

Sensory motor integration in the context of locomotion with the use of virtual reality

Supervisor: Dr. Meir Plotnik

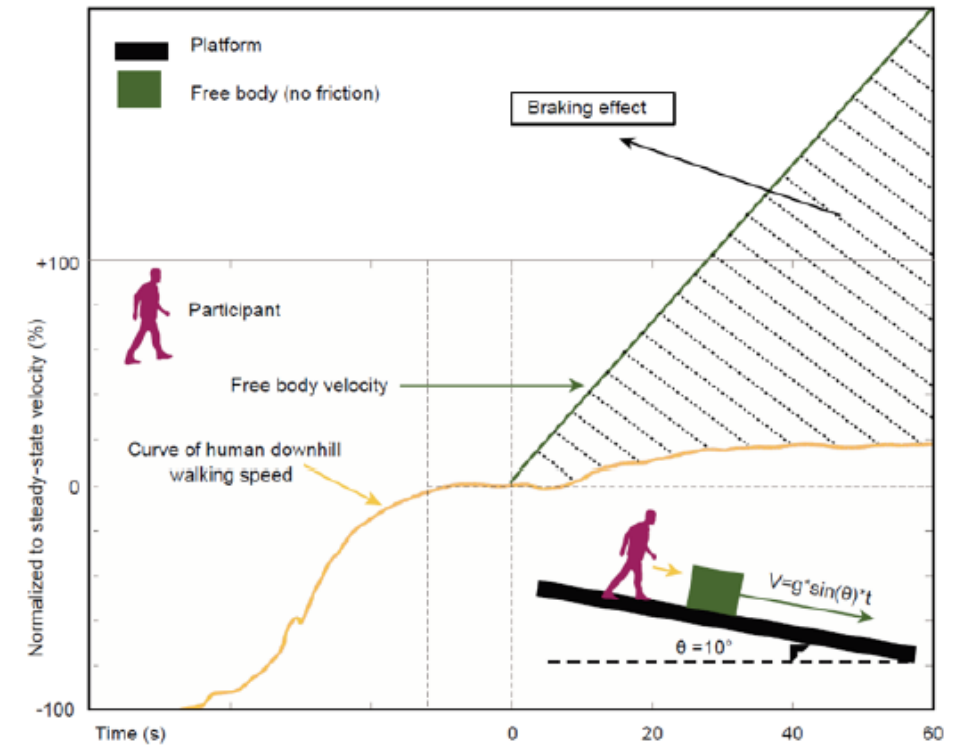
Student: Amit Benady

Center of advanced technologies in rehabilitation, Sheba medical center



A

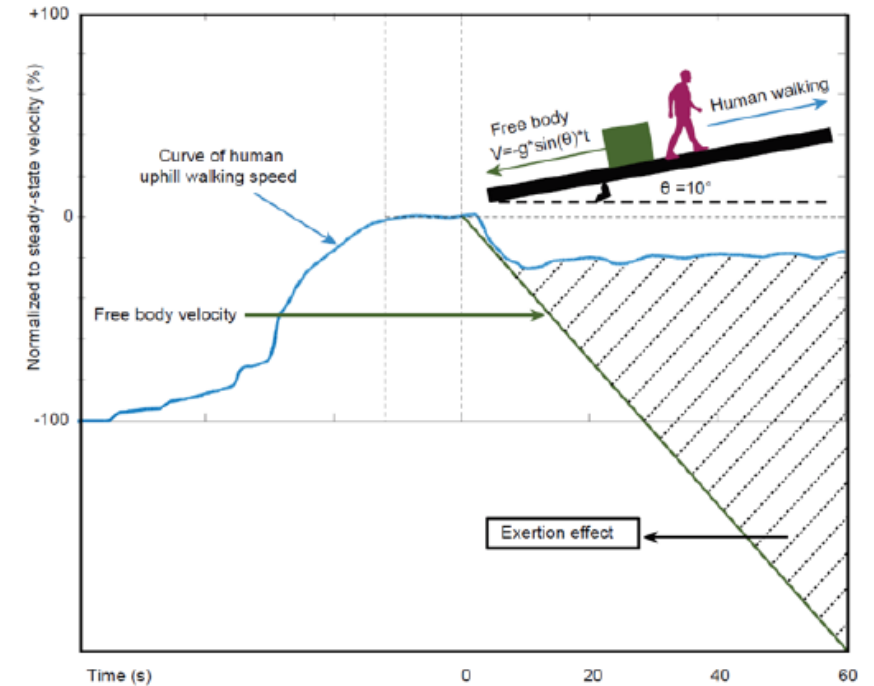
Braking effect



Cano Porras et al., 2019, Revised
Can we see gravity? Evidence from gait

PhD Supervisors: M Plotnik, G Zeilig, R Inzelberg

Exertion effect



Cano Porras et al.,
Can we see gravity? Evidence from gait
2019, revised

The role of vision

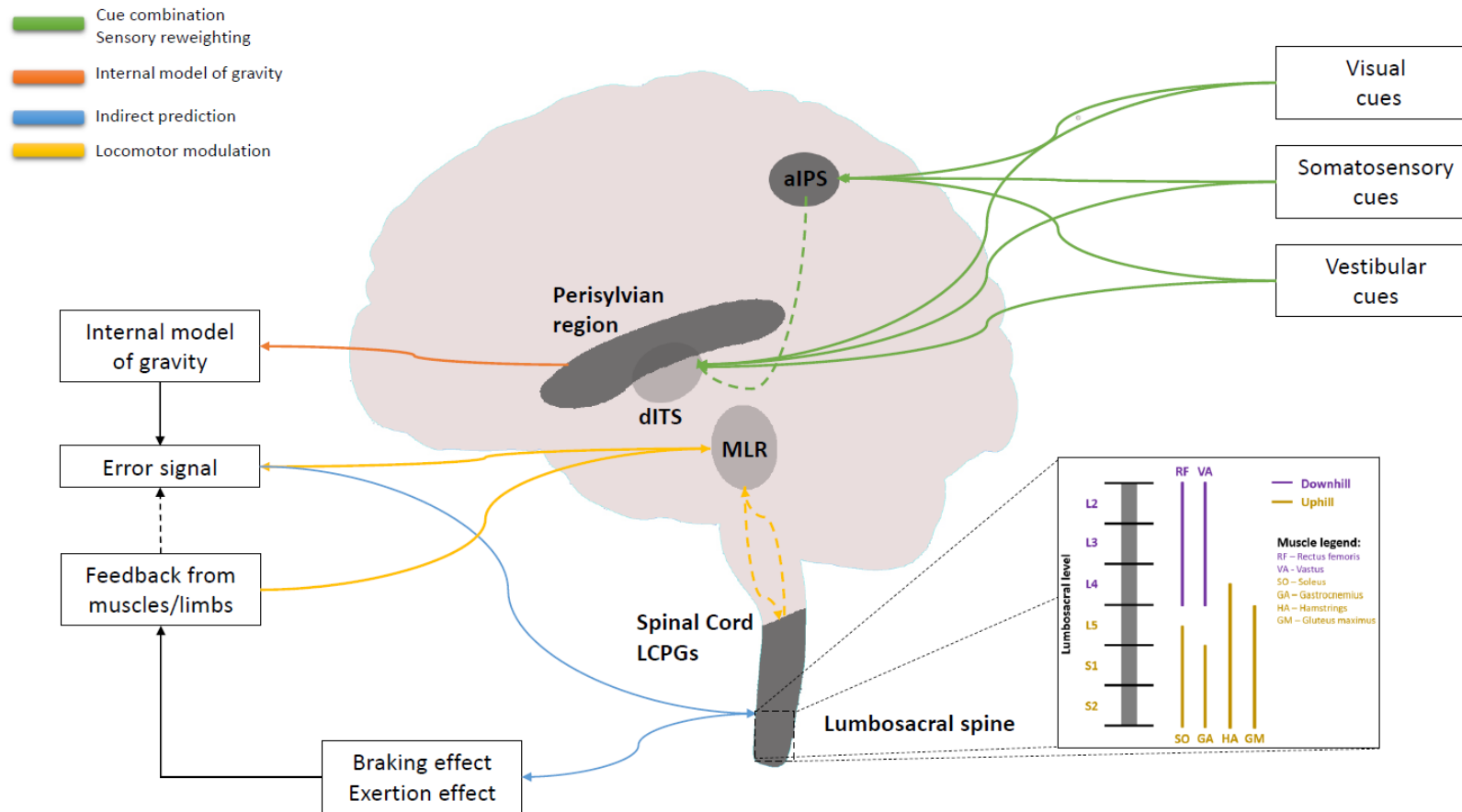
Self paced mode



Introduction

- **Indirect prediction** - processes controlling locomotion patterns relying on accumulated experience, promptly activate pre-programmed gait patterns in the presence of environmental changes.
- **Sensory reweighting** - recalibration of the relative influence of visual and body-based cues leading to gradual further modifications of walking patterns: an iterative mechanism

Internal model of gravity

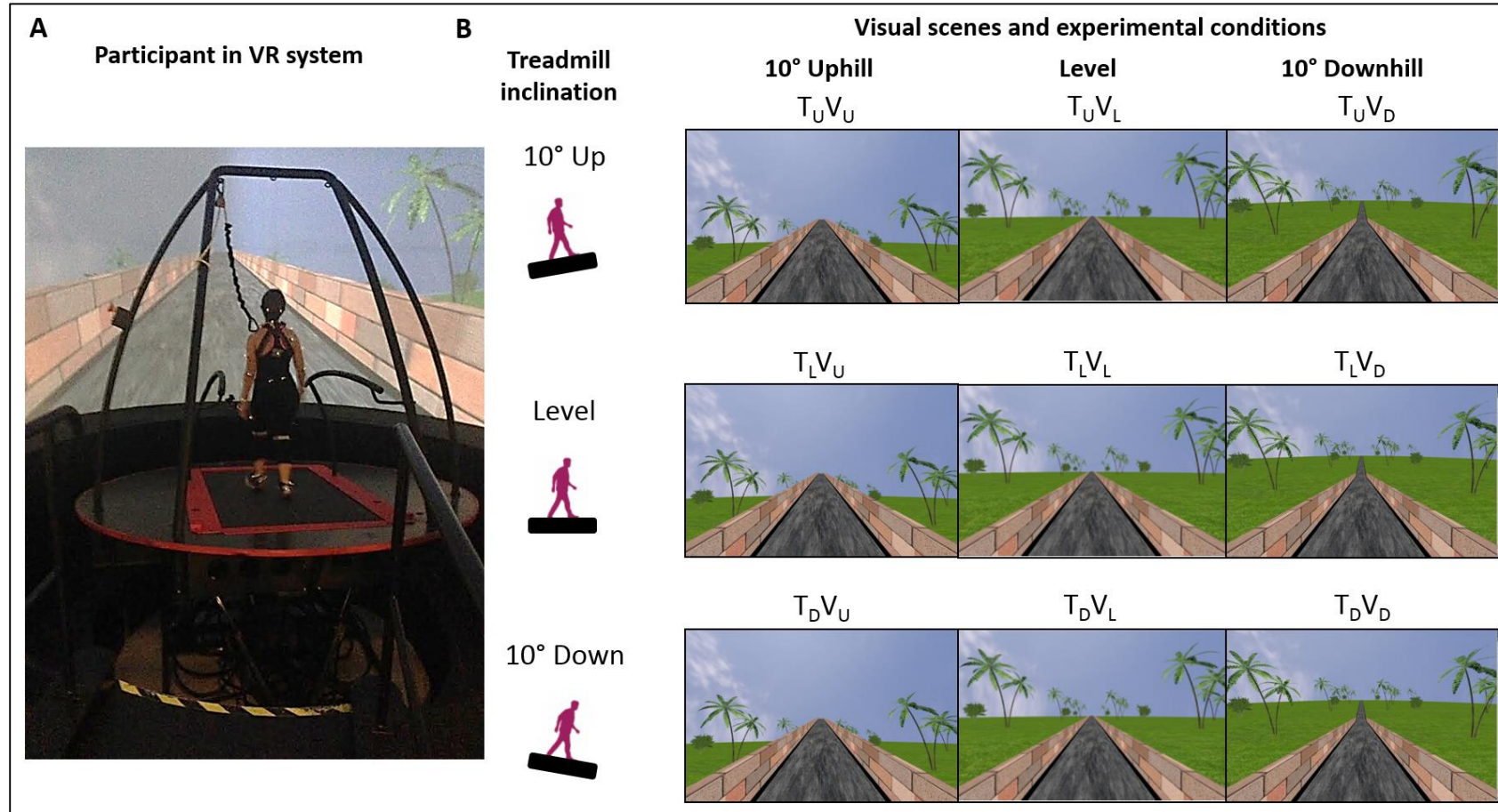


Sensory-motor integration incorporates perception of gravity and visual inputs during locomotion.

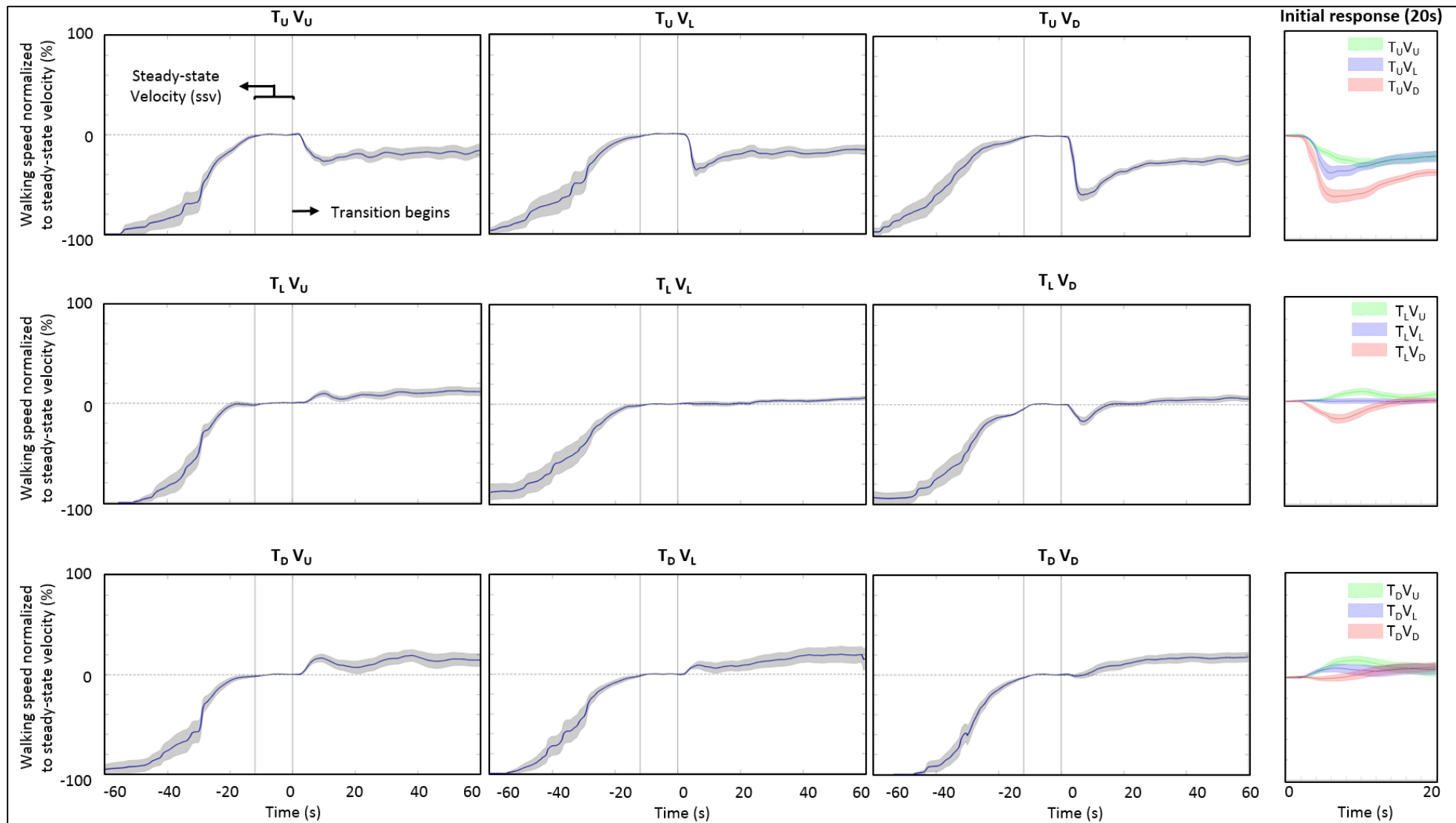
The model predicts that muscle synergies activation will be triggered only by visual cues

Visual conflict paradigm

- self paced
- randomized
- gait speed
- primary outcome
- transition 5 sec'



Results



Interim conclusions

- Visual cues alone appear to drive the perception of gravity
- People brake their downhill “speeding” when they see a downhill slope, even when there is no inclination
- People invest energy (speed up) when they see uphill slope even when there is no inclination
- The sensory reweighting analysis shows that after initial period post de stabilizing trigger (about 10 sec)- locomotion control returns to rely on body based cues

Objective

1. Expand the existing knowledge on the ramifications of the internal model of gravity on human locomotion – i.e., direct impact on muscle synergies.
2. Confirm that visual dependency is a key player regarding the perception of gravity , by using an “orthogonal” paradigm.

Hypotheses

1. Similarly to the adaptation of the body kinematics seen during real incline walking, the same pattern of muscle activation would be observed during a visually stimulated virtual environment
2. The strength of the effects seen during incongruent conditions will correlate with visual dependence level

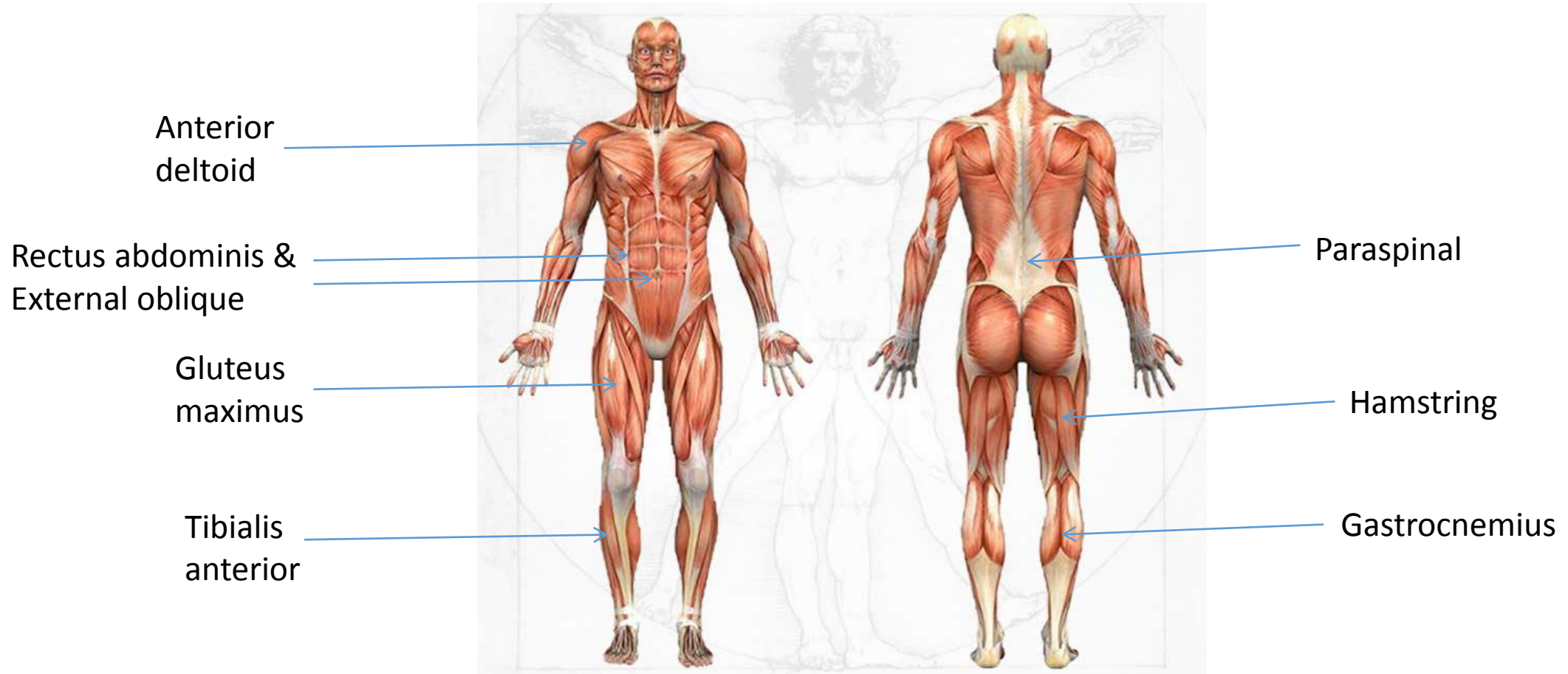
Rod and Frame test

- Assesses visual dependency

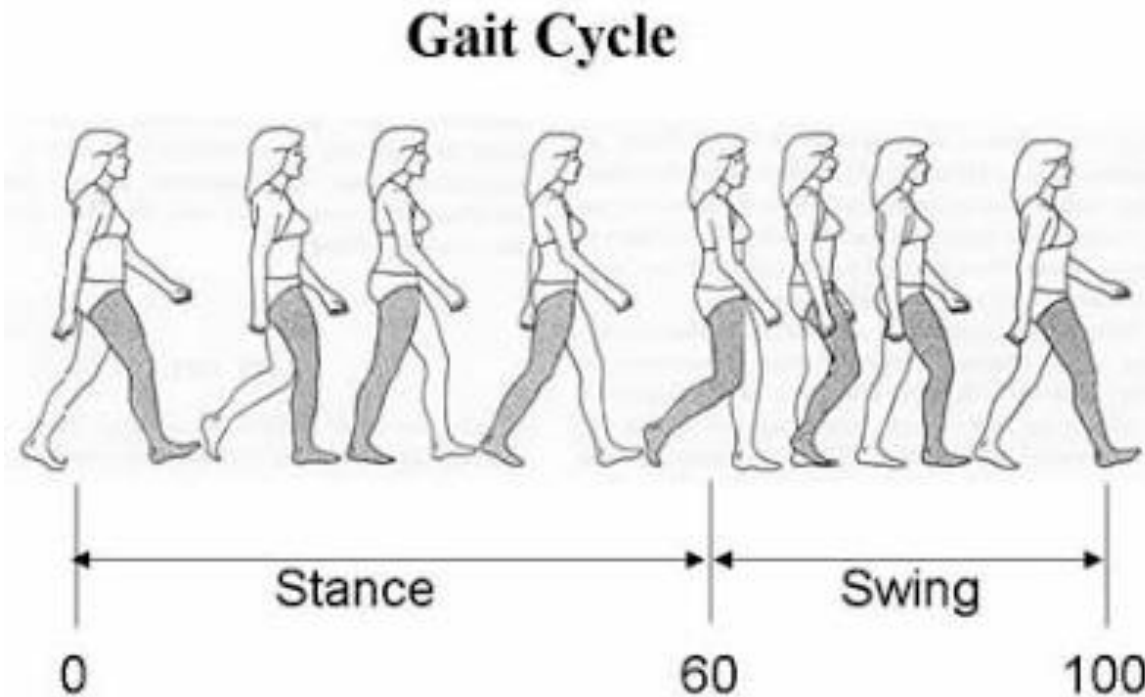


Bagust, J. (2005). Assessment of verticality perception by a rod-and-frame test: preliminary observations on the use of a computer monitor and video eye glasses. *Archives of physical medicine and rehabilitation*, 86(5), 1062-1064.

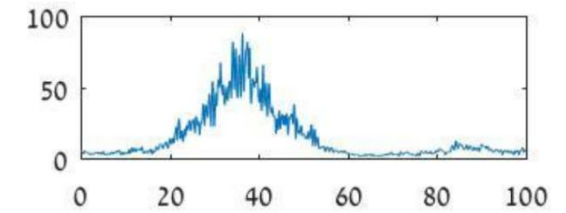
Analyzed muscles



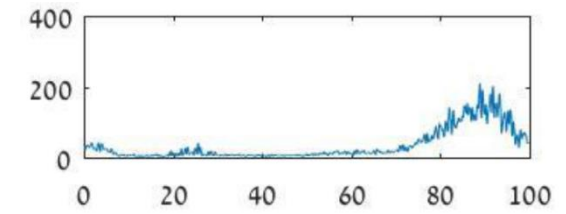
EMG results- Gastrocnemius



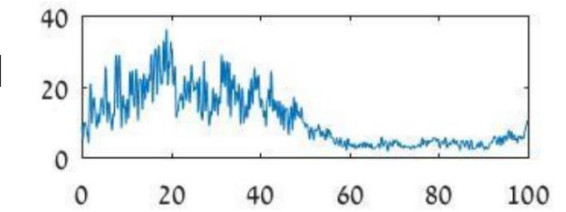
Treadmill & Vision [A]- level



Treadmill & Vision [B]- uphill



Treadmill & Vision [C]- downhill

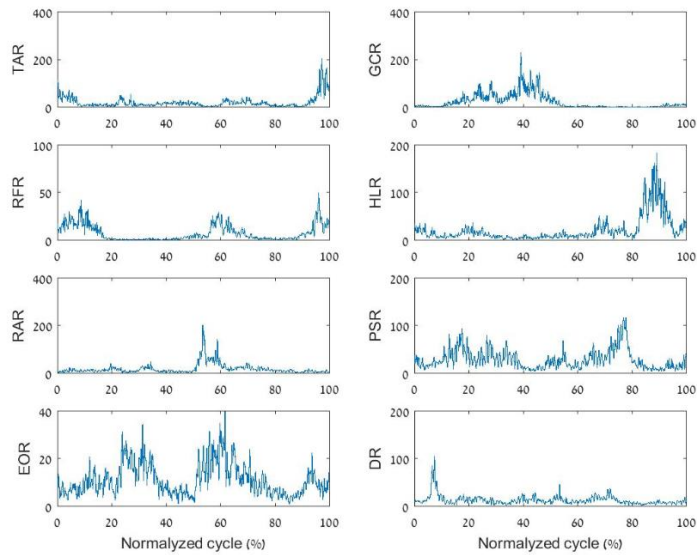


ZB235- condition B, Gastrocnemius

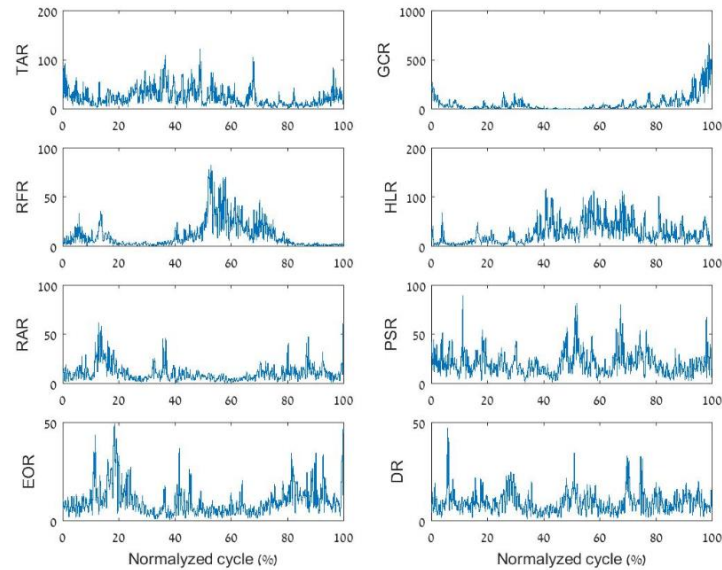


ZB235- averages

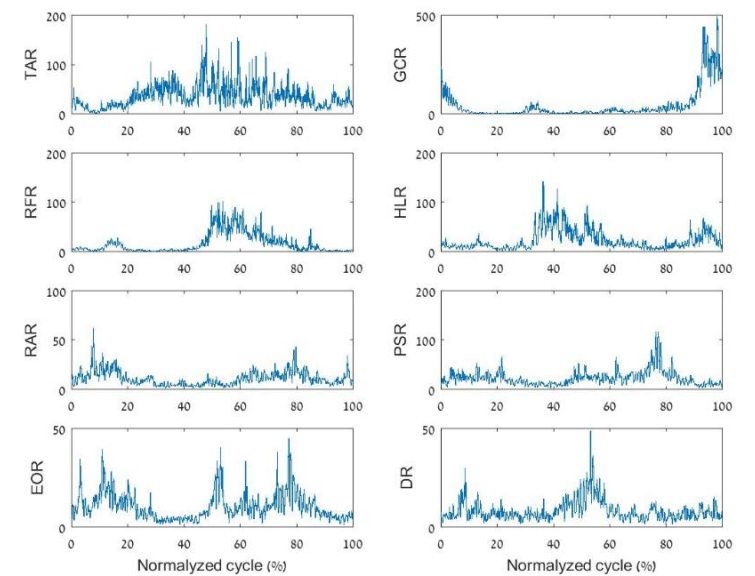
Pre



Transition



Post



Study data

$$15 * 11 * 3 * 8 * 2 = 7920$$



