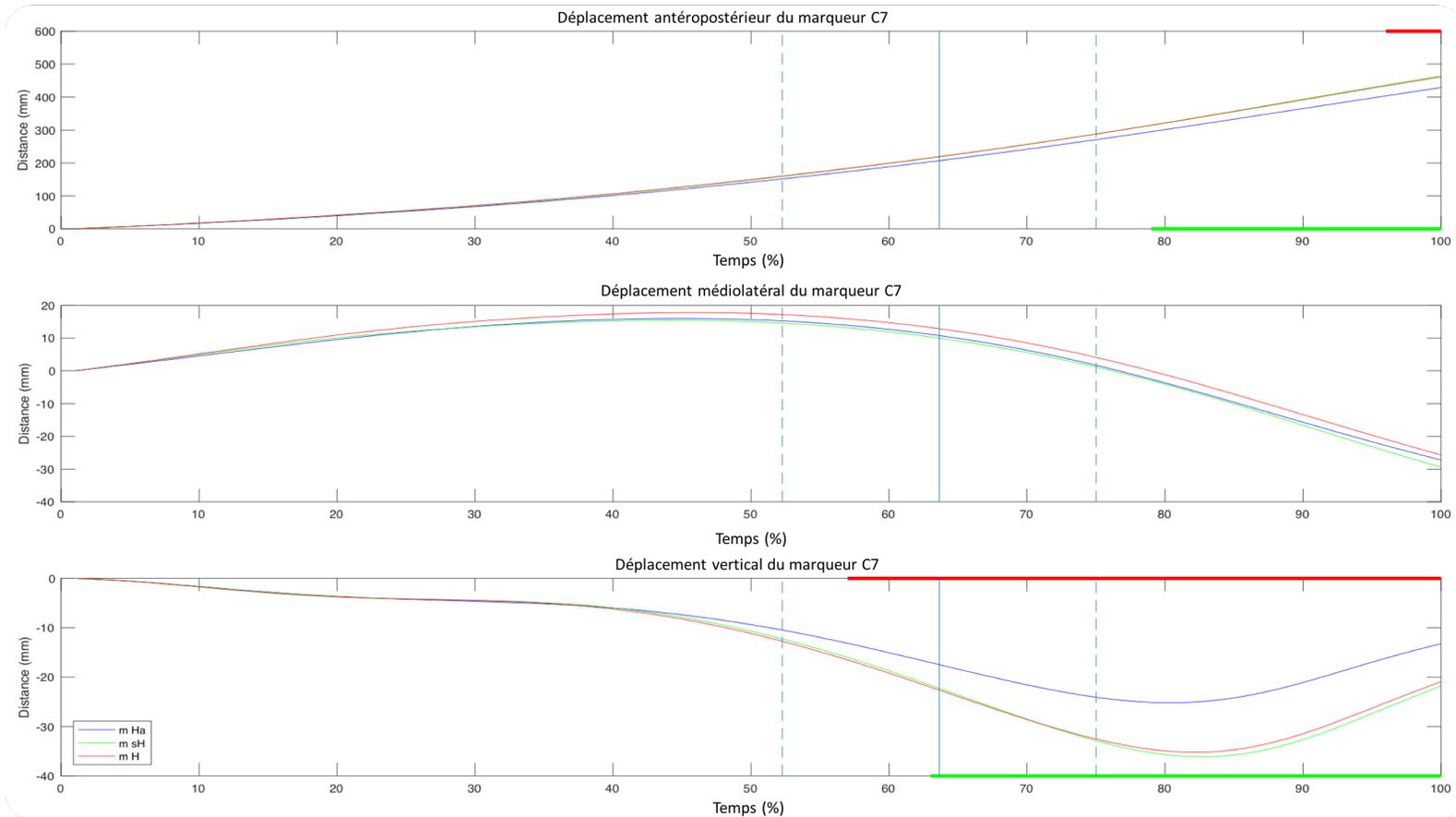
**Kinematics** describes the **motion of points**, bodies without considering the forces that cause them to move.

**Biomechanics** deals with the **forces acting on biological systems** and the associated effects produced by these forces (Herzog, 2010)



# Kinematics - Biomechanics

➔ Example of kinematics analyses

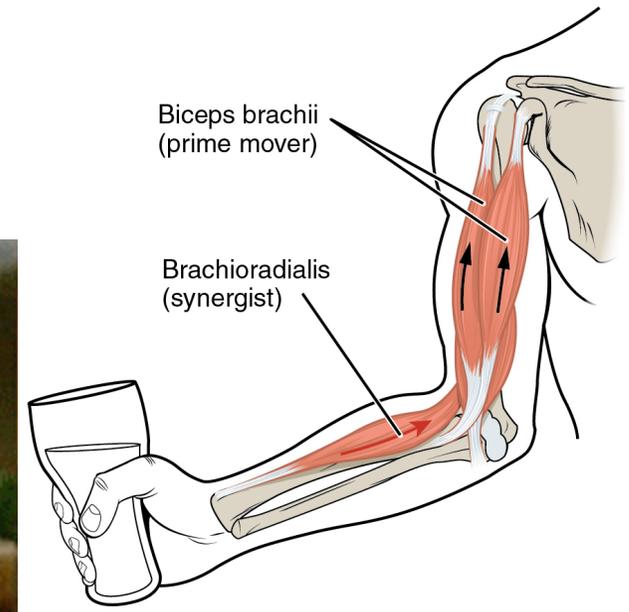


Honvault, Gillet & Cremoux (2017)

# Motion / Body (or weight) Support

## Motor redundancies

- Kinematic redundancy
- Muscle redundancy



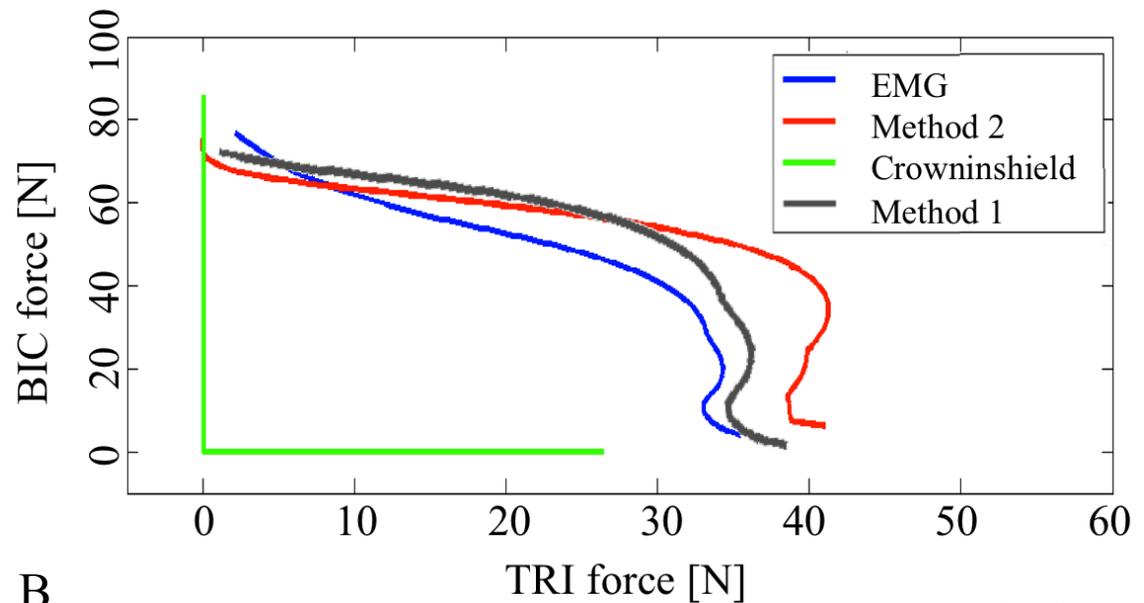
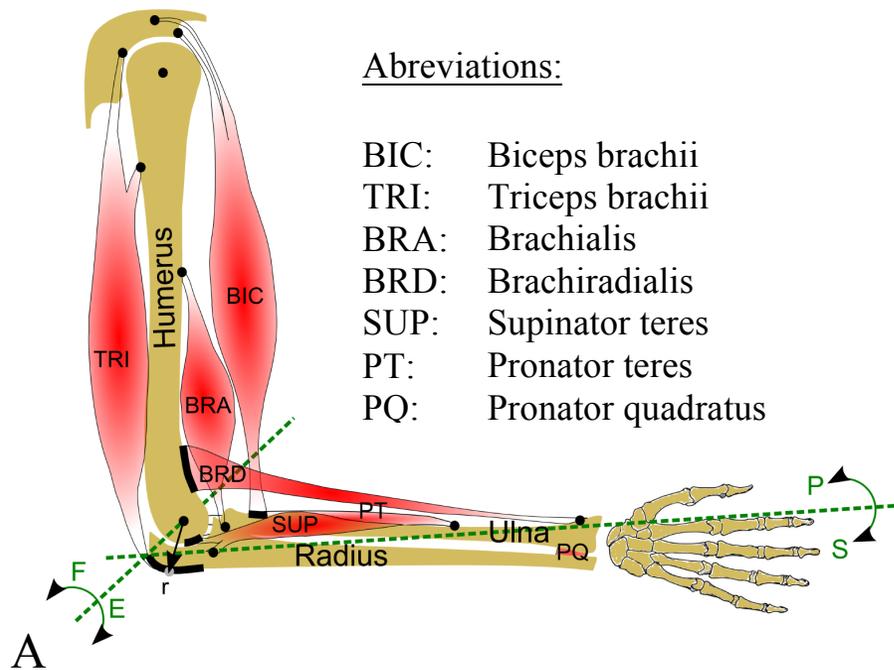
# Motion / Body (or weight) Support

## Muscle redundancy

- synergistic muscles
- antagonist co-activation



Electromyography (EMG)  
+  
Optimization approaches



# Motion / Body (or weight) Support

## Muscle redundancy

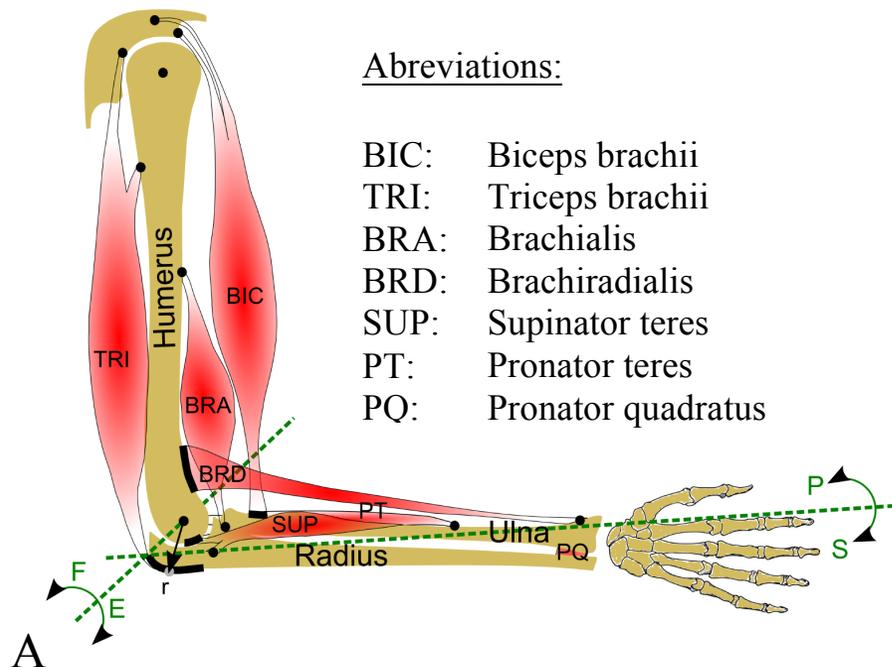
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Electromyography (EMG)  
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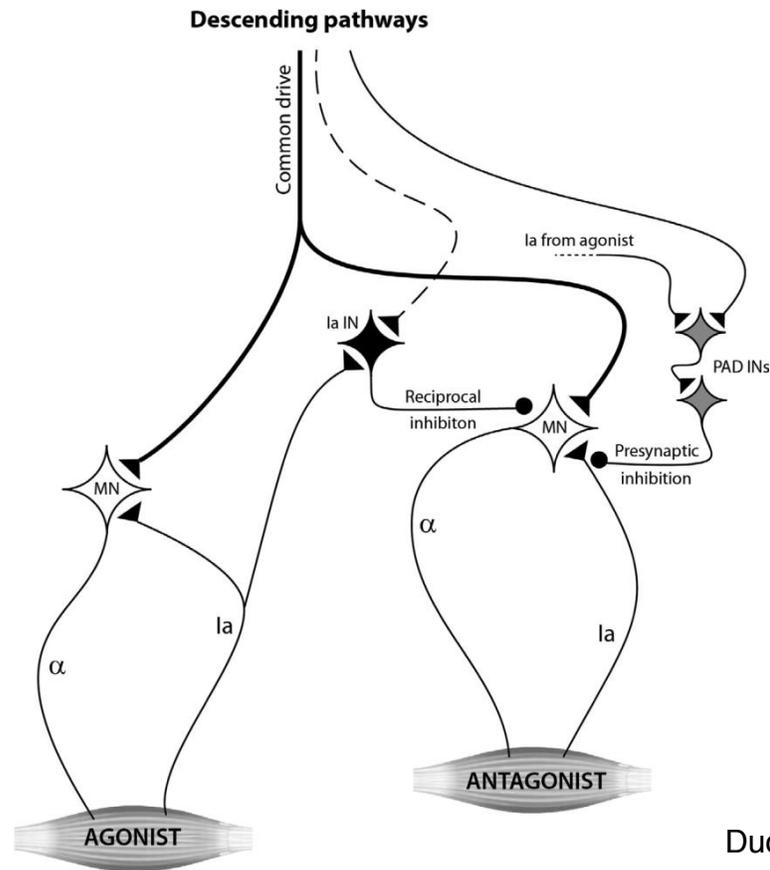


Human motor control !



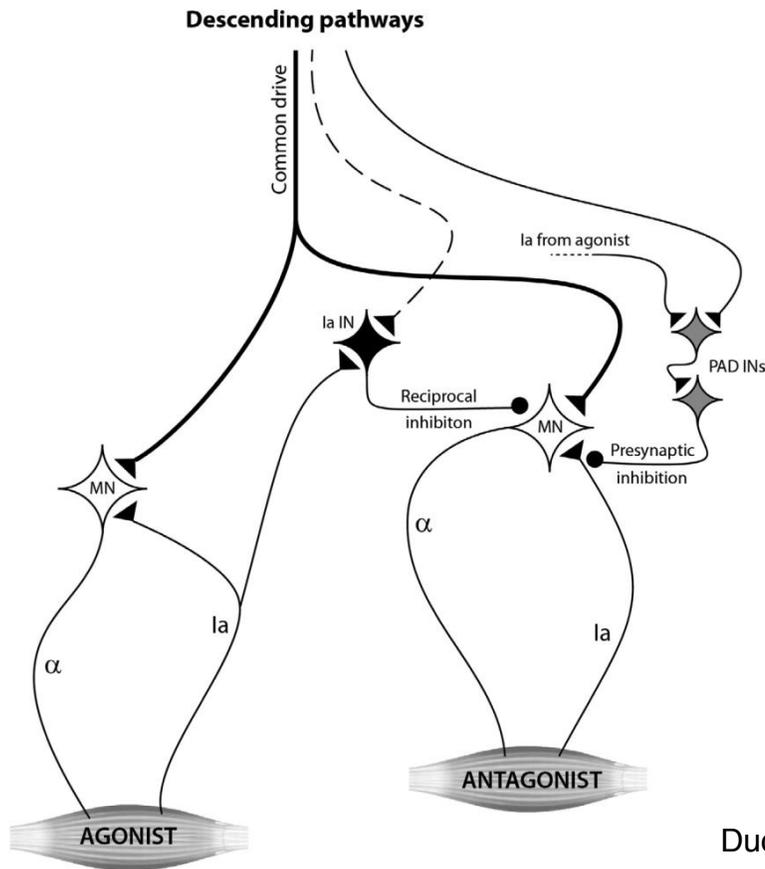
# Human motor control

Can basics of human neurophysiology improve understanding of the motor behavior ?

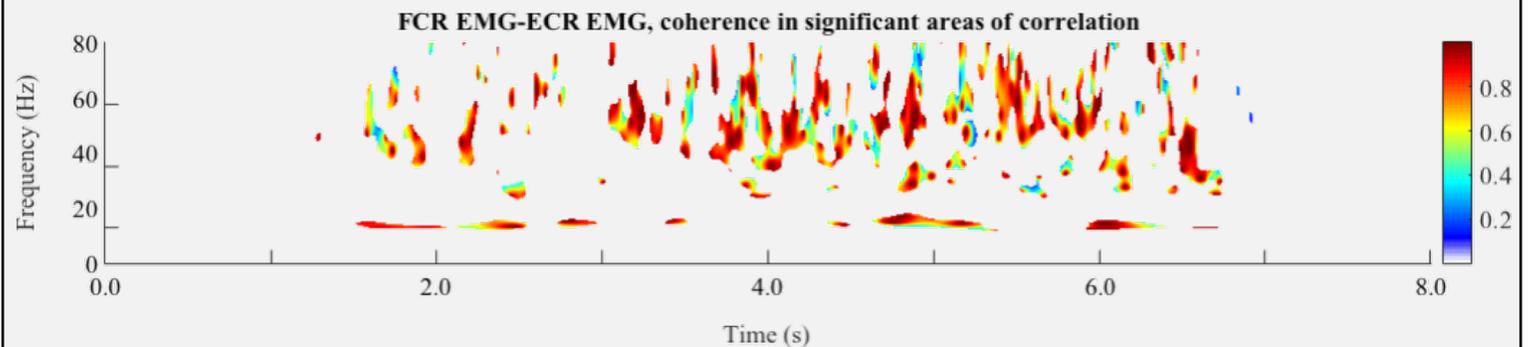


# Human motor control

Can basics of human neurophysiology improve understanding of the motor behavior ?



The intermuscular coherence between two EMG signals is thought to reflect the importance of the **common synchronous drive** reaching synergistic muscles in the control of voluntary contraction.



Charissou et al., 2016, 2017

# Motion / Body (or weight) Support

## Motor redundancies

- Kinematic redundancy
- Muscle redundancy
- Motor unit redundancy



# Motion / Body (or weight) Support

## Motor redundancies

- Kinematic redundancy
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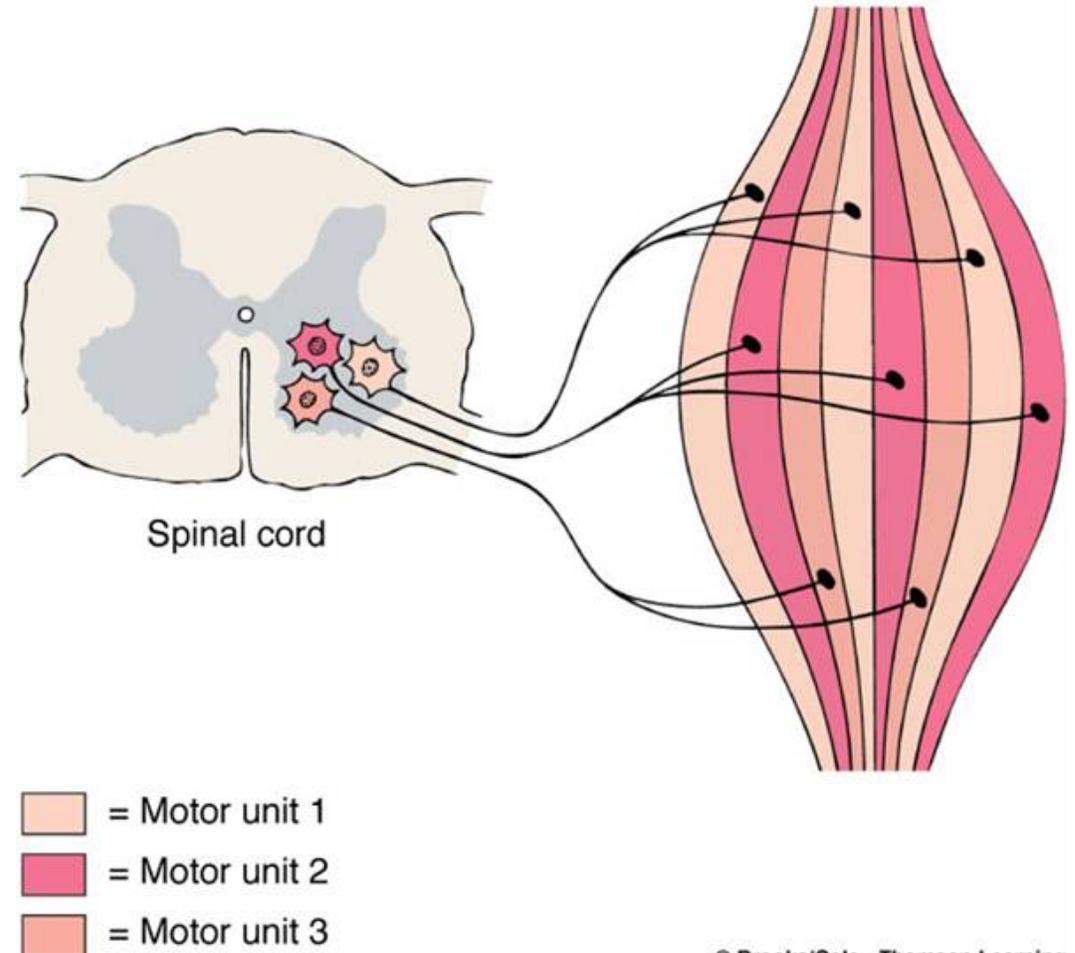


~~Intramuscular EMG (invasive !)~~

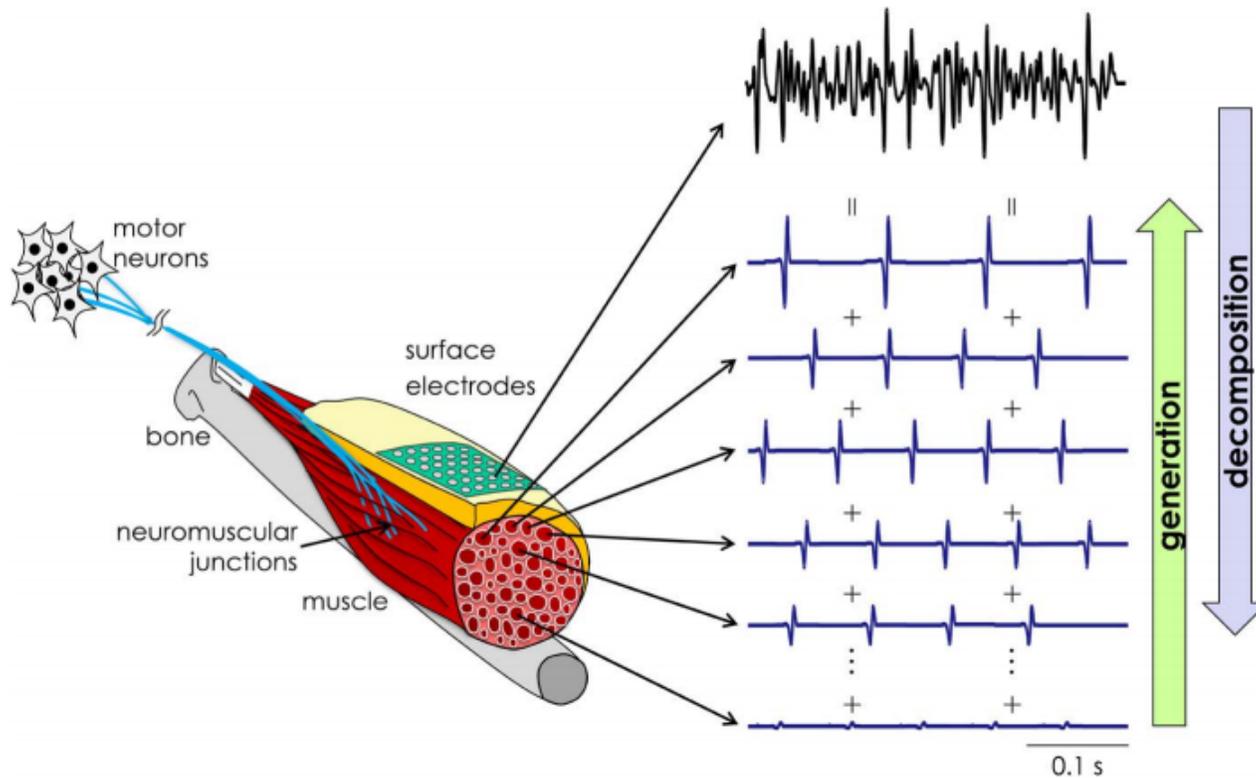
High-density EMG

+

Optimization approaches



# High density EMG



Advanced signal processing technique allows decomposition of hd-EMG signals into Motor unit (MU) signals

## Information retrieved

- MU recruitment
- MU firing rates
- MU conduction velocities
- Common vs. Independent drives

# Effect of chiropractic on spinal motor control during motion/support

- Low back pain (LBP) is a major health problem around the world
- Effectiveness of chiropractic care on LBP patients mobility ?
- Subtyping LBP patients based on neuro-biomechanical markers so the most appropriate treatment can be provided based on their individual needs ?



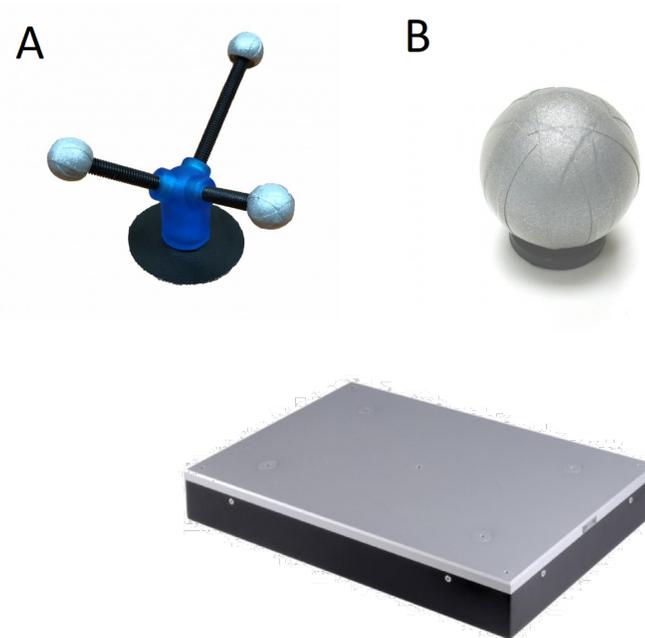
# Effect of chiropractic on spinal motor control during motion/support

- Differences in the **neuro-biomechanical control of the trunk muscles** according to the level of low back pain ?
- **Influence of chiropractic care** on the neuro-biomechanical control of the trunk in subclinical and possibly pain populations depending on **single / multiple session(s)** ?

# Effect of chiropractic on spinal motor control during motion/support

## Recordings

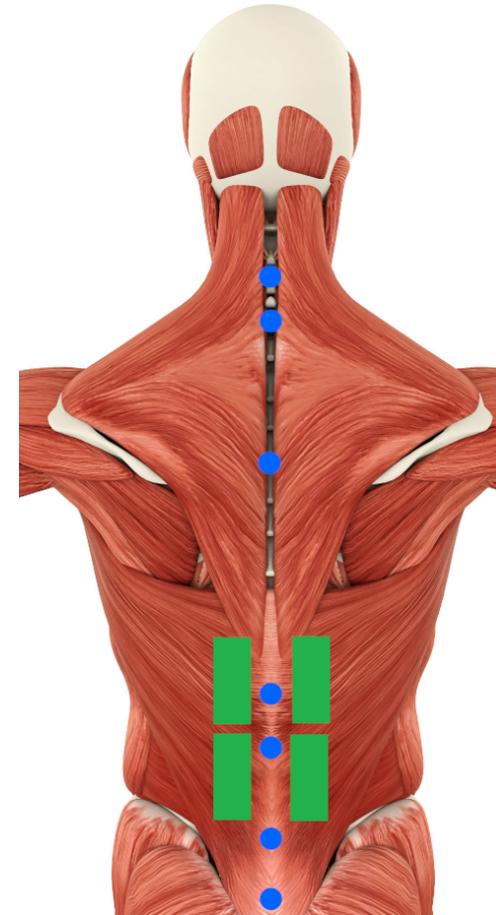
- Motion capture



# Effect of chiropractic on spinal motor control during motion/support

## Recordings

- Motion capture
- EMG and HD-EMG
  - low back extensors muscles
  - rectus abdominis
  - external obliques



# Effect of chiropractic on spinal motor control during motion/support

## Tasks

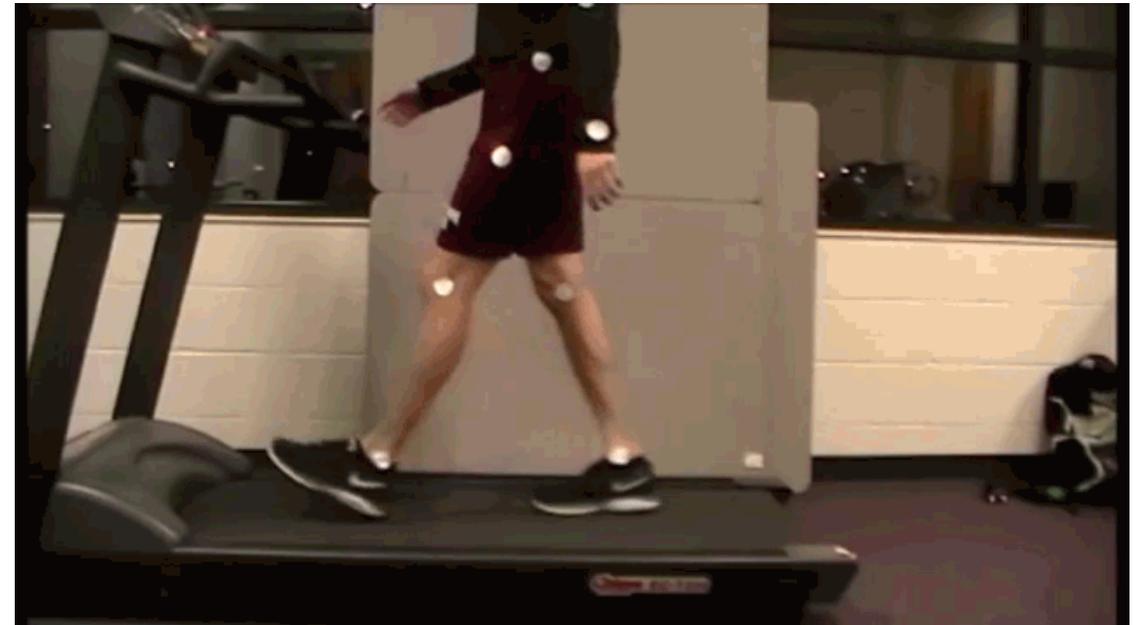
- Postural task
  - Eyes open/ eyes closed



# Effect of chiropractic on spinal motor control during motion/support

## Tasks

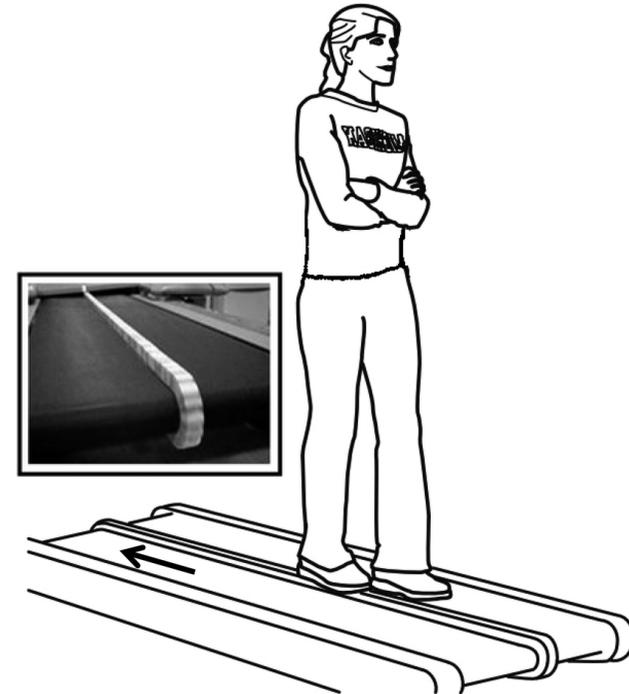
- Postural task
- Locomotor task
  - Preferred speed
  - Fast speed



# Effect of chiropractic on spinal motor control during motion/support

## Tasks

- Postural task
- Locomotor task
- Perturbation task
  - Left belt forward / backward
  - Right belt forward / backward



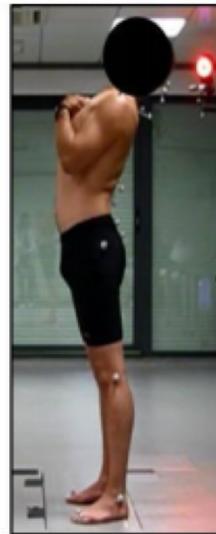
Sipp et al. 2013

# Effect of chiropractic on spinal motor control during motion/support

## Tasks

- Postural task
- Locomotor task
- Perturbation task
- Trunk movement task
  - Back flexion / extension
  - Lateral trunk flexion (left/right)
  - Trunk rotation (left/right)

Extension



Flexion



Lateral Flexion



Rotation



# Effect of chiropractic on spinal motor control during motion/support

**Expected Results** ... according to the level of low back pain

## Behavioral alteration

- ↘ postural stability and ↗ compressive force around the low back
- ⊗ of postural coordination (sagittal plane) when disturbed
- ↘ walking speed and ⊗ of APA at gait start
- ↘ range of motion during trunk movement tasks

## Muscle alteration

- ↘ conduction velocities of the MU due to overall higher sustained activity
- ↘ recruitment rate of the MU
- ⊗ of Flexion-Relaxation phenomenon during trunk movement tasks

*(will differ according to the task)*

# Effect of chiropractic on spinal motor control during motion/support

**Expected Results** ... according to chiropractic intervention

## **Behavioral alteration**

↘ variability of kinematics data

## **Muscle alteration**

↗ conduction velocities of the MU  
↗ recruitment rate of the MU

## **Neuro-biomechanical control of the trunk muscles**

should get closer to healthy values as chiropractic session progresses

...

Yet we suspect that not every LBP or subclinical participant should benefit from it

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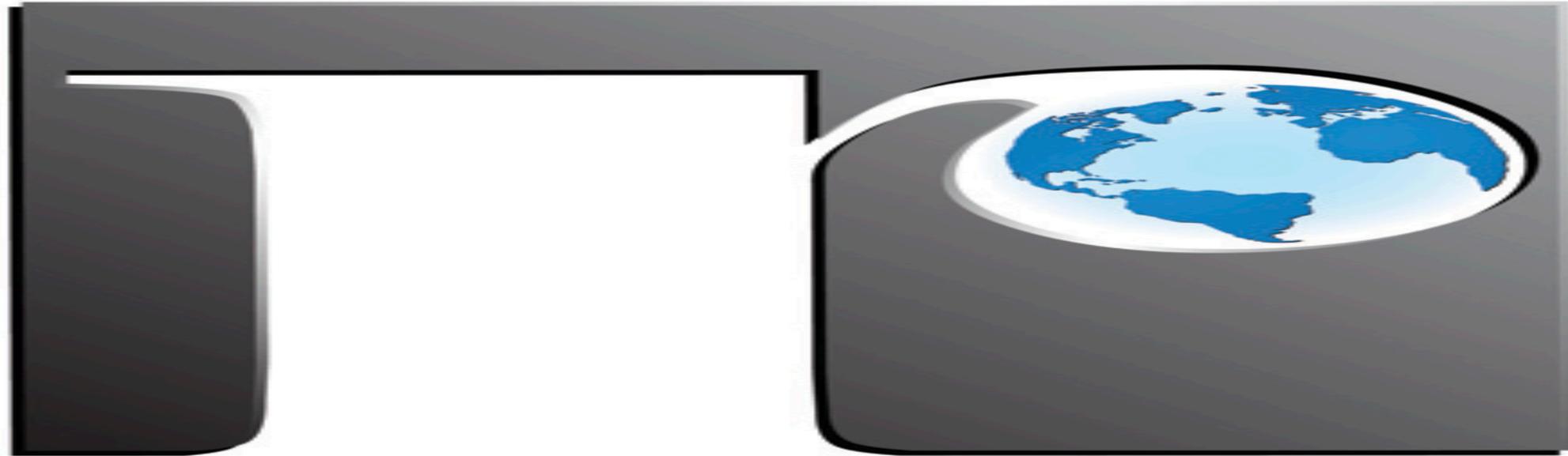
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